AUTHENTICATED
U.S. GOVERNMENT
INFORMATION
GPO

S. HRG. 119–54

WRIGHT NOMINATION

HEARING

BEFORE THE

COMMITTEE ON ENERGY AND NATURAL RESOURCES UNITED STATES SENATE

ONE HUNDRED NINETEENTH CONGRESS

FIRST SESSION

TO

CONSIDER THE NOMINATION OF CHRISTOPHER A. WRIGHT TO BE SECRETARY OF ENERGY

JANUARY 15, 2025

Printed for the use of the
Committee on Energy and Natural Resources

Available via the World Wide Web: http://www.govinfo.gov

U.S. GOVERNMENT PUBLISHING OFFICE
60–065 WASHINGTON : 2025

COMMITTEE ON ENERGY AND NATURAL RESOURCES

MIKE LEE, Utah, *Chairman*

JOHN BARRASSO, Wyoming
JAMES E. RISCH, Idaho
STEVE DAINES, Montana
TOM COTTON, Arkansas
DAVID MCCORMICK, Pennsylvania
JAMES C. JUSTICE, West Virginia
BILL CASSIDY, Louisiana
CINDY HYDE-SMITH, Mississippi
LISA MURKOWSKI, Alaska
JOHN HOEVEN, North Dakota

MARTIN HEINRICH, New Mexico
RON WYDEN, Oregon
MARIA CANTWELL, Washington
MAZIE K. HIRONO, Hawaii
ANGUS S. KING, JR., Maine
CATHERINE CORTEZ MASTO, Nevada
JOHN W. HICKENLOOPER, Colorado
ALEX PADILLA, California
RUBEN GALLEGO, Arizona

WENDY BAIG, *Majority Staff Director*
PATRICK J. MCCORMICK III, *Majority Chief Counsel*
JASMINE HUNT, *Minority Staff Director*
SAM E. FOWLER, *Minority Chief Counsel*

CONTENTS

OPENING STATEMENTS

	Page
Lee, Hon. Mike, Chairman and a U.S. Senator from Utah	1
Heinrich, Hon. Martin, Ranking Member and a U.S. Senator from New Mexico	2
Hickenlooper, Hon. John W., a U.S. Senator from Colorado	4
Hoeven, Hon. John, a U.S. Senator from North Dakota	5

WITNESS

Wright, Christopher A., nominated to be Secretary of Energy	7

ALPHABETICAL LISTING AND APPENDIX MATERIAL SUBMITTED

American Chemistry Council:	
Letter for the Record	285
American Council of Engineering Companies:	
Letter for the Record	287
American Exploration and Mining Association:	
Letter for the Record	288
American Gas Association:	
Letter for the Record	289
Biteman, Bo et al.:	
Letter for the Record	291
Citizens for Responsible Energy Solutions:	
Letter for the Record	293
Clarios:	
Letter for the Record	294
Cramton, Jack:	
Communication for the Record	290
Domestic Energy Producers' Alliance:	
Letter for the Record	295
Heinrich, Hon. Martin:	
Opening Statement	2
Hickenlooper, Hon. John W.:	
Opening Statement	4
Hispanics in Energy:	
Letter for the Record	296
Hoeven, Hon. John:	
Opening Statement	5
Independent Women:	
Letter for the Record	297
Industrial Energy Consumers of America:	
Letter for the Record	298
Institute of Makers of Explosives:	
Letter for the Record	301
Lee, Hon. Mike:	
Opening Statement	1
Liberty Energy Report entitled "Bettering Human Lives" published in 2024	13
National Mining Association:	
Letter for the Record	302
National Rural Electric Cooperative Association:	
Letter for the Record	304

Page

National Stone, Sand, and Gravel Association:
Letter for the Record 305
Neiman, Chip et al.:
Letter for the Record 306
Portland Cement Association:
Letter for the Record 308
280 Earth et al.:
Letter for the Record 309
U.S. Chamber of Commerce:
Letter for the Record 313
Wright, Christopher A.:
Opening Statement 7
Written Testimony 9
Responses to Questions for the Record 235

WRIGHT NOMINATION

WEDNESDAY, JANUARY 15, 2025

U.S. SENATE,
COMMITTEE ON ENERGY AND NATURAL RESOURCES,
Washington, DC.

The Committee met, pursuant to notice, at 10:03 a.m. in Room SD–366, Dirksen Senate Office Building, Hon. Mike Lee, Chairman of the Committee, presiding.

OPENING STATEMENT OF HON. MIKE LEE, U.S. SENATOR FROM UTAH

The CHAIRMAN. Good morning, and welcome to the very first hearing of the Senate Energy and Natural Resources Committee during the 119th Congress. It really is a privilege to serve in this capacity, as Chairman, during such a pivotal moment in our nation's history, particularly as it relates to our nation's energy policies.

Mr. Wright, thank you so much for joining us—joining us no less on your birthday. Now, people, you don't turn 30 twice in a lifetime, but we can count today as your second 30th birthday, if you would prefer. I see that you are here with family, and I really enjoyed meeting each of them, and we will look forward to hearing you introduce them in a moment when we hear from you.

Your nomination, in many ways, really couldn't be coming at a more urgent time. Over the past four years, Americans have suffered under a lot of policies that have made life more difficult, more uncertain, and more expensive. Energy prices have soared, driving up the cost of not only energy itself, but everything around it—everything from housing to healthcare, from gas to groceries. And as a result, families have struggled to make ends meet. As it turns out, you need energy to do just about everything, and when the cost of energy goes up, the cost of everything else does too. The Biden Administration has completely failed to recognize the fundamental role that energy plays in our lives and the devastating consequences of excessive and unwise government intervention. From the cost of goods to the strength of our national defense, affordable and reliable energy is the backbone of our economy, and even our way of life.

Now, America is, of course, blessed with an abundant supply of natural resources. We are blessed with oil and gas, with coal, even with nuclear and the ingenuity behind that, with geothermal, with hydropower, wind, and solar and it's our responsibility to figure out how to harness these things safely, affordably, and effectively. Unfortunately, the Biden Administration has done the exact opposite

of those things. On his very first day in office, President Biden halted new oil and natural gas leases on public lands and waters, effectively cutting off access to resources that could have powered our economy and benefited the lives of ordinary Americans. Over the past four years, this same Administration has dismantled domestic energy production, canceled leases, and weaponized regulations to discourage investment in pipelines and critical energy infrastructure.

Instead of unleashing American energy, this Administration has instead decided to reduce our access to energy, and they have reduced many of these tools within the Department of Energy to a political tool for advancing extreme climate policies, policies that prioritize ideology over innovation, security, and affordability. These failures have caused devastating harm. Skyrocketing energy prices don't just hit consumers at the pump, they raise the cost of manufacturing, transportation, and everything in between. The Strategic Petroleum Reserve has been recklessly drained to historic lows. These policies have eroded our energy independence as a country, making us dangerously and unwisely reliant on foreign suppliers, including some adversarial nations. This is why today's hearing is, I think, so important. The Department of Energy's responsibilities are vast—maintaining our nuclear stockpile, fostering innovation through research and development, and ensuring affordable, reliable energy for the people.

If confirmed, Mr. Wright, you will lead an agency with the potential to transform our energy future for the better. Your track record as the founder and leader of Liberty Energy speaks volumes about your qualifications, and about the expertise and know-how that you bring to the job. You understand the energy sector and the many challenges that it faces, including, and especially those from the government. I am eager to hear your plans for refocusing the Department of Energy on what ought to be its core mission—ensuring energy security, driving innovation, and lowering costs for American families. American energy security is American national security. You cannot separate them. They are inextricably intertwined. Producing more energy here at home is a national imperative, and I look forward to working with you and your colleagues, the people you will work with at the Department of Energy, as well as my colleagues here on this Committee, to ensure that the Department of Energy returns to its founding and all-important purpose.

Mr. Wright, the challenges you will face as Secretary of Energy are significant, but so is the opportunity to restore America's standing as an energy superpower. I am looking forward to the beginning of a collaborative effort to start a new course for our nation's energy policy. Thank you for your willingness to serve, and I look forward to today's discussion.

And we will turn now, and hear now from our Ranking Member, Senator Heinrich.

OPENING STATEMENT OF HON. MARTIN HEINRICH, U.S. SENATOR FROM NEW MEXICO

Senator HEINRICH. Thank you, Chairman Lee. I want to welcome the new members of this Committee, as well as returning members. And happy birthday, Mr. Wright.

It is an honor to address you today as the newly appointed Ranking Member of this Committee. I am honored to represent a state whose economy and whose identity are really so deeply connected to DOE's mission. Sandia and Los Alamos rank among the state's largest employers, offering stable, mission-driven jobs to nearly 30,000 people. In 2023, their combined economic impact on my state reached nearly $9 billion, and these investments have fueled research, development, and scientific progress, driving global advancements in fields such as nuclear science, cybersecurity, clean energy, and materials science.

Now, before continuing my remarks, I must express my disappointment that the Chair has decided to move forward with this hearing over my objection, given the fact that, Mr. Wright, your ethics and financial materials arrived yesterday after business hours. I appreciate your responsiveness to my questions and your willingness to meet with me, but I don't think it is too much to ask that members of this Committee get 24 hours to review those documents. Mr. Wright, it is unfortunate that our first order of business involved breaking Committee precedents. Nevertheless, because my concerns have gone unheeded, we will proceed today.

Some secretaries in the past have been surprised to learn that roughly half of DOE's budget supports the nation's nuclear security enterprise through the National Nuclear Security Administration and the cleanup of legacy nuclear waste from weapons produced during the Cold War through the Office of Environmental Management. And although only a fraction of its budget goes to energy research, DOE is still the single largest supporter of basic research in the physical sciences, not just through the Office of Science, but also through the Title 17 Clean Energy Financing Program and the Advanced Research Projects Agency.

The Secretary of Energy must recognize the importance of DOE's research and development programs at the national labs, and not just for energy production, but also for efficient energy use, national security, cybersecurity, climate change, and maintaining our position of leadership in the world. The Secretary of Energy must also adapt to a rapidly evolving energy landscape driven by three empirical trends. First, electricity demand is growing for the first time in decades. Advances in generative artificial intelligence technologies and investments in manufacturing and data centers are driving up electricity demand. In fact, nationwide, electric demand is expected to grow by 15 percent in just the next five years. Second, distributed renewable energy is getting cheaper. The deployment of renewable energy continues to accelerate exponentially, not in a linear fashion, and consistently outpaces EIA predictions year over year. The pace of this deployment is driving down energy costs, giving Americans more energy freedom to choose how they want to heat and cool their homes or fuel their cars and trucks. Third, clean energy is driving economic growth. According to the International Energy Agency, clean energy accounted for 10 percent of global GDP growth in 2023.

If confirmed, Mr. Wright, you will inherit a department that has received historic levels of investment to fund programs and policies that are literally transforming the U.S. economy. These programs and policies were authorized by landmark legislation, including the

Energy Act of 2020, the CHIPS and Science Act, the Infrastructure Investment and Jobs Act, and the Inflation Reduction Act. Those investments are paying off. Two years after CHIPS and Science, companies have announced more than $395 billion of investments in semiconductors and electronics and the creation of over 115,000 jobs, primarily in manufacturing. Two years after passage of the Inflation Reduction Act, businesses, including battery manufacturers and auto companies, have announced $493 billion of investments, a 71 percent increase from the two-year period preceding that legislation. And three years after the passage of the Bipartisan Infrastructure Law, the Administration announced $568 billion in projects for over 66,000 projects across our country. These landmark laws give the Secretary of Energy new resources and authorities to implement programs and policies that will unlock hundreds of gigawatts worth of solar, wind, and grid battery projects that have been stuck in interconnection queues all around the country. This hearing will provide you with the opportunity to demonstrate to the Committee that you will implement Congress's vision of energy abundance and enforce and uphold the laws of the land.

I look forward to this discussion.

The CHAIRMAN. Thank you, Senator Heinrich.

And to be clear, we did follow the rules of the Committee, and they did not arrive after business hours. They arrived at 5:40 p.m. The bipartisan front office of the Committee is, in fact, open until 6 p.m., and so, those came during business hours.

We are now going to hear from Senator Hickenlooper, who will be introducing Secretary Wright—or Mr. Wright—soon to be Secretary Wright.

OPENING STATEMENT OF HON. JOHN W. HICKENLOOPER, U.S. SENATOR FROM COLORADO

Senator HICKENLOOPER. Thank you, Mr. Chair, and Ranking Member Heinrich.

I am here today to introduce Chris Wright before the Energy and Natural Resources Committee, a fellow Coloradan, on his birthday. As someone I have known for a number of years, I first met Chris at a fundraising effort for scholarships for needy kids. We share the fact that we both married way over our heads. His wife, Liz, is behind him, and like my wife, Robin, far outshines him in many regards. Chris won't be surprised to hear me say that we disagree on a lot of things and we are almost legendary—probably 12 or 13 years ago at a fancy Easter dinner in the middle of the day—for getting rather heated over some of the issues around energy, and I think what was interesting—my wife was very worried about our hosts and us being invited back, whereas I don't think Chris and I took any offense at all. And I think that, you know, some people would be surprised that I am introducing him here, and yet he is a scientist who has invested his life around energy and he is indeed an unrestrained enthusiast for fossil fuels in almost every regard, but he studied nuclear. He started out at the University of Colorado, just so I am perfectly clear, but somehow, he ended up at MIT, a place one of my associates is known to have haunted, and he studied nuclear there in detail—got a master's.

His first years working were in solar. He has experience in wind. He is a practitioner and a key innovator around geothermal and the incredible potential that we have in geothermal. He is a scientist who is open to discussion and he is, again, a scientist who is a successful entrepreneur and has that ability to assess what is possible and what isn't. Again, I am well known—for the last 40 years, I have been worried and working to address climate change and I worry about the acceleration of feedback loops that could make what we saw in Los Angeles over the past couple weeks a grim foreshadowing of other events that could come. But I think that what we are looking at now is the need for a comprehensive approach to energy in every regard. Chris has spent a lot of time looking at poverty, not just in this country, but around the world, and how energy affects that and how it affects the health of people in different countries. He is fully versed on the assessments we have made, both on this Committee and as a Congress in the past couple years to make investments around energy, and he respects that.

And I think, as we go forward, I look forward to continuing the robust discussions. And I am not going to hold back, and I know that he won't hold back either. And I think that is part of the key of a democracy, is being able to sit down and really thrash out your beliefs and what the facts are and be able to measure them. I think we both learned and evolved over the years on a number of issues, and I have a high optimism we can work together. I look forward to figuring out what are the best ways and the fastest ways we can address the climate challenges we face.

So Chris, thank you for being willing to do this public service, and I look forward to the discussion.

The CHAIRMAN. We will hear next from Senator Hoeven.

OPENING STATEMENT OF HON. JOHN HOEVEN, U.S. SENATOR FROM NORTH DAKOTA

Senator HOEVEN. Thank you, Chairman Lee, and also Ranking Member Heinrich.

Welcome, and welcome to you, Chris, and your family. It's great to meet all of you. I think it's fantastic that you are here, and of course, Liz, very important that you are here. That was obvious right away when you came in and gave me that huge hug. Moral support is unbelievable. And to have your mom here is pretty cool, on your birthday—60th birthday. And as far as your grandson, Miles, you know, seven months, but it's never too soon to start getting used to Senate hearings. So I think bringing him and kind of getting him used to what goes on is great.

I am really pleased to follow up Senator Hickenlooper. I have great respect for him, your home-state Senator. He is a trained geologist. He knows energy and he has worked and helped me on a lot of things, and I am very pleased to join you in this introduction. And really, it's appropriate because you live in Colorado, but an awful lot of your work has been done in my State of North Dakota. And you have had a huge, huge impact. When I started as Governor of North Dakota in 2001, we produced less than 100,000 barrels of oil, and it was going down. It was going down because we

were drilling 14,000-foot vertical wells and there were more cost-effective places to do it.

So I started a policy called "EmPower North Dakota," and it wasn't just about producing oil and gas, it was about producing energy, as Senator Hickenlooper said, from all sources, and we do in North Dakota now. We are a powerhouse in energy, and you know it well. But it came from creating the right climate, the right legal tax and regulatory climate to encourage energy development, and it came down to getting entrepreneurs, great thinkers, people who were smart, well-trained, and motivated. People who had gone to places like MIT and Berkeley and had the latest, greatest understanding of technologies and all kinds of things. People who would create companies, like Pinnacle Technologies, that started the hydraulic fracturing mapping industry so folks could figure out where the energy was, and then folks that chaired companies, like Stroud Energy, and then started their own companies, like Liberty Energy, to actually do it, to unlock this energy potential here and do it with the best environmental stewardship, the smallest footprint, right? And as a result of folks like that, North Dakota went from less than 100,000 barrels of oil and going down, to 1.5 million barrels a day—1.5 million barrels of oil a day, not to mention all the natural gas—with the best environmental stewardship in the world.

And the reality is, you are that entrepreneur that I am talking about right now—you, and others. And that's what we are talking about. So if we really want all-of-the-above, we need guys like you, Chris, that really understand energy—all aspects of energy, whether it's, as one of my favorite presidents used to say, "nuclur" energy, or oil and gas or anything else, you have that incredible knowledge and understanding and capability to drive this technology to truly make us energy dominant. And that's what we need to focus on, you know, regardless of what kind of energy you may or may not favor, to truly have an all-of-the-above, we need to continue to drive that technology curve. And I cannot think of anyone better able to do that based on your training, your education, your interest, your accomplishments, and your experience. And I am just pleased that you are willing—you, and your family—are willing to stand up and serve.

Thank you so much for being here today, I appreciate it.

Thank you, Mr. Chair.

The CHAIRMAN. Thanks so much.

Mr. Wright, we are now going to swear you in. If you will stand, and I will administer the oath.

Do you solemnly swear that the testimony that you are about to give to the Senate Committee on Energy and Natural Resources be the truth, the whole truth, and nothing but the truth?

Mr. WRIGHT. I do.

The CHAIRMAN. Thank you.

I will now ask you three questions before you turn to your opening statement, three questions that we ask to each nominee before this Committee.

Will you be available to appear before the Committee and other Congressional Committees to represent the Department positions and respond to issues of concern to Congress?

Mr. WRIGHT. I will.

The CHAIRMAN. Are you aware of any personal holdings, investments, or interests that could constitute a conflict of interest or create the appearance of such a conflict, should you be confirmed and assume the office to which you have been nominated by the President?

Mr. WRIGHT. I am not.

The CHAIRMAN. Are you involved, or do you have any assets held in a blind trust?

Mr. WRIGHT. I do not.

The CHAIRMAN. Thank you.

Now, you may proceed with your opening statement. Thank you.

STATEMENT OF CHRISTOPHER A. WRIGHT, NOMINATED TO BE SECRETARY OF ENERGY

Mr. WRIGHT. Thank you, Mr. Chairman, Ranking Member Heinrich, and members of the Committee. Thank you also to Senator Hickenlooper and Senator Hoeven for your kind remarks, friendship, and for your continued service to our Centennial State and great nation.

Before I begin my remarks, I would like to recognize the members of my family who have joined me today: my wife, Liz; my daughter, Schuyler, and her husband, Greg; my seven-month-old grandson, Miles; my son, Arthur and his fiancée, Aluel. Also in the crowd, not needing identification, is my mother, Gayla, sister, Kim, many other extended family and friends as well. The most fortunate event in my very fortunate life was meeting my wife, Liz, when I was 18 years old. I came home that night and told my sister that I had met the woman that I would marry.

It is truly an honor to appear before this Committee as President-elect Trump's nominee for Secretary of Energy. I am humbled by the great responsibility this position holds. America has an historic opportunity to secure our energy systems, deliver leadership in scientific and technological innovation, steward our weapon stockpiles, and meet Cold War legacy waste commitments.

I call myself a science geek, turned tech nerd, turned lifelong energy entrepreneur. My fascination with energy started at a young age in Denver, Colorado. I enrolled at MIT specifically to work on fusion energy. I started graduate school at UC Berkeley, where I worked on solar energy as well as power electronics.

Energy is the essential agent of change that enables everything that we do—everything. A low-energy society is poor. A highly energized society can bring health, wealth, and opportunity for all. The stated mission of the company that I founded, Liberty Energy, is to better human lives through energy. Liberty works directly in oil, natural gas, next-generation geothermal, and has partnerships in next-generation nuclear energy and new battery technology.

Energy has been a lifelong passion of mine, and——

[Protester shouting.]

Mr. WRIGHT [continuing]. Energy has been a lifelong passion of mine, and I have never been shy about that fact. Then again, I have never been shy about much. President Trump shares my passion for energy, and if confirmed, I will work tirelessly to implement his bold agenda as an unabashed steward for all sources of affordable, reliable, and secure American energy.

I see three immediate tasks where I will focus my attention if I get the privilege of being confirmed.

The first is to unleash American energy at home and abroad to restore our energy dominance. The security of our nation begins with energy. Previous administrations have viewed energy as a liability instead of the immense national asset that it is. To compete globally, we must expand energy production, including commercial nuclear and liquefied natural gas, and cut the cost of energy for Americans.

Second, we must lead the world in innovation and technology breakthroughs. Throughout my lifetime, technology and innovation have immeasurably enhanced the human condition. We must protect and accelerate the work of the Department's national laboratory network to secure America's competitive advantage and its security. I commit to working with Congress on the important missions of the national laboratories.

Third, we must build things in America again and remove barriers to progress. Federal policies today make it too easy to stop projects and very hard to start and complete projects. This makes energy more expensive and less reliable. President Trump is committed to lowering energy costs, and to do so, we must prioritize cutting red tape, enabling private sector investments, and building the infrastructure we need to make energy more affordable for families and businesses.

I have met with almost every member of the Committee, and I appreciate the perspective, priorities, and insight that you have shared. As a nerdy guy who reads and studies data, I will need the guidance and partnership of this Committee. I feel confident we can work together to make a difference. I look forward to answering your questions, and if confirmed, shepherding the President's bold energy agenda to unleash energy security and prosperity.

Mr. Chairman, thank you for the opportunity to be here today. I look forward to answering the Committee's questions.

[The prepared statement of Mr. Wright follows:]

Chris Wright
Before the Senate Committee on Energy and Natural Resources
January 15, 2025

Thank you, Mister Chairman, Ranking Member Heinrich, and members of the Committee. Thank you also to Senator Hickenlooper for your kind remarks, friendship, and continued service on behalf of our Centennial State and great Nation.

Before I begin my remarks, I would like to recognize the members of my family, whom have joined me today. My wife Liz; my daughter, Schuyler, and her husband, Greg; my 6-month-old grandson, Miles; and my son, Arthur; and his fiancé, Aluel. Also in the crowd are my mother, Gayla, sister Kim, many extended family and friends as well. The most fortunate event in my very fortunate life was meeting my wife Liz when I was 18 years old. I came home that night and told my sister that I had met the woman that I would marry.

It is truly an honor to appear before this Committee as President-elect Trump's nominee for Secretary of Energy.

I am humbled by the great responsibility this position holds. America has a historic opportunity to secure our energy systems, deliver leadership in scientific and technological innovation, steward our weapons stockpiles, and meet Cold War legacy waste commitments.

I call myself a science geek, turned tech nerd, turned lifelong energy entrepreneur. My fascination with energy started at a young age in Denver, Colorado. I enrolled at MIT specifically to work on fusion

energy. I started graduate school at UC Berkeley where I worked on solar energy as well as power electronics.

Energy is the essential agent of change that enables everything that we do. A low energy society is poor. A highly energized society can bring health, wealth, and opportunity for all. The stated mission of the company that I founded – Liberty Energy – is to better human lives through energy. Liberty works directly in oil, natural gas, next generation geothermal and has partnerships in next-generation nuclear energy and new battery technology.

Energy has been a lifelong passion of mine, and I have never been shy about that fact. Then again, I have never been shy about much. President Trump shares my passion for energy and, if confirmed, I will work tirelessly to implement his bold agenda as an unabashed steward for all sources of affordable, reliable and secure American energy.

I see three immediate tasks where I will focus my attention if confirmed.

The first is to unleash American energy at home and abroad to restore energy dominance. The security of our nation begins with energy. Previous administrations have viewed energy as a liability instead of the immense national asset that it is. To compete globally, we must expand energy production, including commercial nuclear and liquified natural gas, and cut the cost of energy.

Second, we must lead the world in innovation and technology breakthroughs. Throughout my lifetime, technology and innovation have immeasurably enhanced the human condition. We must protect and accelerate the work of the Department's national laboratory network to secure America's competitive edge and its security. I

commit to working with Congress on the important missions of the national laboratories.

Third, we must build things in America again and remove barriers to progress. Federal policies today make it too easy to stop projects and very hard to start and complete projects. This makes energy more expensive and less reliable. President Trump is committed to lowering energy costs and to do so, we must prioritize cutting red tape, enabling private sector investments, and building the infrastructure we need to make energy more affordable for families and businesses.

I have met with almost every member of the Committee, and I appreciate the perspective, priorities and insight that you have shared. As a nerdy guy who reads and studies data, I will need the guidance and partnership of this Committee. I feel confident we can work together to make a difference. I look forward to answering your questions and, if confirmed, shepherding the President's bold energy agenda to unleash energy security and prosperity.

Mister Chairman, thank you for the opportunity to appear before the Committee today, and I look forward to your questions.

The CHAIRMAN. Thank you very much, Mr. Wright.

We will now proceed to five-minute rounds, with Democrats and Republicans alternating in order of seniority and order of arrival, and we will begin those right now.

Mr. Wright, Liberty Energy's Bettering Human Lives report is something I find an informative document. I have a copy of it right here.

[The report referred to follows:]


Bettering
Human Lives
Liberty Energy | 2024
LIBERTY

Energy Matters

Everyone desires and deserves more energy and the opportunities it unleashes.

Our three cover editions represent the range of living conditions experienced globally.



Deulti, India | Cape Coast, Ghana | New York City, U.S.A.

Liberty Energy | First printing January, 2024. | www.libertyenergy.com

Key Takeaways

1. Energy is essential to life and the world needs more of it!
2. The modern world today is powered by and made of hydrocarbons.
3. Hydrocarbons are essential to improving the wealth, health, and life opportunities for the less energized seven billion people who aspire to be among the world's lucky one billion.
4. Hydrocarbons supply more than 80% of global energy and thousands of critical materials and products.
5. The American Shale Revolution transformed energy markets, energy security, and geopolitics.
6. Global demand for oil, natural gas, and coal are all at record levels and rising — no energy transition has begun.
7. Modern alternatives, like solar and wind, provide only a part of electricity demand and do not replace the most critical uses of hydrocarbons. Energy-dense, reliable nuclear could be more impactful.
8. Making energy more expensive or unreliable compromises people, national security, and the environment.
9. Climate change is a global challenge but is far from the world's greatest threat to human life.
10. Zero Energy Poverty by 2050 is a superior goal compared to Net Zero 2050.

TABLE OF CONTENTS

CEO Letter 6

Energy 22

History of Energy 24
Energy Systems Today 28
Electricity 36
Energy Additions 41

Energy & the Modern World 48

Food & Hydrocarbons 50
Four Pillars of Civilization 53
Energy Security & Geopolitics 57
The American Shale Revolution 62

Energy Poverty 66

Energy Access 69
The Human Impact of Energy 78
The Future of Energy Access 82

Climate Change 96

CO_2 & the Planet 98
Climate Trends & Measurements 99
Extreme Weather 104

Climate Economics 114

The Cost of Climate Change 116
Future Adaptation & Mitigation 118
Net Zero 2050 is the Wrong Goal 120

Liberty Energy 122

Delivering Superior Service 128
People & Culture 150
Results with Integrity 164

INTRODUCTION

A Letter From Our CEO,

Our mission is to better human lives. Human happiness comes through relationships, love, and finding a strong purpose in life. Preconditions for these ultimate ends are food, shelter, health, education, and longevity. None of these are possible without energy, and the quality of each depends on the degree of access to affordable, reliable, and secure energy. This report covers in some detail the profound changes in the human condition — life expectancy, emergence from poverty, nutrition, rising education, and more — brought about by the emergence and spread of hydrocarbon energy. A thriving society must be energized by affordable, reliable, and secure technologies. So far in modern history and for the foreseeable future, hydrocarbons are essential to this goal.

Liberty's mission of bettering human lives begins at home. Our top goal is to improve the lives of everyone in the Liberty family. Liberty's success in our business also positively impacts our communities and the world. We pursue our mission with a straightforward business philosophy: Hire great people and treat them like adults. Play to win and have fun doing it. We have been successful in attracting and retaining exceptional people who together truly shine. Our industry's top market research firm, Kimberlite, has ranked Liberty at the top of the big four frac companies in the five overall quality categories for all seven years that they have conducted their survey! We are committed to constant improvement, aiming to exceed our performance each day, week, month, and year.

The transformation in human lives brought by the modern world has not yet spread fully to all. Perhaps only a billion people today enjoy the full benefits of a highly energized lifestyle. These lucky one billion consume an average of 13 barrels of oil per year, 40% of the global total. The other seven billion people average only three barrels of oil consumption, and every one of them aspires to a higher standard of living. Moving the other seven billion (soon to be eight billion) even halfway to the lifestyles of the lucky one billion requires more than doubling of today's oil production. Roughly five billion people today are wearing hand-washed clothes, as their families do not yet enjoy the time-saving convenience of a washing machine. More than two billion lack access to clean cooking fuels and reliable access to electricity. I could go on, but you get the point.

Yet many people who are already fortunate to be among the highly energized are driving a strong movement, based on genuine concerns about climate change, that threatens to slow the progress of the seven billion striving to achieve the lifestyles of the more fortunate one billion. While the focus on climate change is understandable, the movement fails to address the critical and inevitable tradeoffs involved. This movement would better serve humanity by measuring climate risks against the jeopardy of human deprivation, illness, and death that accompanies a lack of access

to affordable, reliable, secure energy. So far, a myopic focus on climate change and climate politics has dominated.

The result has been the rise of a destructive misunderstanding. It goes something like this: "Climate change is the most menacing threat to humanity, and we can reverse this ever-growing crisis by rapidly transitioning our global energy system to cheaper, cleaner, greener energy sources if only nudged by bold government policy incentives." None of this is accurate. It is based on a combination of climate change exaggerations, a strict focus on CO_2 mitigation instead of climate adaptation, and a failure to appreciate the scale and complexity of the global energy system.

Climate change is a real and global challenge that we should and can address. However, representing it as the most urgent threat to humanity today displaces concerns about more pressing threats of malnutrition, access to clean water, air pollution, endemic diseases, and human rights, among others. This report aims to put climate change in perspective relative to these other threats.

The second half of the destructive misunderstanding involves our energy system. Politicians, policymakers, pundits, and the press talk endlessly about how solar, wind, and batteries can transform our whole energy system and address the climate crisis. The reality is that these politically favored technologies have not, will not, and cannot replace most of the energy services and raw materials provided by hydrocarbons. Today they are deployed almost exclusively in the electricity sector, which delivers only 20% of total primary energy consumption. Manufacturing is the largest user of energy globally, mostly in the form of process heat that cannot effectively be supplied via electricity. Further, the ultra-high-power density required for the likes of aviation, global shipping, long-haul trucking, and mobile mining equipment have no viable replacements in sight. Critical materials from hydrocarbons provide nitrogen fertilizer that is responsible for fully half of global food production. In addition, hydrocarbons supply critical materials to produce plastics and petrochemicals that are essential components of modern lives. They also provide asphalt, paints, lubricants, cosmetics, 60% of global clothing fiber, and thousands of other products. Without hydrocarbons we would have no way to produce the vast quantities of steel and cement that undergird our built world. Even wind turbines, solar panels, and batteries are made of hydrocarbon materials and require huge amounts of energy from hydrocarbons to supply the high-temperature process heat required for their fabrication. Energy sobriety is desperately needed.

I am quite passionate about alternative energies and have been my whole life. Liberty Energy is an investor and partner with companies in next-generation geothermal energy, small modular nuclear reactors, and sodium-ion battery technology. The world needs more energy, better energy. Achieving this requires contributions from all viable energy technologies. Recently the wealthy world has gone beyond over-optimism surrounding the breadth and scalability of a narrow slice of alternative energy and, unfortunately, has rushed head-long into outright obstruction of hydrocarbon infrastructure and production. Obstructing the existing energy system without a reliable substitute is reckless. *Bettering Human Lives* addresses these issues in depth, hoping to inform a more thoughtful dialogue of the inevitable tradeoffs surrounding the nexus of energy, climate, and poverty.

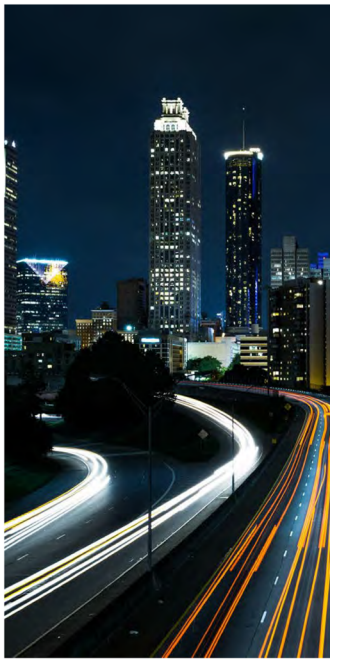
Energy

I once described calculus to my daughter as abstract and tricky, yet critical for understanding our physical world. Energy is far trickier and vastly more important to society and our world. Energy is the essential ingredient that makes everything happen. Everything.

Perhaps this explains why the over 5,000 people at Liberty Energy dedicate our lives to energizing the world. We do this in the face of strident opposition from activists, non-governmental organizations, governments, and an ever-growing list of agencies, regulatory bodies, and media. To thrive in this industry, you must believe in the mission.

And believe we do, with more than 40 frac crews and 30 wireline crews working 24/7, 365 days a year helping produce the oil and gas that supplies nearly 70% of total U.S. primary energy consumption. Liberty's innovative engineers, who helped launch the shale revolution and are now rolling out next-generation natural gas-powered frac fleets, also believe. And so does our supply chain team, which deftly and just-in-time delivers nearly one billion pounds per week of sand from subsurface deposits via our rail and road systems to frac locations across North America. Our distinguished board of directors and everyone else in the Liberty family believe in our mission and relentlessly pursue it as well.

This report will show how the dramatic increase in available energy to humanity brought by hydrocarbons together with the rise of bottom-up social organization — human liberty — transformed the human condition over the last two centuries. Human life expectancy globally has risen from around 30 to over 70 years, just in the last 200 years! Dire poverty, those living on less than $2 per day in today's money, has plummeted from nearly 90% of humanity 200 years ago to less than 10% today. This story is little known and less appreciated, but critical to understanding our world today and where our future might lead. Hydrocarbons vastly expanded the energy available to humanity. They also enabled the creation and rise of industries that never existed before, including modern medicine and communications, high technology, leisure travel, and an endless array of sports and outdoor adventures. Hydrocarbons enabled the creation of machines to harness other sources of energy at scale such as hydropower, modern biofuels, nuclear, geothermal, wind, and solar. These derivative energy sources have very different strengths and weaknesses.





You will read about the transformation of food production in hydrocarbon-energized societies. Throughout human history almost everyone worked in food production, whereas today only 2% of Americans feed our country and the U.S. leads the world in agricultural exports.

History shows that affordable, reliable, secure energy is the agent of change required to live long, healthy lives and realize dreams. Energy enables transformation and pushes back the ultimate constraints on what is possible. A poorly energized society is poor. A highly energized society is prosperous and full of opportunities for its citizens to create and pursue dreams.

It was not until the dawn of the 20th century that coal surpassed wood as the largest global source of energy. Oil surpassed coal a few decades later and natural gas may eventually pass coal globally, as it already has in most wealthy countries. However, the large and rising Asian economies of China, Vietnam, Indonesia, and the Philippines remain dominated by coal and oil and likely will be for some time. Hydrocarbons supply more than 80% of global primary energy, as they have throughout my life.

Hydrocarbons have brought tremendous upsides to humanity via longer opportunity-rich lives, enabling all the modern conveniences of widespread access to clean water, indoor heating and plumbing, modern medicine, plus forest and grassland preservation via reduced need for cropland from huge increases in agricultural productivity. Hydrocarbons also have downsides such as air pollution, climate change, and the geopolitical impacts of uneven resource distribution. Everything involves tradeoffs. There is no such thing as "clean" or "dirty" energy. All energy sources have positive and negative impacts on humans and their environment. Evaluating the tradeoffs in energy systems requires thoughtful analysis in the context of local conditions, values, and needs.

I believe that the American Shale Revolution in which Liberty works has proven upsides that vastly outweigh the downsides. Technology and innovation have more than doubled U.S. oil and gas production over the last two decades while reducing drilling rigs and land required. The abundance of natural gas has displaced coal as the primary source of electricity, reducing U.S. per capita CO_2 emission to levels not seen since 1941. The U.S. has gone from being the world's largest importer of oil and natural

gas to a net exporter of oil and refined products and the world's largest exporter of natural gas! Many benefits have accrued from this surge in supply, first and foremost, the significant reduction in global oil and natural gas prices. Lower energy prices better human lives.

The geopolitical benefits of achieving America's long-sought goal of energy independence are also significant. Figure A shows the transformation of the U.S. energy balance of trade versus China, Europe, and Russia. China has become the world's largest importer of both oil and natural gas. However, coal is China's most important energy source, and it has massive domestic coal resources. China has become the largest producer of energy-intensive manufactured goods, following a century of American leadership in manufacturing. Today the U.S. annually consumes 25 exajoules* of energy across the transportation sector and 25 exajoules in the industrial sector. For China, those numbers are 20 exajoules for transportation and 70 exajoules in manufacturing! China's massive, low-cost coal resources and willingness to deploy them has turned China into the world's heavy industry titan, dominating global production of energy intensive goods such as cement, steel, metals processing, batteries, automobiles, polysilicon, and more. With today's low-priced abundance of natural gas in the United States, the economic benefits of moving energy-intensive manufacturing to China have mostly vanished. We cannot say the same for Europe, which seems destined to continue its deindustrialization.

Figure A

Energy Independence vs. Energy Dependence: Net Exports (Imports) of Oil, Natural Gas & Coal

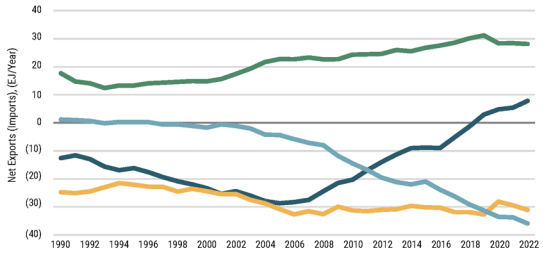


Figure A — Energy Institute - Statistical Review of World Energy (2023), IEA, JP Morgan Annual Energy Paper

Ironically, the wealthy world has outsourced energy intensive manufacturing from modern natural gas-fueled factories in the U.S and Europe to Chinese coal-fueled factories, all in the name of going "green" or reducing greenhouse gas emissions. Every time a large steel plant is closed in Europe or the U.S. due to "climate" policies, the impact is the opposite of a "climate" benefit. Steel, or other energy-intensive manufacturing, is simply being moved from a cleaner manufacturing facility to a higher-emission overseas plant. These "climate" policies grow global emissions, and export well-paying blue-collar jobs. National or state-level greenhouse gas emissions goals have many perverse impacts. Unfortunately, they remain politically popular.

**1 Exajoule (EJ) = 0.95 Quadrillion British Thermal Units (BTUs) = 278 Terawatt-hours (TWh)*

Were there downsides to the shale revolution? Of course. Many communities have seen increased truck traffic, dust, and noise coming with the industrial activity of shale development. Liberty has worked tirelessly to reduce these negative impacts with our Liberty Quiet Fleet®, transitioning to natural gas from diesel for fleet power, and many other technologies detailed in the Liberty sections of this report. All activities have tradeoffs, but the best have upsides that vastly exceed the downsides.

This report describes our mission and seeks to answer the charge that the sooner hydrocarbons are gone, the better the world will be. We answer that charge with an emphatic "No." In fact, quite the contrary. The biggest global energy challenge is that the world desperately needs more energy, not less energy. The world needs more affordable energy, not more expensive energy. The world needs more reliable energy, not less.

How are we doing on the task of adding more global energy, or energy addition, to grow the number of people with highly energized lives like the lucky one billion? In 2010 the world consumed 507 exajoules of energy, which rose to 574 exajoules by 2022. This is progress. Where did this extra 67 exajoules come from? Natural gas, the world's fastest-growing energy source, supplied nearly 40% of the additional energy. Oil supplied 24%, and coal 14%. Hence, hydrocarbons contributed just under 80% of the growth in energy, roughly in line with the little more than 80% of total global energy they have supplied for decades. Wind contributed a little more than 9% and solar a little less than 7%. Hydropower provided 4% and nuclear a net of zero incremental energy, meaning that a roughly equal amount of nuclear capacity was retired as new capacity was built. These numbers illustrate that the term "energy transition" is deceptive and misleads otherwise thoughtful people to support destructive policies that obstruct hydrocarbon production and transportation, driving up energy prices. Hopefully, energy sources outside of hydrocarbons can carry more than 20% of the incremental load in supplying the vital next 226 exajoules to get our world energy system to the 800 exajoules projected for global annual demand by 2050. Nuclear appears to be the most viable option to add sizable new energy resources in the coming decades.

Some retort that we don't need more energy, we just need to use energy more efficiently. The pioneering 19th century English Economist, William Stanley Jevons, addressed this conjecture in his 1865 book *The Coal Question*. He concluded that increases in energy efficiency led to more, not less, coal consumption. Increases



Figure B

Global Primary Energy Demand by Source vs Energy Intensity

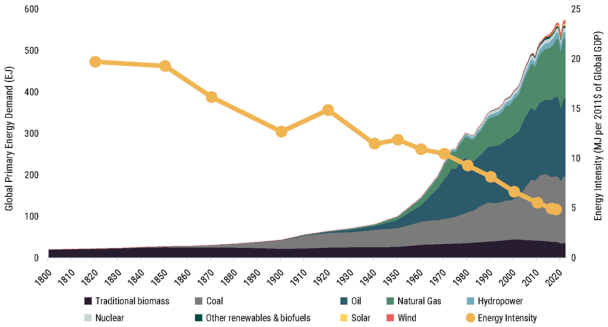
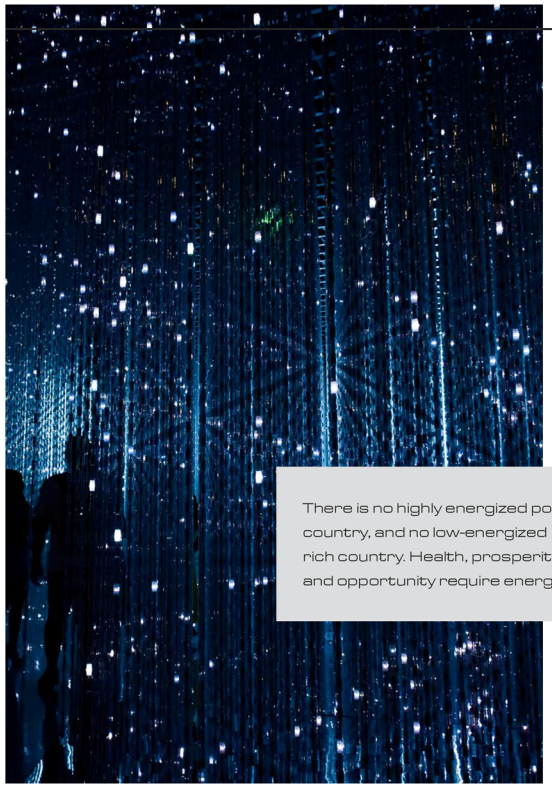


Figure B — Vaclav Smil, 2017, Energy Institute, IEA, Maddison Project, 2020, and Bijou Insights

in engine efficiency make it cheaper to travel, enabling increased travel. Historical trends in U.S. gasoline consumption have been most impacted by price at the pump and economic growth rates. Lower prices and economic growth drive consumption up. High prices and tough economic times reduce demand for all goods. Figure B shows the "Jevons paradox" in action across the entire global energy system over the last two centuries. In it, we can see two centuries of increasing efficiency in energy usage to generate economic value (GDP) combined with two centuries of growing demand for energy. Since 1990, energy efficiency has increased 36% and total energy consumption has increased 63%.





There is no highly energized poor country, and no low-energized rich country. Health, prosperity, and opportunity require energy.

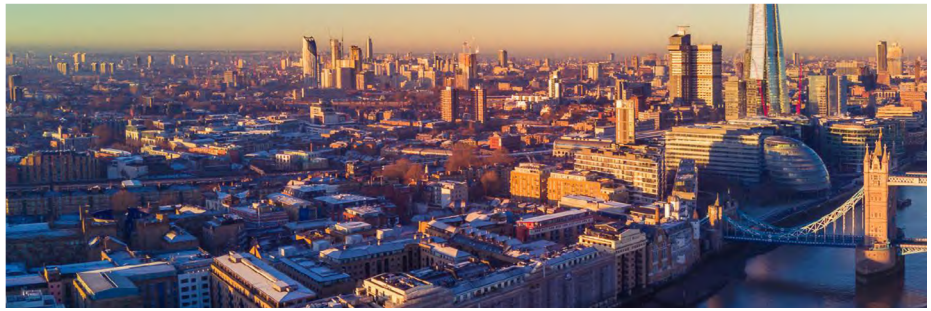
Energy and the Modern World

The world has transformed more dramatically in the last 200 years than during any period in history. Life expectancy has more than doubled and dire poverty has gone from being the normal human condition to a gruesome affliction suffered by less than 10%. Destitution (living on less than $2 per day) remains but is a scourge that we should end by the year 2050. We can do this, but only if we don't stand in the way of increased energy access. No one can rise from poverty without increased energy consumption. Soaring energy availability enabled dramatic improvements in human well-being over the last two centuries, expanding today's life possibilities beyond the wildest imaginations of our ancestors. The enormous increase in energy availability to Americans today is the equivalent to everyone having a hundred human servants working to satisfy their needs, bringing lifestyles that would make Louis XIV envious. Harnessing coal, oil, and natural gas to empower human action, together with the rise of human liberty (bottom-up social organization) have completely transformed the human condition. Economic historian Dierdre McCloskey termed this transformation the Great Enrichment.

There are people in the world today who do not appreciate or understand this transformation. This unawareness is demonstrated by the rapid rise of the ESG (Environment, Social, and Governance) movement in the investment community. A movement often distinguished by its explicit opposition to hydrocarbons and its promotion of a top-down, check (or fill-in) the box definition of social graces. Albeit often well-intentioned, ESG has stood in opposition to the transformative forces that enabled the modern world: hydrocarbons and bottom-up social organization. Perhaps these attitudes can enjoy a moment in the sun among the lucky one billion, but they are unlikely to stand the test of time or enjoy prominence in the developing world.

Liberty Energy and myriad other companies care deeply about the environment, social advancement for all, and good corporate governance. In fact, a vibrant market economy with dynamic companies competing for workers and customers has been the prime driver of the tremendous social and environmental progress of the last several decades. Progress has been most pronounced among societies with free people, free markets, and limited government with low corruption. Segregation on buses in the old American South required governments to first drive private jitney transportation companies out of business. That's because few for-profit ventures are willing to alienate customers. Only when public transportation became a government monopoly could segregation in buses be strictly enforced. Unfortunately, it took Rosa Parks, Martin Luther King Jr., and a strong social movement with legislative and legal enforcement reforms to end legal segregation in the American South. Competition drives businesses to be places of opportunity and empowerment.

Today's global economy as measured by inflation-adjusted global Gross Domestic Product is 100 times larger than it was in 1820! Our world would be unrecognizable to our ancestors and virtually every aspect of it is intimately tied to our complex and massive energy system. Phasing out just one use of natural gas, Haber-Bosch



synthesis of nitrogen fertilizer, would cut global food production in half. Hospitals and virtually all aspects of modern medicine employ an incredible range of custom-designed plastic materials like medical instruments, syringes, masks, gowns, tubing, carrier fluids for vaccines, and more. I had a metallic and synthetic mesh material device implanted 20 years ago to close a flaw in my heart termed Patent Foramen Ovale (PFO). I owe my life to hydrocarbon materials as do countless others. I have yet to mention planes, trains and automobiles, or electricity, telephones, the internet, home heating, lighting, and such. Today's world is built on hydrocarbons. New energy sources such as wind and solar can be components of a diverse energy mix but they are mono-purposed, providing only intermittent electricity at high costs and none of the other human life needs sourced by natural gas and refined products.

Manufacturing of materials and products is the largest and most important usage of energy, because these materials and products make everything else possible. Roughly the same amount of energy (20% of global primary energy) is used to produce just four materials – cement, steel, plastics, and fertilizer – than is delivered by the entire global electricity sector. These four materials are termed the "Four Pillars of Civilization" by our greatest living energy scholar, Vaclav Smil. The modern world rests upon the foundation of these four materials. You will read more about this later in the report.

When I learned that global life expectancy had been stagnant at around 30 years of age for many centuries before the dawn of the modern era, I fell in love with the modern world and the high-quality energy sources that make it possible. Now let's turn to climate change.



Climate Change

Industrial development of the modern world has driven up atmospheric concentration of carbon dioxide by 50%, from a little less than 0.03% to now above 0.04%. This rise has mainly been driven by the combustion of hydrocarbons: coal, oil, and natural gas. Carbon dioxide, methane, and nitrous oxide are the primary greenhouse gases increasing due to human activities. However, naturally occurring water vapor is the most important greenhouse gas. Without water vapor in our atmosphere our planet would be frozen and uninhabitable for humans. Human industrial and agricultural activity increases greenhouse gas concentrations and is contributing significantly to a warming trend that earth has experienced over the past 150 years. Total warming over this period has been about 1.3°C (2.3°F).

A warming planet leads to expansion of seawater and melting of ice caps that drive up sea level. Mean global sea level rose around nine inches in the 20th century and at current rates would add 15 more inches throughout the 21st century.

Another thing that we often hear about climate change is that it leads to a significant increase in extreme weather events with deadly consequences. This claim is false. Extensive reports from the Intergovernmental Panel on Climate Change (IPCC) actually show no increase in the frequency or intensity of hurricanes, tornadoes, floods, or weather-related droughts. Further, deaths from extreme weather have declined significantly for a century as wealthier, more energized societies are much more resilient to extreme weather. Annual deaths from extreme weather events have declined by over 90% even as the global population has quadrupled during the last century. Climate change discourse is unfortunately rife with false claims and alarmist proclamations from all quarters. We seek to address that in this report by giving a brief technical summary of the physical phenomenon and an overview of the empirical data on temperature, sea level, extreme weather, and wildfires. Following the technical sections is a review of climate economics work and the policy implications. A realistic understanding of climate change is important for evaluating tradeoffs around the energy / climate / poverty nexus.

While climate change is a significant problem, it should be considered in the context of the world's other largest afflictions such as malnutrition, endemic diseases, and air pollution. Figure C puts climate change in this context by overlaying comprehensive economic work to quantify the economic damage from the world's most pernicious afflictions as compared to the estimated climate change impacts from Nobel Prize-winning climate economist, William Nordhaus. While the world has made great progress over the last century in reducing the impacts of malnutrition, disease, and air pollution, the impacts today remain quite large in absolute scale, particularly to the world's least fortunate.

Figure C shows clearly that while climate change is significant, it is far less urgent than our other largest afflictions today. Affordable, reliable energy alone will not cure these afflictions, but no cure is possible without it. Prioritizing climate change above these other afflictions threatens to hamper progress on our most urgent issues and losing support for long-term plans to address climate change.

Two things are required for positive progress on climate change: a sober understanding of the issue and the tradeoffs required, and massive improvements in energy technologies that can deliver low-carbon energy that is also low cost, reliable and secure. These are both critical. Despite the grand soirees and proclamations from the annual Conference of the Parties (COP) global climate gatherings, the world's develop-

ing nations are simply not going to implement policies that increase energy costs, reduce energy security, and displace energy-intensive manufacturing from their countries. These policies remain fashionable in many wealthy nations today, but it will not and should not happen in middle-to-lower-income nations. In fact, I don't believe that it should happen in wealthy nations either.

Much of the rich world – the lucky one billion – are losing perspective as they push misdirected efforts to achieve the social and political goal of appearing to "take action" against climate change. Overheated rhetoric is epitomized by current U.N. head António Guterres' "code red for humanity" and "global boiling." Political actions that follow from these farcical proclamations pose a growing threat to the economic wellbeing of the populace and to the geopolitical security of many nations. This report has case studies showing the costly failures of "climate" policy in Germany, as well as the EU, UK, and California. Today the hottest "climate" policy seeks to ban natural gas stoves and heating; New York City passed a law to do just this. New York State gets nearly half of its electricity (the replacement for gas used in heating and cooking) from natural gas, 23% from hydropower and 25% from nuclear before it closed the Indian Point nuclear reactor. Wind and Solar combined provide only 5% of New York State's electricity. Yet it was still sold as a "climate" solution to ban natural gas-burning stoves and home heating furnaces to be replaced with far more expensive electricity, which is largely produced from burning natural gas.

Viable paths to reducing greenhouse gas (GHG) emissions can only come from reliable and affordable low-carbon energy technologies, combined with continuing efforts to reduce the GHG emissions from hydrocarbons that have supplied roughly 80% of global primary energy for 70 years. I say this not as a partisan of hydrocarbons – I began my energy journey in nuclear, solar, and geothermal – but as someone committed to the premise that energy realism is a precondition of humanism. Liberty Energy is working today on next-generation geothermal via our partnership with Fervo Energy and next-generation nuclear with Oklo, a small modular nuclear reactor company. We are quite excited about the prospects for both companies, which is why we took an ownership stake and formed partnerships. We support all forms of energy that can better human lives.

Figure C

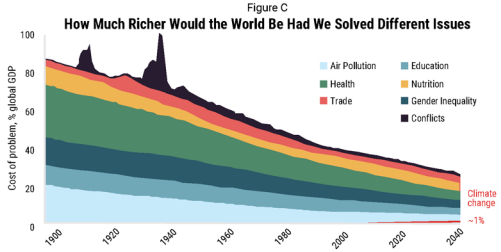


Figure C — Lomborg, Bjorn. "Welfare in the 21st Century: Increasing Development, Reducing Inequality, the Impact of Climate Change, and the Cost of Climate Policies." Technological Forecasting and Social Change, vol. 156, 2020, p. 119981.

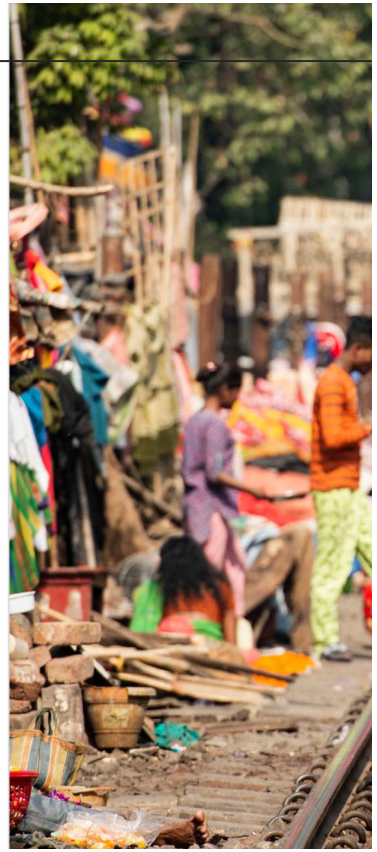
Energy Poverty

I have been lucky in so many ways throughout my life. I could try to list them all, but it would be embarrassing. I will only mention one: I was born in a two-parent family in the United States during the second half of the 20th century. That is winning the lottery. Most people don't win the lottery.

Perhaps only a billion people today enjoy the full package of liberty and energy and, sadly, more than two billion people still lack regular access to basic energy services like clean cooking fuels and reliable, affordable electricity. Most also live in societies without rule of law and secure property rights, the essential ingredients of human liberty. This human liberty and energy transformation is far from complete. We need to expand and improve it, not curtail it.

The most urgent and acute problem in global development is broadening energy access, particularly to energy that is of high quality and clean at the point of consumption. The United Nations estimates that "slow progress towards clean cooking solutions means that the health of 2.4 billion people is at risk." That's one-third of humanity who still lacks access to clean cooking fuel, including some 80% of Africans and half of the Indian population. In concrete terms, over two billion people still cook their daily meals and heat their homes with traditional fuels, typically wood, dung, agricultural waste, or charcoal, often on open fires. This results in low-temperature combustion and high levels of smoke and fine particulate matter — $PM_{2.5}$, one of the world's most deadly pollutants – which is believed to lead to the deaths of about two to three million people every year. This staggering loss of human life and potential could be prevented by providing access to a basic gas stove and a canister of Liquid Petroleum Gas (LPG), which is mainly propane.

Liberty launched the Bettering Human Lives Foundation specifically to address this most urgent energy access issue. If the world's least fortunate are to improve their lives and join the developed world, there must be a dramatic in-





crease in their personal energy consumption, and that of the societies in which they live. There is simply no other way to escape poverty.

Energy access for the world's least fortunate is no bolt-on social goal for Liberty; it is one of the driving principles upon which our company was founded. The greatest force combatting energy poverty has been the American Shale Revolution, the space in which Liberty works. The numbers are astounding: trillions of dollars saved for global energy consumers and over $3,000 each year for every American family. (More details on this in our Shale Revolution section, page 62).

Energy poverty is not limited to the developing world; it is present across all societies. In fact, energy poverty is growing fastest in high-income countries making policy choices that necessarily drive up the local cost of energy. In 2020, some 27% of U.S. households had trouble meeting their energy needs, and 10% of Americans reported keeping their homes at unhealthy temperatures to balance their budgets. This in the world's wealthiest country! Under-heated homes are a significant cause of death among the elderly and people in poor health. In the winter of 2022-2023, due to Russia's invasion of Ukraine and Europe's own failed climate policies, natural gas and electricity prices soared. The European Union estimated that increased heating costs led to 68,000 excess deaths.

Globally, around four million people die annually due to the cold, eight times more than people who die of heat. Raising the cost of home heating is deadly.

Many years of studying these issues has led me to a simple conclusion: Zero Energy Poverty by 2050 is a humane and achievable goal. Net zero carbon emissions by 2050 is neither achievable nor humane, as impeding energy access runs counter to emerging from poverty.



Bettering Human Lives Foundation

In response to the most urgent global energy challenge, Liberty launched the Bettering Human Lives (BHL) Foundation in January 2024. The Foundation strives to increase access to clean cooking fuels and cookstoves for the nearly one-third of humanity that still cook their daily meals burning wood, dung, charcoal, or agricultural waste indoors. We are doing this by supporting businesses, entrepreneurs, and innovators who are working in clean cooking, initially in Africa. Hundreds of businesses supply millions of Africans today with clean cooking fuels and cookstoves. We will help them grow and expand by addressing their most pressing challenges, such as working capital, better stove and fuel technology, and other barriers to growth.

We have already seen a tremendous reception for the BHL Foundation from companies and individuals, both in our industry and outside. Many are eager to join this effort to better millions of lives and expand opportunities for impoverished families, particularly women and girls who suffer most from gathering wood for fuel and preparing meals over smoky fires for hours on end. The size of the challenge is daunting. From the outset, we will focus on one or two countries, learn quickly from failures and success, and relentlessly innovate — the same approach we used building Liberty from a standing start only 13 years ago.

More about the foundation is included in this report. I particularly recommend reading the heartfelt letter on page 72 from Anne Hyre, the Foundation's Executive Director, who has spent her career working on public health in lower- and middle-income countries.

Liberty Energy is a proud passionate family of over 5,000 people who want to spread liberty and opportunity to those born in less fortunate circumstances. We do this through many avenues including educational scholarships, poverty-abatement programs, and hiring practices that don't exclude people who had a tough start in life, including formerly incarcerated individuals. We also focus on helping returning veterans from our armed services, and through the Bettering Human Lives Foundation we are assisting some of the world's poorest families. Our greatest impact, however, comes not from our extensive non-profit ventures but from our daily efforts that help our customers produce vast quantities of North American oil and gas more efficiently and cleanly. Over 10% of American primary energy comes from wells fractured by Liberty. These wells also provide clean cooking fuels for over 100 million people globally! More energy, and better energy, is the path to bettering human lives.

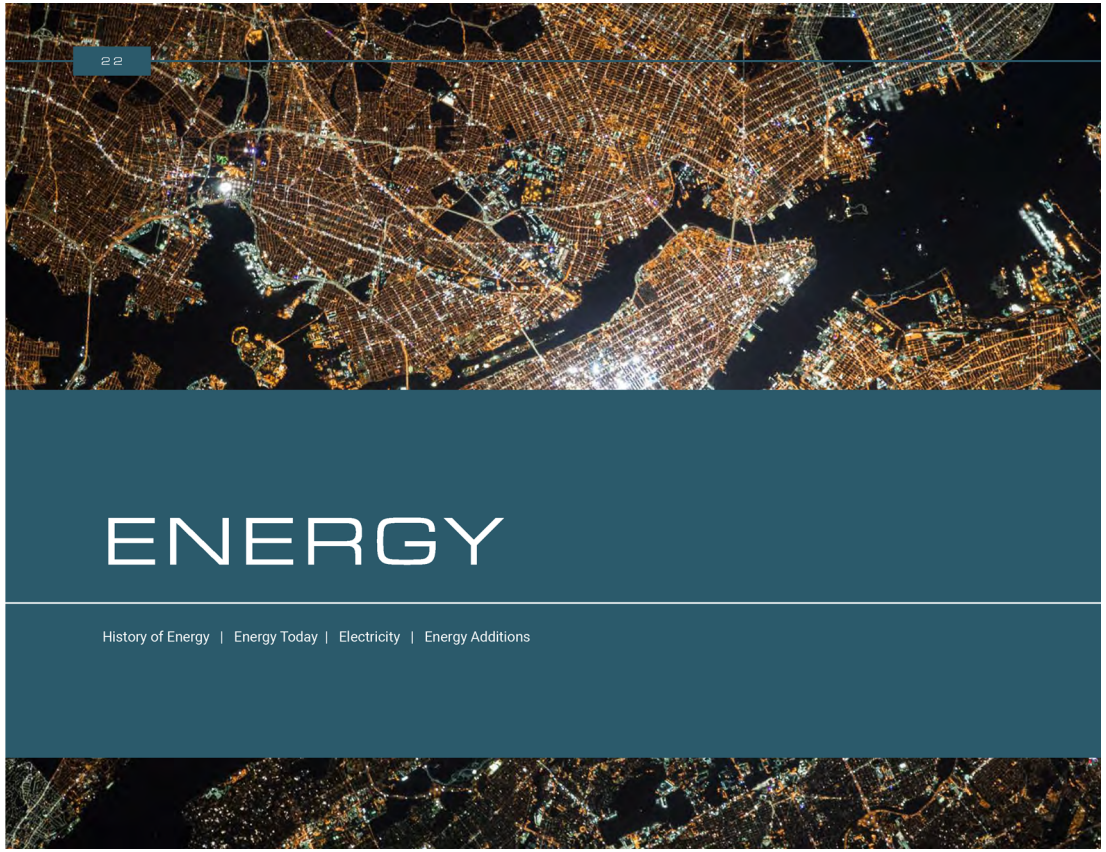
Energy and climate change are critical issues that impact everyone's livelihoods and future opportunities. We aspire to inform these dialogues and steer them towards fact-based discussions about trade-offs. Too many decisions have needlessly driven up energy prices and thereby reduced economic opportunity without making any significant progress on climate change. This report is aimed at providing thoughtful context for decision makers. But this report does not contain specific policy answers, as the social and political process is where these decisions should be made. Different priorities will lead to different choices even when starting from the same basic set of facts and understanding.

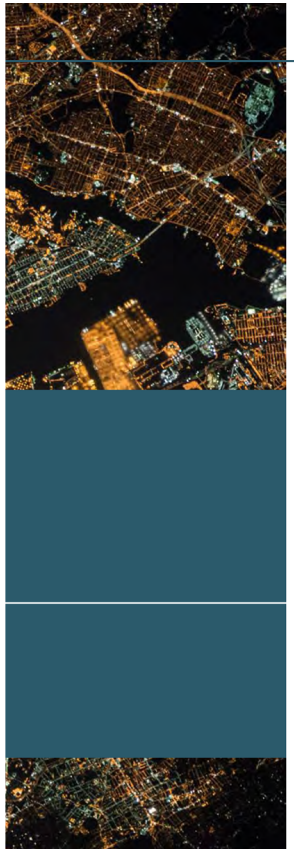
Thank you for joining me and the whole Liberty Energy family on this journey to understand these complex issues and better energize the world's eight billion people.

To Bettering Human Lives!

Chris Wright
Liberty Energy, Founder and CEO




22
ENERGY
History of Energy | Energy Today | Electricity | Energy Additions



Energy

Energy is the essential ingredient that makes everything happen. Every organism, from the smallest micro-organism to the majestic humpback whale, relies on energy. As far back as 3.5 billion years ago, the ability to harness energy released from chemical bonds has made possible the exquisite complexity of all life forms. As life grew in complexity, so did nature's technology, bestowing upon plant and animal kingdoms mitochondria — micro-powerplants that inhabit cells and facilitate movement, growth, repair, and even thought. Throughout human history, physiological demands for greater energy led to substantial and long-lasting cultural change. Our ability to harness the energy of combustion — fire — significantly altered the human diet by expanding the range of foods we consume.

Wood was the sole energy source for heat and cooking throughout human history until the arrival of the modern world. Wood is termed renewable because natural cycles of water and sunlight power photosynthesis to grow trees. Forests provide finite stores of energy that transcend seasons. Modern "renewables" lack natural energy stores. They also require copious amounts of finite, energy-intensive (sometimes exotic) materials to harness nature's daily and seasonal energy flows.

Food is the energy source that powers the human machine. Availability of this energy source was tied to seasonal weather patterns and competition with other humans and animals.

History of Energy



Roughly 10,000 years ago, human progress exploded with the harnessing of energy through the development of agriculture. Our species quickly grasped the benefits of agriculture and planned the use and production of vast quantities and varieties of food energy sources (vegetables, fruits, and grains). The soaring production of energy from agriculture provided cultural changes that led to a substantial rise in global populations previously stunted by hunter-gatherer lifestyles. Over time, greater cultural efficiencies in producing and delivering food, heat, light, tools, and information freed up unused energy to further advance human well-being and civilization. These advancements would not have been possible without growing access to energy.

Following the addition of fire and agriculture, civilization took another large leap, breaking free from the annual photosynthetic constraint by tapping into enormous volumes of energy from coal, oil, and later natural gas. These buried deposits of plant and animal species from millions of years ago provide a concentrated source of high thermodynamic quality energy that enables the rich complexity of life in the developed world. Hydrocarbons represent tens to hundreds of millions of years of energy stored from photosynthesis that freed humanity from the bounds of highly limited and unpredictable harvests of energy. Hydrocarbons now support billions of people's lifestyles that were unimaginable only a few generations ago. Planes, trains, and automobiles changed mobility, facilitating trade and expanding social networks beyond local communities. Improved communications led to the accumulation and availability of knowledge on an unprecedented scale, further expanding with the internet. Technology and research advancements in modern medicine have increased the lifespan, health, and well-being of billions of humans. The expansion of possibilities due to fossil fuels and the technologies they support means that people today enjoy greater freedom — to choose what to eat, where to live, with whom to interact, and how to live.

Figure 1.1 shows a rapid and overwhelming increase in energy supply with the arrival of fossil fuels coinciding with a miraculous increase

Figure 1.1

Global Primary Energy Demand by Source vs. Life Expectancy 1800–2022

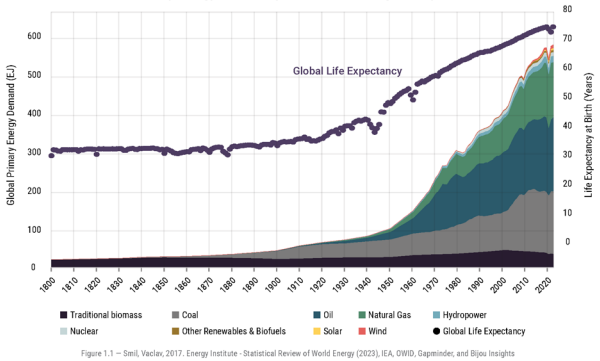
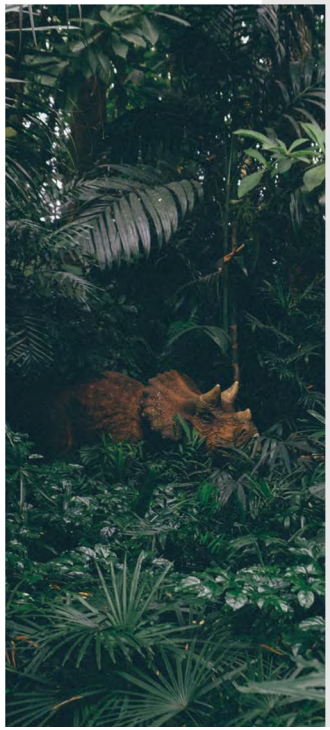


Figure 1.1 — Smil, Vaclav, 2017. Energy Institute - Statistical Review of World Energy (2023), IEA, OWID, Gapminder, and Bijou Insights

in life expectancy. Coal's contribution to global (as opposed to local) energy sources only really emerges in the late 1800s, which coincides with global life expectancy starting to rise significantly. The plot shows two brief 20th century periods of declining life expectancy. The first is World War II. The second, in the late 1950s, is explained by one country: China. Chairman Mao Zedong and the Chinese Communist Party took away the liberty of Chinese farmers and forced collectivization of agriculture on a massive scale. The result of what was termed the Great Leap Forward — tens of millions of deaths from starvation in one of the largest famines in global history.

Northwest Europe, particularly the Netherlands and Great Britain, was the first to adopt large-scale usage of fossil fuels, resulting in the first sustained rise in human productivity. Coal usage was widespread in Great Britain from at least the mid-1500s. Coal consumption grew between 1% to 3% annually up to World War I. Coal likely surpassed 50% of total UK primary energy consumption in the late 1600s. By the 1850s, British society obtained 90% of its primary energy from coal, transforming lives through additional wealth and geopolitical power while supporting a rising population during a period commonly referred to as the Great Enrichment. Coal also explains how a small island nation could have an empire covering one quarter of the earth by the early 1900s. Meanwhile in the United States, forestry timber dominated the energy supply well into the 1870s, although by 1900 coal surpassed wood as the largest energy source in the U.S. Going forward, energy supply growth was dominated by coal and oil in the first half of the 20th century.

The widespread appeal of the human benefits provided by hydrocarbons led to rapid global adoption. By the early years of the 20th century, more than half of the world's energy came from coal and oil. Soon after the end of World War II, the improvement in human welfare and access to hydrocarbons spread across the globe, lifting billions from poverty. This ongoing phase of the Great Enrichment elevated living standards at a rate not seen before in human history. Coal, oil, and more recently, natural gas, remain the primary catalysts in this transformation due to their superior physical qualities, making them indispensable high-quality energy sources.



Where Hydrocarbons Come From

Hydrocarbons represent millions of years of underground solar energy stored from photosynthesis. Photosynthesis consumes energy from sunlight to combine carbon dioxide (CO_2) from the atmosphere with water to form chlorophyll — the building block of earth's carbon-based lifeforms — and release oxygen into the atmosphere. The combustion of hydrocarbons is the reverse of this reaction: atmospheric oxygen is consumed to liberate energy while releasing into the atmosphere the carbon dioxide and water molecules that photosynthesis originally combined.

Earth was far more fertile for life during the time of the dinosaurs, starting roughly 250 million years ago and continuing until 66 million years ago. Ocean-dwelling micro-organisms like plankton and other lifeforms were far more abundant as the earth's average temperature was much higher and atmospheric carbon dioxide (plant food) levels were also far higher. Imagine how much plant life must have been readily accessible to support the giant dinosaurs' daily need for hundreds of pounds of food. This warm, lush, verdant time on earth led to copious amounts of biologic matter accumulating as plankton died and sank to the ocean floor, eventually being transformed into abundant deposits of oil and natural gas. The same thing happened on land in swampy environments as massive accumulations of dead plants were buried and began their long conversion into coal deposits.

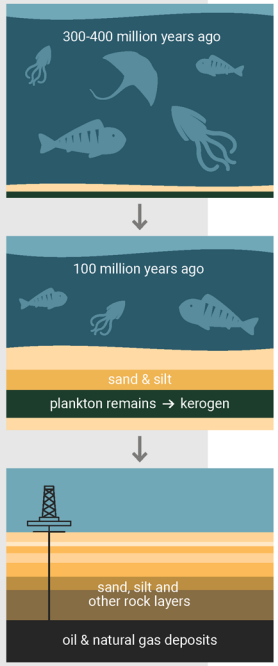
The plankton skeletons on the ocean bottom were gradually deeply buried by sediments flowing into the sea from streams and rivers. Such clay particles eventually were hardened into shale through burial. The gradual accumulation of sediments on sea floors is how new rock layers are formed over millions of years. Geologic processes are very slow. The buried biologic matter from plankton decomposition goes through a sequence of transformations, known as catagenesis, as it heats and compresses over time. With time it progresses to kerogen, a precursor to oil. Further heat and pressure transform the carbon and hydrogen-dominated substance into a viscous black "heavy" oil such as that produced in Canada's oil sands and other places worldwide. Oil buried deeper and at higher temperatures "cooks" longer and further breaks down the long hydrocarbon chain

molecules into ever smaller molecules, forming "lighter" and less viscous oil (think gasoline-like substance). Near the end of the "cooking" process, propane predominates (only three carbon atoms per molecule), then ethane (two carbons), and finally to the fully cooked, simplest hydrocarbon molecule of methane. Methane has only one carbon atom surrounded by four hydrogen atoms and is a fuel that burns so cleanly that it is commonly used to power indoor cooktops and hot water heaters. Because methane is the endpoint of the process, it is also by far the most abundant hydrocarbon. Methane exists not only in fully cooked "dry gas" underground reservoirs, but it is also present in nearly all oil accumulations (associated natural gas) and in all coal deposits.

Oil fields can be small or large surface areas where wells are drilled, typically one to three miles deep, to access underground accumulations of oil and gas that are brought to the surface with ever-advancing equipment and technology. Oil is typically transported via a vast network of pipelines to refineries where it is processed (similar to what Mother Nature does underground) into specific products for uses like gasoline, jet fuel, diesel, lubricating oils, asphalt, petrochemicals, and more.

Natural gas fields produce from rocks where the plankton has fully cooked into the end product: methane. Methane can be directly transported via pipelines to homes or businesses for heating and cooking, to power plants to produce electricity, to industrial plants to power production of materials or consumer goods, to petrochemical plants to make plastics and fertilizers, or exported to countries around the world to energize their societies. Natural gas liquids (NGLs) such as ethane (feedstock for plastics), propane, butane, isobutane, and pentane are derived from the processing of liquid rich natural gas.

Because methane is the simplest hydrocarbon, it burns the cleanest and is also the most abundant, and therefore typically the cheapest of the oil/natural gas family of hydrocarbons produced from marine life. The caveat is that its gaseous form requires a pipeline network to transport it from the wellhead where it comes out of the ground to where it is consumed. In rural areas and lower-income areas that lack an extensive pipeline infrastructure, propane is the common substitute fuel for cooking, heating, and such. Propane is a good substitute because it can be transported easily under pressure as a liquid in trucks and ships, allowing delivery nearly everywhere. At the point of consumption, when it is no longer under pressure, propane burns as a clean gas similar to methane.



Where Hydrocarbons Come From

Energy Systems Today

Following the brief history of energy sources and human advancement in the last section, we now cover where the world gets energy today and how that is evolving with far greater investment into non-hydrocarbon energy sources. We'll also cover what energy is used for and which energy sources can be used for different energy applications. Too often energy is equated with the electricity grid. In fact, the largest usage of energy is as heat in the manufacturing of materials and products. Transportation is also a large and growing usage of energy.

Over the last few decades globally, and in the U.S., hydrocarbons have supplied a little more than 80% of total primary energy. This is not to deny that significant changes are occurring in the flow of investment dollars and government policies in the energy space. Besides natural gas taking market share from coal in wealthy countries, we have also seen solar and wind rising rapidly, largely due to generous subsidies and political mandates in the developed world. But their low energy density, requiring large amounts of land and energy-intensive materials, as well as weather-dependent intermittency, have limited their role to modest players in the electricity sector in middle- to higher-income countries. Their intermittency is one reason that increased deployment of solar and wind has been accompanied by rising electricity prices, as expenditures rise to maintain the reliability of service. So far, these rising electricity prices have not dampened enthusiasm for expanding wind and solar in a quest to lower greenhouse gas emissions.

Figure 1.5 shows the breakdown of energy sources for the United States today, with the lengths of each bar representing a relative contribution to U.S. energy consumption. The bars are also color-coded to show the various uses for each energy source. Notice that the natural gas bar looks like a rainbow as significant quantities are used for multiple applications such as electricity production, home heating and cooking, industrial process heat in factories, direct usage of its molecules to form plas-

Figure 1.2
Number of Homes Served by One Acre of Land Use



Figure 1.2 — Smil, Vaclav. "Power Density Primer: Understanding the Spatial Dimension of the Unfolding Transition to Renewable Electricity Generation (Part V – Comparing the Power Densities of Electricity Generation)", Liberty Energy.

Figure 1.3
Materials Requirements to Build Energy Machines

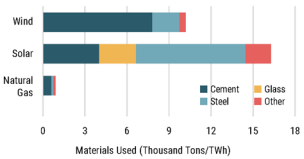


Figure 1.3 – U.S. Department of Energy (DOE), "Quadrennial Technology Review: An Assessment of Energy Technologies and Research Opportunities," September 2015, p. 390G

Figure 1.4
Energy Source Capacity Factors in the U.S. 2022

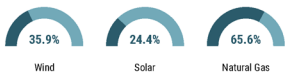


Figure 1.4 — Statista Research Department, and Nov 24. "U.S. Energy Capacity Factors by Source 2022."

Figure 1.5
2022 Estimated U.S. Final Energy Demand by Source & Purpose

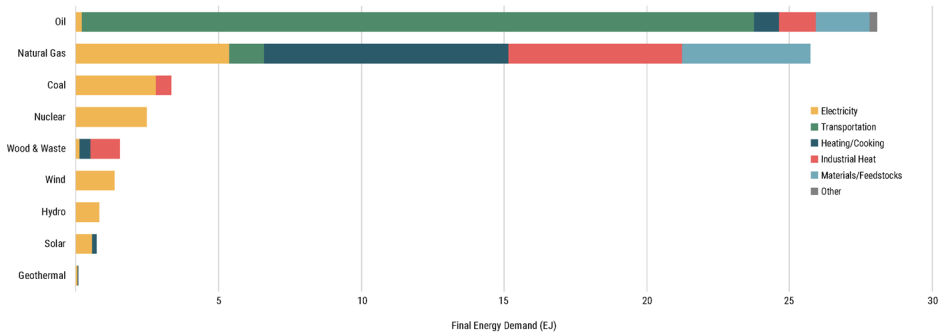


Figure 1.5 – IEA and Bijou Insights

tics and synthetic materials like nylon, and as a transportation fuel for buses, trucks, and cars. Transportation represents the dominant usage for oil in the United States. Globally the oil bar would be more of a rainbow as industrial, electrical, and raw material usage are larger on a relative scale overseas where natural gas is not as readily available to substitute. In contrast, wind and solar make far smaller contributions and are employed almost entirely in electricity production as they are not suited for most other energy usages.

Investment dollars today in wealthy countries are flowing strongly into low-carbon energy sources as part of climate change mitigation efforts. The two largest sources of low-carbon energy, nuclear and hydropower, have struggled to grow. Nuclear is seeing as much decommissioning of legacy plants as construction of new ones, leading to roughly flat energy production. Growth in global energy demand, however, has led to nuclear's share of total primary energy declining from a peak of over 6% in 2002 to only 4% today. It is hard to imagine meaningful global decarbonization without a strongly growing nuclear sector. Hydropower projects struggle with environmental pushback due to the very large land footprint and major effects on waterways and aquatic life. New dams today are only being built in the developing world, with China dominating in global capacity. China continues to grow its energy capacity from many sources to both lift its population out of poverty and continue its dominance as the world's energy-intensive manufacturing powerhouse.

Although opposition to hydropower development may be overstated in individual cases, the environmental concerns are understandable. Much like other renewable energy technologies such as wind and solar, the local regional environmental impact of hydropower can be highly significant. Nuclear, on the other hand, is held back by uncertainty around permitting and regulatory challenges in response to public fears over nuclear safety. In our view, the data does not support the public fears, as nuclear has an outstanding, indeed a pack-leading, safety record.

From the earliest days of humanity, the global energy system has been complex and critical to human welfare. It is too important to get wrong. Our modern world could not exist as it does without the massive increase in energy consumption that has taken place in recent centuries. The global energy system is massive in scale -- successfully redesigning and remaking it is a herculean task. Scientist and author Vaclav Smil said it best: "Energy transitions take time." Governments have been ignoring this fact at our peril.

Any future dialogue should be informed by the past. Despite the ubiquity of the term "energy transition" in today's energy discourse, so far, we have not seen any source of energy decline in absolute global consumption as it is replaced by something new. Instead, we have simply been adding more sources as layers on top of existing sources to satisfy the insatiable demand for energy. A more honest discussion of the new energy sources being touted and heavily supported by mandates and subsidies would be called energy addition, not energy transition. As the following Energy Addition section shows, there is no evidence of an energy transition yet.

Figure 1.6
Global Primary Energy Demand & Projections 1800–2050

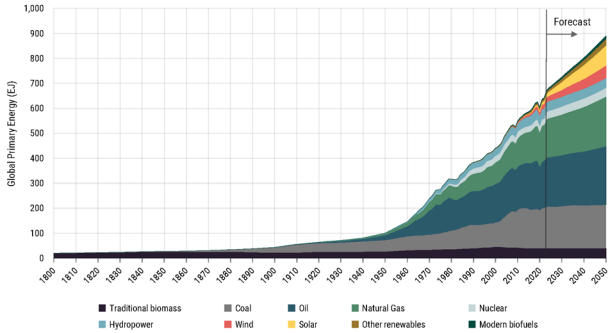


Figure 1.6 – Energy Institute - Statistical Review of World Energy (2023), IEA, EIA Annual Energy Outlook 2022, and Bijou Insights

Figure 1.6 shows historical sources of primary energy production together with Energy Information Administration (EIA) Reference Case projections out to 2050. These projections are consistent with recent history, showing contributions growing from all energy sources to reach the projected nearly 800 exajoules of annual energy demand in 2050. In contrast, the International Energy Agency (IEA) shows scenarios of hydrocarbon demand peaking soon and dropping quickly as the renewables ramp rapidly and global per capita demand for energy declines in the future. The IEA projections ap-

pear less credible, as they do not align with historical trends. Furthermore, the IEA incorrectly assumes that renewable energy technologies are lower-cost, reliable substitutes for hydrocarbons that will drive down the price and market shares of hydrocarbons. What could possibly precipitate a change where people prefer to consume less energy?

Traditional biomass — such as wood, dung, and agricultural waste — supplied the majority of global energy throughout history and prehistory. Since the introduction of hydrocarbons, the share of renewable energy (traditional biomass) has declined precipitously to a low of 13% in 1975. The world did not see a decline in absolute consumption of solid biofuels like wood and dung during this period, only a decline as a total percentage of energy as hydrocarbons grew rapidly. Over recent decades, the percentage of total global energy supplied by renewable energy has increased slightly to 15%.

Unfortunately, the largest source of renewable energy today is still traditional biomass. This is the deadly source of heating and cooking fuel that still predominates among the poorest one-third of the global population. The growth in renewable energy comes from hydropower, the largest source of "modern" renewable energy, and the third largest source of global electricity after coal and natural gas. Growth has also come from the currently favored "renewables" wind and solar, which together account for about 3% of primary energy. The other source of renewable growth is modern biofuels such as ethanol, biodiesel, and aviation biofuel.

Shown in Figure 1.7 is the historical percentage of global energy from renewable sources since 1800, including the wide range of future projections of renewable energy's market share from the International Energy Agency and U.N. out to 2050. Even the most aspirational projection shows renewable energy from all sources only reaching 30% of total global energy by 2050. The transition of the global energy system is a gradual process. It is difficult to replace fossil fuels that are more abundant and possess a higher thermodynamic quality and incredible flexibility in applications. Renewables lack those physical advantages and need the support of policies and subsidies to be cost competitive and even then, only at low grid penetration rates.

Figure 1.7
Renewable Share of Global Primary Energy 1800–2050

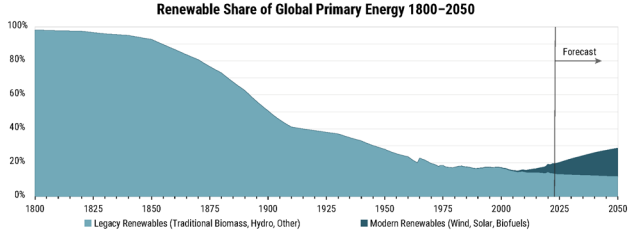


Figure 1.7 — Our World in Data (1800-2022), EIA 2023 Energy Outlook Reference Case (2023 - 2050)

CASE STUDY

Health & Hydrocarbons

Anti-fossil-fuel activists frequently claim that the production and use of oil and natural gas is dangerous to human health, pushing public policies or obstructionist campaigns to slow or stop the production and consumption of these fuels. Despite these impassioned claims, the data does not support their fear-based narratives — in fact, the data shows the opposite.

Access to abundant, scalable, reliable, and affordable energy is a clear precursor for individuals to create protection from their natural environment. As Figure 1.8 illustrates, populations with the highest per capita supply of energy have the lowest mortality risk attributable to environmental risk factors such as access to clean water, air pollution, and exposure to extreme temperatures. According to the Institute of Health Metrics and Evaluation at the University of Washington, global deaths attributed to all environmental risks total 10.1 million annually. Meanwhile, deaths attributed to behavioral risks (such as tobacco, low-quality diets, alcohol/drug use) and metabolic (including high blood pressure and high BMI) total 40.2 million per year.

Figure 1.8
Total Primary Energy Per Capita vs. Mortality Rate Attributed to Environmental Risks

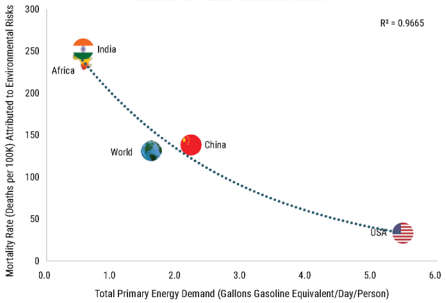


Figure 1.8 — Bijou Insights analysis based on the most recent data provided by the IEA (World Energy Balances 2022) and IHME (Global Burden of Disease 2019).

The U.S. is one of the largest consumers of energy per capita

and its energy mix is heavily weighted to the use of oil and natural gas. Yet, the negative impacts to human health related to environmental risks, including air pollution experienced by U.S. citizens, are among the lowest in the world.

Figure 1.9

Primary Energy Mix vs. Mortality Rate Attributed to Environmental Risks

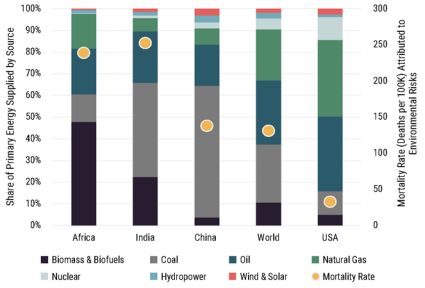


Figure 1.9 – Bijou Insights analysis based on the most recent data provided by the IEA (World Energy Balances 2022) and IHME (Global Burden of Disease 2019).

Figure 1.10

Oil Demand vs. Mortality Rate Attributed to Air Pollution

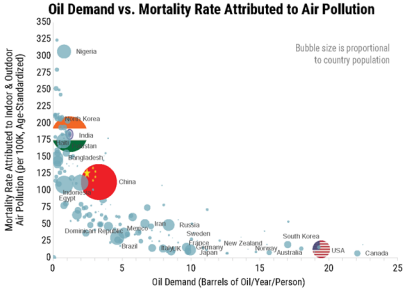


Figure 1.10 – Bijou Insights analysis of data from the WHO Global Health Observatory data repository and EIA.

The data is also clear that populations with access to the most abundant energy supply are those with access to oil and natural gas. Furthermore, those with energy menus that include the highest shares of oil and natural gas also have the lowest negative health impacts from environmental risk factors as shown in Figure 1.9.

One of the most disingenuous claims made by anti-fossil fuel activists is their portrayal of the negative impacts to human health related to air pollution resulting from the production and use of oil and natural gas. The worldwide reality is that an increasing use of oil and petroleum products correlates to lower mortality rates attributed to exposure to air pollution (Figure 1.10). Passion to better our environment and improve human health is laudable, but how best to direct these passions must be informed by an understanding of the tradeoffs involved if the goal is to better human lives.

Globally, about half of total energy consumption is for industrial purposes -- in other words, making the modern world possible. This is the most fundamental use of energy. Without these materials and systems, there would be no electricity, we would lack transportation, healthcare, communications, and all the other derivative uses of energy. Every dialogue about energy should start with "How are we going to produce the required items?" Unfortunately, this critical issue is hardly ever highlighted. In the Energy and the Modern World Section (page 48), you will read about manufacturing the most important building blocks of the modern world: cement, steel, plastics, and fertilizer.

In the U.S., the two primary sectors for energy consumption are industry and transportation. In the U.S. alone, each sector uses approximately 25 exajoules of energy, each representing roughly 25% of the total U.S. primary energy consumption (100 exajoules). However, China's industrial sector uses 75 exajoules compared to only 20 exajoules for their transportation sector. China has become the world's energy-intensive manufacturing center. "Climate" policies often increase energy costs and, therefore, displace energy-intensive manufacturing from Europe or the U.S. to China. Is this an effective "climate" policy? China's industry is powered by coal, therefore, the shift of manufacturing away from Europe and the U.S. will not reduce Greenhouse Gas emissions (GHG), but instead have the opposite effect. Coal supplies over 50% of total primary energy in China compared to around 12% in the U.S. and 16% in Germany.

Energy systems are immense, complex and have evolved based on feasibility and available funding. It matters little what the preferences are among politicians, regulators, investors, businesses, or citizens. When political desires clash with fundamental physics, physics triumphs every time. The trillions of dollars fund-

Industry and transportation combined account for 50% of U.S. energy consumption.



**1 Exajoule (EJ) = 0.95 Quadrillion British Thermal Units (BTUs) = 278 Terawatt-hours (TWh)*



Climate policies in the U.S. and Europe are shifting energy-intensive manufacturing to China, where coal provides the primary share of energy, ultimately increasing global GHG emissions.

ed over the last two decades by governments seeking to remake their energy systems have made rather modest progress in changing the makeup of global primary energy sources. The Energy Addition section will show that they have made only a modest contribution to satisfying the growth in energy demand, not coming close to displacing any existing demand for hydrocarbons.

Political involvement has, however, resulted in significant increases in electricity prices in areas where solar and wind penetration is driven above modest penetration levels. High electricity prices and less stable grids are drawing significant citizen opposition, as are new land-intensive wind and solar projects. Robert Bryce has documented over 500 wind and solar projects rejected due to local opposition. The world energy system is unlikely to transform following this model but will evolve as improved energy technologies outcompete incumbent sources. We are also seeing the rise of new demand sources for energy from AI, cryptocurrency, and continued growth in streaming entertainment. Hydrocarbons have stubbornly dominated global energy systems over the last century and look to continue to do so until truly improved energy technologies arrive and gather scale.

Figure 1.11
Coal Share of Primary Energy Demand

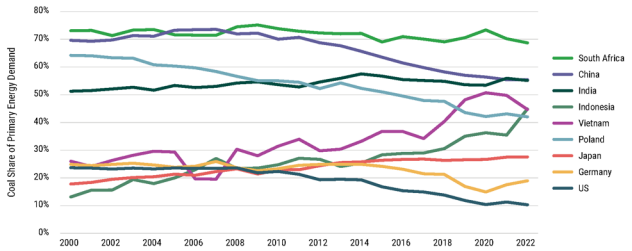
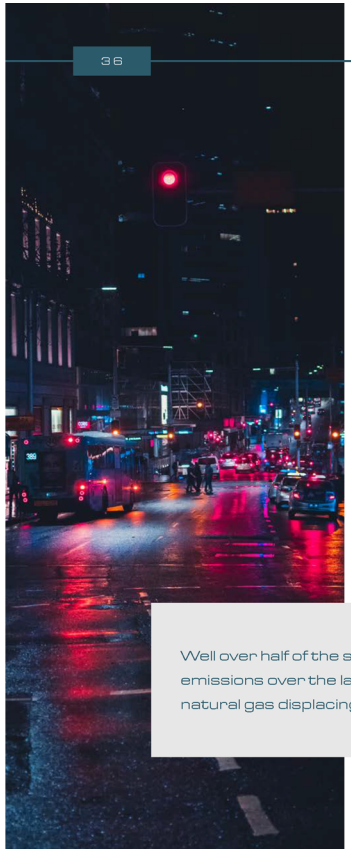


Figure 1.11 – JP Morgan Annual Energy Paper, Energy Institute - Statistical Review of World Energy (2023), and Bijou Insights



Electricity

Globally, electricity accounts for only 20% of total primary energy consumption; however, it dominates the conversation when discussing energy. Perhaps this is because it is so central in our homes and offices and because it is a focus of politicians and regulators. It is a wondrous form of energy, but its large and essential grid infrastructure means that it is delivered in the most top-down means of any energy. Electricity currently accounts for only a small part of industrial and domestic heat and transportation, the largest energy consumption sectors.

The U.S. EIA data in Figure 1.12 give a sense of the increasing demand and changing global sources of electricity over the last 50 years. All things being equal, a modernizing economy will tend to be increasingly electrified, although our case studies on the UK and Germany show that making electricity more expensive ultimately leads to declining demand.

Coal is the primary global source of electricity, contributing about 36%, with natural gas following at approximately 23%. In contrast, low-carbon energy sources such as nuclear, hydropower, wind, and solar collectively provide slightly over 35% of global electricity. Although this market share has remained relatively constant for the past 35 years, there is a modest upward trend.

Well over half of the steep U.S. drop in GHG emissions over the last 15 years is attributable to natural gas displacing coal in the electricity sector.

Over the last 10 years, the American Shale Revolution significantly increased American natural gas production. This increase has introduced ample oil and natural gas to the global market, driving down prices of both commodities. One of the most visible impacts is evident in the U.S. electricity sector, where natural gas has surged to the forefront, now supplying 40% of electricity. In contrast, coal, which dominated over 50% of U.S. electricity supply until just 15 years ago, now provides only around 20%.

This shift has resulted in cleaner air in the U.S., with reduced levels of $PM_{2.5}$, SO_x, mercury, and other pollutants. It has also led to a noteworthy decline in U.S. per capita greenhouse gas emissions, reaching its lowest level in over 70 years. Well over half of the steep U.S. drop in GHG emissions over the last 15 years is attributable to natural gas displacing coal in the electricity sector. This displacement has also led oil and gas to their highest-ever market share of U.S. primary energy — nearly 70% in 2019–2022.

The story is not a surge in the market share of hydrocarbons, but instead a shift in the balance of oil, gas, and coal in the U.S. power sector. After coal and natural gas, nuclear energy provides the third largest share of U.S. electricity at nearly 18%. The rest comes mainly from wind, hydropower, and solar.

Figure 1.12
U.S. Electricity Generation by Source 1950–2022

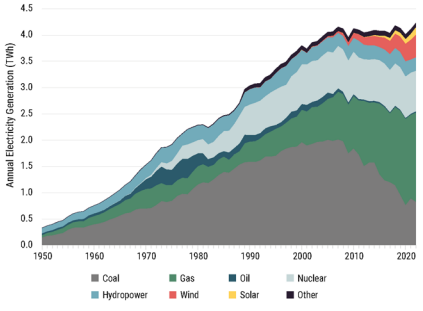


Figure 1.12 — U.S. Energy Information Administration, Monthly Energy Review, February and December 2023, and Bijou Insights

Figure 1.13
Global Electricity Generation: U.S. & Rest of the World (RoW)

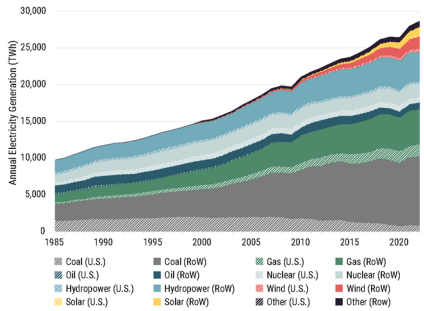


Figure 1.13 — Ember - Yearly Electricity Data (2023); Ember - European Electricity Review (2022); Energy Institute - Statistical Review of World Energy (2023), and Bijou Insights

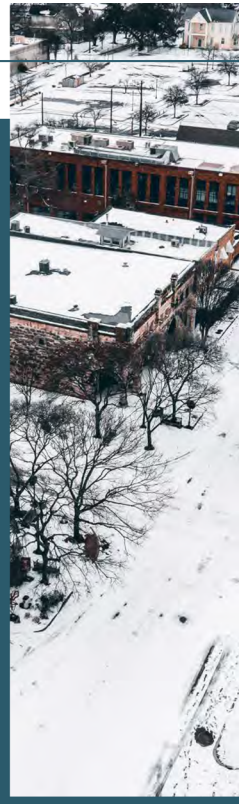
CASE STUDY

Texas Electric Grid Reliability

In the 2022 edition of Bettering Human Lives, we profiled difficulties faced by Texas energy consumers who endured prolonged freezing temperatures and an unstable grid, which led to blackouts during Winter Storm Uri in February of 2021. Thankfully, the winter of 2022–23 did not produce a storm with the severity of Uri. However, as illustrated in Figure 1.14 the winter did produce four periods of minor cold and two periods of major cold weather that materially lifted demand for grid electricity. In each case, increases in dispatchable natural gas-fired generation acted as the shock absorber for wind generation, which declined in all six periods just when customer energy demand peaked during cold temperature periods. How valuable is an energy source that declines substantially when needed the most during demand peaks?

This dynamic was especially pronounced during Winter Storms Elliott and Mara, which could have been particularly dangerous had it not been for the reliability and flexibility of natural gas that proved itself again as the essential fuel for the protection of life and property during freezing conditions.

In the days leading up to Christmas in 2022, Winter Storm Elliott affected much of the central and eastern United States with temperature anomalies particularly wide along the Gulf Coast of Texas and the entire Midwest corridor. Power demand on December 23 exceeded the ERCOT day-ahead forecast by 9% and eclipsed prior summer daily peak loads. As power demand spiked, wind generation plummeted to its lowest level for the month with capacity utilization troughing at 3% at 7 P.M. on Christmas





Eve. In the void left by wind, natural gas met the power demand needs of ERCOT customers while concurrently meeting the highest priority for natural gas, the heating demands of residential and commercial customers who tripled their peak day use during the storm to keep people and properties warm.

Another bout of freezing weather visited Texas in late January and early February 2023. Unofficially named Winter Storm Mara, it spiked demand for electricity and heating, again demonstrating the critical role natural gas plays assuring reliable service to consumers during weather extremes. Unlike Winter Storm Elliott, solar output fell as grid load peaked. Similar to Winter Storm Elliott, wind output again faltered on high demand days during the worst of the freeze. On February 1, wind and solar combined to produce just 5% of ERCOT's electricity, while the share of ERCOT power provided by natural gas rose to 66%. Meanwhile, natural gas reliably met the even more critical heating needs of residential and commercial customers with deliveries of fuel that were 2.5x higher than pre-storm levels.

Case Study: Texas Electric Grid Reliability

Figure 1.14
ERCOT Winter 2022–2023
Daily Average Power Demand vs Power Generation

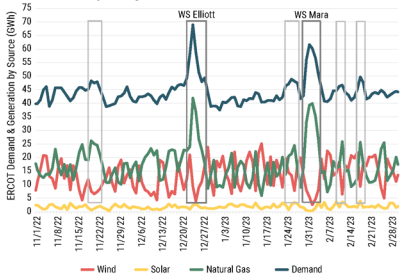


Figure 1.15
ERCOT Hourly Generation Dec 2022

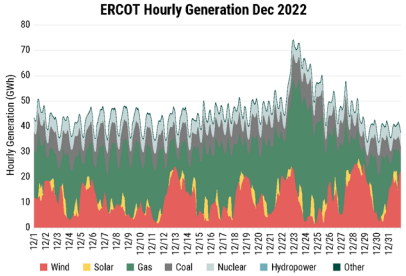


Figure 1.14, 1.15 – EIA Grid Monitor, Bijou Insights

Why is it so important to study power grid performance, especially during the winter months? According to the Institute for Health Metrics and Evaluation at the University of Washington, exposure to extreme temperatures is a risk factor attributed to 7,700 deaths per year (27 per 100,000) just in Texas. Of those 7,700 annual deaths from extreme temperatures in Texas, nearly 7,200 (93%) are attributed to exposure to cold temperatures. Heat exposure contributed to just over 500 deaths. Human exposure to cold kills considerably more than exposure to heat. It's true in Texas (14x), the U.S. (51x), and worldwide (5-10x). There is a growing political movement to push "climate" polices that incentivize and subsidize demand-side electrification for heating and cooking, and supply-side decarbonization of our generation fleet via wind and solar. The above examples show just how destructive and deadly such policies could prove if fully enacted.

Case Study: Texas Electric Grid Reliability

Figure 1.16

ERCOT Hourly Generation Mid-Jan to Mid-Feb 2023

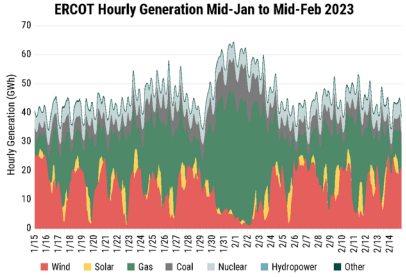
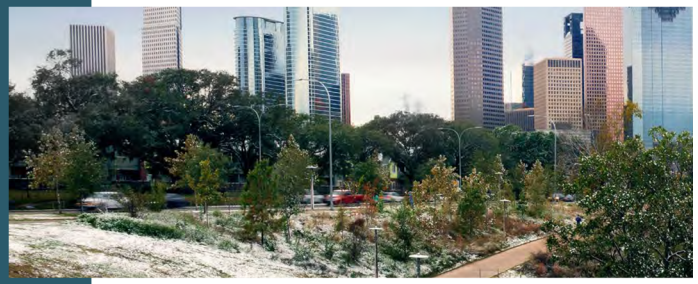


Figure 1.16 — EIA Grid Monitor, Bijou Insights



Energy Additions

The world needs far more energy if we are to better the lives of the less fortunate seven billion global residents who are aspiring to join the lucky one billion who today live highly energized lives. Clearly all those living with the drudgery of hand-washed clothes, dangerous cooking fuels, and unreliable, unaffordable electricity aspire to move up the energy ladder. Despite many setbacks and emerging threats, the world has grown economically and energetically over recent decades. Lives are improving. This section covers what energy sources are growing the total energy pie available to humanity.

In 2010 the world consumed roughly 507 exajoules of energy, rising to roughly 574 exajoules in 2022. Traditional biomass consumption dropped by seven exajoules during this 12-year period as two hundred million people gained access to clean cooking fuels and other substitutions. Traditional biomass, unfortunately, remains a very significant source of energy today (35 exajoules) — far higher than wind and solar combined.

What energy sources provided the extra 74 exajoules (67 growth in consumption plus replacing seven from biomass decline) of energy to expand and improve human life possibilities? Figure 1.17 shows the cumulative ***change*** in energy consumed, by source, annually from 2010 to 2022. You can see not only the total additional energy provided by each source over the last 12 years, but also the annual rate of new energy addition throughout the time period.



Figure 1.17

World Primary Energy Demand: Cumulative Change by Source

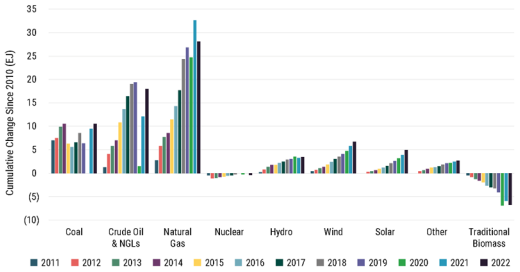


Figure 1.17 — Energy Institute - Statistical Review of World Energy (2023), Vaclav Smil & Bijou Insights



Natural gas has been by far the fastest-growing source of global energy over the last 12 years, providing 38% of the incremental energy added over that period. Oil is the next fastest-growing source, providing 24% of the energy addition even with the abrupt COVID-induced temporary decline in oil demand. Coal comes in third, providing 14% of the growth in energy consumption. Today, hydrocarbons provide over 80% of global energy and also provided 76% of the growth in energy consumption — the energy addition — over the last 12 years. This means that the hydrocarbon share of the total global energy pie has barely budged over the last 12 years.

Wind energy is growing rapidly in percentage terms, but growth in wind power supplied just over 9% of the additional energy consumed in 2022 versus 2010. Growth in solar provided just under 7% of the additional energy, and hydropower supplied about 4%. The growth from hydropower did not occur in the wealthy nations of the Organization for Economic Co-operation and Development (OECD), a club of 38 developed nations, founded in 1961. Hydropower grew in China, Latin America, and Africa. While each dam experiences annual variability in rainfall, water above a dam provides reliable electricity that can be ramped up or down to match demand variability or compensate for the weather-dependent intermittency of wind and solar power. The world has limited rivers suitable for hydropower, so capacity growth expectations may slow in the coming years.

Over the last 12 years, nuclear power has made no net growth contribution to energy demand, as there was roughly as much nuclear capacity retired as was added. The rise of exciting new technology for small modular reactors (SMRs) suggests nuclear energy will be a meaningful contributor to additional energy in the future. SMR technology should address many historical safety concerns and deftly navigate the government regulations limiting the construction of today's large, complex reactors.

The world needs vastly more energy to lift billions out of energy poverty. To achieve large-scale human betterment, we will need significant future energy additions from nuclear, hydropower, geothermal, and all other viable energy technologies.

Natural gas has been by far the fastest-growing source of global energy consumption over the last 12 years.

Figure 1.18
U.S. Energy Production: Cumulative Change by Source

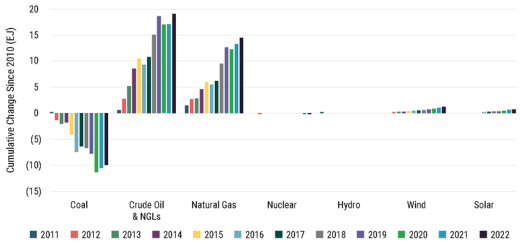


Figure 1.18 – Energy Institute - Statistical Review of World Energy (2023), Bijou Insights

A Closer Look at the U.S.

Figure 1.18 shows the energy addition data for the United States, which had very little growth in energy consumption from 2010 to 2022. However, it did have huge growth in energy production. Hence, Figure 1.18 shows the energy for the U.S. from an energy production perspective. The energy mix story is roughly the same here, with hydrocarbons providing over 80% of all energy addition, even though coal declined significantly. The relatively modest contributions from wind and solar can be seen along with a small decline from nuclear.

A Note on the EIA's Non-Thermal Multiplier

The reported energy quantities in this section are unadjusted. Earlier figures in this report from the EIA have a roughly 2.5x multiplier on electrical energy produced from non-thermal sources like wind, solar, and hydropower. The EIA makes this upward adjustment on non-thermal electrical production because thermal electricity production always involves lost energy in the form of waste heat. However, we take a broader view of the energy system and choose not to make context-specific adjustments. Electrical heating or cooking, or process heat, require a certain amount of thermal energy, whether it be from combustion or electrical matters. No adjustments make sense. Even in other electrical applications, we find the adjustments inappropriate, as electrical power requires precise matching of supply and demand at all times. Thermal electrical sources can provide this on-demand power, whereas wind and solar provide unpredictable, unreliable power. Hence, there is no direct equivalence between the two and we see no support for this 2.5x adjusting upwards of energy production from non-thermal sources. In either case, the central story remains unchanged with or without the adjustments.

CASE STUDY

ESG Incentives vs. Investment Realities

Given the political noise and stakeholder pressure that has influenced energy capital expenditure allocation on a global scale, it would be understandable if one assumed that global energy supply is experiencing a rapid transition to "carbon free" sources.

The political pressure has been intense. The Paris Climate Agreement was drafted in 2015 and signed on Earth Day in April of 2016. While the terms of the agreement were not binding on the parties, it gave increased license for political actors with anti-fossil fuel agendas to escalate pressure on energy producers and their capital providers to restrict capital spending on fossil fuels and accelerate capital spending (investment) on "carbon free" energy sources—namely wind and solar. Perhaps one indicator that illustrates the inflection in political activism is the attendance at the annual U.N.-sponsored climate Conference of Parties (COP). In the years leading up to the Paris Climate Agreement, COP attendance was relatively flat at approximately 10,000 and the tone of comments from then U.N. Secretary-General Ban Ki-moon did not make front page news. Contrast that to the opening remarks delivered at COP27 by U.N. Secretary-General Antonio Guterres, who spoke of a "climate hell highway" and fossil fuel companies "hijacking humanity," or the recent record attendance at COP28 of nearly 84,000. These pinnacles of rhetoric and attendance bookended a year during which leading academic research and the IPCC itself stated that its own most severe climate scenarios were highly improbable.

While energy producers are accustomed to political attacks, financial services companies were not as familiar with intense criticism of their commercial relationships with fossil fuel producers. Perhaps frustrated by their own inability to gather enough votes to pass climate legislation, members of Congress began writing public letters to CEOs of large asset management firms who control proxy voting decisions on behalf of investors and pensioners. The letters included demands that they cast votes for climate activist-sponsored shareholder proposals calling for banks to stop financing activities that supported fossil fuel development and for insurance companies to stop underwriting insurance policies for fossil fuel companies.

At the same time, climate activists dramatically increased their submission of climate-related shareholder proposals to financial services companies in North America and Europe from less than four per year during 2010-2021, to

15 in 2022 and 37 in 2023. Despite the political pressure applied, these proposals received very low levels of shareholder support, but added a nuisance for company management and a disincentive for some firms to maintain or seek new business with fossil fuel clients.

The formation of global coalitions such as the Glasgow Financial Alliance for Net Zero (GFANZ) has been potentially more damaging to efficient capital flows and allocation. Formed in 2021 and led by Michael Bloomberg and Mark Carney, GFANZ rapidly gathered signatories across the financial services sector to adopt business models aligned with the most aggressive (likely physically and socially impossible) net zero targets. Although there have been some who have already abandoned their membership in GFANZ due to anti-trust concerns, the organization currently spans 650 institutions across 50 countries representing 40% of global private assets.

Figure 1.19

Share of Global Energy Capital Expenditures & Primary Energy Mix by Source

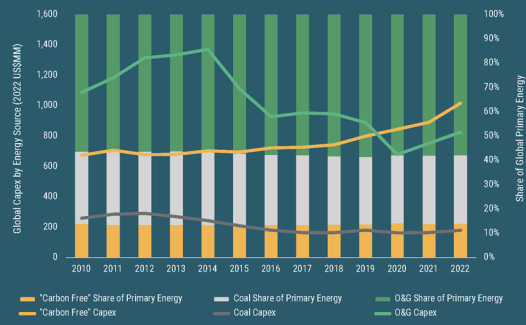


Figure 1.19 — IEA, Energy Institute - Statistical Review of World Energy (2023), EIA, Vaclav Smil, and Bijou Insights

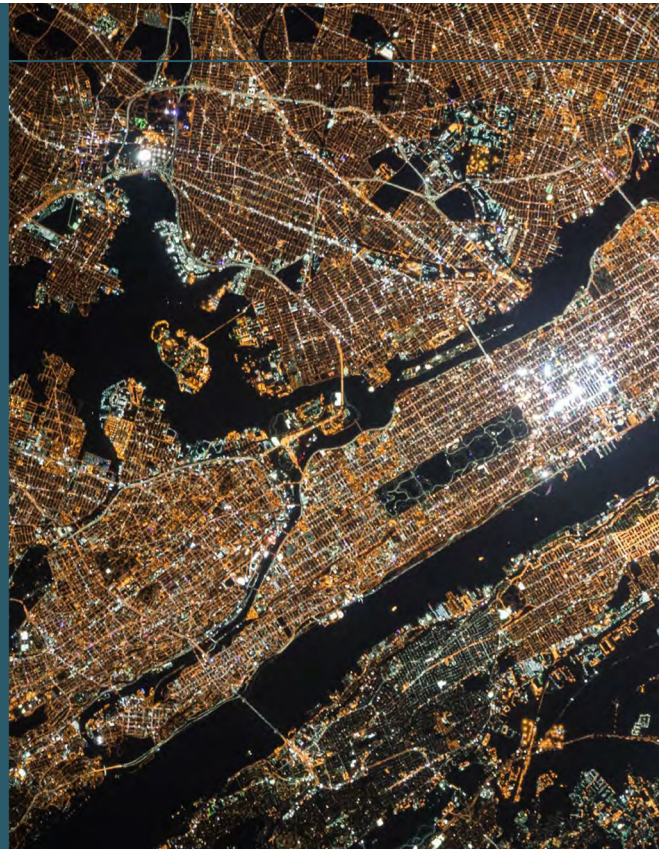
These are just a few examples of the massive influence that a very small number of individuals have on the energy investment climate in which the business sector must traffic and on governments whose policies have followed their lead.

Since its peak in 2014, global capital expenditures for oil and natural gas projects declined by 40% while capital allocated to "carbon free" energy sources increased 45%. In fact, investments in "carbon free" energy sources have exceeded those for oil and natural gas in each of the past three years and are expected to do so again in 2023.

However, despite the material reduction of capital flowing to develop oil and natural gas assets since 2010, our industry was able to increase wellhead production by 51 exajoules per year, which boosted the share of primary energy supplied to the world from oil and natural gas by 1% to 58% — at the expense of coal. Meanwhile, over 50% of the world's energy investments now flow to "carbon-free" energy projects, yet global production has increased just 14 exajoules since 2010 and its share of global primary energy supplied remains under 8%.

The impact from reduced equity, bond and bank debt capital into oil and gas is clearly going to be reduced production and, therefore, higher prices to consumers. It is laudable that oil and gas production still grew with less investment capital, but surely it would have grown a bit more and been a bit cheaper without the reduced investment levels. What does reduced investment mean to future oil and gas production levels? Exploration spending and success has dropped to alarmingly low levels. A lack of success in finding new oil and gas resources may not be felt for several years or even decades, but surely it will be felt eventually in the pocketbooks of consumers. It is dangerous to undermine the future of today's energy system until we have attractive replacements ready to go, which clearly, we do not today.

Case Study: ESG Incentives & Investment Realities



SECTION SUMMARY POINTS

- Energy is essential to life. The world is demanding more, not less, reliable energy.
- Global demand for oil, natural gas, and coal are all at record levels and rising — no energy transition has begun. Energy systems transform very slowly.
- Wind and solar are virtually one-dimensional in function and provide only modest amounts of total electricity generated which, in sum, provides only 20% of global energy consumption.
- We do not yet have the technologies to replace most uses of hydrocarbons. Nuclear appears to be the most viable option for growth in market share.



ENERGY & THE MODERN WORLD

Food & Hydrocarbons | Four Pillars of Civilization | Energy Security & Geopolitics | The American Shale Revolution





Energy & the Modern World

The surge in available energy has enabled the transformation in the human condition that is the modern world. This section highlights specific areas of transformation, starting with food production. Society was simpler and poorer when the majority of humans worked in food production, struggling to garner as many calories as possible to assure their survival. Energized food production freed most people from that drudgery to pursue jobs in manufacturing ever more complex goods, supplying a dizzying array of services to a wealthier populace, or participating in arts, entertainment, and more. Energy is liberating.

This section also covers the enormous scale of production in four basic materials that form the backbone of the modern world: cement, steel, plastics, and fertilizer. That's followed by longer subsections on the interplay between energy and geopolitics, and an overview of the biggest energy transformation of the last 50 years, the American Shale Revolution.

Food & Hydrocarbons

Food is the energy that powers the human machine. It is not optional. Food production, however, has transformed earth's ecosystems more than any other human activity. Roughly one-third of non-glaciated global land is utilized today for food production. Over the last century, the land devoted to food production has roughly doubled. However, the global population has increased four-fold while per capita calorie consumption increased by approximately 50% as billions have risen from near starvation diets.

In the United States, corn yields per acre have risen from two tons in 1920 to over 10 tons today. While this is impressive, the productivity increase per human labor unit is astounding. We can go back even further with wheat farming data. Two hundred years ago, it took 10 minutes of labor on an American farm to yield a kilogram of wheat. Today, it is less than two seconds! Why? A cascading series of innovations, materials, and machines made possible by the rise of hydrocarbons over the last two centuries.

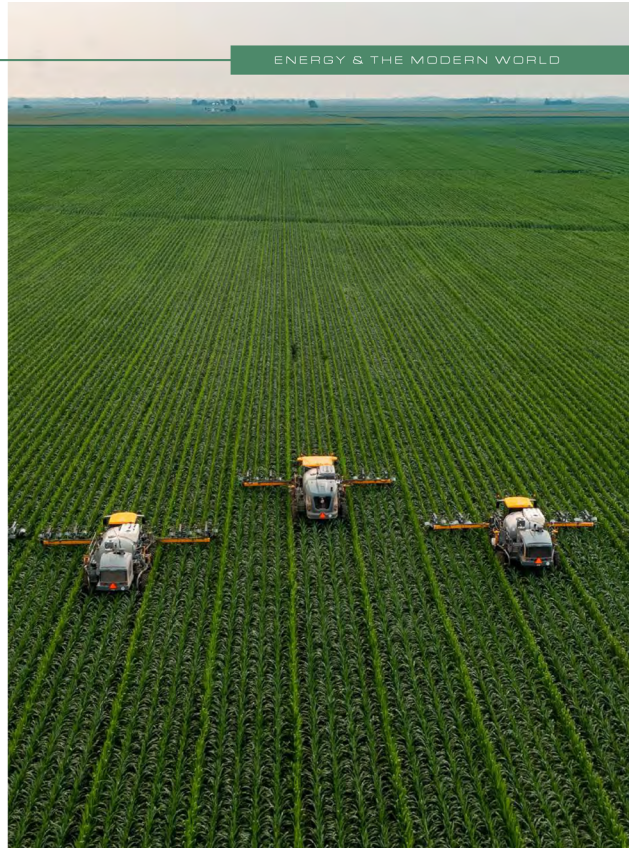
Two centuries ago, over 80% of Americans were farmers and practices were not wildly different than those 2,000 years ago in ancient Egypt. The mechanical energy inputs came from humans and oxen. Thermal energy from wood produced metallurgical charcoal for smelting the iron in rudimentary farm equipment like plow plates, sickles, and scythes. With over 80% of Americans working on farms in the early 1800s, the rate of innovation was limited. A lack of energy, wealth, urban centers, and time for risky efforts that might or might not yield success left laborers stuck in inefficient farming practices.

The following century saw tremendous progress as rapidly rising coal consumption allowed steel production, which led to much-improved farm machinery such as larger plows pulled by teams of horses. Seed drills arrived, as did railroads and steam-powered locomotives that brought better tools, seeds, and access to markets at harvest time. Large steel silos allowed crop storage, giving farmers flexibility on when and where to transport their crops to market.

The 1900s brought further advancement to the agricultural industry through machinery and science. Diesel-powered tractors automated crop planting, harvesting, and processing. Farm seed quality, irrigation, farming practices, and hydrocarbon-enabled pesticides increased yield. And a globally significant breakthrough in chemistry introduced industrial-scale synthetic nitrogen fertilizer.

In the early 1900s German chemists Fritz Haber and Carl Bosch developed a process to use natural gas as both a source of hydrogen and for high-temperature process heat to produce nitrogen fertilizer on a massive scale. Before the Haber-Bosch process innovation, nitrogen content in soil was a major constraint on crop productivity. Existing nitrogen sources from bird guano, manure, and rotating cultivation of leguminous crops like peas, clover, and beans supplied only limited amounts of vitally needed nitrogen. It is hard to overstate the significance of the Haber-Bosch process to today's world. Elimination of natural gas-synthesized nitrogen fertilizer would cut global food production in half. There is no going back from hydrocarbon-enabled food production.

A well-functioning, well-supplied global liquefied natural gas (LNG) market is critical to the world's food production, as natural gas enables global nitrogen fertilizer production. At the end of the summer in 2021, global LNG demand began exceeding supply, unleashing a rapid escalation of LNG prices to reduce demand to match supply, which is inflexible in the short-term due to infrastructure constraints. Nitrogen fertilizer production was curtailed in many places that lacked domestic natural gas production, putting upward pressure on food prices. The rapid rise in LNG prices likely also impacted Russia's timing for the invasion of Ukraine, as the Russian government had maximum leverage when natural gas markets were in short supply. Global grain markets have seen elevated prices ever since, exacerbated further by the ongoing Russian invasion and war on Ukraine.



CASE STUDY

A Warning From Sri Lanka

In April 2021, Sri Lankan President Gotabaya Rajapaksa imposed a nationwide ban on the importation and use of natural gas-based, synthetic fertilizer and pesticides. This forced two million farmers to adapt to organic farming.

The results of these policies were devastating to humans and Sri Lanka's economy. Hungry and outraged citizens launched protests, forcing government officials to resign en masse and the president to flee the country. Nearly three years later, the ban has been reversed but Sri Lanka struggles to manage its hunger crisis and has been thrust further into political chaos.

The impact was rapid and brutal:

In the first six months of the ban, domestic rice production fell by
20%

Domestic rice prices — a staple of the national diet — surged by around
50%

Sri Lanka was forced to import
$450 million worth of rice

The ban also devastated the nation's tea crop, resulting in estimated economic losses of
$425 million

In 2022, Sri Lanka defaulted on
$40 billion in foreign debt



Four Pillars of Civilization









Skyscrapers, highways, dams, power plants, hospitals, airports, seaports, railroads, factories, and housing all rely critically on the "four pillars of civilization." Scientist and author Vaclav Smil coined this expression in his book *How the World Really Works*. Cement, steel, and plastics are central to nearly everything we build in the modern world, and fertilizer is responsible for half of all food grown today. All these pillars critically depend on the combustion of fossil fuels for process heat in their manufacture, and three of the four use hydrocarbon molecules as critical raw materials. Materials such as aluminum, wood, gypsum drywall, metal alloys, and silicon also rely on these essential products. The four pillars serve as the linchpins for every large-scale endeavor by enabling mining, production, processing, and distribution. They are crucial for any economic progress, whether in alleviating dire poverty or achieving a Western lifestyle.

In 2019, the world used a staggering 4.5 billion tons of cement, 1.8 billion tons of steel, 370 million tons of plastics, and 200 million tons of fertilizer. Global demand for these products is at an all-time high and continues to grow. Hydrocarbons are the only answer to producing enormous quantities of these materials.

01. Cement

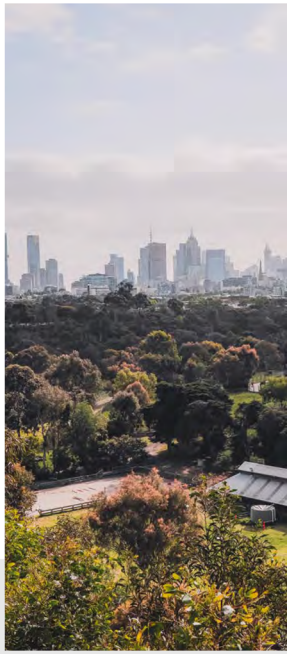
Cement is the key component of concrete, one of the most widely used materials in the modern world. While cement is the only pillar that does not employ feedstock from hydrocarbons, it does require enormous amounts of process heat from the combustion of coal dust, petroleum coke, and heavy fuel oil. Cement is the backbone of modern civilization, creating accessibility through roadways, bridges, tunnels, runways, and dams.

China produced more cement in 2020 and 2021 than the United States consumed in the entire 20th century. China's cement consumption has plateaued, but as large countries like India, Indonesia, Vietnam, and Nigeria develop, we can expect large increases in their cement usage — for the sake of bettering human lives. An example: Parasitic disease could drop nearly 80% if families in Asia and Africa could use concrete to replace mud flooring in their homes. Modernity is material intensive and universally sought.

02. Steel

Steel shapes the essence of modern civilization with robust, durable, and versatile qualities. From skyscrapers to surgical instruments, steel underlies both visible and unseen aspects of our world. Steel requires coking coal or natural gas as a carbon source to turn iron into steel, along with high-temperature process heat typically from natural gas or coal.

Steel alone accounts for 99% of metal consumption because its physical properties can be tailored to an endless array of applications. Steel is everywhere around you: jewelry, food packaging, refrigerators, railways, roads, cars, baby cribs, piano strings, oil pipelines and frac equipment. It is also 100% recyclable; today 90% of steel is recycled.





03. Plastics & Petrochemicals

Petrochemicals, like plastics, are custom-designed hydrocarbon chains tailored to highly specific applications. The building blocks of these wondrous materials are the organic molecules from natural gas or oil. Did you know 14% of worldwide oil demand and 8% of natural gas demand are used not for energy but as building blocks to make petrochemicals like plastics and pharmaceuticals? Petrochemical demand is growing faster than demand for oil or natural gas, representing between one-third and one-half of total projected future demand growth for oil and gas. Most all manufactured products today contain plastics, including two-thirds of global clothing fibers. Plastics and petrochemicals are most indispensable in health care: medical devices and machines, masks and gowns, flexible tubes delivering food or oxygen, sterile packaging, thermal blankets, and more.

04. Fertilizer

Rising crop yields from fertilizers have allowed the world to produce far more food on less land. Without petroleum-based fertilizers, we could not feed the world's eight billion people. Nitrogen fertilizer production typically utilizes natural gas for both high-temperature process heat and to source hydrogen atoms that are combined with nitrogen to make ammonia (NH_3). Hydrogen is the critical element that makes nitrogen chemically accessible for crop growth. Nitrogen accessibility is the limiting factor in crop yield. While air is over three-quarters nitrogen, the diatomic molecule (N_2) in air is not directly accessible by crops.

Phosphate and potassium (potash) are the other two major nutrient fertilizers that are mass produced via mining and chemical processing.

Can you think of anything today that does not directly contain or rely on one of the four pillars? These pillars are humanity's greatest fortune from hydrocarbons.

As demand continues to rise, there has been pressure for policies to reduce greenhouse gas emissions. Wealthy countries attempt to hit their emissions targets by displacing energy-intensive manufacturing. This has not changed the demand for these products. Instead, it has pushed energy-intensive manufacturing to lower-income countries with dirtier energy sectors. For example, China consumes 70 exajoules for manufacturing annually, compared to the United States' annual consumption of 20 exajoules. In only two years (2020 and 2021), China produced as much cement as the United States did in the entire 20th century.

Displaced manufacturing from the U.S. or Europe — where natural gas is the dominant industrial fuel — to Asia's coal-dominant manufacturing sector increases global greenhouse emissions, particulate matter and other global air pollutants. While this transfer has reduced the overall production cost of the four pillars and their countless derivatives, the global carbon footprint has increased. As Dr. Scott Tinker reminds us, there is only one atmosphere. Everything involves trade-offs.

Too often, the electricity (or power) sector is confused with the energy sector, of which electricity is only a modest subsector. Manufacturing — of everything, not just the four pillars — is the largest consumer of primary energy. Despite increasing efforts to electrify everything, less than 15% of energy used in manufacturing comes from electricity — the same fraction that it was 25 years ago. Let's celebrate advancements in electricity production but keep them in perspective as a modest piece of the global energy system.

Just under 20% of global primary energy is used to produce these four essential materials, roughly the same amount of energy provided globally by electricity!

Wind turbines are highly visible embodiments of hydrocarbons; they require enormous amounts of concrete, steel, and plastic. The bases that anchor the turbines are made of steel-reinforced concrete. The towers, nacelles, and rotors contain nearly 200 tons of steel per megawatt of capacity. A mid-size turbine blade uses 15 tons of energy-intensive plastic resins.

Silicon deserves an honorable mention as a pillar of the modern world due to its ubiquitous role in modern computing, communications, and consumer devices. Silicon's impact has been tremendously life-enhancing, but it merits only an honorable mention as everything silicon has brought depends entirely on the four pillars. Silicon is a derivative material of the four pillars, not a pillar itself.

Energy Security & Geopolitics

The intimate link between energy security and national security has been underappreciated in recent years. This all changed when Russia invaded Ukraine on February 24, 2022. Russia's invasion did not cause today's energy crisis. It's more the reverse: Today's energy crisis is likely a critical factor in the timing of Russia's invasion. Over the last 20 years, Europe has significantly reduced its hydrocarbon production, becoming ever more dependent on imported energy, primarily from Russia. Europe has invested massively in wind, solar, and biofuel energy to reduce GHG emissions. These energy sources are far more capital-intensive and lower in energy density and reliability. Europe was in the unenviable position of heavy reliance on Russia for natural gas, oil, and coal. Today, the United States has played a major part in filling the gap as Europe decreased (but not ceased) natural gas imports from Russia. Europe's energy pivot over the past 20 years appears to be a failure. It has delivered significantly higher energy costs, grave energy insecurity, and relatively modest GHG emissions reductions after factoring in the impact of Europe outsourcing manufacturing emissions to more coal-dependent regions. The European and UK Case Study (covered later in this report) provides more detail on this story.

A glance back to the history of energy and geopolitics is warranted.

The Netherlands and England led the rise of modern liberal democracy, the rule of law, free markets, free trade, and the tremendous growth of human liberty over the last several centuries. Perhaps the most critical driver of their rapid rise was substantial advantages in energy supply. The Dutch were famous for their thousands of windmills used to pump water and grind grain in the early 1600s. But windmills do not provide process heat to smelt metals, blow glass, make bricks, or refine sugar. Peat, an immature hydrocarbon produced from partially decayed plant matter, was the key energy source that enabled the rise of a small coastal nation into a worldwide leader in agricultural productivity, early manufacturing industries, and global trade. Peat made the Netherlands the most energized nation on earth and the wealthiest per capita. Peat supplied 20-100 times more energy than windmills in the Dutch Golden Age.

Unfortunately for the Netherlands, England had coal — an emerging source of energy that was far more extensive, energy-dense, and easier to transport. Pre-industrial societies had limited supplies of energy. Forests were rapidly exhausted, and everything else depended on highly variable annual crop yields. Reliable access to affordable energy in quantity has always been the primary constraint on improving the human condition. Coal transformed England and began the emergence of the modern world.

The rise of coal in England began long ago, playing a significant role even during Shakespeare's time. Coal is estimated to have provided half of England's energy before 1700, principally as

thermal energy for heating, cooking, forging metal, and other process heat manufacturing uses. In the 1700s, the invention of steam engines displaced the historical constraint of mechanical energy only coming from humans and animals (horse and oxen) plus some from water wheels. Without the ability to transform thermal energy into mechanical energy with steam engines, most everyone reading this report would still be a farmer or agricultural worker.

The rise of the world as we enjoy it today resulted from more abundant and higher quality energy sources supporting modern transportation, manufacturing, communications, education, healthcare, computing, travel, leisure, and more. None of today's industries could exist in recognizable form without the energy and materials from hydrocarbons, including electricity production from hydropower, nuclear, wind, and solar. Energy supply is critical to all modern warfare — as was food and fodder in pre-modern wars — and has often been the origin of violent and deadly conflicts.

The immense rise in global trade in the 20th century brought economic benefits from harnessing different countries' comparative advantages. A relatively peaceful post-WWII order enabled the rapid spread of industrialization via foreign direct investment, global trade agreements, and capital flows. Rising geopolitical tensions over the last decade (at least) are unfortunately exposing the fragility of today's global economic order.

Today over 100 countries across every inhabited continent produce oil and natural gas. Global markets have generally been well-supplied and, importantly, the inflation-adjusted cost of oil over the last five years has been roughly equal to its average since the industry began in 1860. As the world gets wealthier, the share of total income needed for energy costs has been in long-term decline, a positive trend for human well-being. Unfortunately, we appear to be getting off-track recently.

The world energy system requires meaningful spare capacity to handle inevitable bumps in the road. The last several years have seen this capacity whittled away for multiple reasons. Insufficient energy investment has partly resulted from recent low investment returns due to low commodity prices — in response to surging oil and gas production from U.S. shale. Excess energy production capacity has also shrunk due

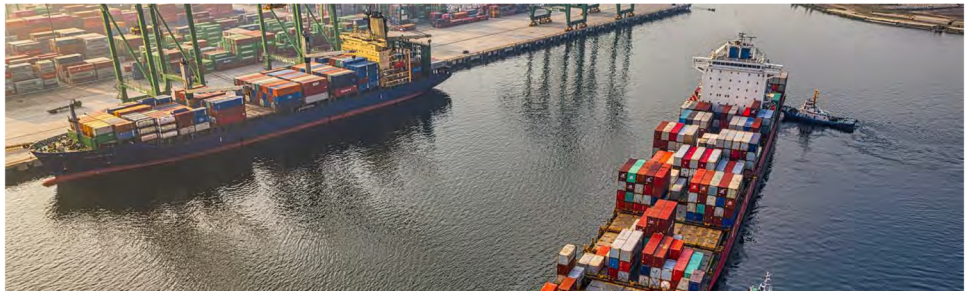


to regulatory blockage of critical energy infrastructure such as pipelines, import terminals, and export terminals. In the U.S., roadblocks for well permitting and leasing on federal lands, low public energy literacy, and ill-informed climate alarmism are stymieing hydrocarbon development. Further constraining investment capital is an over-reaching regulatory framework, including some elements of the corporate Environment, Social and Governance (ESG) movement, that has been myopic in environmental concerns regarding hydrocarbons' negative climate impacts without an accompanying appreciation of their necessity for human well-being. The net result is a constrained supply of oil, natural gas, and coal — which means higher prices and a greater risk of market dislocations. High energy and food price inflation is the cruelest form of tax on the poor.

Unbalanced and unrealistic views of hydrocarbons are driving up the cost of energy for the global population and contributing to geopolitical instability. This was most evident by the rapid rise in energy and food prices that accompanied Russia's invasion of Ukraine. If the world economy continues to grow and we see increased movement from coal to natural gas in middle income nations, we risk another crunch in LNG export capacity. This would come amid an ever-growing demand for natural-gas-generated electricity, home heating, petrochemicals, industrial process heat and raw materials, and most alarmingly, nitrogen fertilizer production.

Should the current war in Israel expand to include Iran directly, as opposed to only supporting militant proxy groups, global oil supplies would be at risk. A loss of Iranian oil exports would significantly escalate global oil prices and the myriad products that flow from oil. Disruptions to the Strait of Hormuz or the Bab al-Mandeb Strait would also threaten flow of oil and natural gas. Hydrocarbon-dominated energy is not just a sector of the economy, it is the sector that enables every other sector.

Now is a time for reflecting on how we got here, how we can rebuild, and how to avoid these costly mistakes in the future. It is not clear how all this will play out in the coming years. It is clear, however, that elevated and uncertain energy and food prices are a real and present danger to the world order.

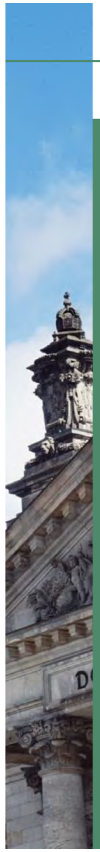


CASE STUDY

Germany

Germany has been the world's frontrunner in government-forced energy transitions. Over the past two decades, Germany has dramatically cut dispatchable electricity sources by reducing coal and eliminating nuclear power. Solar energy now accounts for 10% of electricity capacity, while wind accounts for approximately 30%. These "renewable" energy sources are not only unreliable, but their large grid penetration has resulted in the highest electricity prices for consumers in the developed world.





Several side effects stem from this government policy:

Between 2002 and 2022, total installed electric power capacity has grown from 115 GW to 222 GW, an increase of 93%. However, the percentage of reliable (nuclear and hydrocarbon) power generation capacity has decreased from 84% to 39%. Coal remained Germany's largest source of electricity in 2022.

While almost all of that 110 GW addition was solar and wind, total electricity production in Germany declined by about 15%. This large increase in capacity with a reduction in electricity production explains why electricity prices in Germany are so much higher than before and are about three times higher than average prices in the United States.

The risk of power outages during times of extremely low wind and low solar power generation, a so called "Dunkelflaute," has increased significantly. To maintain reliability over winter months, Germany has become more dependent on imports and has reactivated its domestic lignite-fired power generation — a higher-emission source per unit energy than standard coal.

German per capita CO_2 emissions were reduced by 28%, but this was mostly due to lower overall energy use (-17%). Higher energy prices consistently lead to reduced industrial activity and consumers rationing usage due to affordability.

U.S. per capita CO_2 emissions have decreased by roughly the same amount as Germany due to a switch from coal to natural gas in electricity generation. This change was not accompanied by significant electricity cost increases, except in states with high wind and solar penetration.

German primary energy from hydrocarbons dropped from 80% to 74% as a result of 20 years of huge investment in renewables. Is this an "energy transition"?

Germany used to be Europe's manufacturing hotspot, but high energy prices and expensive energy feedstocks have resulted in a nosedive in German industrial production as many manufacturers moved to more coal intensive countries. Most recently, BASF announced expansion plans in China, and German car manufacturing has also fallen.

The American Shale Revolution

Relative to impacts on energy supply, energy prices, and a country's geopolitical position, the U.S. Shale Revolution is the most transformational event ever executed by a broad collection of private-sector participants. Without change in government incentives or subsidies, the innovative paths of horizontal drilling and multi-stage fracturing technologies intersected in the early 2000s and unlocked massive domestic energy supplies on a globally unprecedented scale and pace (Figure 2.1).

Over the last 20 years the U.S. Shale Revolution has created over 20 times as much new energy than the entire U.S. wind and solar sector, and nearly five times as much as global wind and solar. The incremental energy supplied by U.S. shale oil and natural gas since 2000 would be sufficient to supply the cumulative 2022 primary energy needs of 2.8 billion people spanning India, Pakistan, and all the countries of Eastern, Western, and Middle Africa.

The rapid increase in domestic supplies of oil and natural gas from shale coupled with the freedom to export both dramatically altered long-standing geopolitical relationships and the flow of global energy commodities. Oil produced from U.S. shale formations is generally light in gravity with relatively few impurities, making it a highly desired barrel for refineries to blend with lower-quality crudes to produce optimal mixes of petroleum products around the world. Concurrently, the export of U.S. natural gas and natural gas liquids (namely, LPG/propane) are ably filling the void of Russian natural gas previously delivered to Europe. U.S. exports of propane are surging and enabling improvement in respiratory health and liberation of women and children in developing countries by displacing the burning of wood, charcoal, dried dung, and other biomass in open fires used for daily cooking and nighttime heating. The U.S. has rapidly transformed from the world's largest importer of natural gas to the world's largest exporter. For oil and petroleum products, the U.S. has transitioned from the largest importer to a net exporter.

The fiscal benefits of the Shale Revolution are substantial. In 2020, researchers at the Dallas Federal Reserve estimated that increased supply from U.S. shale oil had acted to lower oil price volatility by 25% and reduced 2018 global benchmark oil prices by 36% or $47/bbl (2022 dollars). The estimated reduction in oil prices saved nearly $1.7 trillion for consumers worldwide in 2018 alone. The U.S. share of avoided energy costs was $333 billion, or $3,000 per U.S. family.

Apart from lower global benchmark prices, being proximate to the surge in supply from shale has uniquely benefited the U.S. consumer through lower regional prices. Domestic regional prices for oil reversed long-term price relationships and now consistently trade below international prices, while U.S. natural gas prices have widened their cost advantage relative to international prices in the post-shale era. Since 2010, relatively stable and lower regional energy costs for U.S. households and businesses translated to savings of nearly $41 billion per year for petroleum expenditures and $197 billion per year for natural gas expenditures relative to global peers — yielding an additional average U.S. energy cost savings of $1,850 per U.S. family annually (Figure 2.2).

Figure 2.1
Global and U.S. Energy Production

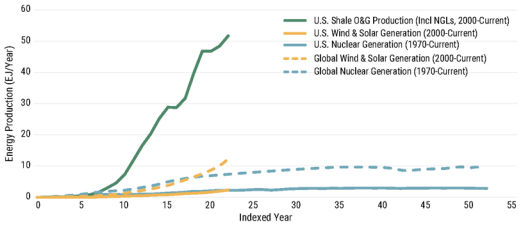


Figure 2.1 – Bijou Insights analysis of data from Energy Institute Statistical Review of World Energy 2023, EIA

Figure 2.2
U.S. Energy Costs Savings vs. Int'l Prices

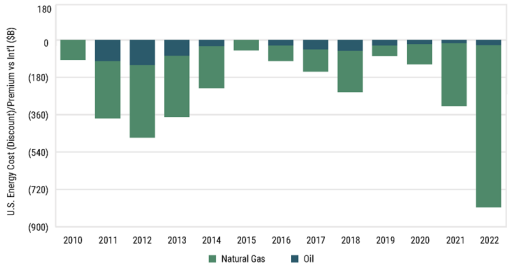


Figure 2.2 – Bijou Insights analysis of data from Energy Institute Statistical Review of World Energy 2023



Energy produced from U.S. shale is equivalent to 58% of U.S. primary energy demand and nearly 10% of global primary energy demand.

In addition to the direct consumer benefits, the U.S. rapidly shifted from an energy net trade deficit to a net trade surplus as the Shale Revolution gained momentum in the 2010s (Figure 2.3). Between 2008 and 2022, the U.S. energy trade balance improved by nearly $500 billion, or approximately $1,600 per person, while drastically reducing our reliance on exporting countries that have materially lower human rights standards and other factors valued by ESG activists and investors. All three figures illustrate the dramatic geopolitical and economic benefits realized by the United States from the Shale Revolution. However, the benefits expand to include public health and a healthy environment.

Are all the benefits provided by scalable, affordable shale oil and natural gas coming at a steep environmental cost? No. Since the Shale Revolution began, U.S. air quality continued to improve based on measured levels of six common air pollutants ($PM_{2.5}$ and PM_{10}, SO_2, NO_x, VOCs, CO and Pb) regulated by the EPA and, ironically, some of the most frequent pollutants anti-fossil fuel activists claim are exacerbated by oil and gas operations (Figure 2.4). Beyond immediately harmful pollutant reductions, U.S. per capita emissions of the most important greenhouse gas, carbon dioxide (CO_2), also began to drop concurrently with the advent of the Shale Revolution. Greenhouse gas emission reductions are largely thanks to shale gas displacing coal as the largest source of U.S. electricity production.

Figure 2.3
Shale Revolution Delivers American Energy Trade Surplus

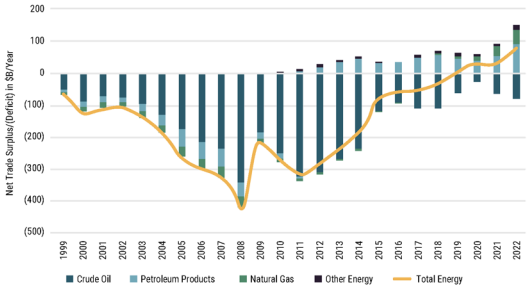


Figure 2.3 – Bijou Insights analysis based on data from the U.S. Bureau of Economic Analysis, IDS-0182, U.S. Trade in Goods.

Figure 2.4
Comparison of U.S. Air Pollution Declines vs. Economic Growth (per Capita)

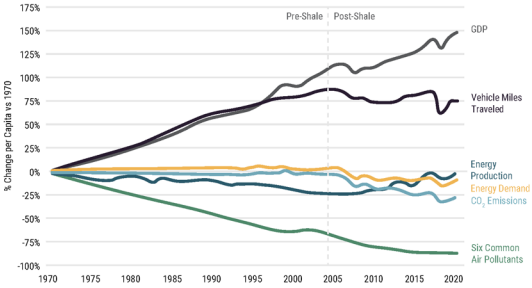
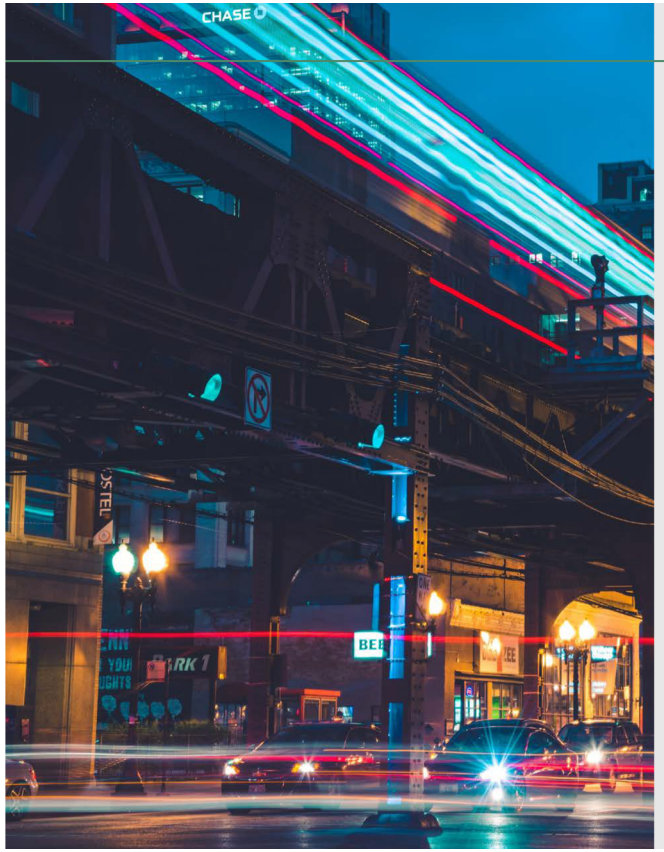


Figure 2.4 – U.S. per Capita Air Pollution and Various Growth Metrics. Data from the EPA and EIA & Bijou Insights



SECTION SUMMARY POINTS

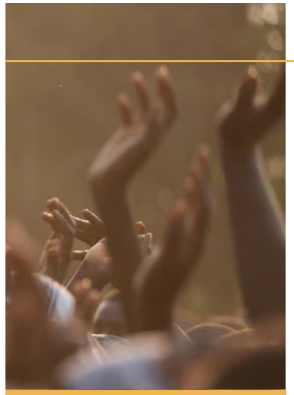
- Coal, oil, and natural gas enabled the rise of the modern world. These hydrocarbons helped double human life expectancy and enabled most of humanity to rise from dire poverty.
- Hydrocarbons supply more than 80% of global energy. They offer unmatched flexibility, meeting the diverse needs of manufacturing, transportation, electricity, heating, and cooking while providing essential raw materials that enable the modern world, especially cement, steel, plastics, and fertilizer.
- The American Shale Revolution transformed energy markets, energy security, and geopolitics. It shifted the U.S. from the world's largest importer of oil (and petroleum products) to a net exporter. For many years, the U.S. was also the world's largest importer of natural gas and is now the world's largest exporter.
- Inflated energy costs around the world — driven by political and environmental initiatives — lead to deindustrialization and stagnating living standards. These societies are becoming increasingly dependent on energy imports, resulting in economic and geopolitical risks.



ENERGY POVERTY

Energy Access: Clean Cooking | Energy Access: Electricity | The Human Impact of Energy | The Future of Energy Access





Energy Poverty

It is too easy to forget that only about one-eighth, the lucky one billion, of the world's population lives in conditions like those enjoyed by most readers of this report. Our energy policies, climate policies, conventional wisdom, and the agendas of green activists typically focus on that top one-eighth — neglecting the realities of life for the remaining 85%.

The most urgent need is broadening energy access, particularly energy that is of high quality and clean at the point of consumption. Today, over 2.3 billion people remain hostage to the daily gathering of fuels and the tending of open-hearth fires to heat their homes and cook for their families. This degree of severe energy poverty is difficult to grasp for the 1.5 billion of us who consume nearly two-thirds of the world's energy. We at Liberty Energy are committed to the liberation of these underserved individuals, households, and economies by unlocking new supplies of modern energy that are scalable, reliable, and affordable.

To improve lives and accelerate economic development, families and societies must dramatically increase their energy consumption. There is simply no other pathway toward growth and prosperity. The surging availability of reliable, affordable energy enabled the modern world and all that followed in our highly energized society. Bringing these liberating, energy-rich living conditions to more people depends on keeping energy costs low. Alternatively, if energy costs are high and rising, this will result in slower or stagnating economic progress.

Figure 3.1
The Range of Living Conditions Among the World's Population

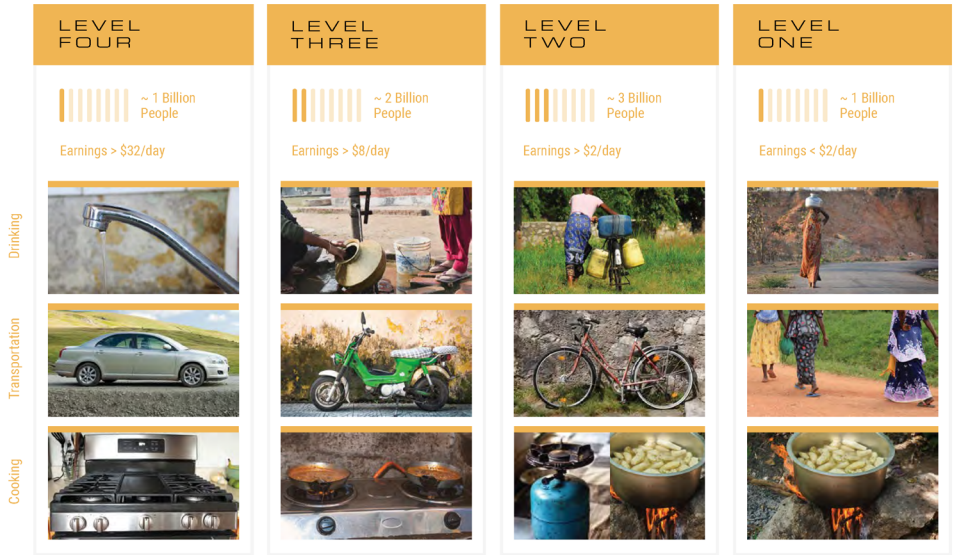


Figure 3.1 — Rosling, Hans, et al. Factfulness. Rizzoli, 2018.

Energy Access: Clean Cooking

The United Nations urges that "slow progress towards clean cooking solutions means that the health of 2.3 billion people is at risk." That's almost one-third of humanity who still lack access to clean cooking fuel, including 82% in Sub-Saharan Africa and nearly 30% of Indians. India has made rapid recent progress in clean cooking fuel access. Yet still over two billion people cook their daily meals and heat their homes with traditional fuels — typically wood, dung, agricultural waste, or charcoal — often on open fires. Burning these fuels results in low-temperature combustion and high levels of smoke and fine particulate matter, or $PM_{2.5}$, one of the world's deadliest pollutants. It is believed that about three million people die every year from the resulting indoor pollution. The World Health Organization (WHO) also estimates that outdoor air pollution — primarily from $PM_{2.5}$ created by the same biomass fires in domestic homes — causes several million additional deaths.

Figure 3.2

People in the World With & Without Access to Clean Cooking 2000–2021

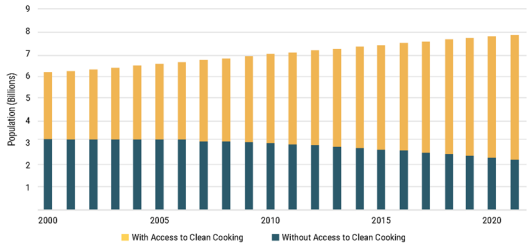


Figure 3.2 – World Bank, United Nations Sustainable Development Goals Report, 2022

Women in energy poverty spend more than an hour each day gathering wood for fuel to cook and an additional hour per day sourcing water.

Figure 3.3
Percent of Population with Access to Clean Cooking Systems

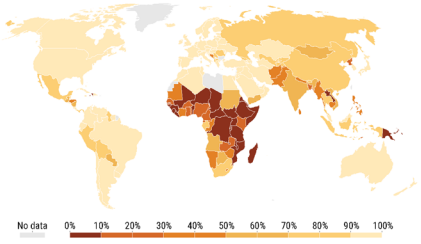


Figure 3.3 — World Bank, United Nations Sustainable Development Goals Report, 2022

Figure 3.4
Global Population-Weighted $PM_{2.5}$ Concentrations, 2019

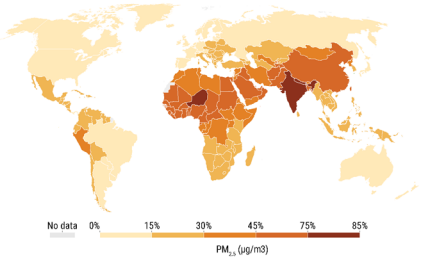


Figure 3.4 — State of Global Air, 2022

Figure 3.4 shows a global map of outdoor $PM_{2.5}$ pollution. This problem is worst in Africa, south and southeast Asia, and China, places where energy poverty drives the indoor air pollution crisis. A crucial step in decreasing outdoor and indoor $PM_{2.5}$ levels is offering a clean alternative to traditional solid fuels. Fortunately, providing access to a basic gas stove and viable fuel substitutes like Liquid Petroleum Gas (LPG), natural gas, and electricity, can prevent the staggering loss of human life and potential currently being experienced across the globe.

Liquid Petroleum Gas (LPG), mostly propane, has proven to be a transformational clean cooking fuel source for populations in developed and developing countries worldwide. Since the advent of U.S. shale development in 2010, the WHO estimates that nearly 700 million people have moved away from dirty cooking and heating fuels such as biomass and charcoal — with Africa being the lone region where the use of dirty household fuels has increased. Concurrently, annual deaths attributed to household air pollution decreased from 3.0 million to 2.3 million — great progress but still a horrific level of preventable deaths on par with the annual death toll due to COVID-19 since early 2020.

High income countries have used high-quality energy technologies to create clean living spaces, clean air, and food and water supplies that are free of pathogens and other pollutants. But in the poorer parts of the world $PM_{2.5}$ pollution, malnutrition, preventable disease, and lack of access to drinking water collectively cause over 10 million premature deaths each year. Affordable, reliable, modern energy is the key to solving these long-standing problems.



Residential LPG delivery in Fes, Morocco

The Toll of Household Air Pollution

In Kenya, using biomass from wood for energy is common, accounting for 65% of the total primary energy supplies. It is estimated that about 80% of Kenyan households depend on firewood for cooking and heating and that up to 95% of the energy consumed in rural areas is in the form of wood, agricultural residue, and animal waste.

Women are disproportionately impacted, as they are the primary gatherers and users of biomass fuels. Children living in households using solid fuel are 2-3x more likely to suffer from acute respiratory infections than children staying in households using clean energy.

The Kenyan Ministry of Health estimates that **21,500 premature deaths occur yearly** because of air pollution due to cooking and that acute lower respiratory infections are responsible for the second largest cause of death, accounting for 26% of all deaths reported in Kenyan hospitals.

Figure 3.5
Primary Fuels Used by Households in Kenya

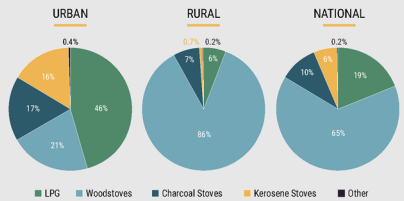


Figure 3.5 — Kenya Ministry of Energy, 2019, Shilenje, Zablon Weku, et al. "A Review on Household Air Pollution and Biomass Use over Kenya." Frontiers, Frontiers, 19 Oct. 2022, www.frontiersin.org/articles/10.3389/fenvs.2022.996038/full.

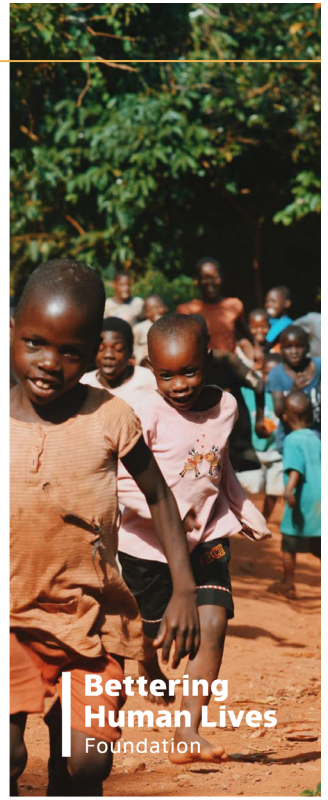
Introduction to Bettering Human Lives Foundation

A letter from Executive Director, Anne Hyre



Despite significant cultural and geographical differences among countries in Sub-Saharan Africa, the scenes outside the window, as I drive from town to town, are remarkably similar, and all include women and girls standing in lines at water pumps, walking in groups in search of firewood and cow dung, and carrying heavy loads of firewood and water-filled buckets. Whether in Malawi, Burkina Faso, Ethiopia, or Kenya, I pass clusters of homes and see women cooking amidst harmful smoke from open fires fueled by wood or cow dung. How is this acceptable in the year 2024? I feel so disheartened that the daily lives of women and girls in many lower-income countries continue to be filled with the tedious, physically demanding, and often dangerous tasks of collecting fuel and water for cooking, cleaning, laundry, and heating homes.

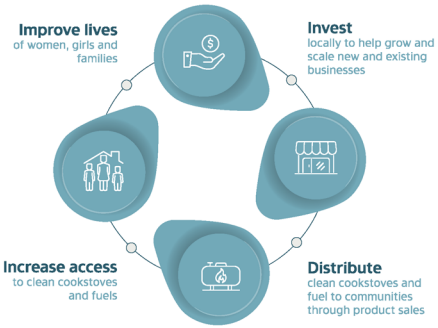
I am a nurse-midwife, and I have spent the past 30 years working to improve poor quality health services for women during pregnancy, childbirth, and the postpartum period. For 25 years, I worked primarily in Southeast Asia, where access to energy and sustained economic growth contributed to visible progress in improving health and quality of life. For the past five years, my work has shifted to Sub-Saharan Africa, and I have encountered a very different reality. Governments and donors have made huge investments in health over decades, and yet most countries in Sub-Saharan Africa remain far from reaching global targets for development in any social sector, including maternal and newborn health. I continually ask myself, "How can a woman possibly enjoy a healthy pregnancy, access health services, and demand better quality





services when she spends her time collecting firewood, cooking over polluting stoves, and missing out on education and revenue-generating activities that ultimately translate into her ability to make decisions and take action to improve her family's well-being?" Better health services are essential, but far from sufficient. There is a great need to tackle more fundamental problems that perpetually constrain women and their families.

A clean-burning cookstove, such as those powered by Liquified Petroleum Gas, can be a life-changer for families, particularly women and girls. It liberates them from the drudgery of collecting fuel and cooking in smoke-filled spaces, affording them time for school or other income-generating activities. It immediately improves their health, safety, and quality of life. The Bettering Human Lives Foundation will mobilize financial and human resources to support LPG and cookstove entrepreneurs and innovators in Africa and Asia with one goal in mind: get a clean cookstove into one million households. As a midwife and a mother, my heart breaks when I see a postpartum mother and her newborns inside dark, smoke-filled homes. I am eager to get on a more impactful path toward bettering human lives.



A Pathway to Prosperity

Our Pathway to Prosperity starts off by offering much needed, catalytic funding to local small businesses and entrepreneurs working across the clean cooking value chain, enabling them to innovate, expand, and grow. This economic development approach leads to sustained increases in access to clean cooking, which, in turn, uplifts the well-being of women, children, and communities. We sustain this cycle through ongoing reinvestment, ensuring a brighter future for all.

Energy Access: Electricity

The developed world takes electricity access for granted, but for a very large part of the world's population, electricity is either an occasional luxury or altogether absent. The United Nations estimates that over 700 million people have zero access to electricity. There has been progress in improving this situation; one billion people received their first access to electricity in the last 20 years — the large majority from generators running on fossil fuels such as coal and gas or hydropower. The global electricity access rate has risen from about 83% in 2010 to 91% in 2020, but as the UN notes, the pace of progress has "slowed in recent years."

We also shouldn't forget that there are grades of electrification. While 91% may have access to electricity, one billion of those have access to electricity for only four hours per day. This is enough to power a light bulb or charge a cell phone, giving marginal improvements in quality of life, but nowhere near enough to drive a water pump or other machinery that could raise their productivity and income. Or power a refrigerator, one of the most important steps for health and hygiene after eliminating cooking with biomass.



The United Nations estimates that over 700 million people have zero access to electricity. There has been progress in improving this situation; one billion people received their first access to electricity in the last 20 years



Figure 3.6
People in the World With & Without Electricity

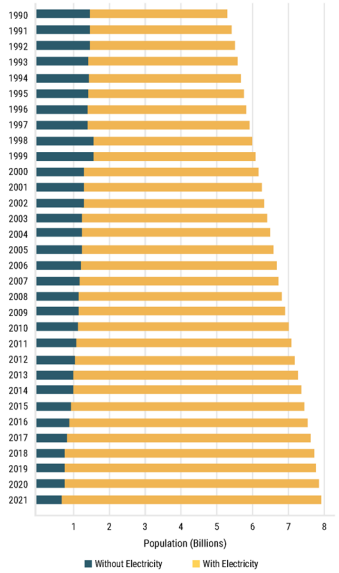


Figure 3.6 – United Nations, World Bank, Bijou Insights

We are very concerned that heavy-handed actions of the world's wealthy nations in the name of climate change are becoming headwinds to progress. Many large banks, including the World Bank and the European Development Bank, are now restricting or simply not offering funding for fossil-fueled power plants. These plants are crucial sources of electricity generation globally, particularly in developing nations where they provide the principal potential new source of low-cost, reliable electricity supply. To continue the improvements in the human condition achieved over recent decades, we must increase the supply of affordable, reliable energy — particularly electricity and clean cooking fuels.

Lower electricity demand directly correlates with child malnutrition.

Figure 3.7
Energy Consumption Per Capita

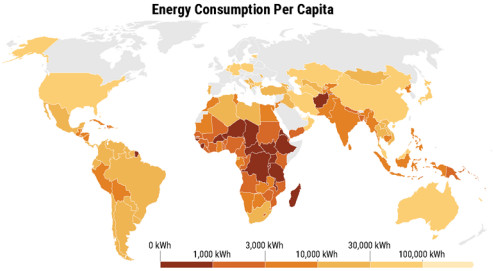


Figure 3.7 – Per Capita Electricity Consumption." Our World in Data, 2022, U.S. Energy Information Administration (2023); Energy Institute - Statistical Review of World Energy (2023)

Figure 3.8
Percentage of Underweight Children Under Age Five

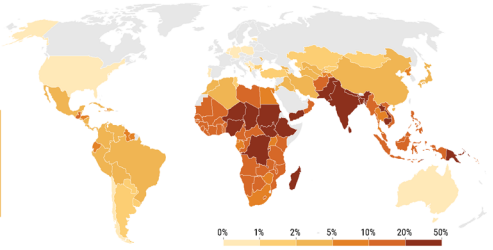


Figure 3.8 – Our World in Data, 2022, UNICEF, World Health Organization and World Bank

"As a child in Senegal, taking a shower was both time consuming and dangerous. When it was shower time, my grandma would use newspapers and a match to light a fire in our charcoal stove. After the coals turned red, grandma would put on a large pot of water and wait for it to boil while occasionally fanning the coals. About 45 minutes later grandma would carefully pour the boiling water into a bucket, adding more water to achieve a safe temperature. Then my uncle or cousin (or anyone stronger than my grandma) would drag the bucket to the shower area where I used a little pot to pour warm water over myself for bathing.

When I arrived in Germany, I was confused the first time my mother told me to take a shower. I asked her "where is the bucket of warm water?" She told me to turn the faucet handle. I was truly amazed when hot water came out almost instantly; this mundane task that took almost an hour back home now accomplished in mere seconds! I wondered why do they have this ease of life and back home we don't? This experience instantly changed my worldview and started my questioning on how and why some countries are wealthy while others remain poor."

Magatte Wade

Author, The Heart Of A Cheetah





Magatte Wade, Age 5



Mame Arame N'Gom, Magatte's Grandmother

The Human Impact of Energy

The United Nations Human Development Index (HDI) "is a simple composite measure of a nation's longevity, education, and income" and can be taken as a reasonable proxy metric for the quality of life in a particular location. In 1990, 62% of the global population (5.3 billion) scored "low" on the HDI. Three decades later, only 12% of the global population are living in countries with a "low" score. However, 12% of today's population equates to nearly one billion people. As with virtually any index of human well-being, higher HDI scores go hand in hand with higher energy consumption. The two figures illustrate the correlation between higher energy consumption and higher HDI's.

Figure 3.9

2021 HDI vs. Primary Energy Demand per Capita

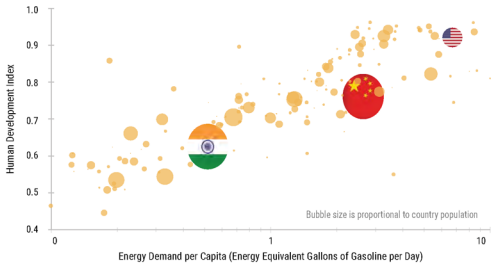


Figure 3.9 — United Nations, EIA, and Bijou Insights

Figure 3.10

China & India Experience Rising Energy Consumption & HDI Improvement

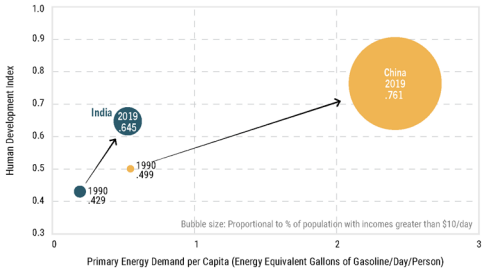


Figure 3.10 — World Development Indicators (WDI) | Data Catalog, 2022, EIA, Bijou Insights

Between 1990 and 2021, India and China have seen a 48% and 54% improvement, respectively, in HDI

None of this is surprising. To a physicist, energy is simply a way of measuring the potential to change the world, to increase or reduce its temperature, for example, or to reshape it in some way, or to move something from one place to another. Changing the world to enhance human well-being requires the use of energy.



INDIA

- Moved from Low to Medium HDI
- Mean education increased 2.4x
- Life expectancy increased 8.6 years *(was +12.3 years prior to COVID)*
- Energy per capita increased 167%



CHINA

- Moved from Low to High HDI
- Mean education increased 1.8x
- Life expectancy increased 10.2 years
- Energy per capita increased 371%

Energy Access Is Illuminating

The Korean peninsula starkly illustrates the penalties of living without abundant energy. North Korea's darkness at night reveals the border location— energy access is quite literally illuminating.



Only 52% of North Korea's population has access to electricity as compared to 100% of South Koreans.

South Korea has 17x higher per capita energy consumption than North Korea, primarily sourced from fossil fuels.

South Koreans are born with a life expectancy 11 years longer than their northern neighbors.

9.3% of North Korean children under age five are underweight compared to only 0.9% in South Korea.

Figure 3.11

Total Power Generation Capacity: North Korea vs. South Korea

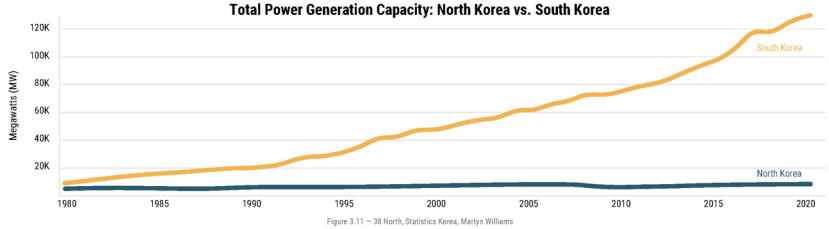


Figure 3.11 — 38 North, Statistics Korea, Martyn Williams

Energy Access Is Green

Energy access is also green. Haiti's extensive dependence on wood for heating and cooking fuel leads to significant deforestation and higher greenhouse gas emissions. Meanwhile, its neighbor, the Dominican Republic, has higher levels of access to modern fuels, is wealthier, and can allow its rainforests to flourish.

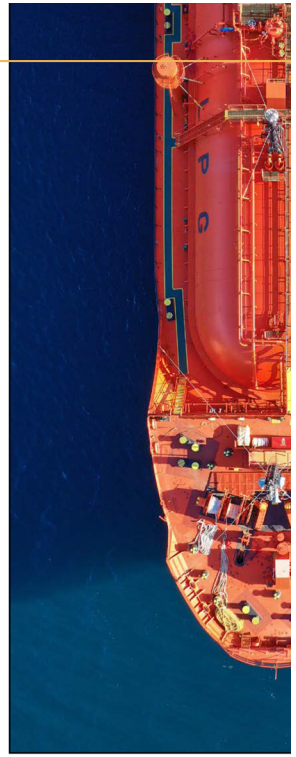
- The national border between Haiti and the Dominican Republic can be seen easily in this photo due to the severe deforestation in Haiti, which results from the use of traditional biofuels as a primary energy source for heating and cooking.
- The Dominican Republic, on the other hand, has eight times higher per capita energy consumption than Haiti, almost entirely from fossil fuels.
- Far fewer people relying on traditional energy sources like wood means thriving forests and a cleaner environment.



The Future of Energy Access

The good news is that energy access is increasing globally. Over the last decade, hundreds of millions of people have transitioned from traditional cooking and heating fuels to LPG and other modern fuels. The United Nations estimates that between 2010 and 2020, the proportion of the world's people with access to clean cooking fuel has increased by 12 percentage points to 69%. The American Shale Revolution has played a dramatic role in reducing the energy cost barrier for low-income families wishing to move from solid biofuels to clean-burning LPG stoves fueled by refillable canisters. The U.S. is now, by far, the world's largest exporter of LPG (mostly propane), and the source of virtually all growth in world LPG trade over the last decade. This has decreased LPG prices while greatly increasing available supplies. If we continue this trend, clean-burning cooking fuel could be universally available within two decades.

But there is no room for complacency. The admirable progress achieved over the last decade is being reversed as the world has been in and out of an energy crisis. This crisis is not due to a shortage of energy resources: The culprit is energy policies that lack common sense and humanity. These energy policies dismiss or distort the rational evaluation of the tradeoffs between the benefits of hydrocarbon fuels in the short and medium term and the longer-term risks of climate change. Policies aimed at reducing the emissions of greenhouse gases (GHG) have led to serious shortages in infrastructure to move Liquified Natural Gas (LNG) around the world, as well as emerging shortages in oil production capacity. The roots of the world's rolling energy crisis go back through years of overly restrictive hydrocarbon policies culminating in demand outstripping supply. Russia's invasion of Ukraine most certainly exacerbates the crisis but is not the source of the problem.



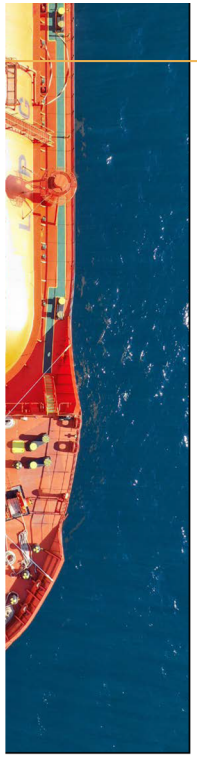


Figure 3.12

U.S. Responsible for Virtually All Global LPG Export Growth

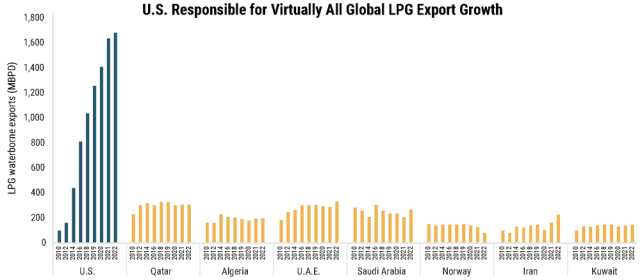


Figure 3.12 — IEA and IHS Waterborne, Enterprise Product Partners, Investor Deck, December 2023

The difficulties arising from careless climate policies are most acute in the global supply of natural gas. Many countries count on shipborne imports of Liquefied Natural Gas as a critical part of their supply. As demand exceeded supply in the summer of 2021, LNG prices skyrocketed. The world experienced extremely elevated LNG prices for much of 2021-2023, which caused massive disruptions in countries. The most dramatic and tragic impacts of high LNG prices are in lower-income countries where unaffordable energy combines with soaring food prices to cause human hardship. Natural gas represents 80% or more of the cost to produce nitrogenous fertilizers (mostly synthetic ammonia), with nitrogen being the most important nutrient limiting agricultural productivity. The one-third of humanity living in energy poverty is now seeing much higher energy and food prices. This dire situation illustrates how costly errors in energy policy can be in human terms, and how critical it is that we get energy right. At the very least, we must prevent the globe's most comfortable and wealthy regions from imposing anti-energy policies that harm or even kill the world's least fortunate.



German wind farm dismantled to mine the coal underneath

Just how bad these energy and climate policy decisions are can be gauged by falling energy consumption in many Western countries. In the United Kingdom, energy use has fallen by 30% to levels not seen since the 1950s, while the rest of Europe has declined to 1990s levels. British electricity consumption, amazingly, has fallen by about a quarter since 2003 and is now back at levels last seen in the late 1980s. Even North American energy consumption is showing worrying signs. Increasing the cost of any good or service drives down the demand. For most products, higher prices simply shift demand to alternative products. But energy is different, as every good and service requires energy. Driving energy prices up is inflationary.

Faltering or falling energy consumption, particularly electricity, is not an indication of a healthy economy. And it likely isn't the result of efficiency, which tends to increase demand for energy, as we know from the Jevons paradox (detailed in the CEO Letter). Energy efficiency has been increasing for two centuries (as shown in Figure B) and we should strive to continue this trend, but there are limits to its role in reducing energy demand.

Case studies in this report on Germany, the UK, and the EU all show that making energy more expensive reduces demand by two main mechanisms: displacing energy intensive manufacturing along with blue collar jobs to other countries, and by reducing energy affordability for consumers. So far, the U.S. has not gone as far down this road, having spent "only" $125 billion between 2008-2018. But the recently passed "Inflation Reduction Act" appears poised to drive the U.S. electricity grid along the European path: higher prices and more grid stability problems.

The EU, where the biggest energy collapse is observed, has spent a staggering $800 billion since 2008, a total that has been increasing at $70 billion a year. And the U.K., a country of 65 million people, is shelling out well over $10 billion every year. And this is to say nothing of the increased cost of managing and making reliable an electricity system dominated by uncontrollable renewable generation. Grid expansion and system balancing costs have ballooned in Europe. All these massive expenditures have resulted in much more expensive electricity for consumers and consequently lower demand as households tighten their belts and energy-intensive businesses relocate to other parts of the

world, such as Asia, with lower electricity and other energy costs. Industrial emissions are simply displaced to other countries. Consumption emissions may fall, but this is because the Europeans are experiencing what economists would call the "price-rationing" of energy. In other words, a lowered standard of living.

When designing our climate policies, we will do more harm than good if we don't consider all the world's citizens, including the poor in both the developing and the developed world. Costs that seem affordable for those already on high incomes are often inhumane and repressive for those on low incomes. Making energy more expensive, or otherwise impeding access to hydrocarbons, crushes opportunity for those struggling to better their lives.

To make matters worse, many of our current climate policies are not only bad for citizens but far from successful in reducing global emissions of greenhouse gases. There is a simple reason for this. Until our climate policies also deliver improvements in human welfare, rather than keeping billions in poverty, they won't be spontaneously and compulsively attractive to those in other regions of the globe.

Figure 3.13
2022 Oil Demand Per Capita

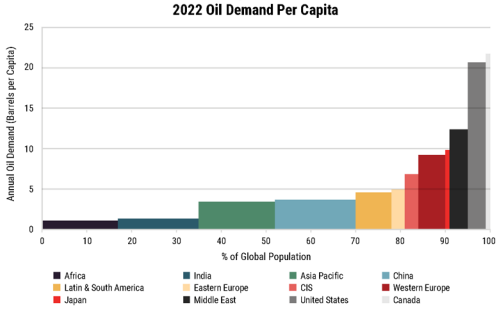


Figure 3.13 – Energy Institute Statistical Review of World Energy, and Bijou insights

Energy poverty is not only limited to the developing world; it is present across all societies.

In fact, energy poverty is growing fastest in high-income countries where policy choices are driving up the local cost of energy. In 2020, 27% of U.S. households had trouble affording their energy needs, and 10% of Americans reported keeping their homes at unhealthy temperatures to balance their budgets. This in the world's wealthiest country!

CASE STUDY

European Union & the United Kingdom

California has been an early mover in aggressive, coercive climate change policies in the U.S. The results do not appear positive. California has driven the state's electricity prices to more than 50% higher than the U.S. national average, leading some energy-intensive industries to leave the state. These policies disproportionately harm low-income residents. U.S. Census Bureau data shows that California now has the country's highest adjusted poverty rate. These strikingly negative impacts are coupled with only modest reductions in emissions and a large part of these reductions are more apparent than real, being transferred with migrating industries as they relocate to other states or countries. Ironically, California continues to import coal and gas fired electricity from other states to meet its energy needs.

Important though California is, by way of example, the European Union and the United Kingdom present the sternest warning against attempts to force emissions reductions while neglecting the physical realities that distinguish hydrocarbons from modern renewables such as solar and wind. This point is brought into sharp focus by the new U.S. Federal program of support for climate change policies known as the Inflation Reduction Act (IRA), a law which is clearly modeled on the European approach and likely to have similar consequences. But the European Union's policies and outcomes are poorly understood in the United States. If they were understood, there would be more concern with the IRA.





The European Union is a large economic area, consisting of 27 countries (28 before the UK left in 2020), with a population of 447 million people, the largest member states being Germany (83 million), France (68 million), Italy (59 million), Spain (47 million) and Poland (38 million). When the UK was still a member it was the third-largest state with a population of 67 million. For comparison, the United States has a population of 335 million. The GDP of the EU in 2021 was approximately $16.5 trillion (€14.4 trillion). The U.S. has a GDP of about $23.3 trillion. In summary, the EU has a somewhat larger population with a somewhat smaller economy, but the EU and U.S. are comparable in scale. The EU's experience of climate policies is relevant, despite differences both geographical, societal, and economic.

Starting around 2000 the EU pursued a program of rapid decarbonization based initially on emissions trading, but increasingly reliant on the subsidized deployment of renewable energy. The increased energy costs strongly suppressed energy consumption. This has rendered the EU less able to recover from exogenous shocks such as the financial crisis of 2008, and the global pandemic of 2020. Astonishingly, energy consumption in the EU has been falling since 2005 — an indication of underlying economic ill-health. In fact, the U.S. and EU economies were quite similar in size in 2008, but since then in dollar terms the EU economy has grown by only 6% versus 82% for the U.S. High energy prices are not conducive to economic growth.

The scale of the policy costs can be illustrated with headline figures. In the period 2013–2021 emissions trading in the EU added about $90 billion in total to industrial energy consumer costs, impairing international competitiveness and adding to the domestic cost of living. Emissions trading continues to add about $18 billion a year to industrial costs. But these costs are dwarfed by subsidies to renewables.

EU income-support subsidies to renewable energy in 2008-2021 added about $800 billion to consumer costs in the EU 27 (i.e., excluding the UK). The annual costs of renewable energy subsidies in the EU 27 now amount to about $70 billion; UK subsidies to renewable electricity generators alone amount to about $10 billion a year.

Unsurprisingly, subsidies on this scale have produced enormous growth in renewable generation capacity, from about 100 GW in 1990, when it was nearly all hydro, to over 500 GW in 2020. This amounts to about 17% of the global total of renewable capacity.

Case Study: European Union & the United Kingdom





Electricity production capacity in the EU nearly doubled from 1990 to 2020, yet total electricity production declined. While thermal capacity (coal, gas, nuclear) has declined due to regulation and a lack of investment signals, a large but under-utilized thermal fleet necessarily remains in place to guarantee security of supply since wind and solar provide no firm capacity. The hospital neo-natal ward must operate even at night when the wind is calm.

With rising subsidies and declining energy sector productivity, it is no surprise that prices for consumers have risen sharply relative to international competition. Electricity prices to households in the EU have been about 80% higher than those in the non-EU G20. EU industrial consumers face electricity prices about 30% higher than their competitors in the G20, even after significant direct government subsidies attempting to mitigate this loss of competitiveness.

Uncompetitive prices are even worse with natural gas. Prices for home heating and cooking have been approximately double those in the G20, and industries have seen prices about 25% higher than those in the G20. Doubling home heating prices is unhealthy and even deadly.

High diesel and gasoline taxes in the EU have elevated fuel prices significantly higher than elsewhere in the world, with gasoline prices being between 30% and 50% higher than those in the G20 nations.

Since wholesale prices for electricity and natural gas were approximately the same in both the EU and the G20 prior to EU climate policies, we can conclude that these very large differences in consumer fuel prices were due to energy policies — mostly climate policies. A similar conclusion can be reached for diesel and gasoline, where wholesale prices were lower in the EU than the G20 prior to the arrival of climate policies.

Case Study: European Union & the United Kingdom

Figure 3.14
U.K. Inland Primary Energy Demand 1970–2022

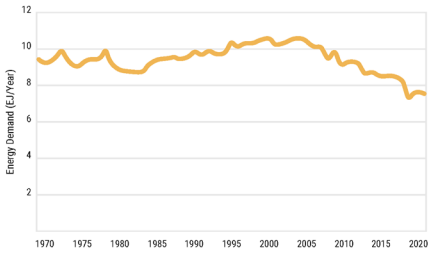


Figure 3.15
UK Electricity Supplied 1951–2022

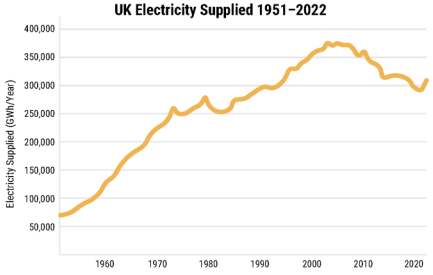


Figure 3.14 & 3.15 — Digest of U.K. Energy Statistics, John Constable

The UK, although no longer part of the EU, has continued aggressive climate policies that have driven up energy prices for its citizens and industry. The results are troubling. Figure 3.14 shows that primary energy consumption in the United Kingdom peaked in 2005 at 10.6 exajoules and has since declined by 28% to 7.6 exajoules in 2022! UK electricity consumption has fallen by 22% over the same period and is at levels last seen in the late 1980s.

These declines in energy consumption should not be misread as implying significant and effective reductions in greenhouse gas emissions. They do indeed track with reductions in the UK, but not necessarily with global emissions. Elevating energy prices has two major impacts: It depresses demand from consumers due to cost, and it leads to the reshoring of energy-intensive manufacturing to locales with lower energy prices. In simpler terms, citizens are impoverished. Industry has been, and continues to be, relocated to Asia and the United States. The first factor reduces emissions by making energy less affordable to citizens, and the second does not reduce emissions as they are simply relocated. Industry relocations are likely to increase emissions, as the EU's primary industrial fuel is natural gas, where coal dominates in Asia.

Case Study: European Union & the United Kingdom

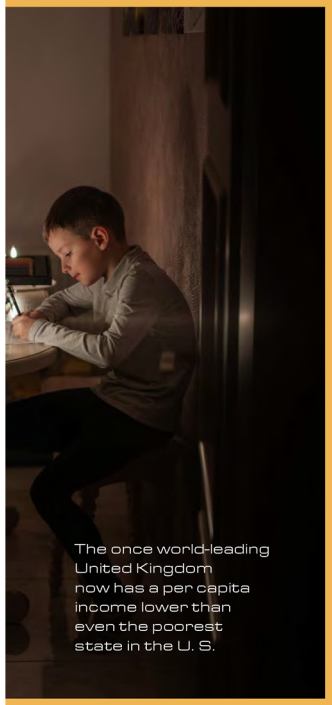
Far from being an encouraging sign, consumption reductions are an indication of systemic weakness; this is an economy and society that is less and less able to change the world in accordance with its requirements. However, the UK and European Union governments do not see it this way and have embraced these signs of policy failure as measures of success. They have set targets for further decreases in consumption. On current trajectories there is every reason to suppose that these targets will be met, as the climate policies render energy still more expensive. The once world-leading United Kingdom now has a per capita income lower than even the poorest state in the United States.

Three further observations can be added to these overwhelmingly negative results from Europe's green experiment. First, the costs to society have been simply enormous for relatively modest reductions in global emissions – exporting emissions to other countries are not actual reductions. As the next section will show, it is almost unimaginable that the costs incurred to reduce emissions will deliver climate benefits in line with the costs. Second, subsidies to renewables have not produced significant reductions in the capital and operating costs of wind and solar, a fact that will come as a surprise to many but is well-documented in the audited financial statements of European wind and solar operators. Third, subsidized deployment of renewables in Europe has failed to give European industries a secure position in the world markets for renewable energy, which is now dominated by Chinese manufacturers. In 2012 European companies held 20% of the world market for manufacturing wind and solar equipment, but by 2021 this had fallen to 13%.

As John Constable concludes in his review of the unfolding disaster of Europe's green adventure: "Distressed policy correction is inevitable but entails significant reductions in European standards of living. Deferring this correction and persisting with renewable energy will increase the depth of economic sacrifice required to put European society back on a thermodynamically sound energetic footing."

Even using the most generous possible assumptions about EU and UK emissions reductions, the estimated lessening in global warming by 2100 would be about 0.01°C using the IPCC consensus of models. That's a huge cost for an almost immeasurable benefit. On the other hand, EU public health records show 68,000 excess winter deaths during the winter of 2022–2023 – above the typical winter seasonal rise in deaths – as many residents could not afford to heat their homes to safe temperatures. It could have been far worse if 2022–2023 had been a





The once world-leading United Kingdom now has a per capita income lower than even the poorest state in the U. S.

cold winter. It is simply unfathomable that the enormous economic and human cost of EU and UK climate policies that enfeebled their energy systems can ever deliver climate benefits commensurate with their cost.

Unfortunately, this chilling example did not stop passage of the Inflation Reduction Act of 2022, putting the U.S. on a similar path to the EU and UK. The Inflation Reduction Act provides a large package of tax credits and energy and climate cash expenditures amounting to around $400 billion over about a decade. This subsidy will likely motivate the investment of several trillions of dollars, most of it for wind, solar and related transmission cables. These enormous investments in response to subsidies will necessarily reduce investment in other areas.

While energy consumption in the United States is not yet showing the decline evident in Europe, it has been nearly stagnant since the early 2000s as China has displaced the U.S. as the world's manufacturing powerhouse. It appears, at least in the electricity sector, that this trend might reverse based on recent projections from major utilities projecting rapidly growing demand for electricity to power the torrid pace of new data centers driven by AI, crypto, and other new applications. The location of these data centers is heavily influenced by cost and reliability of electricity, which is at great risk if the Inflation Reduction Act drives the U.S. electrical grid in a similar fashion to that seen in the EU and UK. It is likely that some states that avoid degrading their electrical grids will disproportionately attract data centers. Of course, the EU's damage to its energy system extends well beyond the power sector. The U.S. must be cognizant of growing harm to our economy and opportunities for our citizens with policies that drive up energy prices.

This report clearly shows that global poverty is a far more pressing problem than climate change (see Climate Economics section on page 114). Many of the West's low emissions policies are detrimental to global efforts to reduce poverty, both in the developing world and in the poorer sections of the West. We must hope that the U.S. learns from the European folly of a politically driven, forced weakening of their energy system. We cannot let the Inflation Reduction Act enfeeble our energy system. A great deal is at stake because energy matters.

Case Study: European Union & the United Kingdom

A Better Way

In our survey of the top-down European experiment, we have seen that subsidized adoption of renewable energy on a very large scale has been unsuccessful as an energy policy, an industrial policy, and a climate policy. This conclusion begs the question: What is a better way forward? Since each country has its own unique opportunities, priorities, and difficulties there is no single answer. History shows that a competitive marketplace with companies vigorously competing to satisfy consumer preferences, overseen by sensible regulation, has been the most effective and efficient way of discovering low-cost, reliable energy resources. Left to themselves, businesses and consumers will gravitate spontaneously towards highly productive energy sources. Market participants respond to the fundamental signals arising from prices, government policies, and underlying strengths and weaknesses of each energy source.

The transformation of U.S. energy via the Shale Revolution of the past two decades provides a clear example of markets working, without government subsidies, to provide ever-cleaner, low-cost energy for American consumers and businesses. This is due to rapid innovation, in which Liberty is proud to have played a leading role. The enormous benefits of increasing energy supplies at lower costs reverberate outside the U.S. as well. (More details on page 62 in the American Shale Revolution section).

What trajectory might be followed by a nation focused both on bettering human lives and a responsible pathway to address climate change? The focus would need to be simultaneously on more energy and better energy. Technologies that significantly raise the price of energy will not help either objective.

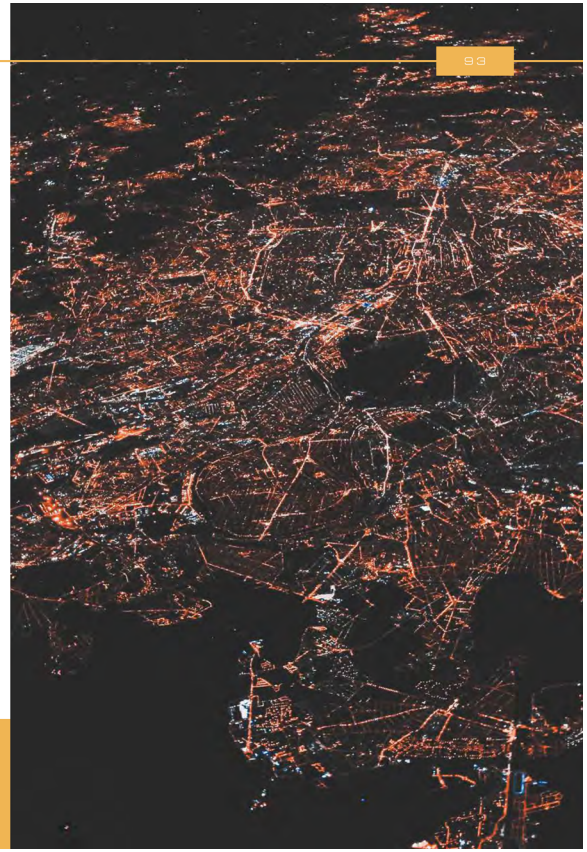
Natural gas has been the runaway winner when it comes to energy addition as shown earlier in this report. Natural gas has provided 40% of the growth in global energy production since 2010 as it serves to keep energy affordable and reliable, while also being a major factor in reducing air-pollution and serving as the largest driver of greenhouse gas emission reductions in the U.S. It is likely that natural gas will remain the fastest growing global source of energy for some time into the future as it will continue displacing coal in wealthy nations while also growing in countries across the globe.

Coal remains the largest global source of electricity for a reason: It is a cheap and reliable source of electricity for billions of people, and is far cleaner than burning wood, dung, charcoal, or agricultural waste. Everything involves context-dependent tradeoffs. There is much room to run in deploying emissions reduction technologies to improve air quality for those living around coal generation. But these technologies have significant costs and hence are not yet widely deployed in lower income nations. Further down the road, perhaps, is the even more expensive endeavor to capture and store underground the carbon dioxide emissions from coal or natural gas combustion. This would significantly increase the cost of electricity genera-

tion, but if it can be done at a cost comparable to the benefits, surely it will take hold. Only time will tell.

Oil is prized for its portability and plethora of uses — transportation fuels, power, heating fuel, petrochemicals, plastics, asphalt, lubricants, and more. Oil will likely remain a major source of energy and materials for the foreseeable future simply because for most (not all) applications there are no viable replacements. Where change is occurring most rapidly with oil has been in the cleaning-up of production practices and the continual increase in engine combustion efficiency across autos, motorbikes, trucks, ships, and aircraft. Improved combustion technology lowers the emission of pollutants immediately harmful to human health and reduces greenhouse gas emissions by liberating more mechanical energy for each quantum of fuel burned. It is easy to demonize oil, but replacing oil is very difficult.

Nuclear, together with natural gas, appears the most viable option for an expanded role in powering the world and reducing global GHG emissions. Nuclear has the energy density, reliability, and scalability that would allow it to become a



large source of global energy. Wind and solar are limited to working in the electricity sector, which today supplies only 20% of total energy. There is much push to "electrify everything," but progress on this front has been quite modest. Electricity is a wondrous form of energy, but it requires a great deal of infrastructure, maintenance, rule of law, and political stability for it to flourish.

Another significant limitation of electricity: its inability to provide high-temperature process heat that is critical to manufacturing. Manufacturing — making stuff — is the largest user of energy globally. Electricity supplied about 15% of the total energy used in manufacturing 25 years ago. Today, it remains at only 15%. Nuclear, fortunately, can not only generate reliable electricity, but can also supply relatively high-temperature process heat. Nuclear-supplied process heat could displace up to 60% of today's hydrocarbon usage for process heat. Today nuclear provides only 4% of global primary energy, down from 6% around the turn of the century. There is no technical reason that nuclear power could not rise well into the double-digits of primary energy in the coming decades. Nuclear energy's biggest challenges are public perception, high capital cost to build, and government regulation. Small modular reactors may overcome these challenges, but significant contribution is likely decades out.

Next generation geothermal involves mining copious underground heat stored in deep rocks. This is achieved by injecting water into deep wells where it flows through underground fractures which heat the water to very high temperatures before flowing up nearby production wells. These production wells convey to the surface super-heated hot water and steam into a conventional turbine to generate electricity. While the technology is new, it appears to have significant running room to supply very low-carbon reliable electricity that can be turned up and down to follow grid demand. This idea from decades ago is made viable today by using Shale Revolution technology in geothermal resources.

We have discussed the relative failure so far of large-scale deployment of wind and solar. However, a huge breakthrough in energy storage could open the door (again) for valuable contributions from growing wind and solar penetration into the electrical grid. Unfortunately, this requires a step-change technological advancement that is not visible on the horizon. Hence today's political desire to increase "renewable" generation is mostly having deleterious impacts on both electricity costs and grid stability. Renewable is in quotes because the wide array of steel, cement, exotic metals, and other energy-intensive materials required to construct wind turbines and solar panels are at least as finite as our underground resources of oil, gas, coal, and uranium. The term "renewable" is hard to defend. All energy is hard.

Innovation is paramount for efforts to expand energy access and affordability, while also reducing GHG emissions. The last two decades have proven that we simply don't have the energy technologies, systems, patience, and political sobriety to simultaneously drive progress on both fronts. The only exception has been the American Shale Revolution, which was driven solely by market forces and not top-down government directives. Innovation thrives in free societies with free markets and aggressive competition for capital and customers. We can solve our energy and climate challenges, but only if we re-embrace the forces that lifted humanity out of grinding poverty and created the modern world.

SECTION SUMMARY POINTS

- Humanity needs greater access to high-quality energy, enabling more individuals to enjoy lifestyles similar to those of the lucky one billion.
- Local availability and affordability of hydrocarbons directly impact living standards, opportunities, and health.
- While global energy access is on the rise, 700 million people do not have electricity, and nearly one-third of humanity lacks access to clean cooking fuels.
- Energy poverty permeates societies of all socio-economic levels not just developing nations.


96
CLIMATE CHANGE
CO_2 & the Planet | Climate Trends & Measurements | Extreme Weather

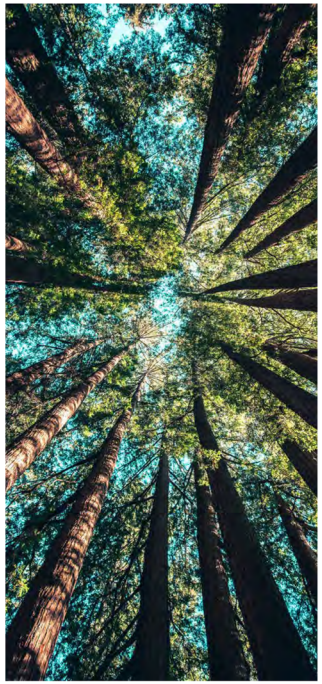


Climate Change

Messaging around climate change is typically catastrophist, projecting visions of planetary doom and gloom with one major culprit to blame: fossil fuels. This narrative is short on facts and shorter still on rational debate about the many trade-offs related to the very real economic, societal, developmental, and energy challenges facing the world.

The human condition has been progressively transformed by three major developments in our use of energy: the harnessing of fire, the advent of agriculture, and the addition of fossil fuels to the energy supply.

The expansion of the global energy supply by adding fossil fuels has greatly improved the human condition; it also brought the risk of climate change caused by increased atmospheric levels of carbon dioxide and other greenhouse gases.



CO_2 & the Planet

So long as agriculture was the primary source of human energy, including that harnessed from draft animals, the carbon cycle had annual flows and seasonal variations. Those organic flows continue today. During the Northern Hemisphere spring and summer, plant photosynthesis, using energy from sunlight, draws carbon dioxide (CO_2) out of the atmosphere to combine with water to make chlorophyll — the basic building block of plant biology. In the fall and winter, photosynthesis drops dramatically, and plant decomposition returns CO_2 to the atmosphere, completing the annual cycle.

Figure 4.1
Atmospheric CO_2 at Mauna Loa Observatory

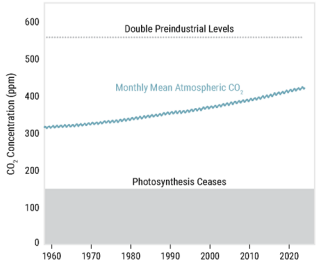


Figure 4.1 — Scripps Institution of Oceanography NOAA Earth System Research Laboratory https://www.e-education.psu.edu/earth103/node/1018

Photosynthesis requires a minimum atmospheric CO_2 concentration of around 0.015% (150 ppm). During the last glacial period (16,000 to 100,000 years ago), atmospheric CO_2 nearly breached this level, falling to only 180 ppm. Before the large-scale use of coal, oil, and natural gas, from the seventeenth century onwards, CO_2 concentration was estimated at just below 0.03%. The fossil-powered global economic growth since World War II has driven a steady climb in atmospheric CO_2 concentration (shown in Figure 4.1) to slightly above 0.04% (420 ppm in 2023) as humans liberated the solar energy

stored hundreds of millions of years ago in ancient plants (coal) and marine plankton (oil and natural gas).

Atmospheric CO_2 concentration rises due to hydrocarbon combustion, which reverses the photosynthetic reaction in which oxygen combines with carbon. The equation below represents the chemical reaction of burning methane, the simplest hydrocarbon.

$CH_4 + 2O_2 \blacktriangleright CO_2 + 2H_2O$

One methane molecule reacts with two oxygen molecules to create one carbon dioxide molecule and two water molecules while liberating energy, primarily as heat, that can generate electricity, drive industrial processes, and home heating or be used for other life-enhancing endeavors.

Carbon dioxide is plant food, and roughly half the CO_2 released in this combustion reaction goes into the oceans or into "greening" the planet. Increased availability of CO_2 in the atmosphere has led to increased agricultural productivity and a significant increase in global plant matter, grasses, trees, and plankton.

Figure 4.2 shows the significant greening of the planet over the last few decades.

Figure 4.2
Global Greening from CO_2 Fertilization

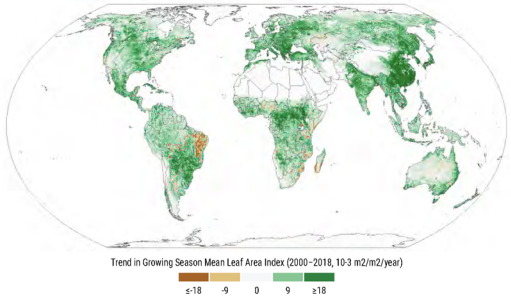


Figure 4.2 — Hille, Karl. "Carbon Dioxide Fertilization Greening Earth, Study Finds." NASA, NASA, 25 Apr. 2016

Climate Trends & Measurements

The other half of the carbon dioxide released has remained in the atmosphere, driving the increased atmospheric concentration shown in Figure 4.1. Since carbon dioxide, like water vapor, methane, and nitrous oxide, is a significant "greenhouse" gas, increased concentration has raised concerns about climate change, particularly rising global temperatures. Greenhouse gases (GHGs) are molecules that absorb the in-

frared radiation the Earth continually emits into space. The earth's infrared radiation sends heat into space that balances the incoming heat received from the sun. The largest warming is in the cold polar areas at night, with progressively less warming measured as we move towards the tropics. Even in the tropics, the warming impact is more pronounced at night than during the day. Estimates from radiation physics predict that doubling the pre-industrial atmospheric CO_2 concentration to 560 ppm, likely to occur by late this century, would result in a 1.3–1.4°C average warming of the planet in the absence of feedback effects.

A recent empirical study of historical temperature data provides similar warming estimates of 1.2–1.8°C in response to a doubling of atmospheric carbon dioxide levels. There remains significant scientific uncertainty around feedback effects, mainly induced changes in atmospheric water vapor (which is a more potent greenhouse gas than carbon dioxide) and impacts on cloud formation. This is a highly technical issue, with ongoing research focusing on this critical topic.

This summary intends to provide a basic understanding and context around climate change and, most importantly, provides a summary overview of historical observational data for global average temperature and sea level, both of which are rising. It will address extreme weather events, for which there is no significant

Figure 4.3

UAH Global Lower Tropospheric Temperature Variations (°C) 1979–2023

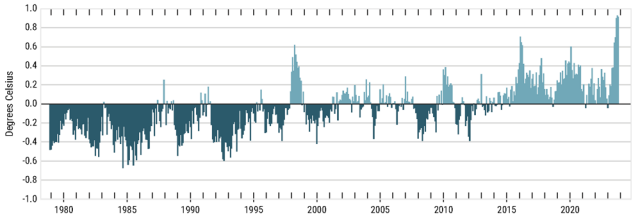
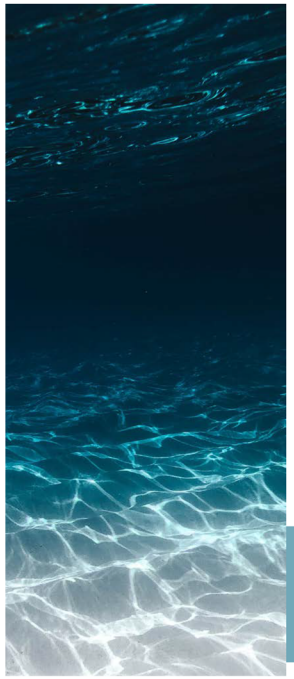


Figure 4.3 – Spencer. "New Reference for Annual Cycle 1991-2020., University of Alabama Huntsville, Apr. 2015, Global Temperature Report." Global Temperature Report: The University of Alabama in Huntsville, 2022





trend, and deaths from extreme weather events, which are falling sharply. These are far from the only areas of climate change discourse, but they are the central ones.

Figure 4.3 shows the entire atmospheric temperature record collected by the University of Alabama Huntsville (UAH) in a collaborative project between UAH, the National Aeronautics and Space Administration (NASA), and the National Oceanic and Atmospheric Administration (NOAA). The data is gathered by advanced microwave sounding units on NOAA and NASA satellites to get accurate global temperature readings — including remote areas where reliable climate data is otherwise unavailable.

By contrast, land-based sensors suffer from uneven spatial coverage, fluctuating conditions around measurement sites, such as urban heat island effects, and a wide variety of temperature sensors employed — all necessitating the use of continuously evolving "homogenization" techniques. Atmospheric measurements are preferable.

Satellite measurement of global temperatures began in 1979. The full 40+ year record of lower atmospheric temperature in Figure 4.3 shows an average rate of warming of 0.14°C per decade. The years 2021 and 2022 experienced global cooling resulting from La Nina conditions. La Niña is the opposite phase of the more famous El Niño Southern Oscillation (ENSO), a cyclic pattern of the surface waters in the eastern tropical Pacific Ocean. During La Niña, there is a net transfer of heat from the atmosphere to the oceans, while during El Niño phases, the net heat transfer runs in the opposite direction. Recently, 2023 has seen a switch to (warming) El Niño conditions.

Remote Sensing Systems also provide global atmospheric temperature measurements that show a somewhat higher rate of warming. Averaging the two satellite temperature measure-

El Niño phases typically occur every three to five years and cause a net heat transfer into the atmosphere.

ment systems results in an observed warming rate of around 0.17°C per decade. This rate of warming implies that we would expect a little more than another 1°C of warming by the end of the 21st century. This is in addition to the roughly 1.2°C of warming that the world has seen over the last century. Economists most often estimate the impacts of climate change based on the total warming from pre-industrial times. (We discuss these projections in the Climate Change Economics section, page 114).

After increasing global temperatures, the principal concerns are sea level rise and extreme weather events. We include the data here on sea level rise over two different time scales and with two different measurement technologies. Tide gauges are the longest direct instrumental record of global sea level rise. Figure 4.4 shows a roughly 150-year tide gauge record of changes in global average sea level. The modern rise in sea level began in the middle of the 19th century as the Little Ice Age ended and the planet started warming. It shows an average rate of rise of a little less than one inch per decade.

The data set quality is limited by the number of tide gauges, as there were fewer in the early years of the record. Despite this limitation, the data provides a worthwhile longer-term perspective on sea level trends. From indirect proxy records, we also know that sea levels have risen around 400 feet since the end of the last glaciation nearly 20,000 years ago. The earth is a dynamic and ever-changing system.

Figure 4.5 shows changes in sea level as recorded by satellites, a time series that begins in 1993. It shows a relatively constant rate of sea level rise over its 30-year record of a little over one inch per decade (1.3 inches per decade). The discrepancy between the rates of

Figure 4.4
Global Mean Sea Level Variation 1700–2022

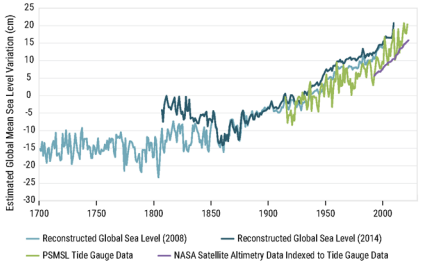


Figure 4.4 — NOAA, NASA, Bijou Insights. 2008 - S. Jevrejeva, J. C. Moore, A. Grinsted, P. L. Woodworth, Recent global sea level acceleration started over 200 years ago?, April 30, 2008; https://doi.org/10.1029/2008GL033611. 2014 - S. Jevrejeva, J.C. Moore, A. Grinsted, A.P. Matthews, G. Spada, Trends and acceleration in global and regional sea levels since 1807, Global and Planetary Change, Volume 113, 2014, Pages 11-22, ISSN 0921-8181, https://doi.org/10.1016/j.gloplacha.2013.12.004

Figure 4.5
Mean Sea Level Rise from Satellite Data 1993–2022

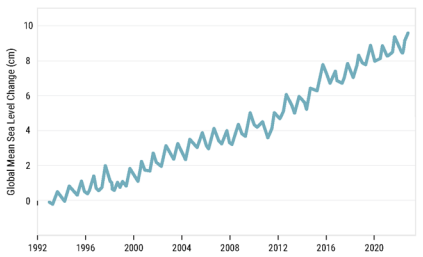


Figure 4.5 — Nerum, R.S., et al. Climate-Change–Driven Accelerated Sea-Level Rise Detected in... - PNAS. Earth, Atmospheric, and Planetary Sciences, 12 Feb. 2018, "Sea Level," NASA, NASA, 18 July 2022, Jet Propulsion Laboratory. "Satellite Mission Keeps a Steady Eye on Sea Level Change from Space." SciTechDaily, Jet Propulsion Labratory, 15 July 2020



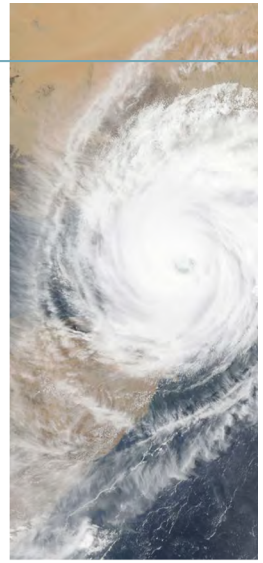
Polar Bear Population On the Rise

In the 1960s, the estimated polar bear population was about 12,000. Today, the U.S. Fish and Wildlife Service estimates the population at 26,000.

rise from satellite and tide gauges is visible in the most recent data and is likely from the different measurement mechanisms employed. It can be concluded, with a degree of confidence, that sea levels are currently rising at a global average rate of a bit more than one inch per decade, with no significant change in the rate of rise over the last few decades.

It must be emphasized that this observation refers to the "global average," as there are significant geographical variabilities in sea level change across the earth. At the end of the last glaciation (10,000 to 20,000 years ago), the massive, mile-thick ice sheets melted off the northern parts of North America, Europe, and Asia. As this weight was removed from the surface of the continental plates, there began an uneven rebound in the height of the land relative to sea level. For example, the sea level near San Francisco and along the U.S. West Coast is roughly static; it is rising at about the global average rate on the U.S. East Coast, and on Australia's West Coast, it rises more rapidly than the global average. Since rising sea level threatens coastal cities and their fresh-water aquifers, it is important to understand what is happening locally so that appropriate action can be evaluated.

Extreme Weather



Extreme weather features prominently in the news, perhaps due to the sense of fear and awe inspired by natural phenomena. This fear is understandable: extreme weather has killed millions of people over the years, displacing and impoverishing countless more. Fortunately, to date, there is no observed increase in the key extreme weather events: hurricanes, tornadoes, floods, and weather-related drought. Fortunately, there has been a dramatic decline in the most important metric of deaths from extreme weather events as a wealthier, more energized world is far more resilient and adaptable.

Cyclones & Hurricanes

Figure 4.6 shows the trend since 1970 in Accumulated Cyclonic Energy (ACE), a metric that captures the frequency, duration, and intensity of global hurricane activity.

Figure 4.7 shows a different hurricane metric: the trend in the number of global land-falling hurricanes since 1970.

Figure 4.6

Global Tropical Cyclone Accumulated Cyclonic Energy (ACE)

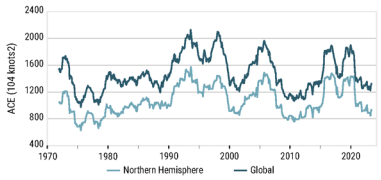


Figure 4.6 – Maue, Ryan. "Global Tropical Cyclone Activity: Ryan Maue." Global Tropical Cyclone Activity , 2023.

Figure 4.7

Global Tropical Cyclone Landfalls 1970–2022

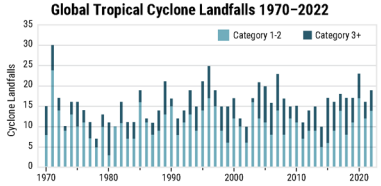


Figure 4.7 – Jr., Roger Pielke. Global Hurricane Landfalls 1970 to 2022, The Honest Broker by Roger Pielke Jr., 18 Jan. 2022. ; NOAA Hurricane Research Division, Colorado State University Tropical Meteorology Project

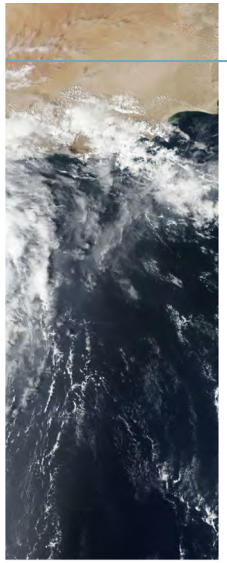


Figure 4.8
Continential U.S. Landfalling Hurricanes 1900–2023

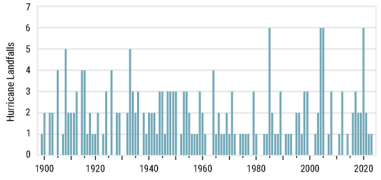


Figure 4.8 — "US Hurricane Landfalls." Atlantic Oceanographic and Meteorological Laboratories. ; Jr., Roger Pielke. "U.S. Hurricane Overview 2023."

Figure 4.9
U.S. Strong to Violent Tornadoes (>F3) 1950–2022

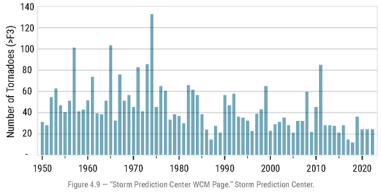


Figure 4.9 — "Storm Prediction Center WCM Page." Storm Prediction Center.

Figure 4.10
Global Area in Severe Meteorological Drought 1901–2017

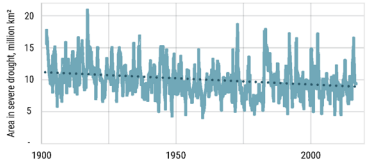


Figure 4.10 — Lomborg, Bjorn. "Welfare in the 21st Century: Increasing Development, Reducing Inequality, the Impact of Climate Change, and the Cost of Climate Policies." Technological Forecasting and Social Change, North-Holland, 24 Apr. 2020.

Figure 4.8 shows the same metric for the United States dating all the way back to 1900.

As one can see from these figures, while there is large annual variability in hurricane activity, the data show no obvious rising trend. The year 2023 saw only a single U.S. landfalling hurricane (Idalia) with less than $1 billion in total damages, which is far less than the over $20 billion average seen in recent years.

Tornadoes

Figure 4.9 shows the frequency of severe tornadoes in the United States since 1954. Fortunately, the trend here appears to be downward.

Drought

Figure 4.10 shows the percentage of the world experiencing extreme levels of drought, starting in 1900. There appears to be a slight decline in global drought prevalence over the last century, which is to be expected as a slightly warmer world implies a slightly wetter world due to increased evaporation.



CASE STUDY

Drought in the Colorado River Basin

During the 1800s, the earliest explorers of the southwestern United States quickly recognized that its hot, arid climate was the primary obstacle to the development of human-friendly conditions on which a society could thrive. In 1810 Zebulon Pike labeled the region as "The Great American Desert." Later that century, John Wesley Powell led multiple expeditions throughout the American West. Powell subsequently published a Report on the Lands of the Arid Regions of the United States in 1879, in which he argued the southwestern U.S. should be developed with great caution and that borders should be based on watersheds boundaries to minimize inevitable conflicts over the right to and use of the region's most scarce resource — water.

Almost 150 years later, Powell's warnings have proven prophetic.

Beginning in 1906, Colorado River flows began to be measured with gauges at Lees Ferry, Arizona. Armed with 15 years of "reliable data" that suggested a baseline river flow of 16.4 million acre-feet / year (MMac-ft/yr), the architects of the Colorado River Compact of 1922 allocated water rights for 15 MMac-ft/yr amongst seven states which had a combined population of almost six million.

Since 1922, average river flows of 14 MMac-ft/yr fell short of the Compact's baseline. Far more dramatic was the 10-fold increase in combined population in the seven states, now at over 60 million. Further, the region just emerged from 23 years of severe drought during which river flows averaged 12.2 MMac-ft/yr. The recent drought laid bare the original sin in 1922 of over-allocating water rights based on an extremely limited history of gauged river flow data. With the benefit of 116 years of gauge measurements and increasingly sophisticated science that now reconstructs river flows for the past 2,000 years, average river flows of the early 1900s were likely the highest in reconstructed or measured history (Figure 4.11).

Furthermore, as Figure 4.11 illustrates, there have been seven multi-year periods during the last 2,000 years where the reconstructed flows of the Colorado River have been below the average flows experienced during the just ended drought. All seven of these drought periods were well before human activities began to harness the energy of fossil fuels and the resulting impacts already discussed in the Climate Change Section of this report. In fact, there is no observable correlation between average reconstructed and measured river flows and the concurrent global temperature record recognized by the IPCC or regional temperature record reconstructed from tree ring data.

Figure 4.11

Colorado River Upper Basin Reconstructed & Measured River Flow at Lees Ferry, AZ

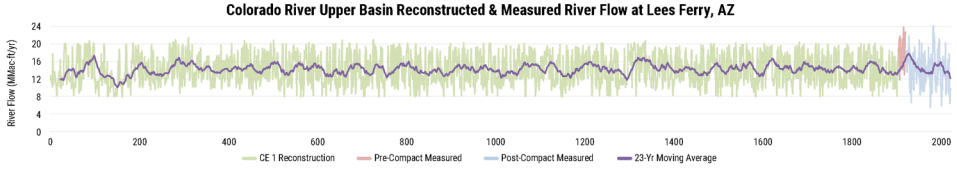


Figure 4.11 – Bijou Insights analysis based on U.S. Bureau of Reclamation data (1906+ CE) and Gangopadhyay, S.; Woodhouse, C.A.; McCabe, G.J.; Routson, C.; Meko, D.M. (2022-03-07): NOAA/WDS Paleoclimatology - Ensemble Streamflow Reconstruction for the Colorado River at Lees Ferry, AZ; Time Period, Water Years 1-1905 CE. NOAA National Centers for Environmental Information. https://doi.org/10.25921/6vba-4g33. Accessed June 2023.

Figure 4.12

Colorado River Flow vs Temperature

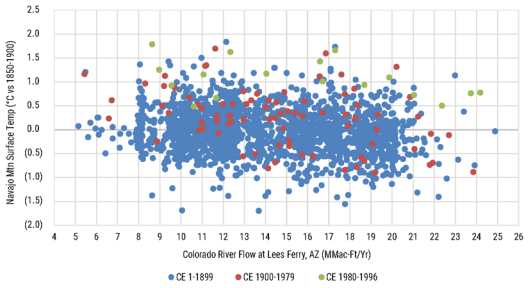


Figure 4.12 – Bijou Insights analysis based on (1) U.S. Bureau of Reclamation data (1906+ CE), (2) Gangopadhyay, S.; Woodhouse, C.A.; McCabe, G.J.; Routson, C.; Meko, D.M. (2022-03-07): NOAA/WDS Paleoclimatology - Ensemble Streamflow Reconstruction for the Colorado River at Lees Ferry, AZ; Time Period, Water Years 1-1905 CE. NOAA National Centers for Environmental Information. https://doi.org/10.25921/6vba-4g33. Accessed June 2023, and (3) Salzer, M.W. and K.F. Kipfmueller. 2005. Reconstructed Temperature and Precipitation on a Millennial Timescale from Tree-Rings in the Southern Colorado Plateau, U.S.A. Climatic Change, 70(3), 465 - 487. doi: 10.1007/s10584-005-5922-3.

Figure 4.12 clearly shows that there were high and low river flow years in both cold years and in warm years. The local temperature and river flow show no correlation at all.

This observation is confirmed by significant disagreement related to temperature attribution and considerable uncertainty of its impacts to the Colorado River flows offered by the latest scientific research. On a global scale, the latest IPCC report indicated low confidence in the assessment of trends in river flows and changes in drought that could be attributed to human influence. Despite the wide array of scientific opinions on the topic, policymakers and the media frequently blame the severity and duration of the recent drought solely on rising temperatures and suggest the river system will not survive if we do not eliminate emissions from fossil fuels. A brief study of the river's extended history quickly dispels this misguided conclusion which, unfortunately, serves as a core justification of their energy policy agenda. However, the challenge remains: How to manage water in the seven-state arid region that has seen a ten-fold growth in population since the original Compact was formed and no apparent slowing of this trend.

Case Study: Drought in the Colorado River Basin

Floods

Floods are harder to quantify except in terms of their economic damage. Flood damage in the United States since 1940 is shown as a percentage of GDP shown in Figure 4.13. There is a significant downward trend, more likely due to better flood preparedness than an actual reduction in floods or extreme rain events. With the availability of abundant and reliable energy, humans have been better able to predict, prepare, and sometimes even prevent these deadly and costly flooding events.

Figure 4.13

U.S. Flood Damage as Percentage of GDP 1940–2019

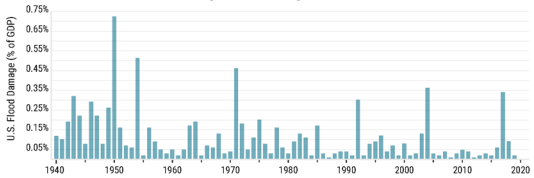


Figure 4.13 — Downton, Mary W., et al. "Reanalysis of U.S. National Weather Service Flood Loss Database: Natural Hazards Review: Vol 6, No 1." Natural Hazards Review, American Society of Civil Engineers, 1 Feb. 2005. ; Contribution of Historical Precipitation Change to US Flood... - Pnas. ; Jr., Roger Pielke. "Global Disasters: A Remarkable Story of Science and Policy Success." The Honest Broker Newsletter, The Honest Broker Newsletter, 14 Jan. 2021.

Extreme Weather & Global GDP

Damages from extreme weather events as a percentage of global GDP have declined by roughly 20% over the last three decades, in contrast to frequent proclamations of rising weather disasters. These proclamations are spurred by an annual NOAA report that documents a rising trend in "billion-dollar disasters." However, inflation and rising wealth automatically lead to increasing billion-dollar disasters unless extreme weather is rapidly decreasing. An honest evaluation of extreme weather costs requires GDP normalization.

Figure 4.14

Global Weather Disaster Losses as Percent of Global GDP 1990–2023

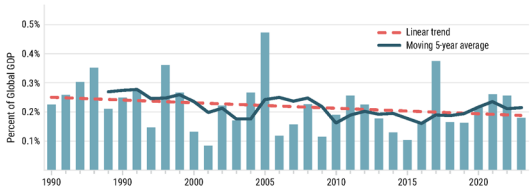


Figure 4.14 — Roger Pielke, Jr., Munch RE, 2023. NOAA National Centers for Environmental Information (NCEI) U.S. Billion-Dollar Weather and Climate Disasters (2024).

Wildfires

Wildfires are intimately tied to forest management practices. In August 1910, the "Big Burn" in western Montana and northern Idaho covered an astonishing three million acres in just two days and killed 78 firefighters. This terrible and tragic event radically altered the national psyche in its attitude towards the ever-present natural phenomenon of wildfires, affecting not only the U.S. Forest Service and policymakers but the wider American public. This led to an extremist policy aimed at preventing and fighting wildfires above all else, with long-term counterproductive consequences.

A study of western U.S. Forests by U.S. Forest Service scientists concluded that increased "live fuel" due to changing forest management practices was responsible for more than 50% of the recent increase in wildfires. From 1977 to 2017, forested areas in the U.S. grew by 3%, yet forest wood volume grew by 34% during this period. Without active forest management, the fuel load for wildfires has grown significantly.

Figure 4.15 shows 100 years of U.S. Forest acres burned annually. In the 1930s, wildfires burned several times more acres every year than they do today. This graph also illustrates the dramatic impact of the U.S. Forest Service

Figure 4.15
U.S. Wildfire Acres Burned 1926–2023

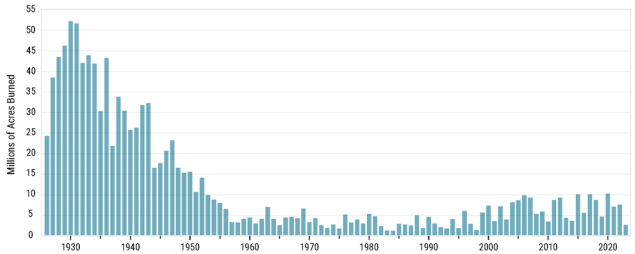
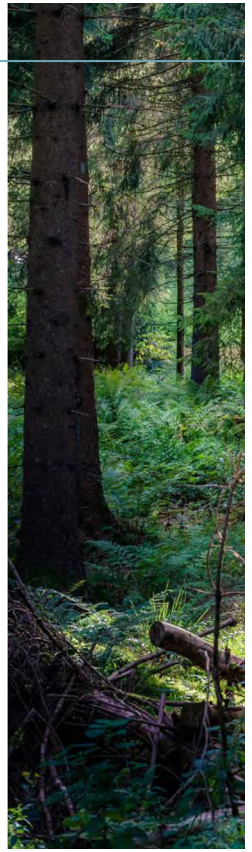
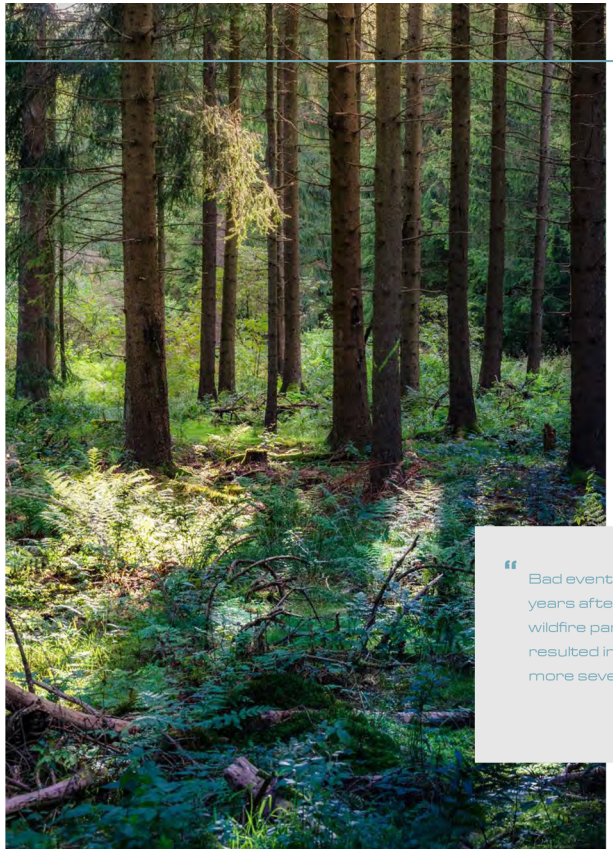


Figure 4.15 – National Interagency Fire Center, Roger Pielke, Jr.





Smokey Bear campaign, launched in the 1940s, to expand fire prevention by enlisting the public in its efforts to prevent and quickly extinguish wildfires. Multiple regulatory changes from the 1960s onwards made it increasingly difficult to perform basic forest management practices like tree thinning, clearing undergrowth, and, importantly, controlled burns. Fortunately, the political will to address forest management practices appears to be growing. However, reversing 100 years of mismanagement will take significant time and resources, although 2023 saw the fewest acres burned in the U.S. during the 21st century. However, the risk of wildfires remains elevated as improved forest management practices are still more talked about than practiced.

> "Bad events create bad policy. Today, more than 100 years after the Big Burn, we are left with our current wildfire paradox: Decades of fire suppression have resulted in accumulated fuels that lead to larger and more severe wildfires that cannot be suppressed."
>
> — Brian Yablonski, PERC Executive Director

Extreme Weather's Impact

By far, the most important factor regarding extreme weather is the impact it has on human lives. Here, the trend is manifestly positive. Figure 4.16 shows the dramatic decline in the deadliness of extreme weather events. There has been a greater than 90% decline in annual global deaths from extreme weather during the last century while the world population has quadrupled over the same period. The downward trend in deaths from extreme weather continues unabated, with the last few years falling even further!

Wealthier societies with abundant access to affordable energy are simply far safer places in which to live.The large majority of the remaining deaths resulting from extreme weather are concentrated in low-income nations with high rates of both poverty and energy poverty, which are nearly synonymous. Improving energy access for the poor, as discussed previously, is the key to further reducing the risk to human lives from extreme weather.

While climate change is both broad and complicated, familiarity with basic science and empirical data is highly valuable and, unfortunately, quite scarce. This brief section is included to provide an introductory overview of the chemistry, physics, and empirical data surrounding the central climate change issues. The following section on Climate Economics touches on the work of economists to quantify the potential human impacts of climate change now and in the future.

Figure 4.16

Global Deaths from Severe Weather 1920–2020

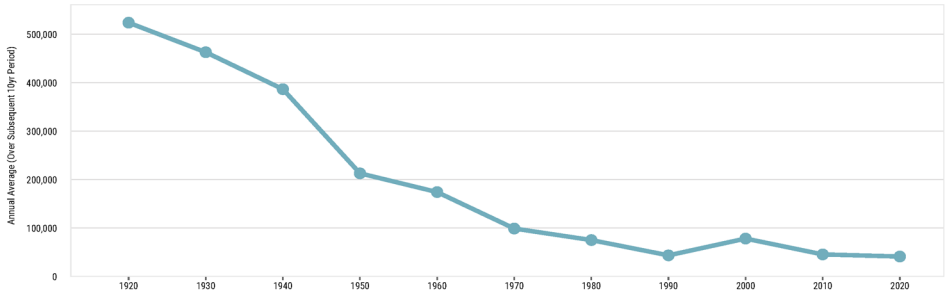


Figure 4.16 — "EM-DAT: The International Disasters Database." EM-DAT, Centre for Research on the Epidemiology of Disasters (CRED). ; Lomborg, Bjorn. "Welfare in the 21st Century: Increasing Development, Reducing Inequality, the Impact of Climate Change, and the Cost of Climate Policies." Technological Forecasting and Social Change, North-Holland, 24 Apr. 2020.

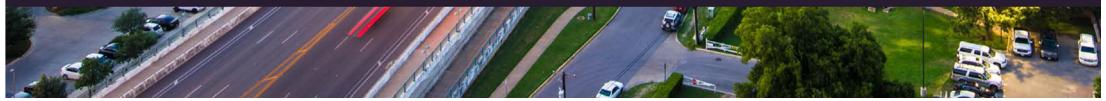
SECTION SUMMARY POINTS

- A higher atmospheric concentration of CO_2 is leading to a warmer, wetter, and greener planet.
- Sea levels are rising at a global average rate of a bit more than one inch per decade, with no significant change in the rate of rise over the last few decades.
- There are no notable trends in hurricane, tornado, flood, or drought frequency or severity.
- Global deaths from extreme weather have plummeted for over a century with cold-related deaths far outnumbering hot weather deaths.

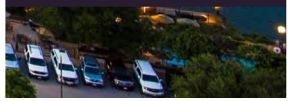


CLIMATE ECONOMICS

The Cost of Climate Change | Future Adaptation & Mitigation | Net Zero is the Wrong Goal







Climate Economics

Climate economics is a rich and relevant topic in the energy industry. There are numerous complexities, such as territorial greenhouse gas emission targets that localize the costs but socialize the benefits across the whole planet. For example, if the U.S. were to rapidly decarbonize its entire economy, as many advocate, the costs would be counted in the trillions of dollars and the benefits to the U.S. would be rather modest. The United Nations' Intergovernmental Panel on Climate Change (IPCC) predicts that a rapid and complete de-carbonization of the U.S. economy would result in a less than 0.1°C reduction in global temperatures by 2100. For the U.S. to realize any material benefits, emissions must be reduced globally. This territorial problem is even more stark at the individual U.S. state level which, unfortunately, hasn't prevented many states from passing legislation with territorial emission targets. It is very difficult to imagine that any state-level emission reduction mandate could have benefits to their residents that exceed the costs.

The Cost of Climate Change

The recent IPCC Assessment Report 6 (AR6) provided — almost certainly incomplete — estimates of economic damage from a cumulative 2°C of warming from pre-industrial times. The report estimates that global per capita income would decline by somewhere between 0.2% and 2.0%. The large range is indicative of the fact that attempting to predict the economic impacts of climate in the coming century is immensely challenging. Nevertheless, for the sake of argument, we accept these estimates as a starting point for discussion.

The world is estimated to have so far warmed about 1.2°C since pre-industrial times. At the current observed rate of warming of 0.17°C/decade from averaging the satellite data, we would expect to hit 2°C total warming around 2070. It is possible that the rate of global warming may increase in the future, or it may decrease.

Nobel Prize-winning climate economist, William Nordhaus, analyzed a scenario at the upper end of the IPCC warming projections where the temperature rises by 3.5°C at the end of the 21st century, even after what Nordhaus calculates as optimal emissions mitigation efforts are undertaken. Nordhaus' Nobel Prize winning work calculated an optimal response to climate change, meaning only taking actions that provide benefits greater than their costs. His conclusion was that only limited cost-effective options were available, and that adaptation was the main appropriate response to the slow-moving impacts from climate change.

The scenario analyzed by Nordhaus, with future warming more rapid than currently being observed, is included in the figure included in the CEO letter at the front of this report (Figure C) and repeated here (Figure 5.1). The estimated current and future climate economic impacts are plotted together with impacts from malnutrition, air pollution, disease, illiteracy, and gender inequality. Nordhaus estimates a less than 1% economic impact from climate change through 2050, rising to over 3% by 2100 with 3.5°C of warming.

Figure 5.1
How Much Richer Would the World be Had We Solved Different Issues 1900–2050

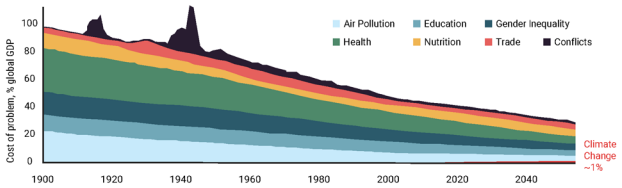


Figure 5.1 — Lomborg, Bjorn. "Welfare in the 21st Century: Increasing Development, Reducing Inequality, the Impact of Climate Change, and the Cost of Climate Policies." Technological Forecasting and Social Change, vol. 156, 2020, p. 119981.

It is difficult to see nearly a century into the future with any confidence. However, if we accept these predictions, we must grant that while the projected economic impacts of climate change are global and large in gross dollar magnitude, they pale in significance to the challenges facing the one-third of humanity which still live in dire energy poverty. Poverty is a pressing and acute problem today, while the hazards of climate change are distant and uncertain.

To put this in concrete terms, the lack of access to clean cooking fuels alone is estimated to cause two to three million annual deaths. Climate change, by comparison, is probably resulting in a modest reduction in annual deaths, despite media proclamations of dramatic threats to human health from rising temperatures and extreme weather. The century-long decline in deaths from extreme weather has already been noted. Although deaths from extreme heat have likely risen, those deaths are almost certainly more than offset by a reduction in the number of deaths from extreme cold, which are globally roughly eight times greater in number than deaths from extreme heat. While there may well be impacts from climate change in the present day, these are quite modest compared to the terrible effects of energy poverty.

Figure 5.2

Total Impact from Temperature Increase Measured in Percent of Global GDP

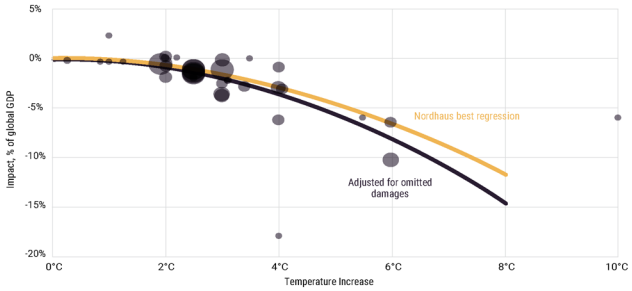


Figure 5.2 – Lomborg, Bjorn. "Welfare in the 21st Century: Increasing Development, Reducing Inequality, the Impact of Climate Change, and the Cost of Climate Policies." *Technological Forecasting and Social Change*, North-Holland, 24 Apr. 2020.

Figure 5.2 is a compilation of work by various climate economists projecting economic impacts from climate change over a wide range of possible future warming magnitudes. One thing that stands out is the broad agreement among the various economists that the economic impacts today and over the next few decades from climate change are likely to be modest. Climate change impacts are projected to rise to a few percentage point reductions in per capita income after temperature rises of 2°C–4°C, perhaps by late this century or early next century.

The time scale for energy poverty, on the other hand, is urgent and now. Growing global energy production coupled with sober energy policy could bring extreme energy poverty to an end before the year 2050. In this same period, we could also make major progress on energy technology to allow decarbonization over the latter half of the century without needless impoverishment.

Future Adaptation & Mitigation

These next few decades will likely see tremendous progress in low-carbon energy technologies, including reliable on-demand (non-intermittent) sources such as advanced nuclear, next-generation geothermal, economic Carbon Capture Use and Storage (CCUS), and possibly meaningful progress in energy storage. The main response to climate change so far, and likely the main response for decades to come, is adaptation. Pre-modern humans survived multiple glaciations with simply massive temperature and climate swings. Modern humans are vastly better equipped to deal with climate change today. Adaptation will happen in all scenarios. Mitigation efforts will depend on energy technology, policy, and social acceptance.



Figure 5.3

Annual CO_2 Emissions by World Region

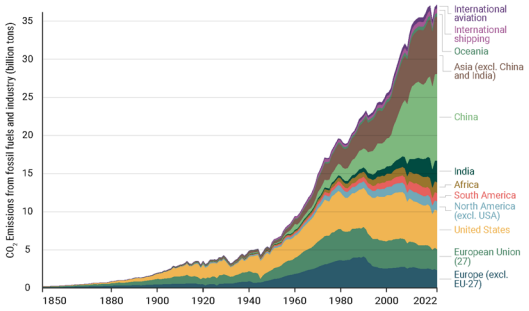


Figure 5.3 – Our World in Data based on the Global Carbon Project

Figure 5.4

Annual CO_2 Emissions from OECD and Non-OECD Countries 1850–2022

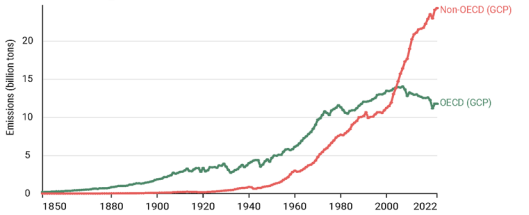
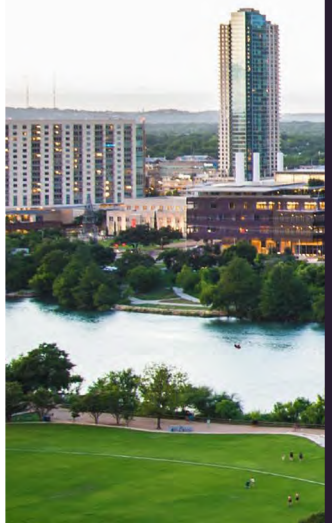


Figure 5.4 – Global Carbon Budget (2023)

Greenhouse gas mitigation efforts have been concentrated in the electricity sectors of wealthy countries. However, nearly all projected growth in emissions is in countries outside the advanced economies of the Organization for Economic Co-operation and Development (OECD).

Figure 5.3 shows global greenhouse gas emissions since 1850 broken down by major regions and countries. While the wealthy countries of the OECD have been reducing emissions for 20 years, those in non-OECD countries are rising as they energize their societies and improve their standards of living – see Figure 5.4. Further, the emission reduction efforts within the OECD have tended to increase energy costs, therefore failing to provide developing cultures with an economically enticing option to lower emissions. This must change if climate mitigation is to spread globally.



CONCLUSION

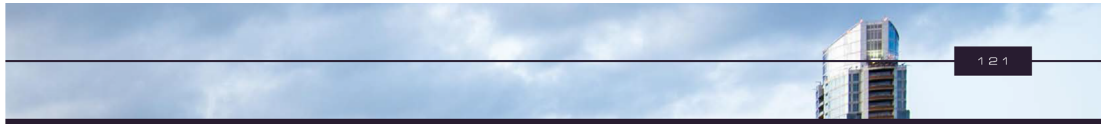
Net Zero 2050 is the Wrong Goal

This report has gone into detail about how the world is energized and how that has evolved over time and impacts everyone's quality of life. The overriding message is that too much of today's political and social pressures are pointing in the wrong direction. A myopic focus on only one factor cannot lead to a favorable outcome. If we broaden our lens to bettering lives and expanding opportunities for everyone, a different direction emerges.

The energy systems in societies are simply vital to the range of possibilities open to their citizens. Many societies simply don't have the energy systems available to open the door for healthy, prosperous lives for their citizens. Meanwhile, existing energy systems are being undermined to such an extent that industries are being outsourced and standards of living are being compromised for little apparent climate benefit. Energy systems should not be politically altered without a clear evaluation of the tradeoffs.

The world would benefit from a massive increase in energy research and innovation as opposed to simply massive subsidies for existing technologies that are not up to the task. Across the board innovation is the only road to more energy and better energy — energy with lower emissions and improved affordability. This will take time and concerted effort. Artificial urgency and timelines have been counterproductive.

The global rallying cry for Net Zero 2050 should be reevaluated and replaced with a more humane and achievable goal: Zero Energy Poverty 2050.



Today's careless obsession with Net Zero 2050 is the wrong goal. In fact, strident pursuit of this goal has been obstructing attempts by the less fortunate to increase their life opportunities. What if the world instead vigorously pursued the eradication of human destitution and energy poverty by 2050?

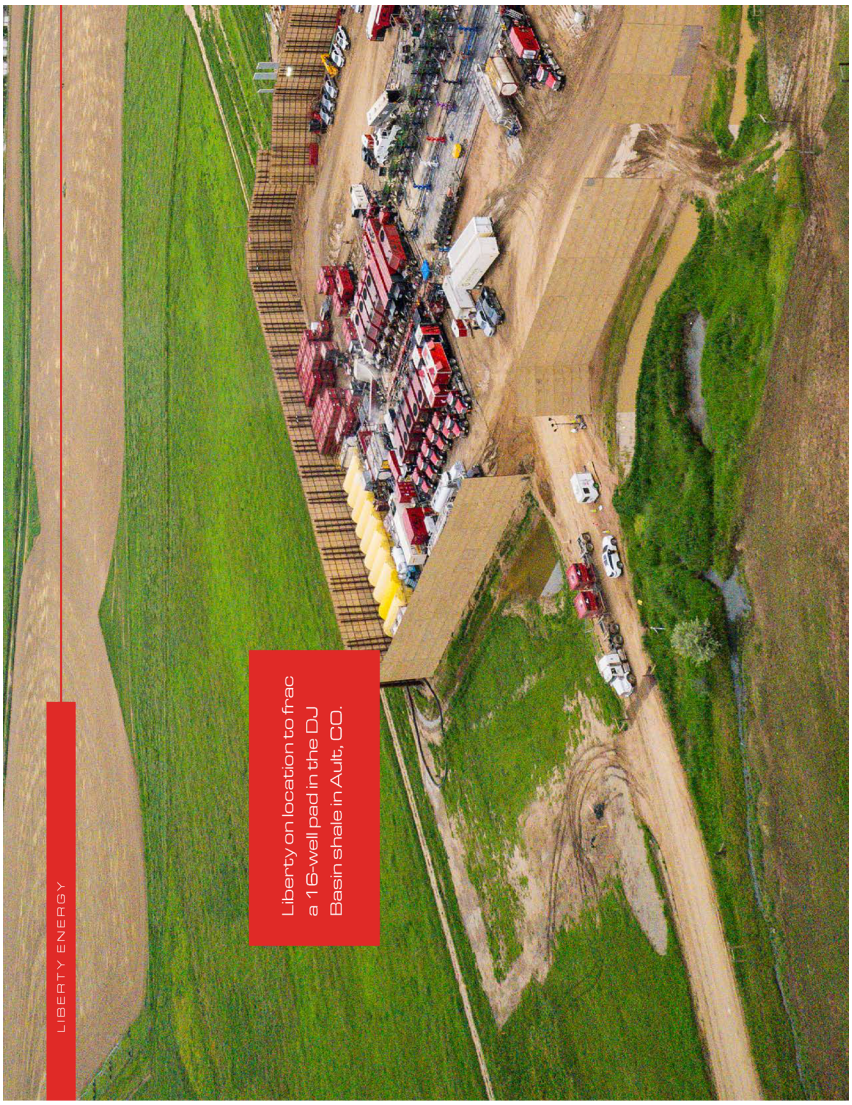
Human destitution — poverty so severe that an individual lacks sufficient calories, clean water, basic healthcare, and shelter to simply assure survival — was all too common throughout human history. The rise of bottom-up social organization and the explosion in available energy from hydrocarbons have driven down the percent of humanity living in dire poverty from nearly 90% two hundred years ago to roughly 10% today. We should celebrate this tremendous progress.

However, 800 million people are still destitute today. An additional two billion people live with very limited opportunities and shortened lifespans due to energy poverty, specifically the lack of clean cooking and heating fuels. Ending destitution and energy poverty could prevent at least 10 million annual premature deaths from malnutrition, indoor air pollution, and easily preventable endemic diseases. In addition to the enormous lifesaving benefits, energizing the least fortunate would markedly expand the life possibilities for this one-third of humanity born in less fortunate circumstances. Affordable, reliable energy is the road out of poverty. Sober energy and climate policy would raise the standard of living and expand the opportunities for everyone, not just the poor.

Unfortunately, the wealthy world is distracted from humane, achievable goals. Today's energy and focus is on "Net Zero 2050." The goal appears unachievable and perhaps undesirable — certainly on the 2050 timeline. Economic analyses, including those conducted by the United Nations Intergovernmental Panel on Climate Change, estimate that achieving Net Zero 2050 would cost tens of trillions of dollars. Their analysis shows the costs of forcing an energy transition without viable replacement sources — a transition leading to insecurity, unaffordability, and unreliability in the energy supply — vastly overshadow the greatest potential climate change harm reductions by reaching net zero carbon emissions in 2050. We cannot achieve this aggressive climate goal without exacerbating widespread suffering and limiting opportunity for everyone. The narrow focus on Net Zero 2050 threatens immediate life-saving interventions. The cure is far worse than the disease.

At the 2021 Climate conference in Glasgow (COP 26) 20 nations — including the United States, Canada, Germany, and the United Kingdom — pledged to end direct public finance for fossil fuel projects. This will clearly impede efforts in developing nations to produce hydrocarbons or build infrastructure to supply clean cooking fuels, electricity, synthetic fertilizer, and other hydrocarbons critical to their advancement. Inflating energy costs — by reducing access, options, and reliability — guarantees more human suffering. Can the myopic focus on Net Zero 2050 really go so far as to stand in the way of saving millions of lives?

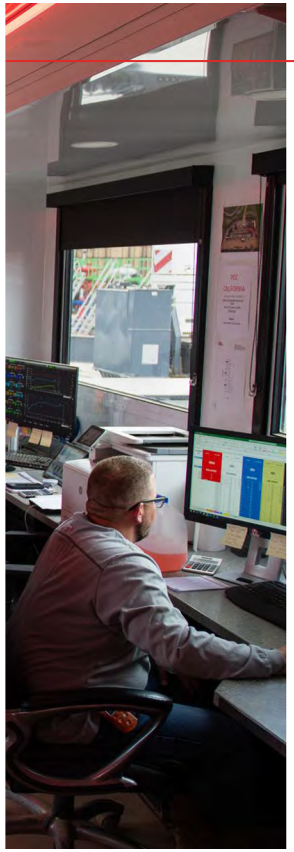
The biggest barriers to eliminating extreme poverty are low-quality, corrupt governance in poor nations combined with the obsession of wealthy nations to achieve Net Zero 2050. We can and must do better by refocusing on humans, particularly those least fortunate. The world can end destitution and energy poverty by 2050 by expanding energy access and affordability. The world needs more energy, better energy.


LIBERTY ENERGY
Liberty on location to frac
a 16-well pad in the DJ
Basin shale in Ault, CO.



The life-cycle energy produced from the wells on this 5 acre well pad is equivalent to the energy produced by 176 2MW wind turbines that stand 443 feet tall and occupy over 55,000 acres of open space.

124



Liberty Energy

Liberty was created with one overriding goal: to build a company that brings together great people and provides them with a culture to excel. The Liberty team creates services and technology that truly make a difference in delivering our mission to better human lives. Liberty is a leader in developing and commercializing technology that delivers safer, cheaper, and cleaner energy at scale to the world.

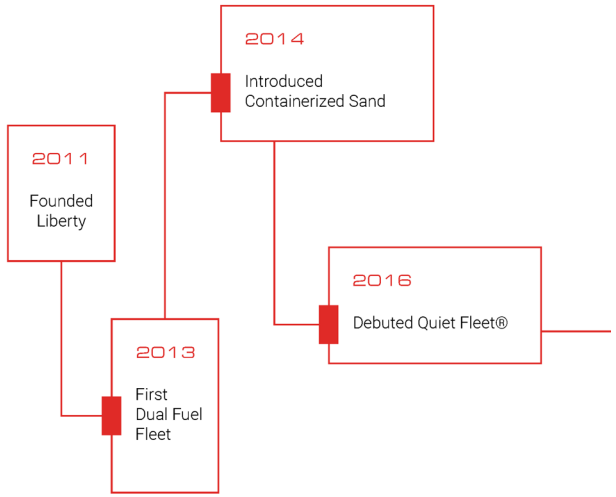
Our primary business operations are on-site hydraulic fracturing services to oil and natural gas producers in the United States and Canada. We work in the Shale Revolution, where hydraulic fracturing has replaced drilling as the largest and most mission-critical of all the steps to construct wells for oil and gas production. Shale production starts with constructing a well pad, which is a few acres of cleared land to site 3 to 30 wells and surface processing equipment.

These few acres of land provide access to several square miles of underground shale rock reservoirs to drain massive amounts of oil and natural gas. Drilling of each well is typically one to three miles vertically downward, followed by a gradual turning of the wellbore horizontally (parallel to the earth's surface) and then one to four miles of lateral wellbore length within the shale rock.

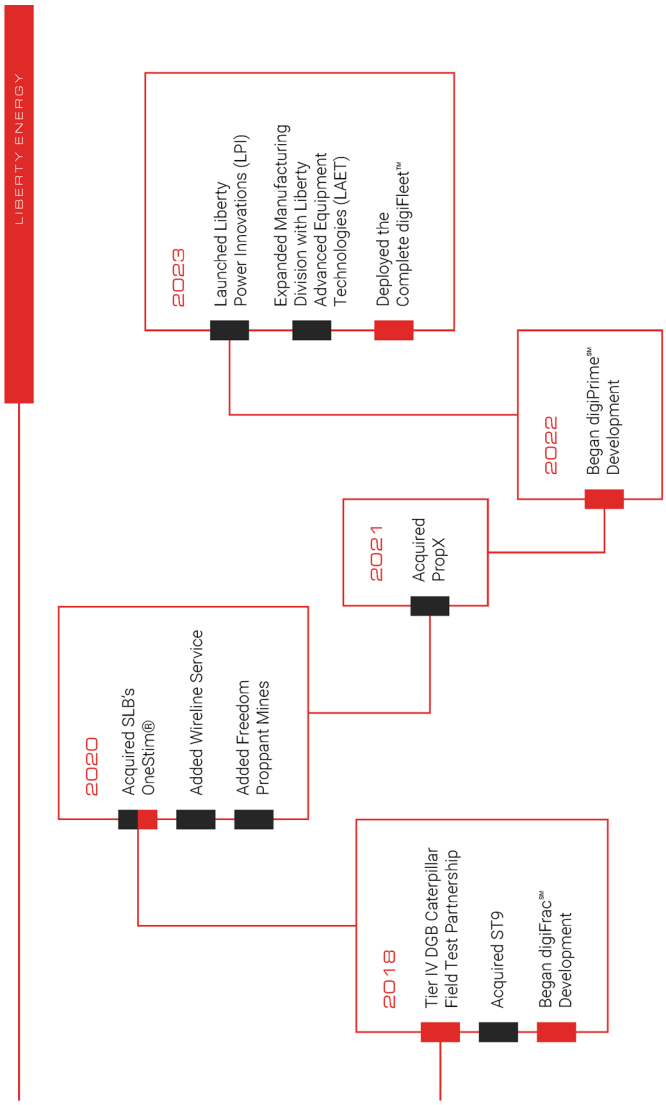
When drilling is completed, hydraulics fracturing of each well takes place. The Liberty section of this report overviews our people and technology that design, construct, and operate all the equipment and systems required to safely enable shale production in the United States and Canada safely.

Our History

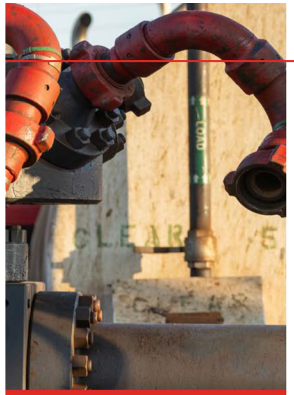
Liberty began as a pure-play provider of hydraulic fracturing operations. We have grown into an integrated supplier of all the supporting services that are required to execute the frac operations. Harmonizing these parts into one orchestra is a big part of how Liberty has distinguished itself as the leading completion provider in North America (based on survey data from the industry's top research firm, Kimberlite).



Liberty emphasizes rapid innovation and growth through technology advancements and improved efficiency with mindful vertically integrated business lines.


LIBERTY ENERGY
2018
Tier IV DGB Caterpillar Field Test Partnership
Acquired ST9
Began digiFrac℠ Development
2020
Acquired SLB's OneStim®
Added Wireline Service
Added Freedom Proppant Mines
2021
Acquired PropX
2022
Began digiPrime℠ Development
2023
Launched Liberty Power Innovations (LPI)
Expanded Manufacturing Division with Liberty Advanced Equipment Technologies (LAET)
Deployed the Complete digiFleet™


LIBERTY ENERGY
LIBERTY
DELIVERING
SUPERIOR SERVICE
Vertical Integration | digiTechnologies℠ | Equipment Design & Manufacturing | Next-Generation Maintenance |
Modular Fuel Supply & Power Generation | Liberty Power Innovations | Supply Chain & Logistics





Delivering Superior Service

Hydraulic fracturing requires a fleet of equipment with 40,000 to 70,000 horsepower able to operate in remote locations 24 hours per day, 365 days a year. It is these frac fleets pumping sand and water down wellbores at high pressures (5,000 to 15,000 psi) that have enabled the world energy transformation that is the Shale Revolution.

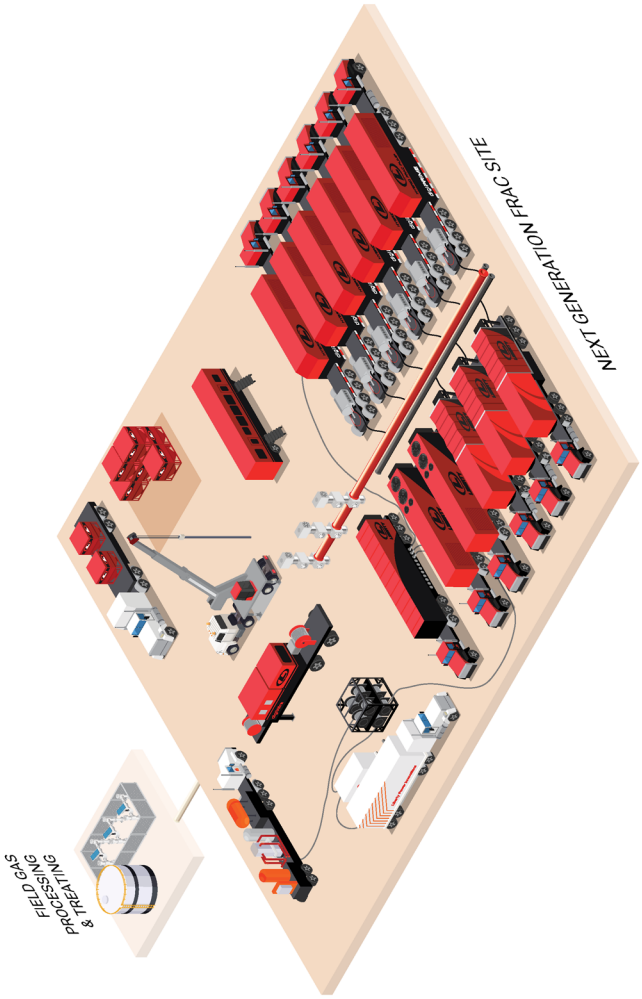
Energy produced from U.S. shale is equivalent to 58% of U.S. primary energy demand and nearly 10% of global primary energy demand.

Vertical Integration

Vertical integration plays a crucial role in shaping the Liberty Energy narrative. Liberty's integrated completions portfolio allows us to control the critical components of hydraulic fracturing operations, including frac, wireline, proppant, chemical sourcing, delivery, and power generation. Owning greater control of a breadth of services provides a range of benefits, including a more diversified supply chain, reduced costs, quicker response to market changes, and stronger technical leadership. These are all particularly true for manufacturing: for individual components and complete pieces of equipment.

To the right is a schematic of an oil and gas well pad location with a Liberty fracturing fleet, PropX sand management equipment, Liberty wireline, and Liberty Power Innovation equipment for a continuous supply of natural gas to power operations.




NEXT GENERATION FRAC SITE
FIELD GAS PROCESSING & TREATING

digiTechnologies

When Liberty built its first frac fleet 13 years ago, Tier II diesel was the best available engine technology. Since then, large diesel engine technology has evolved through three generations: Tier II dual fuel (substituting some natural gas for diesel), Tier IV diesel, and Tier IV dual fuel. Today, Liberty's digiTechnologies™ suite of modular solutions for frac includes mobile power generation, our digiFrac™ electric fleets, digiWire™ electric wireline, and the industry's first hybrid pumps, digiPrime™, which are powered by natural gas and also generate and use electric power with onboard battery storage.

Liberty has continuously led the development of the best available technology, from our Quiet Fleet — making the pumps undetectable above ambient noise 500 feet away — to developing the digiTechnologies that further reduce CO_2e by 40% and NO_x by 60%, while significantly reducing the cost-of-service delivery. Almost seven years ago, we began an internal program to develop the first purpose-built fully electric frac pump, culminating in successfully introducing our digiFrac units to the market in 2023. The introduction of digiFrac was an essential step in our journey to provide lower-emission, lower-fuel-cost horsepower and improve operational efficiency. These electric pumps can be powered by the grid or state-of-the-art low-emission digiPower™ mobile generators driven by natural gas-burning reciprocating engines.

The newest addition to our fleet is digiPrime, the industry's first natural gas hybrid frac system. The digiPrime pump offers an even lower emission profile, higher power density, and 45% thermal efficiency with the MTU 16V4000 engine. This hybrid pump design utilizes direct mechanical drive for the pumps while simultaneously generating power capable of electrifying the entire site, including all frac fleet supporting equipment like the blender, wireline, and proppant handling equipment.

With the addition of Liberty Power Innovations, Liberty's integrated alternative fuel and power solution provider, we have built the internal expertise and capability to supply our digiFleet™ with either reliable compressed natural gas delivered and managed on-site or to treat wellhead gas to use for frac power generation. Natural gas has two significant advantages over diesel: It is much cleaner to burn and far less expensive. The drawback is it requires different infrastructure, like pipelines, to transport. Liberty Power Innovations provides a "virtual pipeline" service to reliably deliver natural gas to remote locations not connected to existing pipeline systems, bringing huge benefits to ourselves, our customers, and the environment.

Today, we have truly differentiated frac fleet technology that sets operating performance records while delivering the industry's highest efficiency, lowest emission fleets.

Our fleet of digiTechnologies creates a modular system that can meet the requirements of any job.





digiPrime
The industry's first natural gas hybrid frac system concurrently generates the power required to electrify the entire site, including the blender, wireline, and proppant handling.



digiFrac
Liberty's electric frac system features the industry's first purpose-built power-agnostic electric pumps.



digiWire
Electric wireline unit fully compatible with both digiFrac and digiPrime pumps. Electric power removes the emission generation from prime mover engines and eliminates common failure modes.



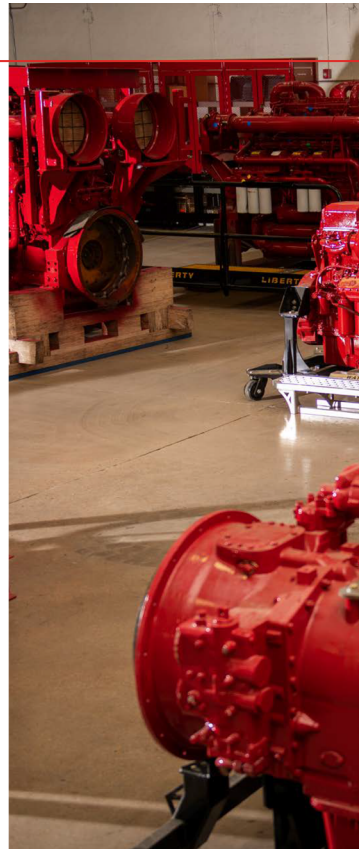
digiPower
The Rolls Royce 20V4000 natural gas generator set provides high thermal efficiency along with the lowest emissions and lowest fuel consumption available on the market.

Equipment Design & Manufacturing

Since its inception, Liberty has been at the forefront of equipment design. In 2018, we created a manufacturing division and acquired ST9. This acquisition provided Liberty with control over our pump design and manufacture and provided critical components, including the valves, seats, fluid ends, and power ends that comprise a pump. By bringing this in-house, Liberty took back control of the supply chain to the steel forging process, including specifying the various components' metallurgy. These changes provided visibility and control that is not possible through third-party providers. Rapid innovation driven by real-time feedback from the field, together with sophisticated instrumentation and monitoring, all contribute to a faster product evolution.

In 2023 we launched our Liberty Advanced Equipment Technologies (LAET) division, further expanding our internal manufacturing capabilities to include complete equipment, specifically our mobile frac pump units including radiators, transmissions, and all other required components. Liberty plans to transition to a primarily natural gas-fueled fleet using digiTech-nologies over the next several years. Given the growing demand for these units, we saw an opportunity to bring a portion of this manufacturing effort in-house, ensuring the same benefits we have seen in the pump components arena. Manufacturing centers in Texas and Oklahoma will improve our innovation cycle and deliver next-generation assets to our operations team. This integration will provide better visibility and quality control into the component supply chain, reduced costs, and seamless integration with existing Liberty assets.

We have carefully considered sizing our manufacturing centers to provide critical baseload capacity for the company while augmenting additional needs with our long-term third-party partners. This combination of internal capability paired with external partners allows us to optimize our capital spending to meet the needs of the business while innovating at the pace required to maintain our leadership position in the industry. We don't want to oversize this operation as we seek to provide stable employment despite industry downturns.





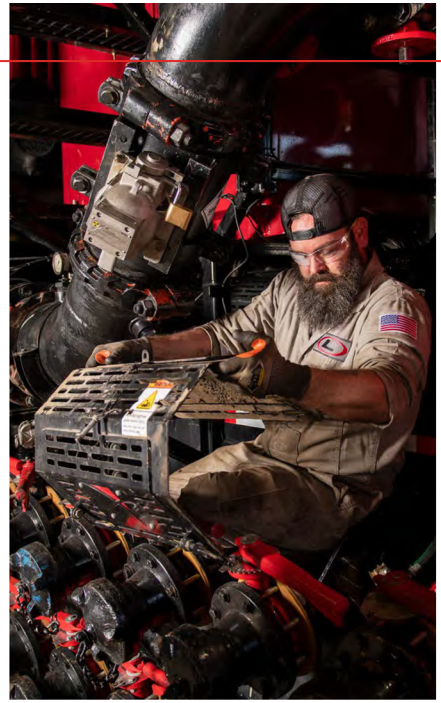
StimCommander™

StimCommander is Liberty's AI frac pump command system, which allows us to optimize pump operation for any pumping rate, pressure, and subsurface execution requirements, ensuring pinpoint control of every hydraulic fracturing job. This software enables Liberty to work with our customers to plan and execute pumping operations efficiently while taking maximum advantage of our digiTechnologies.

- Seamless integration with our digiFleet.
- Improves job execution.
- Orchestrates rate control of high-pressure pumps to achieve master rate setpoint.
- Operates pumps through their firmware to minimize gear shifts and provide flow path management.
- Automatically maintains treating pressure within a specified limit.

Next-Generation Maintenance

We design equipment to provide the lowest total cost of operation, which means the highest operational efficiency plus the lowest cost per pump hour. Maintenance goes hand in hand with our equipment design and operations. We are continuously deploying advanced functionalities throughout our fleet to optimize the monitoring and operation of our equipment and to provide a constant feedback loop to our design and supply chain teams. At Liberty, each of our crews has a dedicated maintenance team, facilitating improved communication between the field and the shop. This structure aligns with our focus on delivering superior service in the field by integrating how equipment is operated and maintained. It extends equipment life, reduces downtime, and reduces our cost of operations. For example, our patent-pending asset management platform, FracPulse, detects wear of fluid end valves and seats. Our AI machine-learning-driven algorithms trigger preventive maintenance events, helping our crews avoid failures predicted by a combination of factors that may not be obvious to equipment operators, ensuring minimal downtime disruptions.



FRAC PULSE

Liberty's FracPulse asset management platform utilizes cloud-based maintenance management software to collect over 250 million data points daily, effectively taking the pulse across all our operations at any moment. FracPulse allows our equipment to interact with our maintenance and operations teams, providing access to concise real-time information and outlining a path to higher throughput and equipment longevity. Liberty's advanced technology enables our field personnel to continue leading our industry in frac performance (based on survey data from the industry's top research firm, Kimberlite).



Proactive Response to Equipment Issues

- Creates a health profile for equipment, allowing for prioritization of maintenance and optimizing turnaround times.
- Leverages advanced AI and machine-learning algorithms to detect subtle patterns, improving our ability to perform predictive maintenance.
- FracPulse notifies operators of irregularities in real time by analyzing telemetry data.

Real-Time Emissions and Gas Substitution Reporting

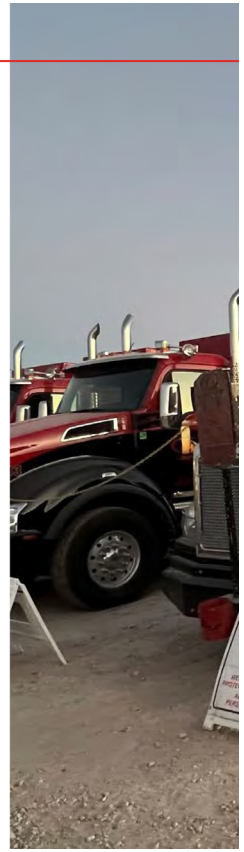
- Allows operators to view current and historical data on gas substitution and manage engine parameters to maximize the natural gas displacement of diesel fuel.
- Provides a summary of emissions data for all the wells and frac pads by combining the contributions of each engine's emissions profile and the hours it operated on the site.
- Targets optimum operating efficiency to produce the lowest emissions relative to the power requirements of each job.

Modular Fuel Supply & Power Generation

The world is becoming increasingly electrified, and the oil and gas industry is no exception. Drilling, hydraulic fracturing, and production facilities are all moving away from diesel-powered motors towards natural gas and electric motors. As this progression occurs, Liberty provides industry leadership through a thoughtful approach to the most efficient way to generate power for the unique demands of hydraulic fracturing. Through a five-year effort, Liberty developed and deployed a fully electric frac fleet centered around our digiFrac electric pump. An essential part of this effort involved determining the most efficient power supply for the electric fleet.

An electric frac fleet uses a significant amount of power — around 20MW, or enough power to supply a town of 25,000 people. Because of the high load and intermittency for frac operations, power from the public grid is impractical in most locations. Instead, power for the frac location is generated on-site with Liberty equipment. As we thought about how best to power the next-generation fleet, we had several minimum requirements:

1. Modular power generation — ensuring the right amount of on-site power to meet the needs of the job, from as little as 10MW to as much as 40MW for a simul-frac operation, which can more than double the lateral footage stimulated per hour of pumping.
2. Natural gas-fueled — the cleanest and most cost-effective fuel source for our needs.
3. Lowest emissions footprint per megawatt hour.
4. Redundancy — reliably maximizing pumping efficiency.
5. A robust supply chain with readily available parts and technical in-basin support.
6. The durability to withstand the rigors of a wide variety of operating conditions and regular moves on bumpy rural roads between frac locations.





An evaluation of these requirements pointed clearly to natural gas reciprocating engines as the right choice for power generation. Each digiPower trailer contains a 20-cylinder MTU (Rolls Royce) gas engine paired with a 2.6 MW generator. At 43% thermal efficiency, they provide the most efficient means of converting natural gas into mechanical energy. Gas reciprocating engines produce 25% less CO_2e and 60% less NO_x than Tier IV DGB, which is the next best technology on the market. This combination performs at least 25% better. Gas turbines are clear winners at large scale (hundreds of megawatts) and for continuous operations. However, reciprocating engines are superior at smaller scale and for intermittent power demand. The digiPower units are highly mobile and scalable. Over 3,000 of the 20V4000 engines are in service in various industries, which gives us access to a strong dealer network and robust supply chain for parts.

While digiPower units support the digiFrac electric fleets, they also provide Liberty Power Innovations with the ability to supply low-emissions, mobile power in a wide range of scenarios, including remote industrial applications, construction projects, and emergency backup power during interruptions in primary generation or where grid transmission infrastructure has been damaged.



Liberty Power Innovations

In 2023 we announced the launch of Liberty Power Innovations (LPI), which marked a pivotal moment in commercializing integrated full-service alternative fuel and power solutions for remote applications. Specializing in compressed natural gas (CNG) supply, field gas processing, and well-site fueling and logistics, LPI is leading the oilfield's transformative shift from diesel to clean-burning natural gas.

Uninterrupted access to fuel is paramount for optimizing well-site operations. LPI has multiple natural gas supply sources, in concert with our natural gas compression, creating a vast network of mobile CNG supply. LPI has acquired and built gross compression capacity of 38 MMcf per day by the end of 2023, which will likely double in 2024. LPI also offers a comprehensive suite of transportation, logistics, field gas treating and processing, and pressure reduction services.

CNG Delivery & Logistics

Virtual Pipeline Services

Natural gas is the fastest-growing energy source in the world, but gaseous fuels are more challenging to transport and use than liquid fuels. LPI aims to solve that problem for the oilfield and will continue to expand our expertise in delivering gas to applications outside the oilfield 24 hours a day, every day.

LPI provides just-in-time fueling services via a new fleet of CNG tankers, with technology enabling coordination with Liberty's industry-leading Sentinel™ Logistics management platform.

Field Gas Processing

LPI provides fuel gas treatment and conditioning services. These enable producers to utilize gas produced on-site or at nearby wells to fuel today's ultra-clean natural gas engines for power production.

Seamless Integration with digiTechnologies

LPI and Liberty collaborate to offer on-site fuel management services, incorporating advanced cloud-based software that seamlessly connects with engine control systems, maximizing fuel efficiency and monitoring real-time consumption rates. These detailed insights and interactions facilitate efficient logistics management, granting the operations team timely access to fuel. This collaboration enhances capital efficiency and optimizes efficiency through just-in-time fuel delivery.

Transforming operations from diesel to natural gas-powered.

Liberty Power Innovations

Supply Chain & Logistics

Hydraulic fracturing has become increasingly efficient, leading to a continued trend of more hours and higher volumes pumped daily. We operate at a faster pace while doing more with less. These improvements benefit the surrounding communities, the environment, North American energy production, and Liberty's profitability.

Liberty's commitment to supply chain excellence is apparent during the entire span of a frac job, including proppant sourcing, delivery, and on-site management. Our strategy combines diverse partnership-driven sand sourcing with a vertically integrated solution to supply and delivery.

We pride ourselves on our strong partnerships with various sand and last-mile trucking providers across North America. Our strategy emphasizes working closely with our supply partners to understand what makes our operations most efficient and how we can streamline our supply chains into one cohesive process. This partnership requires proactive open lines of communication for long-term accurate forecasting and daily interaction to ensure execution efficiencies.

Liberty's frac sand mining division, Freedom Proppant, acts as a pillar of our vertical integration. Freedom Proppant offers eight million tons of sand mining capacity in the Permian Basin annually, with both wet and dry sand capabilities. Our ownership of these mines and our expansive partnership network allows Liberty to ensure a reliable product flow to all our operations. This also provides cost and supply stability for our customers throughout all market conditions.

Liberty acquired sand handling technology company PropX in 2021. PropX complements our robust sand network with versatile state-of-the-art equipment, delivery, and storage solutions. This union allows our team to be an









industry leader in sand handling and delivery. PropX and Liberty's collaboration has led to further expansion of technology, allowing for a simplified, efficient, and reliable well-site proppant management system.

The Liberty and PropX engineering teams have worked together over the past four years to develop a new process to transport and manage wet sand which retains the moisture content created during the mining process. Drying sand is energy-intensive, which could be cost-prohibitive for new sand mines and impossible for mobile small mines built near frac operations. Wet sand handling technologies are a lower cost and lower emissions alternative in sand mining — an economic and environmental win.

The transportation and handling of wet sand is made possible by PropX's second-generation sand delivery system, the Sand Scorpion®. This system is purpose-built for wet sand, ensuring consistent on-site product delivery while allowing a broader range of sand sources and moisture contents. The integration of this system reduces operating costs, enhances safety by eliminating silica dust exposure, and improves mine accessibility. The Sand Scorpion is the most versatile sand handling system; integrated with Liberty's robust supply chain network, we can source any proppant from any sand mine or transload facility. Proving the ability to add

wet and proximity mining to the Liberty supply network, the Sand Scorpion raises the bar for efficiency, cost-savings, and safety. This addition has allowed Liberty to adapt to the ever-changing proppant supply and logistics landscape, creating a model that can efficiently utilize as many options as possible.

The execution efficiencies derived from vertical integration and the development of next-generation equipment would be impossible without Liberty's most crucial differentiating factor—our exceptional team of individuals.

The Liberty supply chain team oversees specified basins and crews committed to real-time monitoring of live jobs, making agile adjustments for optimal performance that reflect our dedication to precision and efficiency. Our ability to quickly respond to changing demand facilitates our supplier partnerships and allows for the successful delivery of over 20 million tons of proppant and one million truckloads annually across North America. A unique and complex supply chain, choreographed in real-time behind the scenes, makes this possible.

To support our teams in achieving efficient and proactive execution, we have created a specialized, fully integrated supply chain platform tailored for frac operations. Liberty's Sentinel Logistics platform expands on the foundation built by PropX's PropConnect™ software. Sentinel provides real-time updates on truck driver selection and trip segment execution. This data is combined with driver trip data in our engineering database to provide accurate and timely executable data for our supply chain team. Sentinel's visibility and predictive analytics have allowed Liberty to maximize pick-up and delivery efficiencies while substantially reducing our overall active truck count. With Sentinel, we do more with less.

The strategic combination of the sand supply network, the vertical integration provided by Freedom Proppant and PropX, and the Sentinel platform allow Liberty stability in a complex, ever-changing world.





Streamlining Proppant Logistics with Sentinel

Liberty's Sentinel platform is an advanced system that harnesses real-time data from every frac location to precisely predict on-site proppant inventory for the upcoming 24- hours. This comprehensive data set considers current on-site sand inventory levels, consumption rate trends, proppant truck count, truck locations, loading facility wait times, traffic conditions, and weather updates to forecast sand volumes to ensure our team is optimizing inventory levels on location.

Utilizing Sentinel, we execute proppant delivery, monitor frac location and road conditions in real-time, and analyze all data points in-house to create a streamlined and cohesive process. The strategic combination of the entire Proppant Supply Chain (Freedom Proppants, 3rd Party, Wet & Dry) and Logistics (Trucking and PropX Delivery System) eliminates supply interruptions, stabilizes costs, and maximizes safety, reflecting our commitment to excellence and efficient execution.

Sentinel Makes a Real Impact

- 90% reduction in proppant delivery downtime, leading to emission reductions.
- 35% decrease in drivers needed for a job, lowering Liberty's footprint on the road.
- 33% decrease in total time required to deliver a load of proppant.
- Leverage real-time data from each frac location.
- Understand the cadence of every job and proactively plan for proppant delivery.

Chemistry, Engineering, & Frac Design

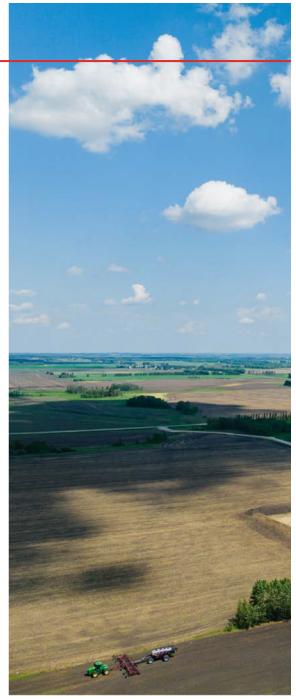
Liberty is a pioneer in advancing frac fluid chemistry, enhancing production efficiency while reducing the cost of extracting natural gas and oil from shale. Our commitment includes developing and using environmentally friendly chemicals, reflecting our pledge to continuous improvement of frac fluids.

Water is the most critical and dominant ingredient in hydraulic fracturing. First, pressurized water breaks the rock in tension, creating complex networks of underground hydraulic fractures. Second, water is the carrier fluid that places sand in these hydraulic fractures. After a frac job, the remaining sand holds open a flow path for hydrocarbons that flow from the pore space within the rock, through the propped fracture into the well, and then up to the surface to empower our world.

Frac fluid chemistry continues to evolve, and Liberty leads the way in this process. Previously, favorable placement of sand in fractures was achieved using viscous fluid systems derived from various chemicals, like guar, an ingredient commonly used in ice cream, toothpaste, and chewing gum. These guar-based systems dominated fracturing until a decade ago, but have primarily been replaced with slickwater fluid, a simpler, more water-dominant fluid with a low-concentration of Friction Reducer (FR).

The current fluid mixture Liberty pumps is over 99% water. We aim to continue innovation in frac fluid systems, ultimately pumping swimming pool-like water with some friction reducer, biocide, surfactant, and 99.8% water. We can achieve proppant placement through faster pumping, which achieves more velocity to allow low-viscosity water to carry the proppant downhole to its desired location.

Additionally, Liberty's advanced pumping system employs commodity chemicals commonly found under household sinks, replacing the proprietary chemicals used in the past. This approach lowers the cost of placing a pound of proppant downhole and ensures we use the best available products.





GreenSelect℠ Hazard Scoring

Liberty's GreenSelect program uses a chemical hazard scoring system for each of our products. This system incorporates a product's complete Globally Harmonized System of Classification and Labeling of Chemicals (GHS) classification, transport classification, and hazardous disposal information to generate a numerical score.

The GHS, developed by the United Nations and adopted globally, categorizes hazards into health, physical, and environmental aspects, each with different severity levels from Category 1 (most severe) to Category 4 (least severe). Our hazard scoring system assigns a weighted numerical score based on these categories, considering a product's transport classification and hazardous disposal information.

We diligently gather all relevant information to facilitate this process in collaboration with our chemical vendors. The resulting GreenSelect score for each product serves as a valuable tool for both us and our customers, aiding in the selection of safer and more environmentally friendly products for use in oilfield applications.

Good Chemistry Makes for Good Neighbors

Liberty is a leader in reducing the cost of placing proppant downhole, driven by efficiency gains and considerations of well economics. This initiative has resulted in cost savings and paved the way for cleaner and safer alternatives. Liberty's commitment started on day one in North Dakota's Williston Basin, where we. Liberty was the first company to advocate for slickwater-based frac jobs, now standard practice in the Williston Basin and other basins nationwide.

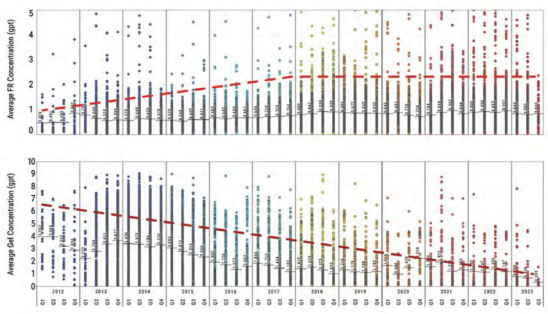
In Colorado's DJ Basin, Liberty's arrival was crucial in steering the industry away from the expensive, chemical-intensive frac fluid systems to simpler, cleaner alternatives. Our engineers and chemists have utilized advanced technologies, including flow-loops, oscillating rheometers, and mass spectrometers, combined with extensive knowledge, to enhance shale gas and oil production economics. This approach reduces costs while mitigating environmental impacts and risks.

Our industry's compliance with state and federal regulations, including the Safe Drinking Water Act, is paramount. The sector has been BTEX-free (no use of benzene, toluene, ethylbenzene, and xylenes) since the early 2000s, thanks to innovation and these regulations.

Frac Design Optimization

Liberty has built and rigorously maintains a database of over 100,000 wells across all major North American shale basins and the Western Canadian Sedimentary Basin. We began assembling this database right at the launch of Liberty to bring cutting-edge big data analytics to the Shale Revolution. Our proprietary FracTrends™ database, coupled with our expertise in advanced data analysis, gives us a unique understanding of what happens underground during a frac job and spots trends in the key drivers of oil and gas production. This analysis leads to efficiency on location while lowering the cost of producing a barrel of oil. Liberty is widely recognized as a leader in frac optimization, helping improve production economics while minimizing land surface disruption.

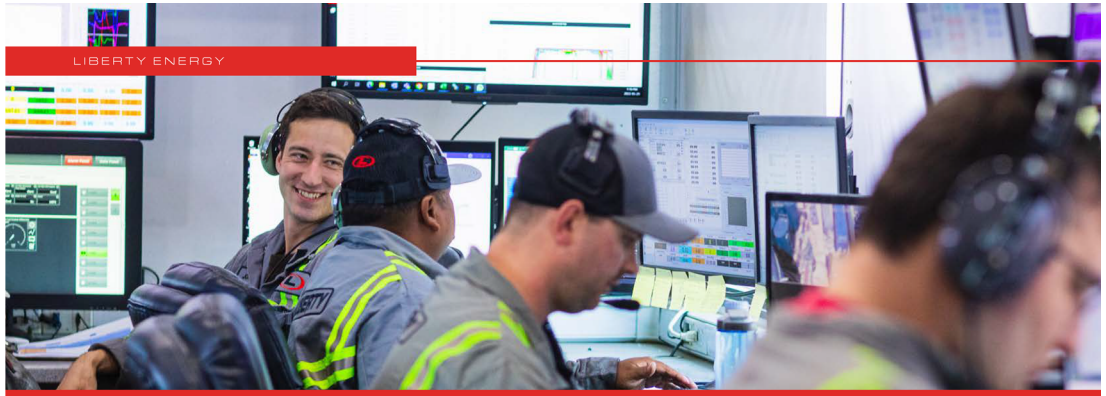
FR and Gel Use by Liberty 2012–2023



Water Use in Context

- 11,000 wells were hydraulically fractured in 2022 in the United States, using an average of 61.3 acre-feet per well.
- Total water use for hydraulic fracturing is about 670,000 acre-feet. That is 0.17% of all U.S. water consumption; 15,000 U.S. golf courses combined use 2.5 times more water than hydraulic fracturing.
- Irrigation consumes the most U.S. water, at 84 million acre-feet —140 times the amount used for hydraulic fracturing.
- Liberty's frac jobs in Texas use 27% recycled water, based on Liberty's tracking of the origin of the water source.
- Combusting a gallon of oil produces more than a gallon of new water. Thus, the overall water balance of fracking is water-positive after the end product's use.
- Over its productive lifespan, a shale well using 20 million gallons of water produces 50 million gallons of oil and 75 million gallons of new water in the form of water vapor during combustion that is returned to the water cycle via rain or condensation.
- The energy derived from hydraulically fractured wells creates 58% of America's energy production, serving the needs of 193.3 million Americans — using only 0.17% of U.S. water!

Since 2011, the industry has disclosed the composition of every pound and gallon in the FracFocus database, which is accessible to the public. Liberty welcomes these disclosures and uses this data in our FracTrends frac-optimization database.



PEOPLE & CULTURE

Safety & Training | Amplifying Employee Voices | Community Engagement







People & Culture

At Liberty, we anchor our unwavering commitment to excellence with our guiding philosophy: Consistently embed our values in our operations. We embrace innovation, diversity, and progressive practices to create a positive impact within our organization and the broader community. This philosophy is the bedrock upon which we build our actions, decisions, and interactions. It reflects our core values in all that we do. We do more than adopt our values; we integrate them into our day-to-day operations.

We recognize that Liberty's team members are the heart and soul of our success. We know there is a direct correlation between employee satisfaction and long-term commitment. We have built a culture of dedication, loyalty, and consistent growth by fostering an environment prioritizing the well-being of our workforce and their families. Bettering human lives starts with those in the Liberty family. A happy workforce translates into a driven team that delivers exceptional service quality, leading to heightened customer satisfaction, safer operations, and lasting relationships.

Safety & Training

Liberty views safety as a collective responsibility. We are proud to maintain a culture in which all team members know others have their back — whether in the field, shop, or office. The results are evident in that it is twice as safe to work at Liberty versus our industry.

Comprehensive training, often in a team environment, helps ensure that the Liberty team can adeptly navigate the intricacies of day-to-day operations. Liberty works to continuously evaluate and expand our health, safety, and training programs. These efforts include improving alignment with our customers and vendors through ongoing communication and participating in industry working groups to share best practices.

"If I can do my part, to make sure my guys go home, get to hold their kids, kiss their wives, see their moms — whatever it is they do when they leave here, safety is our highest priority."

- Brian Fields, Field Safety Representative, Haynesville district



Balancing Data with Human Factors

Our culture is, and always will be, people first. In an increasingly digitized world, we stay on top of technological advancements while maintaining the human touch. We expanded our ability to collect and analyze safety trends by implementing our Behavior Observation Card (BOC) app, which simplifies reporting of potential hazards, unsafe behaviors, and safe behaviors.

While this data provides valuable and actionable insight, we carefully avoid allowing it to supersede the human element of our work. Our field safety representatives maintain routine communication with their crews, working to ensure everyone adheres to our procedures and the highest safety standards.

- Positive acknowledgment of employees.
- Direct notification of hazards.
- Tracking of serious injury and fatality (SIF) and potential SIF events to identify, mitigate, and prevent life-altering injuries and fatalities.

Safety Top 10

Liberty emphasizes a commonsense approach to safety. Over the last year, we have analyzed our internal data, spoken with our crews, and identified 10 core concepts that positively impact our culture of safety. The Liberty Top 10 campaign, deployed across our operations, establishes simple, clear, and actionable directives that align with our belief that keeping it simple keeps it safe.

01. Eyes on Path – Watch for slips, trips, and falls.
02. Proper PPE for the Task – Use your last line of defense.
03. Situational Awareness – Keep your head on a swivel.
04. Working at Heights – Tie off to safety harness every time.
05. Fit for Duty – Show up ready.
06. LOTO (Lock Out Tag Out) – Kill the energy.
07. Stop Work Authority – Trust your gut.
08. Drive Right – Follow the regulations.
09. Brother's Keeper – Keep an eye out for one another.
10. Proper Tool and Procedure for the Task – Take the time.

Training & Development

Liberty established its training program with a dual purpose: to prioritize hands-on training and ensure our team masters core competencies and to provide a pathway for career development.

Our training team immerses new employees in our distinctive culture, emphasizing the paramount importance of safety and competency. Liberty has designed a structured career path and assembled comprehensive training materials, equipping team members with the skills to excel and to ensure a safe and competent work environment.

Selected Training Offered at Liberty

- AFEX system training for operations
- Access to employee exposure and medical records
- Basic SafeLand Training
- Bloodborne pathogens
- CMV driver basics
- CMV pre/post-trip
- CPR/first aid/AED
- Explosives Awareness Level 1
- Fit test respiratory protection
- Forklift training
- Hazard communications
- Hazards materials handling general awareness and security awareness
- Hot work
- Hours of service
- H2S awareness training
- Loads securement
- Lock-out tag-out training
- Manlift training
- Portable fire extinguishers
- Pressure Awareness Level 1
- Radiation Awareness
- Telehandler forklift
- Drug and alcohol policies
- Working in extreme temperatures
- FSU Training
- Fire Theory and Elements of Fire Training
- Behavior-Based Safety/ Human Performance Using Behavior Observation Cards
- SAMSARA / Driving

Liberty Offers Over 400 Individual Trainings Through Our Training Department

Samsara Partnership

- Our partnership with Samsara gave us a single solution to unify our processes, capture accurate data in real-time, and ensure the safety of our distributed teams.
- Together, we created an application programming interface (API) to build 24/7 driver record, allowing us to provide coaching and monitor drivers across our operations.
- We can understand and predict risk to keep everyone as safe as possible while on the road.
- Able to identify and support drivers with training, ensuring that we are targeting the right tools for their jobs.
- We leverage Samsara's data to optimize our routes, resulting in a 25% reduction in fuel usage across our on-road fleets.
- Using Samsara's AI Dash Cams has resulted in a 50% reduction in vehicle accidents!

Evolution of the Fire Suppression System

- Redesigned skids that are effective and easy to use, essential in responding quickly.
- Our units rely on non-carcinogenic, environmentally safe foam to protect our employees, the communities where we operate, and the environment.
- Our Armor unit is mounted in a trailer for quick access and easy deployment on location.
- There are two fire suppression units on each supported Liberty fleet.

In 2023, our Total Recordable Incident Rate (TRIR) was 2x better than the industry average.



Leading Liberty

Liberty believes in the quality of our people. We focus on development and promotion from within, fostering a highly passionate and dedicated workforce. As employees grow into leadership roles, they require additional skills and support to contribute to the success of their colleagues and teams. To set our leaders up for success, we built a course that addresses the unique challenges these employees face. The Leading Liberty program works hand in hand with our Training Department to provide a course structure that equips new and long-term leaders with the skills and tools they need to thrive.

Classes in the Leading Liberty program invite a range of employees from Crew Lead level up through our executive team to come together as peers. Courses cover various topics: how to transition into a leadership role, tips on working with different personality types, and implementing conflict management skills. The program teaches that leadership is a journey, not a destination, and that we must constantly evaluate and reflect on ourselves as leaders. As of publication, 81% of Liberty leadership have participated in the Leading Liberty program.

The Leading Liberty program remains dedicated to its mission to add value to its participants through continued support and engagement.

"Leading Liberty taught me new skills to apply in all aspects of my life. Strong leadership and integrity are a necessity for success for myself and my team."

- Stephanie Vossler,
Senior Manager of Financial Reporting



Amplifying Employee Voices

We pride ourselves in building a workplace where everyone feels heard, respected, and included. Our commitment to our employees includes ensuring everyone can contribute to and shape their futures, Liberty's future, and our customers' futures.

Liberty believes a diverse workforce is more than beneficial— it is essential. We enrich our collective knowledge, creativity, and problem-solving capabilities by welcoming individuals from various backgrounds, perspectives, and experiences.

Liberty's community culture empowers each team member to help shape our narrative and values, regardless of background, ensuring that everyone has the chance to rise, innovate, and lead.

Women of Inspiration Series:

Our Women of Inspiration series was launched in 2022. To date, we have welcomed six unique guests, providing valuable insight from diverse voices within our community. This program will continue to offer encouragement and support to help our team flourish.

Support for Liberty Families:

On day one, every employee – and their families - has access to our full suite of benefits, a robust network of spouses to offer support, and opportunities to meet other Liberty families in their districts. Unique to Liberty, our spouse network is built and managed by Liberty families and provides the relationships and networking that connect the broader Liberty family.

Flexible Work Schedules:

Liberty offers a flexible work schedule for our non-rotational employees. We base these schedules on practicality and business needs at each location. Our rotational employees work a schedule that is two weeks on and two weeks off, which is dramatically more family-friendly than our industry's typical schedule of two weeks on and one week off.

A Family-First Approach to Benefits:

At Liberty Energy, our unique approach to benefits goes beyond providing traditional offerings focused solely on the employee. We recognize that the well-being of team members directly correlates with the health and happiness of their families, who are no less important than our employees.

As part of our commitment to the families of our team members, Liberty proudly offers comprehensive medical, dental, vision, and supplemental coverage. And, true to style, we have gone above and beyond to make an impact on our families' lives.

A few examples include:

- The Wellness Rewards Program offered through our Liberty Mobile App and used by 76% of Liberty employees.
- Heart Health Monitoring and digital coaching that drives lifestyle change in the field and at home.
- Legal Plans that allow convenient and affordable legal protection for life's big and small moments.
- Direct contact with the Benefits Team through our Mobile App for employees, spouses, and dependents during crisis or life events.
- Dedicated HR Rep for each basin, 24-hour, or less, response time.
- Childcare benefits through Bright Horizons, with local options for employees.

Our family-first approach to benefits is a compassionate and responsible choice. We want every employee to know that they matter, their family matters, and we are here to support them.

44% of employees are minorities

Our corporate offices are 39% women, with 22% of our management roles held by women

Over 300 internal promotions in 2023

Veterans make up 11% of our workforce

Community Engagement

Liberty's passion for our communities began in 2011 when we chose our name. We believe everyone should have Liberty — the freedom to pursue their dreams without barriers. To support that mission, we established three pillars of outreach that are now ingrained in our company culture: education, alleviating poverty, and military services. We have built lasting and impactful partnerships with organizations to support our shared passion for creating opportunity and meaningful change in our world.

We feature three organizations in this publication: Montana Tech University, ACE Scholarships, and the Permian Basin Strategic Partnership. All three of these partnerships have been built and cultivated throughout the years and will continue to impact Liberty and our communities well into the future.







Montana Tech

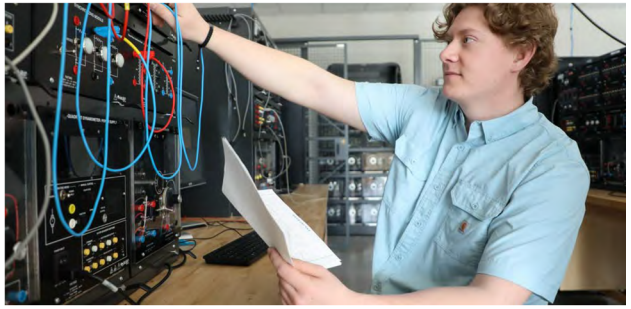
MONTANA TECHNOLOGICAL UNIVERSITY

As an organization committed to promoting education and empowering students, Liberty established a scholarship program in 2020 at Montana Tech University. The Liberty Scholars program recognizes and supports low-income high school students who demonstrate exemplary academic achievements, leadership qualities, and a passion for advancing in science, engineering, and technology. This scholarship provides financial assistance to deserving individuals and fosters a community of scholars dedicated to making meaningful contributions to the world around them. With Liberty's generous support, the scholarship ensures that talented students at Montana Tech have the opportunity to pursue their dreams of higher education. Since the program's inception, Liberty has bettered the lives of 31 students through our donation of $200,000.

"The program is providing opportunities for students who would have never considered education as an option. We couldn't be more grateful for Liberty's support and the difference they are making in the lives of our students."

- Les Cook, Montana Tech Chancellor









ACE Scholarships

ACE Scholarships is Liberty's longest community partner. Our mission, to better human lives, aligns with ACE. At Liberty we believe that there is no greater return than investing in children's futures, leading to our 11-year partnership with ACE.

ACE Scholarships was founded in Colorado in 2000 to help low-income parents provide a better education for their children. Their mission is twofold: provide children of these families with scholarships to private schools in grades K-12 and advocate for expanded school choice.

Throughout the years, Liberty has proudly provided 770 scholarships and donated over $1.9 million to ACE. In addition to monetary donations, we are avid supporters of ACE Annual Luncheons to help spread their vision and mission to our many customers. Liberty has had the honor of hiring many ACE graduates in internship and full-time employment roles.

"Kids like me can still achieve the American dream because of people like you. For any of you who have given to ACE Scholarships in the past to allow me and my siblings to get a good education, you are the unsung heroes"

- David Banda, ACE Alumnus

Permian Basin Strategic Partnership

In 2023, Liberty joined the Permian Strategic Partnership (PSP), a coalition of energy companies and academic institutions collaboratively addressing the evolving challenges of the Permian Basin in Texas and New Mexico. The Permian Basin Strategic Partnership focuses on education, healthcare, housing, workforce development, and road safety — all issues that Liberty cares about deeply.

Liberty invests in communities where our employees work and live, and there is no better vehicle to make a difference than the Permian Basin Strategic Partnership. Liberty is committed to an annual contribution of $1 million dollars for five years. Members of the partnership pool funds together to address issues that maximize the community's benefit. This partnership shows the unique characteristic of our industry with our ability to stand beside our customers, competitors, and suppliers for noble causes. Through dedicated efforts across the region, the PSP has leveraged over $145 million in member company contributions into more than $1 billion in community investments throughout the region.

"Liberty exemplifies the Permian Basin Strategic Partnership's dedication to innovation and community focus. With a shared dedication, we join forces to improve lives in the Permian Basin. We are fortunate to have Liberty's thought leadership and transformative efforts as invaluable assets in our partnership."

- Tracee Bentley, President and CEO of the Permian Strategic Partnership






163
LIBERTY



RESULTS WITH INTEGRITY

Corporate Governance | Business & Regulatory Affairs | Cybersecurity | Metrics & Disclosures







Corporate Governance

Liberty is committed to operating our business with integrity and in a manner aligned with the long-term interests of our stakeholders. Good governance principles fortify our commitment to acting ethically, thoughtfully, and responsibly in pursuing value creation. As we work to support societal needs for reliable and affordable energy, our team continually finds ways to enhance our service offerings and deliver value. Our dedication to economic, environmental, and societal leadership and performance is an integral part of our corporate strategy. This has led to a track record of strong cash returns over the lifespan of our company. The Liberty Board of Directors provides independent judgment that strengthens accountability, promotes the long-term interests of our shareholders, and builds public trust in our company. Our senior management team further utilizes sound governance practices to ensure we manage our risks and opportunities toward the continued vitality and sustainability of our business in a responsible, transparent, and ethical manner.

Board of Directors

Liberty Board of Directors have a unique set of leadership experiences and perspectives that foster productive dialogue and decision-making when conducting strategic and oversight responsibilities. Our board has adopted Corporate Governance Guidelines aligned with New York Stock Exchange (NYSE) rules within which our board and committees operate. This includes practices and policies that relate to the board's structure and composition, membership criteria and qualifications, director responsibilities, evaluation of management and succession planning, and interaction with external constituencies. We regularly assess our governance principles to ensure they effectively support a culture of high ethical standards.

Through its ongoing guidance, the board protects the interests of our shareholders and believes those interests are best served by combining the roles of chairman and CEO with a strong and independent lead director. Our board believes a combined chairman and CEO role allows the company to execute its strategy more effectively, especially where our chairman's deep industry expertise, technical leadership, and company knowledge can be leveraged in a cyclical industry. The combined chair and CEO role, coupled with a strong and independent lead director, has enabled the board to respond to challenges and opportunities as they continue to arise. Liberty is fortunate to have William Kimble serving as the lead director. The lead director has many critical duties, including conferring with the chair on board agendas, serving as a liaison between the chair and non-management directors, and presiding at executive sessions of non-management directors and other board meetings at which the chairman is not present. Our board believes that this structure, combined with our corporate governance policies and processes, creates an appropriate balance between strong and consistent leadership and independent business oversight.

7 of 9 independent board of directors

4 female or ethnically diverse directors

The board met formally 6 times in 2022 and 5 times in 2023.

Adopted incentive compensation recovery policy, director resignation policy and stock ownership guidelines for officers and non-employee directors

All board committees are comprised entirely of independent directors



Audit Committee

The Audit Committee oversees, reviews, acts on, and reports on various auditing and accounting matters to our board. Those include ensuring the integrity of our financial statements, compliance with legal and regulatory requirements, independent auditor's qualifications and independence, and effective performance of our internal audit function and independent auditors

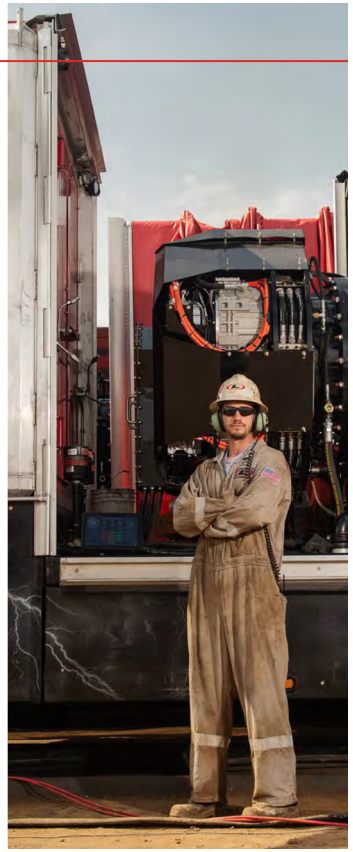
Compensation Committee

Our Compensation Committee assists our Board in establishing salaries, incentives, and other forms of compensation for officers and other employees. Our Compensation Committee also assists the board with the administration and oversight of incentive compensation and benefit plans, incentive compensation recovery policy, and stock ownership guidelines.

Nominating & Governance Committee

Our Nominating and Governance Committee oversees our corporate governance framework, including identifying, evaluating, and recommending qualified nominees to serve on our board, succession planning for senior management, evaluating director independence, continuing education for directors, and leading the annual performance evaluation process of the board and committees and senior management.

The board provides robust oversight through three fully independent committees: Audit, Compensation, and Nominating and Governance. William Kimble, Peter Dea, and Gale Norton are chairpersons for the respective committees. Each director has a background particularly relevant to the committee's oversight. The diversity of perspectives thought leadership, skills and industry experience, and personal background, including gender, of our directors is a strength. Increasing board diversity remains an ongoing emphasis at Liberty. Our board includes two female directors, two ethnically diverse directors, and directors from a wide variety of backgrounds in technology, energy, public policy, finance and accounting, and international business. Liberty maintains an independent board in adherence with NYSE rules and our Corporate Governance Guidelines, with seven of our nine directors meeting the qualifications of independence. All directors are serving staggered three-year terms. Our director resignation policy provides for majority voting in uncontested director elections.





Bettering Human Lives is Foundational to Our Business

Liberty believes that access to life-enhancing modern energy presents the most pressing global energy challenge. The Liberty team works passionately to better the process of bringing hydrocarbons to the surface in a clean, safe, and efficient fashion. Liberty views environmental, social and governance principles as foundational to our success. The board and its committees provide oversight of risks and opportunities associated with the company's ESG initiatives, with ongoing review of matters and challenges by the full board at each regular board meeting. Various aspects of our mission to better human lives are managed in board committees depending on the topics, including technology innovation, human capital management, and enterprise risk management. The board assesses investment decisions through the lens of risk and opportunities.

At the heart of investment is whether the deployment of capital resources towards new or leading-edge technology, mergers, acquisitions, and other areas aids the company's ability to maintain top-tier service and efficiency for our customers while mitigating any adverse environmental impacts of our business. Liberty is uniquely positioned to take a leadership role with continuous innovation and investment in subsurface engineering and equipment design and optimization, which improves operational efficiency and reduces emissions. Of note, our digiFrac electric fleet investment, coupled with technological upgrades to dual fuel equipment, allows customers to choose what works best for them. These technologies serve the dual purpose of lowering emissions and providing fuel cost savings, thus a more economically viable opportunity for customers to pursue environmental benefits while efficiently providing the world critical energy resources.

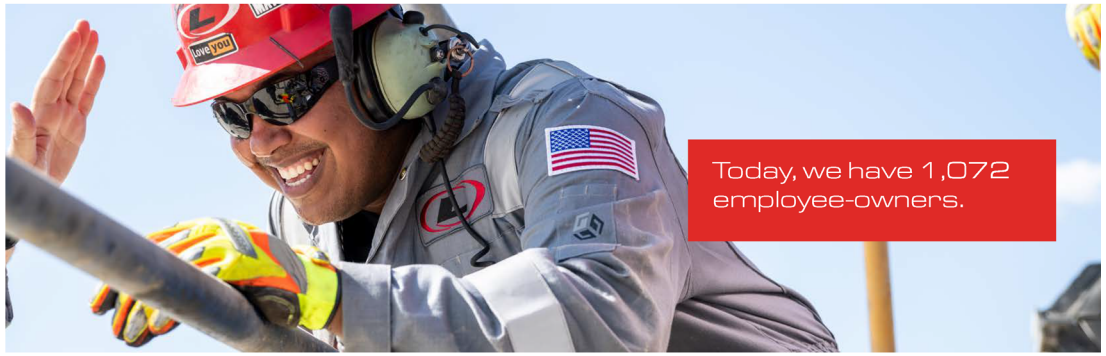
Leadership Accountability: Pay For Performance

The Liberty team has been aligned with shareholders since our founding. Our pay-for-performance compensation philosophy strategically uses incentives that align employee behaviors with their responsibilities to drive better business outcomes. This persists across all areas of the company, from our employees in the field managing efficiency and safety, to our sales team's ability to improve profitability. At the helm, our executive team has a compensation program with a high percentage of variable compensation designed to align with the long-term interests of the company and our shareholders. Incentive compensation includes a focus on pre-tax earnings per share, pre-tax return on capital employed (ROCE), and adjusted ROCE benchmarked against a peer group and the broader marketplace. Our peer group includes the S&P 500 and the OSX. Measuring our results against the broader market enhances our commitment to meeting shareholder priorities. The Compensation Committee reviews shareholder votes and feedback to ensure executive compensation programs align with their interests on an ongoing basis. Additional details on our executive compensation program are available in our 2023 proxy statement.

Our executive officers and non-employee directors are subject to stock ownership guidelines intended to foster equity ownership and align interests with shareholders. Under the guidelines, officers and directors are expected to beneficially own shares having a value based on a multiple of their base salary or cash retainer, as applicable, ranging from two to six times within five years of serving in such position, and to maintain that ownership level for the duration of their service.

Business Ethics

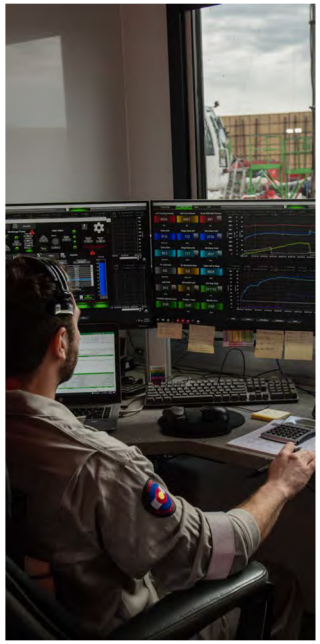
Liberty thrives with robust partnerships that we have cultivated with our customers, suppliers, and communities over the years. The basis of these relationships includes a strong sense of business ethics that underscores the reputation and trust we have built with all our stakeholders. Our Corporate Code of Business Conduct and Ethics (Code) and our Financial Code of Ethics set the stage for how we operate our business by establishing expectations for our team to maintain high integrity, ethical standards, and compliance with all legal requirements. Liberty's Code includes topics ranging from conflicts of interest, employee practices, and compliance with applicable laws. We require annual employee commitments to the Code, acknowledging an understanding of our key policies. This includes a strict policy against improper payments or gifts from the company that benefit any government, labor union, customer, or supplier. Doing so guards against corruption and bribery across the supply chain. To protect the company, Liberty has an anonymous whistleblower hotline, found on its website, and encourages employees and members of the public to report suspicious conduct. Liberty prohibits retaliation for good faith reporting of violations. All reports are investigated, including those of retaliation.



Risk Oversight

At the core of our business is leading-edge innovation and technology, which often involves measured risks. Risk assessment and oversight are integral to our governance and management processes. Our board is responsible for monitoring and assessing strategic risk exposure and providing oversight of risk management with the assistance of the Audit Committee. The board encourages management to promote a culture incorporating risk management into our corporate strategy and day-to-day operations. Liberty management discusses strategic and operational risks at regular management meetings and conducts specific strategic sessions during the year, which include a focused discussion and analysis of material, operational, and financial risks.

The company also conducts a comprehensive risk management session with the executive leadership team regularly. Liberty includes the help of outside consultants, where key risks are identified, prioritized, and documented with mitigation strategies assigned to the appropriate risk owner. Throughout the year, senior management reviews risks with the Audit Committee and board and acts to mitigate or eliminate such risks. These ongoing discussions assist us with identifying, monitoring, and controlling or mitigating exposures, providing assurance that the risks we take are consistent with the board's risk tolerance. For a comprehensive discussion of material risks Liberty has identified, please refer to our filing with the Securities and Exchange Commission, including our most recent Annual Report on Form 10-K.



Cybersecurity & Data Protection

At Liberty Energy, safeguarding our systems, networks, applications, and data is paramount, especially as cyber threats are becoming more frequent and sophisticated. Recognizing this, Liberty Energy is committed to continuously enhancing our cybersecurity practices, protocols, and standards to stay ahead of emerging risks and evolving requirements.

Advancing Cybersecurity Practices

Liberty Energy adheres to a rigorous cybersecurity framework, aligning with top-tier standards like those from the National Institute of Standards and Technology (NIST) and the Center for Internet Security (CIS). Enhancing this framework, our strategy includes regular evaluations by independent assessors, ensuring compliance and proactiveness in identifying and addressing vulnerabilities. This approach follows industry benchmarks and also incorporates third-party auditing, providing an objective assessment of our cybersecurity readiness and effectiveness. Through these measures, Liberty Energy maintains a dynamic defense posture, consistently fortified against evolving cyber threats.

Innovative Security Strategies

Our cybersecurity strategy incorporates advanced practices such as "Defense in Depth" and "Zero Trust" models. These strategies are designed to fortify and protect our computing assets, networks, data, and user access against potential breaches. We employ strong endpoint protection and network, cloud, and mobile security, coupled with effective threat detection and incident response mechanisms. Regular external penetration testing and continuous evaluation of our security protocols keep our defenses robust and responsive.

Empowering Our Workforce

Understanding that human factors play a crucial role in cybersecurity, Liberty Energy provides comprehensive annual training for all personnel with access to company systems. This training focuses on information security best practices and adherence to company policies. We also conduct regular phishing simulation campaigns and provide additional security awareness training in high-risk areas.

Staying Ahead of the Curve

Liberty Energy proactively monitors the dark web and employs advanced cybersecurity strategies to identify and mitigate threats, ensuring operational resilience. Their approach includes sophisticated dark web surveillance integrated into their broader digital risk protection and incident response planning. Liberty Energy actively monitors sources such as the Microsoft Security Response Center, InfraGard, US-CERT, and CISA for the latest data security guidance. This vigilance allows us to adapt to emerging threats swiftly, maintain data security and system integrity, and align our practices with the latest standards from NIST and CIS. By utilizing these comprehensive cybersecurity measures, Liberty Energy remains equipped to handle disruptions and maintain continuous operations.

Cybersecurity

Our commitment to cybersecurity is part of a broader focus on operational resilience. Liberty Energy has developed and rigorously tested plans to ensure the continuity of our operations in various crisis scenarios. Our swift and effective response to disasters and incidents, transitioning to a fully operational remote workforce within days, is a testament to our preparedness and adaptability.

Investing in Digital Infrastructure

In Liberty Energy's strategic governance, a key focus is on building a resilient digital framework. By adopting a 'Cloud First' policy and collaborating with leading cloud service providers, Liberty has developed a geographically diversified and redundant infrastructure. This design is crucial in ensuring Liberty's preparedness for supporting alternative operational sites in the event of disasters or disruptions. Additionally, the segmentation of Liberty's technology infrastructure plays a pivotal role in isolating and managing any threats or downtime scenarios, enhancing the company's ability to maintain continuous operations under various conditions.

In summary, the governance aspect of our Bettering Human Lives mission report highlights Liberty Energy's comprehensive approach to cybersecurity and data protection. Our strategies, encompassing advanced technology, skilled personnel, and strategic partnerships, demonstrate our commitment to maintaining the highest cybersecurity and operational resilience standards. This commitment is a testament to our dedication to responsible governance and protecting our stakeholders' interests.

Employee Ownership

Liberty takes pride in fostering an entrepreneurial workplace where employees have the autonomy to take ownership of their work and grow professionally. Some 19 percent, more than one thousand, of our team members are employee-owners. As a part of our professional development and annual goal setting for our team, Liberty offers restricted stock units to attract, engage, retain, and reward our employees while further aligning their interests with our public shareholders. Employee ownership connects our employees' work to Liberty's strategic decisions, supporting both our long-term business model and our people.

Business & Regulatory Affairs

At Liberty, our success intertwines with that of our customers. This means close collaboration with our customers and industry allies and active participation in legislative and regulatory procedures via workgroups and trade associations. The alliances we have built extend far beyond our physical borders, with the entire Liberty family serving as staunch advocates for the industry — wherever they live.

We are committed to the idea that through concerted effort and transparent dialogue, we can advocate for policies prioritizing health and safety while sustaining our industry's ability to deliver the affordable energy we all rely on.



























Key Metrics & Disclosures

FORWARD LOOKING STATEMENT

In order to utilize the 'safe harbor' provisions of the United States Private Securities Litigation Reform Act of 1995 and the general doctrine of cautionary statements, Liberty is providing the following cautionary statement. This report contains certain forecasts, projections, and forward-looking statements – that is, statements related to future, not past events and circumstances with respect to the financial condition, results of operations and businesses of Liberty and certain of the plans and objectives of Liberty with respect to these items. For this purpose, any statement that is not a statement of historical fact should be considered a forward-looking statement. These statements may generally, but not always, be identified by the use of words such as 'will', 'expects', 'is expected to', 'aims', 'should', 'may', 'objective', 'is likely to', 'intends', 'believes', 'anticipates', 'plans', 'we see' or similar expressions; however, the absence of these words does not mean that the statements are not forward-looking. These forward-looking statements are subject to certain risks, uncertainties, and assumptions, including those disclosed from time to time in Liberty's filings with the Securities and Exchange Commission (the "SEC"). As a result of these factors, actual results may differ materially from those indicated or implied by such forward-looking statements. Any forward-looking statement speaks only as of the date on which it is made, and, except as required by law, we do not undertake any obligation to update or revise any forward-looking statement, whether as a result of new information, future events or otherwise. New factors emerge from time to time, and it is not possible for us to predict all such factors. When considering these forward-looking statements, you should keep in mind the risk factors and other cautionary statements in "Item 1A. Risk Factors" included in Liberty's latest Annual Report on Form 10-K and in our other public filings with the SEC. All forward-looking statements, expressed or implied, included in this report are expressly qualified in their entirety by this cautionary statement. This cautionary statement should also be considered in connection with any subsequent written or oral forward-looking statements that we or persons acting on our behalf may issue.

Sustainability Accounting Standards Board (SASB) Index

TOPIC	ACCOUNTING METRIC	2021	2022	2023
Emissions Reduction Services and Fuels Management	Total fuel consumed, percentage renewable, percentage used in: (1) on-road equipment and vehicles and (2) off-road equipment	Off-road: 20,271,760 GJ On-road: 604,165 GJ	Off road GJ: 26,863,499, On Road GJ: 709,379	Off-road GJ: 32,099,769, On-Road 848,736.82 GJ
	Discussion of strategy or plans to address air emissions-related risks, opportunities, and Discussion of strategy or plans to address air emissions-related risks, opportunities, and impacts	Environmental Performance, Frac Engines		Delivering Superior Service
	Percentage of engines in service that meet Tier 4 compliance for non-road diesel engine emissions	21%	21%	20%
	Scope 1 Greenhouse Gas Emissions ($MTCO_2e$) calculated in accordance with GHG Protocol	1,427,200 ($MTCO_2e$)	1,995,196 ($MTCO_2e$)	2,329,847 ($MTCO_2e$)
Water Management Services	(1) Total volume of fresh water handled in operations, (2) percentage recycled		(1) 124,500,375.2 m3, (2) 20%	(1) 147,400,009 m3, (2) 15.8%
	Discussion of strategy or plans to address water consumption and disposal-related risks, opportunities, and impacts	Water		Chemistry, Engineering, Water Use in Context
Chemicals Management	Volume of hydraulic fracturing fluid used, percentage hazardous	98,063,510 m3 of frac fluid slurry (includes sand volumes); 0.076% hazardous chemicals	131,545,232 m3 pf frac fluid slurry (includes sand volumes); 0.075% hazardous chemicals	155,273,040 m3 of frac fluid slurry (includes sand volumes); 0.071% hazardous chemicals
	Discussion of strategy or plans to address chemical-related risks, opportunities, and impacts	Frac Fluid Chemistry		Chemistry, Engineering, Water Use in Context
Ecological Impact Management	Average disturbed acreage per (1) oil and (2) gas well site			Energy, See footnote
	Discussion of strategy or plan to address risks and opportunities related to ecological impacts from core activities	Ecological Impact		Energy

Workforce Health & Safety	(1) Total recordable incident rate (TRIR), (2) fatality rate, (3) near miss frequency rate (NMFR), (4) total vehicle incident rate (TVIR), and (5) average hours of health, safety, and emergency response training for (a) full-time employees, (b) contract employees, and (c) short-service employees	(1) TRIR .51 (2) Fatality rate 0.0 (3) NMFR 1.76 (4) TVIR 6.16 (5a) 18.3 (5b)not relevant (5c) not relevant	(1) TRIR .89 (2) Fatality Rate .032 (3) NMFR .36 (4) TVIR 5.91 (5a) 19.15 (5b)not relevant (5c) not relevant	(1) TRIR .49 (2) 0.0 (3) NMFR .22 (4) TVIR 3.12 (5a) 28.7 (5b)not relevant (5c) not relevant
	Description of management systems used to integrate a culture of safety throughout the value chain and project lifecycle			Safety
Business Ethics & Payments Transparency	Amount of net revenue in countries that have the 20 lowest rankings in Transparency International's Corruption Perception Index			See footnote
	Description of the management system for prevention of corruption and bribery throughout the value chain			Results with Integrity
Management of the Legal & Regulatory Environment	Discussion of corporate positions related to government regulations and/or policy proposals that address environmental and social factors affecting the industry			Results with Integrity
Critical Incident Risk Management	Description of management systems used to identify and mitigate catastrophic and tail-end risks			Results with Integrity

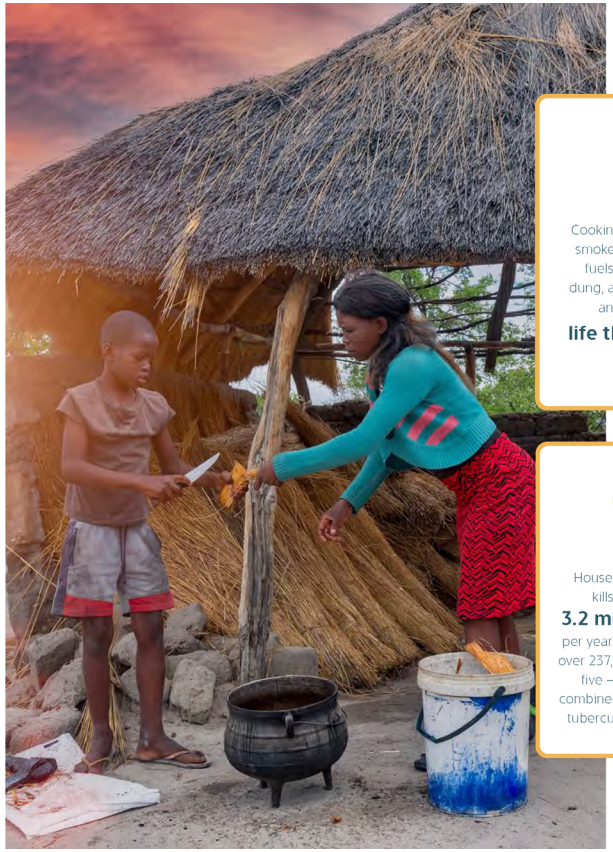
ACTIVITY METRIC	UNIT OF MEASURE	2021	2022	2023
Number of active rig sites	Quantitative			See footnote
Number of active well sites	Quantitative			See footnote
Total amount of drilling performed	Quantitative			See footnote
Total number of hours worked by all employees	Quantitative	9,797,096 hours	9,425,456.09 hours	12,043,579 hours

1. Ecological Impact Management was deemed not applicable, as management of disturbed acreage per oil and gas wellsite is outside of Liberty's operational control.

2. Liberty does not operate in any countries that fall within the 20 lowest rankings in Transparency International's Corruption Perception Index.

3. Number of active rigsites, number of active wellsites, and total amount of drilling performed are not relevant to the Liberty's operational control, and have been omitted.

Find our full list of sources and view the report online at:
https://libertyenergy.com/esg/bettering-human-lives/



Cooking amidst harmful smoke from traditional fuels such as wood, dung, agricultural waste, and charcoal is **life threatening.**

Worldwide, **2.3 billion people** — predominately women and girls — cook today using these harmful fuels.

Household air pollution kills an estimated **3.2 million people** per year. In 2020 it claimed over 237,000 children under five — more than the combined annual toll of HIV, tuberculosis, and malaria.

Gathering fuel and cooking over inefficient, polluting stoves **consumes considerable time** for women and children, preventing them from pursuing education and other productive activities.

Bettering
Human Lives
Foundation

OUR MISSION

We believe in the power of clean cooking to transform lives.

One-third of humanity prepares meals over open fires or polluting stoves, contributing to premature death and limiting human potential. The Bettering Human Lives Foundation aims to increase access to clean cooking fuels by directly supporting local innovators and entrepreneurs to start and grow their businesses. Together, we are committed to providing families with a pathway out of poverty through access to modern energy that betters human lives.

DONATE TODAY

BetteringHumanLives.org


Cover 3 of 3





The CHAIRMAN. It is something that brings what I regard as a pretty clear-headed perspective to the climate change dialogue, which I think has been sorely missing in our discussion of many of these issues. As with anything that we do, and basically everything that we build, there are trade-offs. In energy, there are trade-offs at the nexus of energy security, energy poverty, economic prosperity, upward mobility, and various environmental considerations. The U.S. Department of Energy can play a pivotal role, but unfortunately, during the Biden Administration, we have seen many levers within our system of government, including and especially the Department of Energy, being used as part of a "whole-of-government" approach to reduce greenhouse gas emissions, and doing this without considering the consequences of this kind of unbalanced approach. The trade-offs that I mentioned aren't really taken into consideration. It is one objective taken into account as part of a whole-of-government approach that has really harmed a lot of American families.

So how, in your view, can and should the Department of Energy focus on energy abundance, and how will doing that help to restore the balance that American energy policy has been lacking over the last four years?

Mr. WRIGHT. Thank you for the question, Senator, and for the points you made. Yes, energy is hard, but it is critical for our civilization and for the prosperity and security of our country. The Department of Energy—I will start with just the magnificent 17 national labs. You know, these launched during World War II, and were a key part of actually America winning that war and securing a post-war peace. Our labs have been pioneers in energy innovation across the spectrum. Very important for me is to keep the labs focused and energized to work on science—basic fundamental science, but also science that will someday, and maybe someday soon, have applications to energy. Our labs have a proud track record there, and I want to champion that. And the labs, and the Energy Department as a whole, work across the energy spectrum with reasonable involvement in virtually every meaningful energy source we have today.

So my mission would be to inspire people in the Department and in the labs and across the network to focus on what is most important for Americans, which is growing the supply of affordable, reliable, secure American energy.

The CHAIRMAN. Growing the supply. That is a novel and very important concept to grasp, especially in a moment when American energy demand is growing—growing because of our growing population, and also growing because of the ways in which we use energy, with data centers and artificial intelligence making a dent and about to make a much bigger dent in what it is that we need to energize our economy. It's a very poor time indeed to be declining in terms of our energy production relative to anticipated demand.

Well, it sounds like you grasp that fully and are ready to take that challenge on.

Mr. WRIGHT. Yes, sir. I agree with you, Senator, very much.

The CHAIRMAN. In an interim report that was released last month, the Department of Energy's Inspector General raised sev-

eral pretty serious concerns regarding potential conflicts of interest within the Department of Energy's Loan Programs Office. Those concerns include the troubling dual roles of some contractors who may be advising both the Loan Programs Office and potential loan recipients at the same time. The IG recommended that the issuance of new loans should perhaps be suspended until these potential conflicts are fully addressed and the safeguards necessary to correct them are implemented.

If you are confirmed, will you commit to following the Inspector General's recommendation and suspend the issuance of new loans until the Loan Programs Office compliance with conflicts of interest regulations and contractual obligations is guaranteed?

Mr. WRIGHT. If I have the privilege to be confirmed, I will immediately engage in that issue. Nothing is more important than the integrity of the loan process, of following the rule of law. Without integrity, without fair processes, you lose confidence, you undermine businesses' ability to invest and where capital is deployed to. I am aware of the report and will dive into that issue immediately.

The CHAIRMAN. Great.

My five minutes are expired. We will hear now from Senator Heinrich.

Senator HEINRICH. Thank you, Chairman.

Mr. Wright, I am going to start with a real easy one. Will you commit to visiting both Sandia and Los Alamos National Labs in your first year, if you are confirmed as Secretary?

Mr. WRIGHT. Thank you, Senator. I will absolutely commit to visit those two prestigious and hallowed institutions, and I would love to coordinate with your staff, and if at all possible, we could visit together.

Senator HEINRICH. Great.

Mr. WRIGHT. And I am a huge fan of those two institutions and look forward to walking their halls.

Senator HEINRICH. All right, I appreciate that very much.

I would like you to talk a little bit about your divestment plans. You do—and you mentioned it—a lot of work in the energy space, and we had a conversation about the need to maintain not only the avoidance of conflicts of interest, but also the avoidance of appearances of conflicts of interest. So can you talk a little bit about your plans for divestment?

Mr. WRIGHT. I agree with all of that, Senator. I have been a lifelong entrepreneur in the energy space. And of course, I have submitted my disclosures of all of my work and the appropriate ethics counselors within the Federal Government have——

[Protestor shouting.]

Mr. WRIGHT [continuing]. Appropriate ethics people have reviewed my investments, my personal holdings and other interests, and I have agreed to take all the appropriate action to avoid any real conflicts or perceived conflicts of interest. I am fully aligned with you there, Senator.

Senator HEINRICH. I appreciated your comments about the fidelity to the rule of law, and so I want to ask you a particular question, in part because the OMB nominee has stated his support for using executive impoundment of funds passed by Congress in order to achieve spending reductions. And so, I have a little bit of a two-

part question for you. As Secretary, if the OMB Director was to try to direct your Department not to fund a program or an activity that Congress had expressly appropriated funding for, would you follow the law?

Mr. WRIGHT. Thank you, Senator.

Yeah, my mission—the only way I roll—would be to follow the laws and statutes of the United States of America.

Senator HEINRICH. With respect to permitting, in the last Congress, this Committee actually advanced a comprehensive, all-of-the-above permitting bill by a vote of 15 to 4. That law was not signed into law because we have not reconciled it with the House, but I want to ask you—because included in that package were really important transmission reforms that would actually help us to meet the growing demand that we are seeing due to what is going on in artificial intelligence right now, the increased electrification of our economy, and an incredible bump in manufacturing that we have seen in the last couple of years—so, in your view, how important is it that transmission line permitting reform be included as part of any broader permitting reform that we may be able to achieve?

Mr. WRIGHT. Thanks for that question, Senator, and thanks also for the wonderful dialogue we had in your office. I appreciated that very much, and I know we have lots of overlaps—lots of common interests, lots of common concerns. And we have had roughly a hundred-year history in the United States of making electricity more affordable on inflation-adjusted terms and our grid more reliable, one of the engineering marvels of modern times. And as we discussed, we have seen that trend reverse, and in the last few years, we have seen electricity prices go up and the reliability of the grid go down, and both of us are very concerned about that, particularly as we are seeing future demand growth. And I agree with you entirely that being able to build new transmission lines, to be able to repower existing transmission lines, and grow their capacity and many other things, are very important to meet this growing demand for energy and hopefully return to a trend of a decline in the real cost of electricity and a growth in reliability. I am aligned with you there.

Senator HEINRICH. I am actually wearing my dad's IBEW 60-year pin today because it reminds me of the importance of that grid. DOE's Grid Deployment Office has supported a lot of really valuable projects through the Transmission Facilitation Program, including the Southline Transmission Project in my home state. These projects will save customers money and they increase grid reliability. Can you assure me, at a time when things like Project 2025 have proposed just eliminating the Grid Deployment Office, that DOE will continue to use its authorities and its resources to support the kind of transmission projects that increase reliability and save customers money?

Mr. WRIGHT. Senator, thank you for your dad's service in building our grid and maintaining it with a gorgeous track record all those years. And yes, I am aligned with you, and we will seek to find the best ways to improve our transmission grid, including expansion and new lines.

Senator HEINRICH. Thank you, Mr. Wright.

The CHAIRMAN. Senator Justice.

Senator JUSTICE. Well, thank you, Mr. Chairman, and thank you, Mr. Wright—Chris—and thank you to all his family. I mean, you being here is testimony to who you are, and that is really good stuff.

Now, I wish you happy birthday and I would like to tell everyone just a little bit about me. You know, I am the new kid on the block, that's for dadgum sure. I am not a politician. I am a business guy, and I am hung up on this—I am hung up on honor and truth and respect and reason and logic. And you will find that as you go forward with me.

Now, today, I tell you just this—I come from West Virginia, and West Virginia truly knows energy. That's all there is to it. And I would just tell you this, and I would promise you that this will be the case: energy is everything—everything. If we think less than that, we are thinking absolutely wrong. At the end of the day, every country in the world, the more energy they have, the healthier they are, the longer they live. Energy is every single everything. It's the key to inflation. It's the key to our defense. It's the dollars that fund the Russian war with Ukraine. It is every single thing, and absolutely, we have to solve this. We have to have a real energy strategy and we have to solve this. I have had many, many conversations with President Trump. He absolutely believes exactly just this.

So Chris, in the days ahead, you will have a task beyond belief, in my opinion. With all that being said, I know—I know—you will carry on that task in a great, great way. Now, listen, from West Virginia, you may think, you know, that all we can think about is one thing, and one thing alone. I would tell you just this—we need to embrace all the energy forms, but with that being said, the moment in time when you absolutely believe that we can do without fossil fuels in this world today, you are living in a cave. You are absolutely living in a cave, in my opinion. We don't need to blow our legs off so China or India can dominate in so many different ways. Absolutely, today, we need to solve the whole——

[Protester shouting.]

Senator JUSTICE. I would just tell you just this—I think that gentleman is misdirected in his thought, but with all that being said, I would always be respectful to that gentleman. And that's how we all ought to be.

So with all that being said, I would say just this to Chris: Chris, are you in a position of thinking of embracing all the energy forms, solving the whole riddle? And I will ask that question just in that way. So please answer.

Mr. WRIGHT. Senator, thank you for your question and your impassioned remarks. We share a passion for energy. And the reason I sit in front of you today is because President-elect Trump shares a passion for energy and an instinctual understanding that energy is not a sector of the economy, it's the sector of the economy that enables everything else we do. When I met him, he was just on fire about energy. He got how it impacts American quality of life, American economic strength, our geopolitical power, and what the possibilities are for the future, how we can make our children and grandchildren's lives so much better than ours. So I agree with you

100 percent. Energy is core. It is central. We want energy from all sources we can that can add to our pile of affordable, reliable, secure American energy.

Senator JUSTICE. Well, Chris, that pleases me, and I would just say just this—America has a big, big crisis right in front of them. If we don't solve this riddle in a year and a half from today, we will have a crisis like you can't imagine. With all that being said, we are sitting on the answer for America to be the footprint of the world, and we have to do it.

Mr. Chairman, I thank you so much for allowing me to speak, and Chris, I am positive you are going to be confirmed, and God bless each and every one of you for being here and your family, thank you so much.

Mr. WRIGHT. Thank you, Senator.

The CHAIRMAN. Thanks, Senator Justice.

Senator Cortez Masto.

Senator CORTEZ MASTO. Thank you, Mr. Chairman.

Let me, right off, say, I do hope that the comity of this Committee continues into the next Congress, and I am disappointed that unfortunately, right out of the gate, we are creating controversy where none exists and shouldn't exist here. But I am hopeful that the comity continues.

Mr. Wright, congratulations on your nomination.

Mr. WRIGHT. Thank you.

Senator CORTEZ MASTO. And thank you for your willingness to serve in this environment and the way that it is today. I appreciate that. Welcome to your family, and to your wonderful mother being here as well. I appreciate that.

Let me ask you a couple questions that are important for Nevada. We talked about this in our meeting, and I thank you for meeting with me, but can Nevadans count on you to acknowledge that the failed Yucca Mountain project is unworkable?

Mr. WRIGHT. Senator, thank you for that question. And as we discussed, I think if you are going to build large infrastructure, and nuclear waste disposal would certainly fall in that category that has concerns, you need to have on board the local community as well. And I think Nevadans, and as you have expressed clearly, have deep concerns about seeing that facility go ahead, and I think that's your answer.

Senator CORTEZ MASTO. So President Trump has said he doesn't support waste at Yucca Mountain. So let me ask you again, because you didn't really answer the question—can Nevadans count on you to acknowledge that the failed Yucca Mountain project is unworkable?

Mr. WRIGHT. I am new to politics, as you can see, and you will see all day long today. I think there has been a clear record that Nevadans oppose the project. I will work with you and with senators across the country to find solutions for long-term disposal of nuclear waste. And I agree with you that a central part of that is going to be local buy-in on the project.

Senator CORTEZ MASTO. What is your understanding of DOE's role in defense and national security today?

Mr. WRIGHT. Oh, it is essential that the NNSA, as a part of DOE, is the critical designer, maintainer, and builder, through con-

tractors, of our nation's nuclear arsenal. This is the ultimate guarantor of our sovereignty. I take that responsibility very seriously. Together, with the coming instabilities in our electrical grid, it is my single biggest concern in this job. We have lost our ability to enrich uranium in this country, to construct plutonium pits, and to do so many critical things that are key to our nuclear arsenal. I am highly motivated and highly concerned that we need to make progress on the safety and security of the stockpile of our nuclear weapons.

Senator CORTEZ MASTO. The Department of Energy provides essential programs and research across all corners of my state. Its critical defense measures at the National Security Site that you talked about—our workforce cybersecurity collaboration that we have with our universities and colleges in Nevada, the public-private partnerships to create new, innovative technologies—is actually happening in Nevada thanks to legislation that we have passed, bipartisan legislation, as well as the Inflation Reduction Act and the Infrastructure Law.

Let me ask you this: would you push back on any attempts by the Trump Administration to cut any of these critical programs?

Mr. WRIGHT. Senator, I appreciate your passion for them. It is too early for me to give any specifics about this program or that program, but is cybersecurity critical for our country? Absolutely. Is——

Senator CORTEZ MASTO. Well, let me be more specific, because you talked about that when I asked you about the role of DOE, you specifically talked about the National Security Site in Nevada. Would you push back on the Trump Administration if they attempted to cut any critical funding to the programs for the National Security Site?

Mr. WRIGHT. I will support, to the extent I can, all of our efforts in national security, including those that are in Nevada.

Senator CORTEZ MASTO. Let me ask you this—you talked about in your comments to some of my colleagues that you want to grow the supply of energy. Define for me the sources of energy you are talking about that you would like to grow.

Mr. WRIGHT. All sources of affordable, reliable——

Senator CORTEZ MASTO. What sources are they?

Mr. WRIGHT. Pure energy.

Senator CORTEZ MASTO. Sure, which sources?

Mr. WRIGHT. It's different sources in different circumstances. I mean, our economy today is underpinned by energy, dominantly from oil and natural gas. Coal is a major source of energy in our country. Nuclear power is a major source of energy in our country. Hydropower is a major source of energy in our country. Wind and solar are growing rapidly. And geothermal, particularly in states like Nevada, is early on, but has potential—significant running room to become a meaningful source of energy in the future. And every source of energy that either today or with technology innovation can be a growth engine for affordable, reliable, secure energy—I am for all of those.

Senator CORTEZ MASTO. Good. You did not mention solar. Solar is the number one energy for us in Nevada. It has created jobs, it is growing our economy, and it has major impact. So I am dis-

appointed that I did not hear solar coming out as a part of the energy, but I assume—I am not going to assume anything. I am just going to say, the conversation we are going to have and continue to have around energy is important, and it should be balanced, and it's not just focused on fossil fuels. No matter what some of my colleagues say, there should be a balanced approach to it for our portfolio for energy, and that is what I am looking for always.

Mr. WRIGHT. I agree entirely, Senator. And if I didn't say solar, it was an oversight. I worked in solar energy. You have tremendous resources for that in Nevada, and we are seeing a lot of growth in solar energy, and I expect that to continue.

Senator CORTEZ MASTO. Thank you.

Senator BARRASSO [presiding]. Senator Cassidy.

Senator CASSIDY. Hey, Mr. Wright. I really enjoyed the conversation we had in my office. I like your emphasis upon abundance. You know, I had a chance to scan your Bettering Human Lives from Liberty Energy, and I think you just nail it. Just speaking about abundance, both in terms of our natural resources, but the abundance it means in terms of an increasing per-capita GDP, and we do it in a way that we lower emissions as we increase GDP. And you look at a country like Germany, and they have almost entered energy poverty, in which we have lowered our emissions on a per-capita basis more than they, and our economy has grown more than theirs. So I just want to—I mean, we are sympatico on this. And I think, frankly, we should all be.

Now, I am also very interested, because one thing that I mentioned in our conversation—I have been very concerned about an offshoring of carbon emissions to countries like China, but as we offshore, we offshore the job, and that prosperity we are trying to build for working Americans, we lose to a working Chinese. Now, they don't enforce their environmental regulations, so their SO_X, NO_X, and whatever blows over on us, when we are trying to do it right, and they use it for competitive advantage. All that to lead into, and by the way, you alluded to that. You talk about how Great Britain has actually offshored their carbon intensity and then they reshore it through the products they buy. So it is an artificial depression in their carbon intensity. I mean, I think you bring a sophistication to this argument, this discussion, which is just like—we just need.

Now, one thing I have been supporting is something called a foreign pollution fee, in which we look at the emissions profile of a U.S. industry—you name it—concrete, and then you compare it to aluminum—let's say aluminum—and we compare it to a competitor like China, which does not enforce emissions and we put a fee roughly equal to their avoided cost of not complying with internationally acceptable emissions profiles. Any thoughts on that? Because it seems very consistent with the problems you point out in the Bettering Human Lives from Liberty Energy.

Mr. WRIGHT. Thank you for that question, Senator. And thank you for the great dialogue we had about all these issues—about energy, about bettering lives, about trade practices, about prosperity for Americans. I think yourself and I and President-elect Trump are very aligned on all of those. And I think you have a creative idea about how do we address some of these asymmetries that have

developed. If you look at the data of economic growth in the United States versus manufacturing growth in the United States in economic output, they roughly track for a century. And right after the year 2000, when China was admitted to the world trade organization, they diverge dramatically.

Senator CASSIDY. With ours going down for the manufacturing and China's manufacturing going up, but also, their emission profile exploding at the same time.

Mr. WRIGHT. One hundred percent. And as you said, look, the United Kingdom and Germany and other of our European allies led with us and they have gone even further on, I think, this destructive habit of just moving their energy-intensive manufacturing out of their country and then——

Senator CASSIDY. So I am taking that as a yes, you will support my foreign pollution fee. But anyway, let me ask you, because one critical role of DOE is to help calculate the embedded emissions. Now, some fear that, thinking it's going to be some regulatory crackdown. I see it as a way to competitively outcompete others, because if theirs is here and ours is there and we know that from this calculation, then that helps our domestic manufacturers because there will be a higher fee placed upon the product coming from overseas. Do you follow how I am saying that?

Mr. WRIGHT. Yes, I am following you, Senator.

Senator CASSIDY. Now, so, DOE has a pilot project currently calculating embedded emissions. Would you commit to continuing to support that program?

Mr. WRIGHT. Again, if I have the privilege to be confirmed, I will look into all of these efforts. It sounds like a——

[Protestor shouting.]

Senator BARRASSO. We will have order restored. There will be no additional outbursts. The officers will remove this individual from the room and we will continue with the hearing. We ask that the testimony be delayed until the room is cleared.

Please proceed, Mr. Wright.

Senator CASSIDY. May I suggest that the people who are protesting look at your monograph on Bettering Human Lives because it shows that U.S. emissions have come down in absolute amounts, per-capita amounts, every way you want to measure it, since 2000—since 1990. We are doing the job, led in part by, you know, the things that you and I have talked about in our meeting.

So going back to—you also will be negotiating international energy partnerships through the Office of International Affairs, and you spoke about global leadership as well. It wasn't in your written remarks, but it was in your spoken testimony. Do you want to elaborate on that, please?

Mr. WRIGHT. Yes, as we discussed, energy is the enabler of everything we do, but America, going from 20 years ago the largest importer of oil in the world and the largest importer of natural gas in the world, to today, the largest exporter of natural gas in the world—enormous growth in our geopolitical leverage. We were able to fill most of the gap when Russia invaded Ukraine and Russian gas imports into Europe were reduced. Most of the replacement gas came from the United States. We couldn't have done that 20 years ago.

Senator CASSIDY. Thank you, Mr. Chair.

And I will just say, we began the five-minutes to talk about abundance for the American people, now we talk about our abundance helping our allies. We are all about abundance. Thank you, Mr. Wright.

Mr. WRIGHT. Thank you, Senator.

Senator BARRASSO. Thank you, Senator Cassidy.

Senator Hickenlooper.

Senator HICKENLOOPER. Thank you, Mr. Chair, and thank you, Mr. Wright, for being here.

As we consider our energy future, we have so many challenges to deal with—energy prices, energy poverty, and you have written about—obviously climate change is such a big one. As Secretary, do you think there is a possibility that the Department of Energy could finally begin to build a plan, a comprehensive plan, on how we deal with the energy future, but also really look—take a hard look at climate change?

Mr. WRIGHT. Senator, yes, indeed, I am very interested in that idea, and it is certainly something I have been thinking about. The Department of Energy created a look into energy and what the future of energy might bring about 20 years ago. I think it's time to do that again, and to look not just at energy and the energy trajectory we are on, but the other issues related to energy, and top among those, climate change.

Senator HICKENLOOPER. And I think, just on that note, and you have in the past, some time ago, but described how slowly climate change is evolving, and it's so far out in the future, it probably shouldn't command as much attention. And yet, I continue and I think a lot of people are concerned about the acceleration and how soon can we recognize those feedback loops. We are talking about the salinity of the oceans, the massive ice melts, and calving of glaciers. Those things have the potential to create a much more rapid rate of change. And I think that is part of the ability to get a plan. As of 2024, they are saying we are about 1.5 degrees Celsius in increased temperature. If it goes much faster than that, do you think we should have some contingency plans ready so that we can address that scenario? Even now, we look at the—again, the fires in Los Angeles, some of the hurricanes, these extreme weather events, and we are obviously not prepared for them. We don't have an insurance system that works. You know, each of those suggests or commands that we should have backup systems in place.

Mr. WRIGHT. You know, absolutely, Senator. As you know, I have studied and followed the data and the evolution of climate change for at least 20 years now. It is a global issue. It is a real issue. It's a challenging issue. And the solution to climate change is to evolve our energy system. I have worked on that most all of my career, again, in nuclear, in solar, in geothermal, and in new battery storage technology now. And do I wish we could make faster progress? Absolutely. Are there things we can do—investments, together, through the Department of Energy to accelerate development of new energy technologies that are really the only pathway to address climate change? Absolutely. And we should have nothing but American leadership in this area. Energy and climate is a global

problem, but America should be the leader. And I think President Trump is firmly aligned with that position as well.

Senator HICKENLOOPER. Great.

On a more parochial note, obviously, the Renewable Energy Laboratory—a large portion of that work is done in Colorado. Do you feel that those budgets are properly spent, or do you think they should be reevaluated?

Mr. WRIGHT. It's too early for me to comment on something like that. I visited the National Renewable Energy Laboratory years ago, as a fellow energy guy in Denver, a lot of great work there, a lot of great humans there that are driving innovation and that are working with businesses too. It's not just basic research in the lab, it's very focused on applied research and new technologies. So I am very keen to engage on a more detailed level with what is going on there——

Senator HICKENLOOPER. Great.

Mr. WRIGHT [continuing]. And how to drive that further and faster.

Senator HICKENLOOPER. You know, this, I think this is going to be the first time I have ever got to five questions within a testimony. So I am not sure what that says. We spent a lot of work looking at the grid, and as we do begin to build infrastructure that can respond, if we need to make more dramatic changes to our energy system, whether it's climate change or whatever other constraints may come along, we have really been stymied, both in terms of the permitting process and finding ways that we can make sure that we protect local communities, make sure that their voice is heard, make sure that we respect the environmental importance of our landscapes, but at the same time, realize we have to move more rapidly in building things like electrical infrastructure.

Can you talk a little bit towards electrical infrastructure?

Mr. WRIGHT. Yes, Senator. I think you have hit—in the energy world, the most pressing problem we have is our electricity grid, and this problem is only going to get worse. I am very concerned about that. We need to change the gear we have been in the last several years and we need to get serious about building infrastructure and investment, bringing the cost of electricity prices back down, and keeping our grid stable. I am deeply concerned about our current trajectory.

Senator HICKENLOOPER. No, I appreciate that. Thank you.

I yield back to the Chair.

Senator BARRASSO. Thank you, Senator Hickenlooper.

Senator Hyde-Smith.

Senator HYDE-SMITH. Thank you, Mr. Chairman, and thank you, Mr. Wright, and this lovely family that you have behind you.

I certainly enjoyed our visit in my office when we had the opportunity to discuss the importance of this Committee, the importance of what you will be doing, and your leadership. You know, everybody in here, sitting up here, we have economic developers come to our state and we certainly want economic development, we want good jobs for our citizens, and so much of that is a part of what kind of energy we can provide for that company. So thank you for discussing those things with me because they are certainly important to my people in Mississippi, as well as other states.

The Department of Energy, themselves, they classify nuclear energy as the largest source of clean power in the United States. And containment, as we well know, is critical to every aspect of nuclear energy. High-efficiency, particulate air filters, you know, what we refer to as the HEPA filters, are the operational barrier between the containment and the release of radioactive particles. So I am proud, in my home state at Mississippi State University, where my daughter is in graduate school there, but not in this area, they have been for a long time researching new technologies in order to develop better performances in the capabilities of these HEPA filters for new reactors' containment ventilation, and this research really plays an important role in advancing the next generation filtration systems that we are all concerned with because we are certainly concerned about the future of the policies that we are passing now, for Miles, when he is an adult, of how the things we are talking about today will affect him.

And what do you see as the deficiencies related to containment ventilation issues for waste processing and new generations of power reactors?

Mr. WRIGHT. So thank you, Senator, for the question, and thank you for our fabulous dialogue and for what you do for the great State of Mississippi. You kept hitting on technology and technology at Mississippi State. Technology really is the key for growing our energy future for both growing more abundance to better——

[Protestor shouting.]

Senator BARRASSO. The Committee will stand in recess until the Capitol Police can restore order in the Committee.

Senator HYDE-SMITH. Thank you. I think we figured out it's every other speaker here. So just heads-up, but I threw out a lot of them.

[Laughter.]

Senator HYDE-SMITH. So I'm sorry about that.

Mr. WRIGHT. And you were talking specifically about advancements in nuclear technology. How do we get—it's already a significant source of energy in the United States, but it hasn't grown in decades. How do we get it growing again? How does that research in Mississippi on air filtration and in research, so many other places, how do we get it going again? My view on that is building large projects in this country. We are seeing that with transmission lines and so many other things—very hard to do. We need to fix that problem. You know, a typical nuclear reactor is a gigawatt, it's a thousand megawatts. The last ones we built took well over a decade and multiples overcost budget.

Fortunately, with nuclear, we have a new generation of reactors that are smaller, and they will be manufactured in a facility. Anything that is manufactured in a facility—think a semi-conductor or a bike or something—the costs of those are coming down. Anything that is built on location, the costs of those have been going up. So we have to figure out how to get some of these cost barriers out of the way. We have to get better technologies, like they are working on at Mississippi State, to get Americans comfortable with the safety of nuclear, with the security of nuclear. But I think the facts and the technologies today are pretty compelling.

Nuclear, today, is a little less than 20 percent of U.S. electricity. That is pretty significant, but we also have to remember, electricity is just one sliver of energy. The biggest use of energy is high-temperature process heat. And I would say it's the most important use of energy, because it's how we make steel and cement and metals and all those things that we make everything else out of. We can't build an internet or a car or a factory without those materials. Nuclear could provide energy, could provide high-temperature heat to really impact manufacturing as well. There is just so much room to run and to grow for nuclear energy. And I think we are going to see broad investments across our country in the research and enabling technologies. And hopefully, before long, we are going to see the energy source deployed widely as well.

Senator HYDE-SMITH. It is so refreshing to hear you say those things, and I so look forward to working with you and the things that—all the questions have been so good today, but it really gives us hope and optimism. Thank you for your willingness to serve, and I am out of time.

Mr. WRIGHT. Thank you, Senator.

The CHAIRMAN [presiding]. Senator Hirono, you are up next.

Senator HIRONO. Thank you, Mr. Chairman.

Before I get to my questions, I just want to note that we did not receive information relating to this nominee until really late yesterday, and it would have been good if we could have followed the process that would have given us more time, which meant that this hearing would not be happening today.

So for the nominee, as part of my responsibilities as a member of this, as well as all my other Committees, I ask the following two initial questions to ascertain the fitness of the nominee for the job. So I ask you, since you became a legal adult, have you ever made unwanted requests for sexual favors or committed any verbal or physical harassment or assault of a sexual nature?

Mr. WRIGHT. I have not.

Senator HIRONO. Have you ever faced discipline or entered into a settlement relating to this kind of conduct?

Mr. WRIGHT. I have not.

Senator HIRONO. It is shocking to see the devastation that is caused by the wildfires in Los Angeles, and of course, we are seeing that. It is shocking. In 2023, a wildfire killed 102 people and destroyed the town of Lahaina on Maui, and Hawaiian Electric, which is our major utility company, received a $95 million award from the DOE to help in rebuilding Maui's electric grid and reduce the risk of future wildfires. The State of Hawaii has also received other support and funding from the DOE to proceed with this kind of modernization.

Do you acknowledge the need for improvements to our electric grids that will reduce the risk of wildfires and ensure reliable access to power?

Mr. WRIGHT. Senator, thank you for your question, and boy, I remember watching with horror the fires on Lahaina and the fires today in LA. It is absolutely a human tragedy. It is devastating. But to answer your question, absolutely, yes. We need to improve our electric grid both for increased supply, for increased resilience to natural disasters, and——

Senator HIRONO. So as we see these kinds of natural disasters, I think, states are—municipalities will need help from the DOE. So will you continue allocating funding for grid improvements as authorized by Congress? Yes or no?

Mr. WRIGHT. Well, I am not sure it's quite as simple as that, but I think my short answer would be yes, of course, I want to work with you and other states to increase grid resilience.

Senator HIRONO. I appreciate that.

DOE is required to ensure that all construction and repair projects funded by the DOE under the Infrastructure Investment and Jobs Act pay prevailing wages. Will you pay prevailing wages as required under the Infrastructure Law that I just mentioned?

Mr. WRIGHT. Senator, if I have the privilege to be confirmed, I will follow the laws and statutes of the United States.

Senator HIRONO. And that would mean paying prevailing wages on these kinds of projects.

The Washington Post reported that in April 2024, Donald Trump told a group of about 24 oil executives at Mar-a-Lago that they should raise $1 billion for his campaign, which would be a deal, given his commitment to reversing environmental regulations, expanding oil and gas leasing on federal land, and approval of natural gas exports. Did you attend that meeting at Mar-a-Lago?

Mr. WRIGHT. I was at a dinner with President Trump in Mar-a-Lago in April. Quite a bit different than what you just described, but yes, I was at a dinner.

Senator HIRONO. Well, it was reported that he talked about $1 billion. So do you think that it was appropriate for the President to even put forth the possibility of such a deal?

Mr. WRIGHT. I was at the dinner, and the President put forward no such deal.

Senator HIRONO. That's not what was reported.

As Secretary of Energy, you will have oversight over a lot of contracts, grants, and loan guarantees. Are you prepared to engage in vigorous oversight of the DOE's funding, even if President Trump pressures you to approve sweetheart deals to one of his favorite businesses? Will you be objective should you be confirmed?

Mr. WRIGHT. I have followed rigorous and ethical business practices my whole life, Senator, and will continue to do exactly that at the Department of Energy, if I have the privilege of being confirmed.

Senator HIRONO. I only have a little bit of time, but I do want to get to this. If you are confirmed, your obligation will be to the American people, not to the shareholders or board members for an oil and gas company. Would you allow all exports of natural gas to China and anywhere else around the world, regardless of whether the exports would increase heating and power bills for the American people?

Mr. WRIGHT. Senator, I would love to have more time to talk about natural gas exports. The brief history of them is, as we have grown our natural gas exports, our price of natural gas has gone down because the natural gas production industry has benefited from the scale.

Senator HIRONO. I am asking whether you would take into consideration what the impact for the cost of energy in America would

be if you allow export of oil and gas. So would you—you would keep that uppermost in mind, right, what the impact of these kinds of exports would be to the cost of energy to our American people?

Mr. WRIGHT. Absolutely, Senator.

Senator HIRONO. Thank you.

Mr. WRIGHT. I share your concern there.

The CHAIRMAN. Senator Hoeven.

Senator HOEVEN. Thank you, Mr. Chair.

Chris, as you have talked about, deploying the latest, greatest technologies is how we produce more energy more cost effectively, more dependably, with the best environmental stewardship, not only here at home, but when we implement those technologies, the world follows. So that is actually the global solution. How do we actually bring folks along on that where they are skeptical, like in fossil fuels? If they are skeptical of fossil fuels, how do we demonstrate to them that that technology, where we lead and we have the best environmental stewardship, actually benefits globally? How do we convince them? What can you do?

Mr. WRIGHT. Senator, thank you for the question. Thank you for your opening remarks as well. This is tough. I have spent my whole adult life engaged in dialogues about energy. I went to MIT to work on fusion energy. I worked on solar energy at UC Berkeley. My whole thing is, we want more energy in the world because it's what makes people's lives better. And you have to understand that there isn't dirty energy and clean energy, all energies are different and they all have different trade-offs. Different people have different weights or valuations of trade-offs. Different geographies or locations have climates more favorable to this energy versus that energy. So it's a complicated dialogue, which means it's not easy to get people to share this broader perspective on it. I think we are seeing a little bit of that in passioned, well-meaning, wonderful people that have been sitting in the hearing room today.

But one of the things I have worked on is to try to just assemble the numbers and the data, and when I was born, the world got kind of a mid-80 percent of its total energy from hydrocarbons. And I was born, as we know, pretty much very close to 60 years ago and a few hours right now, but today, total global primary energy is, sort of, low- to mid-80 percent. So global demand for energy has grown a lot. We brought a lot of new energy technologies along, thankfully, or we wouldn't have as much energy as we have today. But it has proven very hard to displace hydrocarbons in the global energy system.

And I will say one last thing, Senator, and turn it back to you. The other perspective I think that is important to look at is that one billion people live lives like us. We get to wear fancy clothes made out of hydrocarbons. We get to use motorized transport and travel to visit our family and we have warm houses in the winter and we have cool houses in the summertime. But that is one billion people in the world. There are seven billion people in the world that don't live lives anything like we do. And I have traveled to 55 countries, and one thing I know, those seven billion people, they want this. They want what we have. And of course, they should get what we have. And through market forces and improvement, and leadership, particularly leadership from the President-elect Trump,

I think we are going to see growing more abundant energy resource coming out of our country, and hopefully, out of the world, so that everyone else can live lives like we do.

Senator HOEVEN. And I think it's really important that you are a voice for that because you will have a platform to convince people and to explain what you just explained here. All different types of energies have strengths and weaknesses, but when we deploy these technologies, we lead the way—more energy, higher standard of living, and better environmental stewardship. And that's really what you're all about rather than folks trying to say, well, we can't have this and we have to only have that. And so, that's a big role for you to play.

And following on that, you worked on hydraulic fracturing and so forth—it was technically feasible, but it wasn't economically feasible, right? Same thing with other things like, as the President has talked about, clean coal technology. We have addressed SO_X, NO_X, mercury, and now CO_2. Will you commit to working with us to address the carbon capture—CO_2 capture—not only to address CO_2 concerns, but also to use it as a resource for additional oil recovery? Our state is leading in that area. Do you know that?

I want you to touch on that and then respond to whether you will come with me to the University of North Dakota, the Energy and Environmental Research Center there, and see what we are doing and work with us on things like Project Tundra to do this.

Mr. WRIGHT. Thank you, Senator.

Senator HOEVEN. All in ten seconds, I'm sorry.

Mr. WRIGHT. My answer is a resounding yes.

Senator HOEVEN. Great.

The CHAIRMAN. Senator Padilla.

Senator PADILLA. Thank you, Mr. Chair.

Look folks, we have all seen the devastation in Los Angeles due to the ongoing wildfires that have burned more than 40,000 acres of land this last week and have destroyed more than 12,000 structures and have led to more than two dozen lives being lost. The fires are now the most destructive natural disasters in Los Angeles history, and despite the misinformation that is circulating here in the Capitol, into California, and everywhere in between, it's clear that these fires only reached the size and the scale that they have because of unseasonably dry vegetation and extremely high winds, both of which are a direct result of climate change.

Mr. Wright, thank you for being here. But as you have seen in the last week, the climate crisis and its deadly effects are very real to my neighbors and my constituents. As we discussed in our meeting yesterday, you were a long-time resident of California. So you have seen the conditions evolve firsthand. So I have to tell you, I was pretty disappointed to come across some social media posts of yours, and I will quote. I understand you have written that "the hype over wildfires is just hype to justify more impoverishment from bad government policies." Given the devastation that we are currently experiencing in Los Angeles, do you still believe that wildfires are just hype?

Mr. WRIGHT. Sir, it is with great sorrow and fear that I watch what is happening in your city of LA——

Senator PADILLA. Do you think it's just hype or not?

Mr. WRIGHT. Climate change is a real and global phenomenon.

Senator PADILLA. Is it hype or not?

Mr. WRIGHT. I stand by my past comments.

Senator PADILLA. So you believe it's hype.

Mr. WRIGHT. Climate change is——

Senator PADILLA. Tell that to the families of the more than two dozen lost in these fires and counting, because urban search-and-rescue teams are still going property by property with cadaver dogs. That number is going to climb. I am disappointed, Mr. Wright.

Let me make reference to another element of your social media. You reposted a statement, so not your words, but you felt it important enough to amplify a social media post, and I will quote, "Now, obviously, burning to death in a fire is pretty grim, but that is not what's happening like the climate zealots would like you to believe." So again, to the families of more than a couple dozen of my constituents who have died in these fires, and that number is growing, I think I mentioned—do you believe the Californians who have died over the past week are somehow just a figment of our imagination?

Mr. WRIGHT. Of course not, Senator. It is heart-wrenching to watch the destruction. Most importantly——

Senator PADILLA. And I'm not sorry for cutting you off here. I think the point has been made, and you are standing by your posts, and I assume the reposts as well. And I will tell you why I am further disappointed. We had, I think, a genuine conversation yesterday in my office. You said you are—you have a science background. You pride yourself in leaning on facts and truth and evidence and data as you make decisions and decide which actions to take. So let me ask you to transition to something that is very substantive in this role, should you be fortunate enough to be confirmed. One of the most important functions of the Department of Energy is research. We have discussed the 17 national labs, and you referenced it earlier in your testimony, that are working hard to tackle critical scientific challenges. California is home to three of these labs, and we understand the need for these labs to advance our research and our knowledge. The data and research published by these labs at the Department, writ large, are foundational for unlocking new technologies and maintaining our competitive advantages globally.

Will you commit to publishing, and not censoring, non-classified Department of Energy research?

Mr. WRIGHT. Absolutely, Senator. The scientific process has been a key driver of our progress, of our country, and of our world.

Senator PADILLA. And let me tell you why I feel the need to even ask the question. It should be a no-brainer because it is a very real possibility that you may be asked by incoming President Trump, maybe through one of his intermediaries, to not publish or to withhold or otherwise suppress DOE research and studies. What would you do if asked?

Mr. WRIGHT. I am very proud to be serving, I hope, if I have the privilege to be confirmed, with incoming President Trump. He shares my passion for energy and for bettering American lives.

Senator PADILLA. If asked, what would you do?

Mr. WRIGHT. I will follow the scientific method. I will be honest in integrity, and follow the laws and statutes of our country—of course I will, Senator.

Senator PADILLA. One other question in my very little time remaining, and I will just sort of cut to the chase. In my office, you shared with me your opinion that federal subsidies do not make sense for mature industries, correct?

Mr. WRIGHT. Less fruitful there, yes.

Senator PADILLA. And you included oil and gas in the examples of mature industries, correct?

Mr. WRIGHT. Correct.

Senator PADILLA. So please share with me, with my colleagues on this Committee, expand on your belief that if oil and gas are truly mature industries then subsidies don't make sense here anymore, and we should retract those subsidies and maybe redirect those into smarter, more contemporary investments.

Mr. WRIGHT. Yeah, as a career entrepreneur and a free market advocate, my goal is to have a small role for government in business, particularly in mature businesses, just as I discussed. You have to have the rule of law. You have to have the enforcement of contracts. But the best role for the Federal Government is basic research and helping launch new technologies that are just getting their footing.

Senator PADILLA. So I take that as a supportive position of rolling back subsidies for oil and gas.

Thank you very much.

The CHAIRMAN. Thank you very much.

We are in the presence of greatness, as we have Senator Risch, who is the Chairman of the Foreign Relations Committee. He has another Cabinet nominee, with Senator Rubio in front of his Committee. Senator Barrasso has graciously agreed to allow Senator Risch to take the first couple minutes of his time, and so we will hear from Senator Risch, and then, immediately thereafter, Senator Barrasso.

Senator RISCH. Thank you very much. Thank you, Mr. Chairman, and also Senator Barrasso, for your indulgence here. I do have to get back.

Mr. Wright, first of all, thank you for taking the time to meet with me, and I came here today because I want to give you an opportunity to underscore your understanding of the importance of nuclear energy. As you know, Idaho is the birthplace of nuclear energy in the universe. We still have the first light bulbs that were lit with nuclear energy there at the Idaho National Lab. And as I explained to you, the Idaho National Lab is an incredibly important cog in the wheel of nuclear energy, and I appreciate your commitment to visit there, and we will look forward to that.

As I explained to you, with the renaissance of nuclear energy, not only in America, but even louder, really, in the world writ large, we compete—we, the United States of America, compete with Russia, China, and France in providing, being the purveyor of nuclear power plants to other countries who are interested, and there is so much interest right now. And as I explained to you, the importance of us, when a contract is put out from another country, the importance of us being the winner in that, because it creates a 100-year

relationship as we go forward with nuclear energy. Could you take a minute to articulate your understanding of the importance that we, the United States of America, and particularly, the Idaho National Lab—the importance they have in leading the world as we go forward over the next decades and through this century on converting over to nuclear energy?

Mr. WRIGHT. Thank you, Senator. And I very much enjoyed our visit—a lot to be proud of in Idaho, particularly Idaho National Lab, but the United States invented the technology of nuclear, first for abrupt-action weapons, and then for commercial nuclear power. Of course, we should lead in that. President-elect Trump and I are entirely aligned on this. But you are right, there are other players out there in this space. And if the U.S. moves slowly, other players are going to fill that vacuum. Much better if that technology, that alliance, that partnership, is with the United States. I am firmly in favor of that.

Nuclear is probably a smaller, today, energy source, only four percent of global energy, that could grow huge. It has had that potential for some time, and I would like to see it move faster as soon as we can.

Senator RISCH. Yes, I appreciate that. And I agree with you, it not only can move faster, it will move faster. The advent of the small modular reactor, the SMR, and the advent of the micro, which is going to be behind it fairly quickly. We are moving quick. China is competing with us, as far as who can get these online quick enough, who can get them demonstrated quick enough, who can get the first commercials up and running. When that happens, there is going to be a stampede by countries to sign up to get SMRs and micros, and I, after talking with you, I am convinced that you agree that we need to be a leader—the leader—in doing that.

So thank you for your understanding in that regard, and I look forward to working with you on that.

Thank you, Mr. Chairman.

The CHAIRMAN. Senator Barrasso.

Senator BARRASSO. Thanks so much. And first, I want to congratulate you, Senator Lee, on being Chairman of the Committee, for your first hearing at the helm, and I am very grateful for your thoughtful leadership on these important hearings. We are getting underway, and tomorrow we have North Dakota Governor Burgum, who is here to testify, who is a nominee, and I assume we are going to hear another wonderful introduction by the great Senator, the former Governor of North Dakota, Senator Hoeven.

Senator HOEVEN. Absolutely.

Senator BARRASSO. Great, thank you.

Mr. Wright, congratulations. We have had a chance to visit. I have a number of questions, and I am going to submit most of them in writing.

There were some questions from the senior Senator from California about wildfires, and you were abruptly cut off from trying to answer, and he apologized for cutting you off, but I would want to give you time to now respond, if you would like to, to some of the comments that he had made that you were not able to respond to.

Mr. WRIGHT. As someone who has spent my life focused on poverty, and poverty abatement in our country and abroad, seeing people suffering, seeing people in pain, seeing people lose family members, lose their property, lose their sense of self, lose their security, is absolutely heart-wrenching. It is horrible to watch what is happening in LA today. And wow, these are the kinds of things we want to protect people from. We want to make our society more resilient, stronger. There are no words to say in the middle of a personal drama, you know, that reflect global policy in all that. These are human tragedies that touch every one of us.

I lived in California for 19 years and have lots of friends in the LA area. I will probably get emotional talking about it. It is horrific to see what is happening there. We need to do everything we can to get those fires out, to get that infrastructure rebuilt, and to get people to return to the lives they had before it was visited on by these horrific fires.

Senator BARRASSO. I agree, it is heartbreaking. And I know we have our Wyoming National Guard there, equipment as well as manpower, and trying to do that.

I did want—Senator Cortez Masto made a point about—actually, it was your answer to Senator Cortez Masto that mentioned that we have lost the capacity to enrich uranium. And America is dependent on imports right now to fuel our nuclear reactors. We have extremely limited commercial enrichment and conversion capacity—not in America's best interest. In 2023, Congress passed the Nuclear Fuel Security Act. We repurposed $2.7 billion in funding to support this goal. If confirmed, will you make it a priority to build and secure our nuclear fuel supply chain?

Mr. WRIGHT. Senator, absolutely. I know we shared that concern in our dialogue in your office. It is a significant hole in the U.S. arsenal right now in technology we developed, but yet we import most of it from abroad and most that is enriched in the U.S. is by companies that are not American companies in the U.S. Yes, we need to build American nuclear infrastructure on mining, on enrichment, on power production, and on waste disposal, which is a tough challenge.

Senator BARRASSO. Congress passed legislation to ban imports of Russian uranium in the United States. This law is intended to revive American uranium production and strengthen our nuclear fuel supply. It has to be implemented correctly. The Secretary of Energy has the discretion to provide waivers to companies seeking to import uranium from Russia. Do you agree that these waivers should be very limited and used only in extreme circumstances?

Mr. WRIGHT. Senator, I would agree with that assessment. It is very sad how dependent we have become on imported enriched uranium from Russia. That is sad state of affairs where we are today. We need to get beyond that, but we need to get beyond that without shutting down the nuclear power plants we have running today. So it is an area that requires urgent action.

Senator BARRASSO. Because it does seem that with the shutdown on Russian uranium that we see more imports from China. So the next issue is to confirm you will support efforts to end uranium imports from China as we continue to try to build the U.S. nuclear supply.

Mr. WRIGHT. Yes, Senator, that is another country we should not be dependent upon for critical supplies. And of course, enriched uranium to turn on our lights and power our factories are critical supplies.

Senator BARRASSO. And then finally, with regard to advanced nuclear reactor demonstration projects, the Department of Energy's Advanced Reactor Demonstration Program is meant to help developers overcome some of the hurdles that we have in terms of the expense early on with the development. The program has received broad bipartisan support from this Committee and across the Congress, so I look forward to getting the current projects over the finish line. Will you ensure the Department continues to be a faithful partner in this mission?

Mr. WRIGHT. Yes, Senator, I think that is a key role of the U.S. Government and particularly of the Department of Energy to help bridge these technologies that have lots of running room, but mostly for government regulatory burden and uncertainty, have not been able to reach full commercial status yet.

Senator BARRASSO. Thank you.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you very much.

We are now going to turn to another new member of the Committee, our new colleague, representing the state where I was born, and it turns out, a fellow fan of mariachi music, Senator Gallego.

[Laughter.]

Senator GALLEGO. Gracias, thank you, Chairman.

Thank you, Mr. Wright, for your attendance here today, and thank you as well for meeting with me yesterday for a productive discussion about the energy future of Arizona. I would like to follow up and expand on a couple areas that we discussed and have not discussed here.

So number one, I really do appreciate your enthusiasm for nuclear energy. And in my time in Congress, I have supported annual appropriations for small modular reactors. We have heard a couple times about them here—SMRs. And I do see great potential in them as a safe, renewable energy source. However, SMRs and nuclear energy, more broadly, face several challenges, including the costs of scaling, commercialization, public perception, and permitting. As Energy Secretary, what actions will you take to improve the development and deployment of SMRs?

Mr. WRIGHT. Thank you, Senator, for the question. Thank you for our great dialogue recently, and congratulations also to being a new Senator in this august body.

It's a big challenge, and I am new to government, so I can't list off the five levers I can pull, but I will—I have certainly been in dialogues and investigations about how do we make it easier to research, to invest, to build things. I think DOE has land and facilities that can be helpful in this regard. My current company, Liberty Energy, owns part of a small modular reactor company called Oklo, and their first small modular reactor is going to be built in the Idaho National Lab, a DOE facility. So is there an enabling role DOE can play to help launch nuclear energy? I think, absolutely. I think it's creative things like that. It's also research. It's also communication about the energy and the technology. But this

should be a huge part of America's future energy source, but that won't happen without action within the legislature of the United States, with action from the Department of Energy, and our incoming Administration.

Senator GALLEGO. And I assume that this is where we would have some communication from your leg staff to us—what kind of legislation could we also be passing here to help, you know, really scale up SMRs and other types of nuclear energy to help cut through the regulations too.

Mr. WRIGHT. Absolutely. The ADVANCE Act that was passed not long ago, I think, is early on, and I think it's a great first step. So some steps have been taken, but certainly more can be done.

Senator GALLEGO. Excellent.

Arizona is a state with ample renewable resources—sun—and a rapidly growing industrial sector. Since the passage of the IRA, Arizona has seen billions of dollars in new clean energy investments, and created tens of thousands of really good-paying jobs in some of our rural areas too. Some Republicans have started talking about dismantling and narrowing the energy provisions from the IRA, which, in the end, would not actually save money, and doing so would actually cost Arizona middle-class jobs, economic growth, and also clean energy production, which I think, we all agree, we want as much energy production, no matter where it comes from. Will you commit to protecting clean energy production provisions of the IRA, and how will your Department, how will the Department of Energy ensure that previously authorized IRA funds are efficiently distributed?

Mr. WRIGHT. Thank you for the question, Senator.

Look, I am not involved in lawmaking. That will be here in the body of the Senate and the House. My goal would be to implement the laws of the land, and maybe make some decisions on allocation of capital or funds that are approved by Congressional bodies. And I will seek to allocate those funds in the most efficient way to grow our supply of affordable, reliable, secure energy and to invest in technologies that can't do that today, but have a clear pathway to do that in the future. That, I think, is a critical function of the DOE, from basic research to emerging technologies, to technologies that have been born, but are not at commercial scale yet. I think there is a critical role for the DOE in all of those things.

Senator GALLEGO. And now, moving on from generation now to transmission, because it doesn't really make a difference if you generate if you can't move it, right? So I do believe that more transmission construction will also be vital to meeting the energy demands in the coming years all over the country. And I voted repeatedly to streamline the permitting for transmission energy projects. What will your approach be to improving the timeline for transmission project approvals?

Mr. WRIGHT. Well, I have been a passionate advocate for making, as I said in my opening statement, to make it easier to build things in America. It will always be hard. It involves communities and space and movement of materials, but we need to be able to build things in America. You can't build the next generation system if you can't build anything. I think President Trump campaigned aggressively on building things again in America, on growing Amer-

ican energy production, on securing our electricity grid, and driving down the price. The only way you can drive down the price of a critical commodity is to grow the supply.

So there is going to be many different avenues to pursue there, and as a political novice, I am going to be learning along the way, learning from all the members of this Committee the most effective ways to do that, but I am 100 percent committed to growing our electricity grid, and our energy production, and removing those barriers that are standing in the way of doing things in Arizona and across our country.

Senator GALLEGO. Great. I look forward to working with you.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you, Senator.

We will turn now to our former Chairman, Senator Murkowski.

Senator MURKOWSKI. Thank you, Mr. Chairman, and it's nice to be able to call you that. I think one of the benefits that you will see as being Chairman is you get to listen to the testimony from beginning to end.

And I will tell you that your testimony this morning, Mr. Wright, is so encouraging. I love the fact that you are a self-described energy geek. I love the fact that our colleague, Senator Hickenlooper, in his introduction, calls you a scientist who has invested his life around energy. To have somebody before the Committee who understands energy from the scientific perspective, from the entrepreneurial perspective, from the economics perspective, to the security perspective, is truly extraordinarily unique. And so, the fact that you have been nominated to this position, and you have agreed to go through this process, thank you for that. You bring to the table, I think, just the type of enthusiasm, and quite honestly, the ability to communicate why energy is so key.

In our office, we talked about the fact that we have those who view energy somehow as a liability. We view it as an asset. We agree on that. But your focus about affordability and abundance is so important to understand. So there has been a lot of passion that you have heard in the back of the room today. And you have had your back to it, but your ears, and I think your heart, is attuned to it because there is so much emotion that is attached to what we are seeing with the changes in our climate today. And we can argue about the percentages or how much is human-caused or whatever, but we are seeing that undeniably, there is change. You are not denying that. You have said before this Committee and in other places that climate change is real. Is that correct?

Mr. WRIGHT. Absolutely, Senator.

Senator MURKOWSKI. And I heard you say this morning, and make sure I wrote this down correctly, that the solution to climate change is how we evolve our energy system. Is that a correct summation?

Mr. WRIGHT. Absolutely, Senator.

Senator MURKOWSKI. So it's about technology. We are acknowledging it, we are dealing with it, we are living it, we are feeling it. We are feeling it in Alaska right now. I wish that I could tell you it was as cold in Alaska right now as it is in Washington, DC this morning, but we are seeing changes that are detrimental to our system. Our thermostat is out of whack. And we want to have

the Arctic temperatures up North, but one of the ways that we know we are going to get there is through our technologies that will help us adapt, mitigate, and to really help prevent.

So I want to direct a couple of my comments this morning more to the parochial side. We are talking about Arctic. We don't necessarily have the national labs, although we do a great partnership with NREL, with our Cold Climate Housing Research Center. We are very, very proud about that. But where do you think the Arctic Energy Office, the Office of Indian Energy, and NREL's Alaska Campus fit into your thinking when you are thinking about not only the technologies but how you can use a place like Alaska as a proving ground for so many of these technologies where our energy costs are higher than just about any other place in the United States of America, and arguably, in other parts of the world?

Mr. WRIGHT. Senator, thanks for the question and thanks for the fabulous dialogue we had in your office.

Senator MURKOWSKI. It was good.

Mr. WRIGHT. It was so broad-ranging, and as I think we discussed there, I view Alaska as a microcosm for the world. You know, it's hard to call Alaska micro, but here you are, a state with just enormous energy resources, set right next door to remote communities with very little energy access, and the energy access they do have is expensive. You know, this is the combination of resources, lack of infrastructure—different settings need different energy sources. I have worked for years in this area, and in fact, sitting behind me is the gal who runs our Bettering Human Lives Foundation, trying to bring energy access to remote villages in Africa. So when I hear of your Arctic Energy Office and the communities you are trying to serve, this is the global problem. How do we get different energy solutions for different communities at different stages of economic development, at different lifestyles, different cultures?

And my vision, if I get the honor to be confirmed, maybe is to expand on that Arctic Energy Office to—this is an energy office for remote communities, for different communities. There are different technologies and different answers there than for industrial energy for manufacturing steel—not going to do that in a small Alaskan village.

Senator MURKOWSKI. It's appreciating the diversity of where we all are, as well as the diversity of resources.

I want to ask one quick question, even though I am at the edge of my time here because nobody has really spoken to critical minerals this morning. And I view this as this next looming security vulnerability. If we want to move out with these energy technologies, regardless of where they are, we are going to need these minerals, and we recognize that, and I think we recognize that we are stronger when we are developing more of that here at home. I shared with you in our meeting in December how frustrated I was with the Department of Energy over its repeated subsidization of a graphite processing plant that was getting its supply of graphite from Mozambique. We have a natural graphite deposit up in Alaska, outside of Nome. The same day that we met, the company behind that project that was importing graphite from Mozambique

was forced to declare force majeure. Why? Because of the violent unrest in Mozambique.

And so, now we have millions of U.S. taxpayer dollars that are at risk. And so, it's something that I hope you will look at very critically in terms of what we are doing to ensure that we are responsibly accessing our resources here, particularly in the critical minerals vein, but making sure that we are not embarking on exercises that are going to result in a loss of taxpayer dollars without any net benefit to the people here in this country.

I am over my time, but I am really excited about the potential that you will bring to the energy discussion in this country.

Thank you, Mr. Chairman.

Mr. WRIGHT. Thank you, Senator.

The CHAIRMAN. Thanks, Senator Murkowski.

We will go next to Senator Cantwell.

Senator CANTWELL. Thank you, Mr. Chairman. And before I begin my questioning, I just want to comment on, you know, I have been on this Committee since working with Chairman Murkowski. I mean Frank Murkowski, which means I have served with a lot of chairmen and a lot of different committees. This Committee has debated and argued over a lot of issues, but paperwork has never been one of them. So I just hope that everybody will take a deep breath and understand that transparency in the process here is all that people want. And I know that people are anxious in the new Administration to get their people. We want them to have that opportunity, but the transparency that it takes to just get the paperwork and have time for people to digest it is important. And I think everything will go smoother if we can get that done.

Mr. Wright, congratulations on your nomination, and my colleagues have said thanks for your willingness to serve. I have to start with Hanford cleanup. I think you could go back to my record on every energy secretary, and that is where we would always start. I mean, we played a very important role for our nation during World War II. We are very proud of that, but the cleanup after the Manhattan Project also has to be historic, and committed to over a long period of time. I have definitely voted for Republicans to be Energy Secretary, but they have also committed to cleaning up Hanford. And I want to ask you about your same commitment. We, as stated in the Department of Energy, entered into a Tri-Party Agreement that has been updated recently into a final agreement. Will you commit to upholding the commitment that DOE has made to the time frame and cleanup of Hanford waste?

And usually what happens is, energy secretaries are—actually that's not true—OMB people come in and say, oh, we can save money, we can do cleanup on the cheap or we can get it done faster. Most of the time those ideas go in the trash can, but it puts you in a horrible situation because you have to fight for those dollars. So will you commit to upholding the Tri-Party Agreement between DOE and the State of Washington and others in supporting Hanford cleanup and advocating for a budget that represents that commitment?

Mr. WRIGHT. Senator, I can't overstate how critical I think it is to finish the job, finish the cleanup at Hanford. The majority of our country's plutonium was produced there, not just for World War II,

but also for the post-war period and our arsenal today. So Hanford gave a lot to this country, and we, behind, left a mess, and that needs to be cleaned up. It's being cleaned up, thanks in part to your efforts and many in your state to push for that, but I am firmly committed to continuing our obligations and our moral obligation to clean up the mess that was left in your state.

Senator CANTWELL. Under that legal framework?

Mr. WRIGHT. I will——

Senator CANTWELL. You can take it for the record, but you need to look at that and just say, yes, I believe in that legal framework.

Mr. WRIGHT. Yes.

Senator CANTWELL. You know, it's the process. That's where people get into trouble because somebody else starts to redefine the agreement that has been made or says let's just make it simpler. They try to redefine what is the waste and then they try to reclassify very hazardous waste into something else, and then just say we are just going to leave it in the tanks or grounds, which are leaking, and we don't want those leaky tanks and those sources of very severe issues.

Okay, secondly, do you believe in upholding investments in our capabilities in our national labs, particularly when it comes to the issue of AI and quantum? I think you and I had a chance to have this conversation. We think both of these things have major implications, but we have to have our labs continuing to play a leadership role with the right amount of funding to continue a very important competitive and national security agenda for our nation.

Mr. WRIGHT. I agree very much with your comment, and your question, Senator. And PNNL has done fabulous work in this area. Cybersecurity is a growing threat. It's not obvious to all Americans because we don't see it, but the infiltration into our systems across our government and our industry from foreign actors is huge, and driving that research forward is critical for the security of our country—the economic and geopolitical security of our country.

Senator CANTWELL. Great.

I know you know a lot about fusion. Do you think it's time that we look at fusion, and let's just say, the Tri-Cities is doing everything, okay? So they are very much a hub for a lot of different energy innovation because of both the long history of the Hanford cleanup and the national lab footprint and a lot of just natural resource issues, but do you think when it comes to fusion that we ought to be more aggressive in thinking about, in case this does become a reality, supply chain and grid integration? Do you think it would behoove us as a nation to be faster at our deployment of such technology, if we knew what those supply chain issues were now and identifying them and identifying what a faster process for getting something like that integrated into the grid would look like?

Mr. WRIGHT. Yes. Yes, Senator, this is exciting new technology, which, again, just huge room to run, and it has moved very rapidly. The last decade has seen more progress than in my lifetime. And I would love to see that come to commercial power in the next decade.

Senator CANTWELL. Great.

And then, just lastly, DOE has invested more than $14 billion in U.S. power grid, and many states have had grid resiliency programs. I hope you will continue to support those projects.

Mr. WRIGHT. Grid resiliency, yes, as I have talked throughout this hearing, is critical. It is the most urgent energy issue we have today.

Senator CANTWELL. Thank you.

Thank you, Mr. Chairman.

Mr. WRIGHT. Thank you.

The CHAIRMAN. In just a moment, we are going to turn to another one of our new members, who comes from an energy-rich state, a state with some oil refineries as well—Senator McCormick. Before I do that, I just want to clarify one thing. You submitted your paperwork in a timely manner, and your paperwork, now having received the final certification last night before close of business, should it trigger any questions, you will make yourself available to members, should they have any, is that right?

Mr. WRIGHT. Absolutely.

The CHAIRMAN. Thank you.

Mr. WRIGHT. Any questions about my disclosures or paperwork, please just reach directly out to me.

The CHAIRMAN. Senator McCormick.

Senator MCCORMICK. Thank you, Mr. Chairman.

Mr. Wright, good to see you. It was great to have a meeting with you, and I am excited about working with you. And we believe in Pennsylvania that the road to energy dominance goes through Pennsylvania, and it is critical to our future in Pennsylvania. So I am going to ask you a couple of questions. Forgive me, they are parochial, but I want to stay focused on the things that matter to Pennsylvania as I am going to hopefully do a quick lightning round here with you.

First, the East Coast is at a significant disadvantage on LNG export capacity compared to the Gulf Coast, which is a big problem for getting Pennsylvania energy production to other parts of the country and allies around the world. Can we work together on getting export terminals online starting in southeastern Pennsylvania, outside of Philadelphia?

Mr. WRIGHT. Senator, the more energy infrastructure we have in this country, the better for America, the better for Americans, the better for Pennsylvania. I agree very much with your desire there. I have expressed that view many times. We have the Marcus Hook Terminal for natural gas liquids, but not for the main event—for methane and for natural gas. It would be hugely beneficial to Pennsylvania and to our country to have an LNG export terminal on the Pennsylvania coast near Philly.

Senator MCCORMICK. Great. Thank you.

And we can't power the AI revolution without cheap and reliable power for data centers and tech clusters. In Pennsylvania, we have seen recently an innovative approach with a Microsoft arrangement with Three Mile Island. You and I spoke when we were together about the potential for Pennsylvania to become, really, a leader with energy and AI going hand-in-hand. And so, as we discussed in our meeting, I am putting together a Pennsylvania energy—an innovation summit later this year to bring together the energy sec-

tor, leading AI companies, huge sources of capital, and global investors to deliver on President Trump's vision to unleash American energy and technological leadership. And so, I am looking forward to working with you and Secretary Burgum on that. Can I count on your support?

Mr. WRIGHT. We had a great dialogue about that, Senator, and absolutely, you can count on my support. It's a great way to frame this issue. We want to build a new American industry in artificial intelligence, and we want to lead the world in that industry, and boy, for our economic and national security, we'd better. You can't build any new industry without the energy to support it. So you have this vision that is a great coming together of a new manufacturing industry to manufacture intelligence and use the energy resources you have in Pennsylvania and attract the private investment capital to make it happen. I am all in on that.

Senator MCCORMICK. Thank you.

Finally, we have a major opportunity in Pennsylvania to leverage our natural gas resources and carbon capture and storage technologies to produce blue hydrogen. Will the Trump Administration, with your leadership, ensure that federal support for hydrogen development does not disadvantage blue hydrogen projects?

Mr. WRIGHT. Senator, I know of what you speak, but I would say it's too early for me to speak about trade-offs between different technologies and all that stuff, any commitments there. I will say again that the President, who I hope to be honored to serve, is very passionate about energy, about growing energy, about growing American production of energy, with the end not just for energy in itself, but to enable better lives for Americans, stronger power, economic and political security for our country. In every part of that mission, I think you will see this Administration's support.

Senator MCCORMICK. Great.

And finally, the Office of Fossil Energy has a storied history of driving innovations in the industry, including contributions to the shale revolution. One of the major labs is in Pittsburgh. How can we, you know, as you take leadership, if confirmed at the helm here, revitalize this office to focus on the next generation of fossil fuel innovations?

Mr. WRIGHT. Yes, you know, again, fossil fuels, again, who have powered the world throughout all of my lifetime and will continue to do so, have somehow fallen out of fashion and out of favor. So even though it's a critical technology for us, there has been less interest to invest in it, less interest to talk about it. I don't share those aversions. I am all about new technology to improve energy sources across the board, of course, including hydrocarbon energy sources as well.

Senator MCCORMICK. One of the things the Senator from Alaska said, which I am excited about too, is you are an innovator, you are a scientist. One of the consistent trends we have seen over the past decade is the reduction in carbon emissions as a consequence of technological innovation. So by developing these innovations, we have more national security, we have greater economic growth in places like Pennsylvania, and we have a cleaner environment. What energy innovations are you most excited about given the trends that you are seeing?

Mr. WRIGHT. Well, there are so many. As you are talking there about natural gas in Pennsylvania, it has been the biggest driver of reducing America's greenhouse gas emissions. On a per-capita basis, they were lower last year than any year since I was born. Like, think about that—this is not a recent trend. This is any year since I was born, and everyone knows my age now, so, I am not going to say it, but everyone knows it since it's my birthday. But thank you, Senator.

Senator MCCORMICK. Oh, you are going to end on happy birthday. Thank you.

The CHAIRMAN. Senator King.

Senator KING. You picked a hell of a way to spend your birthday. [Laughter.]

Senator KING. Mr. Wright, I think your position on climate change is more subtle than is publicly recognized. As I understand it, you don't deny that there is climate change happening in the world, and that things like sea level rise and warming are occurring, and that they are related to the combustion of fossil fuels, which has drastically increased the amount of CO_2 in the atmosphere. Is that correct?

Mr. WRIGHT. Absolutely, Senator. I enjoyed our dialogue about that and look forward to future dialogues about that. But yes, I have been outspoken about this for probably at least 20 years. Mostly from the combustion of hydrocarbons to enable our modern world, we have increased atmospheric CO_2 concentration by 50 percent.

Senator KING. And that has affected——

Mr. WRIGHT. Absorbs infrared radiation, makes it harder for the earth to shed heat.

Senator KING. But as I understand, your position is, as I say, more subtle. You see a tension between diminishing our reliance on fossil fuels and powering those six million people who don't have adequate energy sources today. That is the kind of balance that you are talking about, is that correct?

Mr. WRIGHT. Well stated, Senator. That is my view. Energy is critical to human lives. Climate change is a global challenge that we need to solve, and the trade-offs between those two are the decisions politicians make, and they are the decisions that will impact the future of our world and the quality of life.

Senator KING. Those trade-offs are critically important. I think there are two observations. One is, you have said there is no energy transition. You are a walking energy transition. What you did in your work in shale was an energy revolution in this country that transitioned us, in many ways, toward natural gas. So there is possible transition. It can happen either slowly, probably faster—fusion, SMRs, battery storage, all of those technologies. And I note that your company wasn't exclusively oil and gas, but it also has investments in battery technology, in nuclear SMRs. So you do believe that we do need to diminish, where we can, the emission intensity of our manufacture of energy?

Mr. WRIGHT. Absolutely, Senator. You are bringing me back to the great dialogue we had about energy, about climate change, about trade-offs, and I appreciate very much your comments today.

I am for improving all energy technologies that can better human lives and reduce emissions. They go together.

Senator KING. I would add one note, however, and I understand the tension, and I think that is reasonable. I remember saying years ago, we can't tell the Indian nation that they can't have air conditioning because we don't want them to be using energy. The thing that has to be considered though is, what if you are wrong. What if we are wrong and something really drastic happens. My concern that isn't discussed very much is a climate effect on the Atlantic currents. If something happened to the Gulf Stream, Britian and Scandinavia, would be uninhabitable. So I think we need to bear in mind that it's not as easy as saying we are going to help the Third World and we are going to keep burning fossil fuels, there is a significant risk that we have to have in our calculation. Would you agree?

Mr. WRIGHT. Senator, I agree with that comment as well. You know, in my writings on climate change, what I record a lot and talk about is what we do know, which is the past, up to today. Predictions are hard, particularly about the future. And so, yes, I think we need to be humble about that. We don't know what is coming in the future. But advancement of energy technologies that grow the amount of energy we have, drive down the cost, improve the quality, and lower emissions, those are all wins in all scenarios.

Senator KING. And I am hoping that ten years from now we will look back on this discussion as rather quaint because technology will have solved the problem. We are all working in that direction.

A couple of very quick questions. The Department of Energy has a role in approving LNG export terminals. It's supposed to determine the public interest, and I think Senator Hirono asked this, but I want to confirm that your office, your department, will consider the effect on domestic natural gas prices of expanded LNG export capacity.

Mr. WRIGHT. Absolutely true, Senator. Nothing is more important than the supply, the affordability, and the access to energy to Americans in America. So absolutely, that is a critical factor in that determination.

Senator KING. And one other question I want to—a couple of others I want to underline. Improving the energy structure of this country includes improved transmission, is that correct?

Mr. WRIGHT. Absolutely. That is one of our major bottlenecks today.

Senator KING. And one of the things I hope you will continue research on is what are called GETs—grid-enhancing technologies—which are non—you don't have to build a whole new tower, you can reconductor their technologies to improve the throughput of our grid. That, I think, is a direction we should move in. I commend the research on that to your department.

Mr. WRIGHT. Thank you, and I agree with that comment as well, Senator. Actually, it was a dinner discussion last night.

Senator KING. Well, I appreciate your testimony here today and look forward to working with you. This is a critical area. You bring a unique perspective and breadth of knowledge, and I appreciate your willingness to take on this challenge. Thank you.

Thank you, Mr. Chairman.

Mr. WRIGHT. Thank you, Senator.

The CHAIRMAN. Senator Daines.

Senator DAINES. Chris, good to have you here. I get the best view here to see your family, see Liz, and you had a grandbaby there for a while, but as new grandfather, like you, of six, I understand sometimes you have to step out—those busy moms and dads—but I did get a picture of that with your grandbaby there. I sent it to you as well. So you will have that as a memory from today.

But it's great to have you here. I mean, your track record is amazing, as an innovator, a scientist, mechanical engineer, electrical engineer. I am a chemical engineer, so we can geek out here for a moment, but I just appreciate your thoughtfulness, looking at trade-offs in this complex area as it relates to energy and being thoughtful and intentional going forward here with getting the right policies for our country. So thank you for stepping into the public service world. It's a sacrifice for you and your sweet family, and I want to thank you both for doing that.

As I step back and look at the numbers from a 30,000-foot view, I think we are going to need 50 percent more energy in the next 25 years than we currently consume today globally. This has got to be a discussion on how do we increase—how do we get more energy, not less, as we think about these trade-offs. I think you will play a really critical role here, when confirmed as our Secretary of Energy. Over the last four years, I have seen, I think, taking some steps backward, unfortunately. We saw pauses on LNG exports, prohibiting new coal leasing in eastern Montana, putting a pause overall on oil and gas development, even trying to ban new gas appliances. I think that's out of touch with where the reality is, and that's why I appreciate, I think, your pragmatism as you look at where truth is, where physics are, and what the demand is going forward.

One of the first things you can do as Secretary, I think, is to refocus the Department on pro-baseload energy policies. Baseload power resources, like coal, natural gas, hydropower, nuclear, I think, will ensure that we have access to reliable and affordable energy year-round, whether it rains or snows or the sun is shining or not. The world needs more energy, not less, and with the proliferation of data centers, thinking about, well, how do Google and Microsoft and others think about it right now, they are buying baseload power. They need to think about baseload power as a way here to fund what they need to do here as it relates to the revolution going on in AI, blockchain technologies, and quantum computing. I think the 50 percent forecasted is probably low, where this is probably actually going to land here. And you can help us get ahead of that curve.

So here is my question, Mr. Secretary to be—will you promote policies both at DOE and throughout the government that will expand energy development and ensure that reliable and affordable baseload sources of power are protected?

Mr. WRIGHT. Absolutely, Senator. If I get the honor and the privilege to be confirmed and to serve, the top goal of mine—you just summarized the top goal—our electricity grid. As I have said earlier in the testimony today, it has become more expensive and less reliable, reversing a 100-year trend where that was becoming

cheaper in inflation-adjusted cost and more reliable, and we have gone the other direction. We cannot go that direction. That's not good for America. It's not good for our industries. And that is a top priority of mine to work on.

Senator DAINES. I think we violently agree that reducing emissions is better through innovation, not regulation. What are some ways you think about how innovation could help drive a reduction in emissions?

Mr. WRIGHT. Yeah, I mean, if you look at the track record right now, almost all of the emission reductions in our country and across the globe, almost all of them have come from innovations. You know, in the United States, the biggest one by far has been the arrival of low-cost natural gas through the shale revolution. That was innovation. It was not imposed. We got low-cost gas, lower-emission gas, not just lower greenhouse gas emissions, but lower pollutants, lower particulate matter, lower SO_X, lower NO_X. That helps air quality. Countries that have reduced—a lot of country emission reductions that have been from regulation and from top-down mandates have actually not been the emissions reductions they appear to be, they have more been an emissions removal. You know, if you shut down industry in your country, or in your state, the emissions from that industry don't go away, they just go somewhere else. And if they go out of the United States, with the cleanest and most advanced manufacturing technology, those emissions just go up. So really the only pathway to reduce greenhouse gas emissions and lift up people's quality of life is through energy innovation. And America has been a hotbed of that, and we need to return a vigor and a focus on innovation on energy right here in this country.

Senator DAINES. All right. I am out of time. One final, quick sentence and statement is that, you know, Montana is becoming a quantum powerhouse. Places like Bozeman, my hometown, are leading some of this high-tech innovation. We have the Quantum Leadership Act that we are working on to spur more jobs and research in this area.

My question is, when confirmed, will you work with me to bolster quantum and other next-gen technologies?

Mr. WRIGHT. Not only I will, more importantly, this Administration will. This Administration and President-elect Trump are passionate about leading the next generation industries and leading them here in America. Absolutely.

Senator DAINES. Great. Thank you.

Mr. WRIGHT. Love your passion.

Senator DAINES. Thank you.

The CHAIRMAN. Okay, we will turn next to another new member of our Committee, the great Senator from the great State of Arkansas, Senator Cotton.

Senator COTTON. Thank you, Mr. Chairman. Mr. Wright, congratulations on your nomination. I apologize for my tardiness. I have been presiding over John Ratcliffe's hearing at the Intelligence Committee.

A geological survey recently found anywhere from 5 to 19 million tons of lithium reserves in the Smackover Formation, in particular, in South Arkansas. Can you commit to working with my office to

feasibly develop this rare and strategically vital supply of minerals?

Mr. WRIGHT. Senator, thanks for your question. Thanks for your service to our country. And absolutely, this is a different lithium production technology, to get it out of brines. There seems to be an enormous resource of it in Arkansas, and to the south of you. And I think that is an area of critical interest to our country and should be looked at, evaluated, and if it's commercially viable, developed.

Senator COTTON. Thank you very much for that commitment.

One of the responsibilities of the Department of Energy that is sometimes overlooked is the national laboratories. We do everything from nuclear development to quantum computing and other high tech, cutting edge. Unfortunately, these laboratories are a target of foreign espionage. In Fiscal Year 2023, more than 8,000 citizens from China and Russia were granted access to DOE national labs out of a total of 40,000 foreign users. It is my opinion, and the opinion of many other Senators, in particular on the Intelligence Committee, that the Department of Energy cannot continue to allow adversarial nations to exploit military and dual-use technologies for their own gain. What steps can you take to ensure that the Department's national labs and other sensitive facilities are not compromised by our adversaries?

Mr. WRIGHT. Thank you for the question, Senator. Thank you for your concern and focus on this issue. I have spoken at length today about what a treasure our national labs are, how they have transformed our country to where it exists today, and how they are really a vector to transform our country going forward as well. But if we have American innovation funded by American taxpayers performed by American citizens walk out the door and go to our foes for free and without knowing it, clearly that undermines our national security, that undermines our economic security. I am aware of the problem in concept. If I have the privilege to be confirmed and serve in this role, I will quickly learn a lot more about the problem, including working with the team there and across the Administration to find solutions to this critical problem you have identified. I agree with you about the gravity of the threat and the need to address it.

Senator COTTON. Thank you. I appreciate it. I will just say that, in our experience, many of the personnel at the labs are brilliant scientists who go on to become managers, but oftentimes, they have a purely scientific mindset and they have it in their minds that they collaborate openly with fellow scientists from around the world, which may be fine if we are dealing with French scientists or Japanese scientists, but I would say it's not the case with Chinese and Russian scientists. I would also point out that the equivalent kinds of sites in China and Russia are not nearly so open to American scientists, and that would violate President Trump's treasured principle of reciprocity with foreign nations.

Finally, another key responsibility of the Department of Energy that is sometimes overlooked is the National Nuclear Security Administration. It actually constitutes almost 50 percent of the Department's budget. Can you give us assurances that you will advocate that the NNSA receives adequate resources to complete this top-priority mission for our national security?

Mr. WRIGHT. Absolutely, Senator. I have significant concerns in that area. You know, our uranium enrichment capabilities in the United States have been denuded over the last few decades, even our ability to produce plutonium pits has collapsed to nearly nothing. There are some efforts in place to reverse that, but I want to make sure they move as fast and expeditiously as possible. That is the ultimate guarantor of the sovereignty of our nation, is our nuclear arsenal. That is not something we can cut corners on and not worry about.

Senator COTTON. Well, thank you very much. I appreciate, again, your testimony and your answers on these critical questions that are not always highlighted when you think about the Department of Energy, but they cross into our work on the Armed Services Committee and on the Intelligence Committee, where I believe we will see you in the future as well, in addition to vital energy development questions like the Smackover Formation.

So thank you very much for your testimony. Congratulations again. I look forward to working with you.

Mr. WRIGHT. Thank you, Senator, particularly for working two hearings at the same time.

The CHAIRMAN. Thank you, Senator Cotton.

Round one is now complete. And I hereby notify all members, if you want to participate in a round two, come back right away because round two tends to go pretty fast. We will start that now, again with five-minute rounds.

For the beginning of my second round, I just want to ask you a little bit about the Department of Energy's appliance standards programs. Some of these regulations are of concern, or at least ought to be noticed by the American people, as they impact all Americans in one way or another. They reach almost all equipment that uses energy to any significant degree in Americans' homes, so, dishwashers, clothes dryers, clothes washers, light bulbs, and a whole lot more. There are consumer protections, of course, built into the statute—protections that were designed to ensure that things wouldn't get too expensive and that, you know, quality didn't fall off the table in connection with them.

But in contrast to the previous Trump Administration, the Biden Administration has run somewhat roughshod over some of those consumer protections built into the law. This effort was, of course, in service of the Biden Administration's whole-of-government focus on reducing greenhouse gas emissions, sometimes to the exclusion of authorized statutory mandates. What will you do to ensure that maximum protections for American families and consumers will be recognized and respected, if you are confirmed as Energy Secretary, when implementing the appliance standards program?

Mr. WRIGHT. Thank you, Senator. Thank you for that question and for raising that concern. I can assure you that concern is on the mind of millions of Americans across the country. I hear it very often. You know, we want to drive—and the Department of Energy and the government want to drive innovation and more efficient technologies, meaning delivering the same end with less input. That's advancement. That's technology. But to take clothes dryers, for example, you know, it takes heat and it takes air flow, and both of those take energy. And I look at some new appliances today and

well, they use half the energy per minute, but if it takes an hour to dry your clothes instead of 30 minutes to dry your clothes, it's the same energy consumption and you lost a half an hour.

So does regulation go well beyond what is sensible and logical? It does a lot. It does a lot. And what I want to do is look at what is happening there, what is driving that analysis, and are we playing a role of a reasonable regulator or are we trying to check boxes or make achievements where the trade-offs are simply not worth it? I think you should always be a little humble and a little cautious when you are proposing to reduce the choices of American consumers.

The CHAIRMAN. That is a fair point, especially when you are dealing with administratively promulgated rules that themselves have the effect of generally applicable federal law. They are enforceable as such. If they are not complied with, they can result in massive fines. They can result in somebody's business getting shut down. They can even, in some cases, with some administratively promulgated regulations, result in prison time if you fail to abide by them. And so, that is all the more important, any time you are taking away consumer choice, that is of concern. Any time you are making new law outside the people's elected lawmaking branch, that is also a concern.

We have a number of things in front of us. One of the things that I have enjoyed reading is this document, which I understand you, yourself, wrote. It's entitled "Bettering Human Lives." And you see energy as playing a significant role in that. In this, you take on a whole bunch of different issues, including the fact that as a result of the fact that we, as Americans, have access to reliable, affordable, clean electric power. We are able to avoid a lot of problems that in many other countries they face. For example, you cite some alarming statistics from the government of Kenya. The Kenyan Ministry of Health talking about respiratory infections. Tell me how those relate to the availability of affordable, reliable electric power?

Mr. WRIGHT. Yeah, I view this as maybe, Senator, the most urgent energy challenge on the planet today, which is just simply the access of basic, clean cooking fuels, also used for heating, but all of our ancestors stayed warm and cooked food burning wood. And regrettably, more than two billion people on the planet today still burn wood indoors—sometimes charcoal or dung—but mostly wood, indoors, to cook their meals and keep their house at a safe temperature. That indoor air pollution kills over two million people every year. This is outrageous and it is entirely solvable. And in fact, one of the things I am most proud of from the shale revolution is that while we have well more than doubled oil production and nearly doubled natural gas production, we have quadrupled U.S. propane production. We have gone from the eighth largest exporter to by far and away the largest exporter, and we are making propane, that critical fuel that replaces wood to make people's lives longer, healthier, and more opportunity-rich.

A lot to be proud of in this country, but there are so many other energy challenges out there that are little-known, and therefore, not addressed. But we can do better.

The CHAIRMAN. Indeed, thank you.

Senator Heinrich.

Senator HEINRICH. Thank you, Chairman.

So I tend to approach energy with four goals, and one of the primary ones is affordability. Reliability is always non-negotiable. That is critical. And to the extent our policies can make them both abundant and clean, those are things that are incredibly important to my constituents. We have heard a lot about cost today, and I know you and I talked a lot about affordability when you visited me in my office. And so, I pulled up the latest cost data for wholesale generation costs in cents per kilowatt-hour from Lazard. Would you consider Lazard data to be fairly reliable?

Mr. WRIGHT. Well, Lazard is——

Senator HEINRICH. They were the easiest to pull up, but——

Mr. WRIGHT. They are the most famous for publishing statistics on levelized costs of energy.

Senator HEINRICH. Got you. No subsidies involved, levelized.

Mr. WRIGHT. Levelized misses the boat on electricity generation because it treats it like—would you take an Uber that was 10 percent cheaper in cost if you didn't know when the Uber was going to show up and where it was going to drop you off?

Senator HEINRICH. So one of the reasons why I raised this is because in New Mexico I think we have been able to do both of those things at the same time. So we have pursued both affordability—actually, I should say, all three things: affordability, reliability, but also clean. And I know in 2023 there was a statement that you made that said, wind and solar energy will "likely never leave single digits." I guess that is a percent of total energy. And I know you understand the difference between the grid and transportation and heat energy that we use in our total energy balance, but when it comes to the grid in New Mexico, in just my utility, which we talked a little bit about in my office, they now produce 58 percent of their generation from carbon-free renewables and nuclear, nuclear being the smallest of that at about seven percent, solar being 35 percent, and wind being 15 percent of their kilowatt-hours.

So that means that when you combine that with storage resources, which are primarily getting charged by clean excess renewables, that their penetration rates are now well into the 60s, even the low 70s. When Chris Wright says these resources will likely never leave single digits, it's one thing; but if the Secretary of Energy says that, I think people will get a different impression. So how do you square those two very different datasets?

Mr. WRIGHT. Thank you, Senator. And I appreciate the question, I appreciate our shared interest in affordable, reliable, secure energy, and I think New Mexico has done some great things there. Globally, which is what I talk about mostly in that report, in 2023, the last year for which we have full data, wind, solar, and batteries were 2.6 percent of global primary energy. In the U.S. they are a little more than three percent, but not wildly higher than the global. Electricity only delivers 20 percent of global primary energy. So getting, you know, 50 percent in electricity, which would be an incredibly high penetration, that would be double digits. But where most of the energy is consumed in the world today, and where it's growing the fastest, is in South Asia, Southeast Asia, North Africa, and through the—mostly South Asia and Southeast Asia. These are

countries with very poor wind resources and actually not very good solar resources. India has got some dry places and some deserts and good resources, but Vietnam, Malaysia, Indonesia, if you go to the places where energy growth is rising the fastest, they don't have great energy. They don't have great wind and solar resources.

Senator HEINRICH. That was the context of your statement in 2023.

Mr. WRIGHT. Global energy.

Senator HEINRICH. Because I want to make sure that we understand what we as a country are accomplishing, and if you just look back at the last year's worth of data, the first 11 months of 2024, and you look at new generation, the vast majority of that—and I don't have the figure in front of me, but it came out in the last couple of weeks—the vast, vast majority of that is all clean energy. And so, if we can take some of these lessons from what we have been able to accomplish as a world leader in energy and use them to help people in the world have access to the abundance that you talked about, I just think it's important to understand the rate of change in some of these systems is not linear. And so, we are seeing, for example, last year in the U.S., the vast majority of that generation on the electric grid being clean.

Mr. WRIGHT. I agree, Senator. Thank you, and I appreciate your passion for numbers, and energy as well. Thank you for the good comments.

Senator HEINRICH. We need more data guys.

The CHAIRMAN. Senator Murkowski.

Senator MURKOWSKI. Thank you, Mr. Chairman, and I appreciate the opportunity for a second round here.

I mentioned critical minerals. I would like to ask you more—a little bit more about geothermal because as we think about these areas of opportunity, there is a lot of focus on wind and solar, and I don't mean to be pointing to my friend from Colorado there, but geothermal is kind of like, it's the mature technology because it has been around for a while, but the technologies that are being used nowadays are not necessarily what we have seen in the past. You have had an interest in this—a business interest—and I am a little bit excited to know what you think the potential is for you in this new role at DOE to help accelerate more in the geothermal development space and reduce some of the project uncertainty.

So I am looking for better assurance for some of those bright people who have these crazy wild ideas that we can do things on Adak and Unalaska and out on Mount Spurr to try to reduce these barriers to entry in an energy area that has been around for a long time. It shouldn't be so hard. What can we do? And are you excited about it from a DOE perspective?

Mr. WRIGHT. Very much so, very much so. Look, I am uprooting my life and moving to Washington, DC, if I get the honor and privilege of being confirmed, because I love energy, all kinds of energy for all Americans. And I love that you highlight geothermal, just a tremendous potential energy source. I worked on this 30-some years ago and wrote some papers about it, and a new idea called hot dry rock, where geothermal today is where there are hot rocks, approachable, they have fractures in them so fluid can flow and they are full of water. Well, that is a small set of the microcosm,

but anywhere we drill, right here, we drill three miles underground, it is exceedingly hot. That energy is sitting there. So the idea of hot dry rock is to inject water into a well, flow through that rock and therefore take some of the heat out of that rock and make that water very hot and then flow it up and produce electricity from it, produce heating for homes or houses. It's just an enormous abundant energy resource below everyone's feet.

Senator MURKOWSKI. Can I interrupt you and just ask you to save that energy and passion for when you are confirmed as Secretary of Energy and elevate this within the Department. I know everybody wants to get to the top of the list, but if I can express disappointment with what I have seen within the Department of Energy over the years, we have seen great things in great areas, and geothermal just kind of sits back there as kind of the forgotten child. And we are not going to allow that to happen. So I appreciate that passion.

Let me ask you about Alaska's natural gas. You have talked a lot about how we have really seen this revolution when it comes to being able to access our natural gas through the fracking. You know Alaska. You have been up there. You know our issues. Congress has approved a loan guarantee for an Alaska gas line, and I would just ask for your support, if confirmed, that you are going to work with the delegation to help stand up the loan guarantee through regulations, whatever may be necessary, to ensure that DOE can actually accept the application when the project proponents are ready. It should be an easy answer.

Mr. WRIGHT. Yes, Senator, tremendous resources in Alaska of oil, natural gas, minerals, mining, logging, geothermal, you have got it all. You have got it all. And to grow natural gas production in Alaska, and build infrastructure to export that to the world, given how close it is to the biggest, fastest growing markets in the world in Asia, I think, is a tremendous idea.

Senator MURKOWSKI. Well——

Mr. WRIGHT. Great for our country, great for Alaska, and I am confident that President-elect Trump will be a champion of these ideas of growing American energy production and influence in the world.

Senator MURKOWSKI. Well, we have got it, as you mention. We have it and we are ready and willing, we just need good partners at the federal level to help us advance this.

And last point on that, we have seen some really critical energy investments in Alaska as a result of the Infrastructure Investment and Jobs Act. A lot of folks on this Committee helped with that, but the DOE programs that are funded by IIJA have provided a lot of benefit to Alaska projects so far. Most of them are already underway. They range for everything from the rural renewable energy investments, carbon storage, transmission upgrades is huge, demonstration of long-duration storage. So I just want your assurance that we are going to still be able to continue these projects as a priority within DOE. What we have started, we don't want to have a drop-off here. We want to have a smooth transition for these existing DOE projects to be able to continue to allow us to build out that infrastructure, that transmission capacity that is going to

allow for a betterment of Alaskans and really our opportunity to help Americans.

Mr. WRIGHT. I am thrilled to see the breadth of energy innovation in Alaska, and would love to see that continue, and expect that it will continue.

Senator MURKOWSKI. Are you going to come up and visit?

Mr. WRIGHT. Absolutely.

Senator MURKOWSKI. I figured it didn't take much of an invitation. I appreciate the fact that you have ties to the area already, and I appreciate that, but thank you for your willingness to give the Committee this much time. I know that you have a lot more energy, but I think that your grandson is probably bored with us, so it might be time to end, Mr. Chairman.

The CHAIRMAN. I think his grandson seems riveted, actually.

[Laughter.]

The CHAIRMAN. Before we go to Senator Hickenlooper, I will note that—love the geothermal discussion. Senator Heinrich and I have a bill together on geothermal. We have access to heat like that, and might as well harness it, just as we would with Puff the Magic Dragon. If we could find and harness him, we would make power out of him somehow.

Senator Hickenlooper, and then we will go to Senator Hoeven.

Senator HICKENLOOPER. Thank you, Mr. Chair.

And again, glad to be back. I don't think I have to extend an invitation to come to Colorado.

[Laughter.]

Mr. WRIGHT. I accept.

Senator HICKENLOOPER. And I do appreciate, and there was some—I understand how quickly things were working and how hard you worked to get your financial information and your ethical disclosures, the FBI background check that we didn't get it until—I didn't. I never saw it. I had a dinner last night and then I had meetings starting this morning. But I do look at geothermal, which I share your enthusiasm, and I want to ask a question about how rapidly you think you can scale, but it's something so promising, obviously, you thought through your conflict of interest in something like that where you have helped, you dramatically—you have been part of the catalyst to allow the geothermal that we can imagine at its scale—at least I can—I am imagining it at scale. You fought through that. I don't have any of the numbers in front of me yet.

Mr. WRIGHT. Yes, thank you for that question, Senator. But my involvement with a particular company, I think a leader in next-generation geothermal, Fervo Energy, I will sever all ties, all financial involvement with Fervo——

Senator HICKENLOOPER. Right.

Mr. WRIGHT [continuing]. In everything I do in energy. I am still passionate about it. I am going to be a champion for it, but even in my world in the small modular reactor, our company, and I am a director of one of those small modular reactor companies, but I am cheering for all of them. And yes, I will sever all of my ties from across the whole energy space, but I won't sever my passion for seeing those technologies advance to better American lives.

Senator HICKENLOOPER. I appreciate that, and I appreciate that you are open to discussing it with other Senators, if they have—once they have seen those documents, that they have questions, I appreciate that.

Mr. WRIGHT. Absolutely, yes, given the compressed time frame, if anyone has any questions about anything in my disclosure form, as you know, sometimes to your detriment, I am an open book and so are you.

[Laughter.]

Senator HICKENLOOPER. Fair enough.

In terms of geothermal, and you know the details better than I—how rapidly can we get that to scale, because the transformational capability of that, as you have described before, it can do some of the making of things. It can be high temperature that actually does displace hydrocarbons in a successful way.

Mr. WRIGHT. So Fervo, right now, is building a 400-megawatt plant in Senator Lee's state, and one of the reasons they can do it in that scale is there already is nearby electrical infrastructure, but Senator, we will circle back to everyone's top issue today—one of the limiters in the growth of geothermal are there are so many resources out there, but there are not easy ways to connect to power lines to sell that power to users.

Senator HICKENLOOPER. Right.

Mr. WRIGHT. There are a number, so we are going to see gigawatts come on in the next few years, but could it be tens of gigawatts? With infrastructure, it could.

Senator HICKENLOOPER. Well, we are aligned on that. And I have a couple bills that we have worked on, the BIG WIRES Act. You will get immersed in all that soon enough.

Let me talk a little bit about nuclear waste, because we haven't really talked about that, but you know, I was someone, when I was a kid—protested against nuclear energy, couldn't get my arms around how we deal with the waste. I think looking now at some of the risks of climate change and the potential and the possibility that acceleration of climate change is worse than they think makes the nuclear issues around the waste—we still have to deal with it and deal with it safely. Do you have any ideas on how to do that and help, especially some of the younger people in this country who are very concerned about that, that nuclear as a solution—but it's clean. It has high temperature capability. It can do so many things if we can figure out how to deal with the waste.

Mr. WRIGHT. Yes, and I think that concern of kids and us when we were young and everyone else of nuclear, and of climate change—they are all very justified concerns. These are real things. Radioactive materials are dangerous. But fortunately, I think with engineering and sensible regulation and safeguards, I think the nuclear waste problem is one of the most manageable problems because the volume of waste is relatively small. We have been selling commercial nuclear power for over 70 years, and all of that waste today is in swimming pools on location cooling off at the start, and then it's in big dry casks, right on location, in urban or suburban areas, and it has been there for 70 years. And the radioactivity near those power plants is lower than Grand Central Station in New York City—the subway station.

So I think even without a permanent repository, we have been able to do that in a safe way. It is better in the long run to have a more remote, probably deep storage, but there are many ways to do it. I think the politics of it are the trickiest part, but they matter. You need to have people on board. We don't want people with fear and anxiety about what's going on. So it's a political and social challenge, but technically can we deal with nuclear waste safely? I believe firmly we can and we have.

Senator HICKENLOOPER. Well, thank you, and I am out of time, but I do—I think that discussion, and we are going to have to figure out how to have that national discussion to make sure people are aware of how engineering and how technology and innovation can help us make sure that is truly safe.

Thank you.

Mr. WRIGHT. Thank you, Senator.

The CHAIRMAN. I hope we are not actually seeing them in swimming pools where people are swimming.

[Laughter.]

The CHAIRMAN. Senator Hoeven.

Senator HOEVEN. Thank you, Mr. Chairman.

Chris, I am also on Defense Appropriations, and I just want to follow up for a minute on a question that was asked by Senator Tom Cotton, and that is the work of the NNSA and the national labs in regard to our military. In my state, we have the only dual nuclear mission base—Air Force base—in the country. And the work at the NNSA and the national labs is vital as we upgrade our nuclear triad. Will you commit to work with me on that very important function for DOE on behalf of our country, and you know, our military?

Mr. WRIGHT. Absolutely, Senator.

Senator HOEVEN. Okay.

Mr. WRIGHT. This is foundational to our security, to our way of life.

Senator HOEVEN. Right on.

I want to thank you for your very open and articulate responses across the board this morning, just an outstanding job. And I mean open, knowledgeable, and articulate, and I think all of us on the Committee could see that very clearly.

And the only other thing I would put forth, is there anything else that you would want to put on the record? I just want to give you that opportunity, you know, before we adjourn, and the Chairman may well do that as well, but if there is anything else, I want to give you that opportunity, anything you wanted to respond to or anything else that you wanted on the record.

Mr. WRIGHT. Well, thank you, Senator, for that. I will end with just a couple comments that have been in my mind. One is to come back to Senator Heinrich and say New Mexico has fantastic solar and wind resources and you have responsibly developed them. So look, I don't want you to feel there is more tension or disagreement there than it sounds like.

The other thing I will end with, and I think we share that, everyone in this room, is the importance of energy and the affordability of it. Ten percent of Americans got a disconnection notice for their utilities in the last 12 months. You know, more than 20 percent of

Americans report struggles paying their bills, whether it's paying their energy bills, you know, whether it's filling their car with gas or heating their home or paying their electricity bill. So this is important. It's not just important for national security and industry and all that, it's important for the quality of life of every American.

So I thank every one on this Committee for being dedicated to energy and natural resources. I am honored—would be honored—to work with you all on this just critically important thing, and energy is the infrastructure of life. It's what makes everything possible. Thank you all for the great dialogue, questions today, and thank you for your service to our country.

The CHAIRMAN. Thank you so much, Mr. Wright. I really appreciate you being here. My colleagues and I, we can be a lively bunch, and you have handled our questions, responded well to them, and I appreciate your family coming. I want to thank the members of the Committee and the Committee staff and especially the Capitol Police who have been here today to keep us safe and keep things orderly. Thank you for your work.

The record for today will stand open and ready to receive questions for the record until 6:00 p.m. today.

And we stand adjourned. Thank you very much.

[Whereupon, at 12:45 p.m., the hearing was adjourned.]

APPENDIX MATERIAL SUBMITTED

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

Questions from Chairman Mike Lee

Question 1: A December 2024 report from the Daily Caller exposed that the U.S. government has awarded sensitive research grants to scientists affiliated with Chinese Communist Party talent programs. This included funding for research conducted at our national laboratories—facilities overseen by the Department of Energy that are at the core of our national security and technological innovation. In fiscal year 2023, thousands of Chinese nationals were granted access to Department of Energy national laboratories.

If confirmed as Secretary of Energy, what specific steps will you take to:

- Identify and mitigate the oversight failures that allowed scientists affiliated with foreign talent recruitment programs to obtain access to our national laboratories?
- Strengthen DOE's vetting process for foreign nationals to prevent further exploitation by foreign adversaries?

Response: Protecting U.S. innovation and intellectual property is essential for national security and economic competitiveness. I intend to be fully briefed on this upon confirmation by DOE officials and determine any additional steps that should be taken to ensure necessary protections are in place related to foreign talent recruitment, proper vetting and awarding of sensitive grants, and access to national laboratories given mounting global threats meant to undermine our great nation.

Question 2: The Biden administration required "Community Benefits Plans" for the billions of dollars of awards it issued. These plans could require discrimination and other actions of dubious legality.

- Will you review the requirements DOE has imposed in recent years and included in its awards to ensure the federal government is not funding or requiring actions that could result in discrimination? This is especially true of awards to Universities which could violate Title VI of the Civil Rights Act of 1964.

Response: Yes, I intend to direct a full review of DOE requirements imposed in recent years for DOE issued awards to ensure the federal government is not funding or requiring actions that could result in discrimination. I appreciate you bringing this to my attention and I look forward to working with you on this and other issues.

Question 3: Over the past few months, I have met with numerous electric utilities. The overarching theme in those meetings is the challenge of meeting the demand for electricity, which is growing faster now than it has in decades. In the near future, our country could potentially see dozens of gigawatts of demand growth, largely from data centers and manufacturing. Building energy infrastructure take years and sometimes decades. What role can and should DOE play to help meet this demand while keeping the grid reliable, affordable, and secure?

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

Response: President Trump is committed to lowering energy costs and that means prioritizing cutting red tape, enabling private sector investments, and building the infrastructure America needs to make energy more affordable for families and businesses. This is an essential duty and objective for the Department of Energy and through my work as Secretary of Energy, if confirmed, and as a member of the National Energy Council, I will be an unabashed steward for all sources of affordable, reliable and secure American energy and the infrastructure needed to develop, deliver and secure them.

Questions from Ranking Member Martin Heinrich

Question 1: The strength of our National Labs lies in the diversity of their science and engineering programs. Even at nuclear weapons facilities like Los Alamos, a key factor in attracting and retaining top talent is the opportunity for scientists to collaborate with leading experts across a wide range of fields. Do I have your commitment that you will not reduce research capabilities and staffing for open science at our DOE National Labs?

Response: Open science is an important part of technological and scientific innovation and I am committed to supporting the missions and expertise of DOE National laboratories.

Question 2: Artificial intelligence will radically change the nature of national security science and engineering by accelerating the rate at which scientific discoveries are made and by broadening access to knowledge that was previously only available to a few experts. If confirmed, how will you build on DOE's proposal, known as the Frontiers in Artificial Intelligence for Science, Security and Technology or FASST initiative to ensure that our National Labs help us lead the world in AI for science and national defense?

Response: Artificial intelligence is changing the face of industries, leading to scientific breakthroughs and a host of other societal advancements. If confirmed, I look forward to learning more about the FASST initiative and identifying other ways to support our national laboratories in leading the world in AI for science and national security.

Question 3: New Mexico's Waste Isolation Pilot Plant, or WIPP, is essential to our Nation's nuclear cleanup liability. I was pleased to see all affected parties were able to successfully negotiate a settlement agreement with DOE on the facility's next ten-year permit term. The agreement includes improved safeguards and oversight as well as prioritization for legacy defense waste from places like the Los Alamos National Labs. Do I have your commitment that you will follow through on the terms of this agreement?

Response: I look forward to visiting the Waste Isolation Pilot Plan and New Mexico's leading national laboratories with you in the year ahead. I intend to review the terms of the settlement agreement upon confirmation. Improved safeguards and oversight are important for all DOE facilities, including WIPP, and I will prioritize them.

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

Question 4: The GAO and National Academies have reported that the cleanup mission could be accelerated and save on costs in the long run if larger investments in R&D on innovative cleanup technologies were made in the near term. Despite these findings, annual investments in R&D have steadily declined to only tens of millions of dollars over the years. Do you think the U.S. government should be investing more in cleanup R&D?

Response: Investments in research to accelerate and lessen America's legacy waste is important and I will do my best to balance this research against other departmental objectives.

Question 5: Many U.S.-based cloud computing companies are eager to build their new data centers abroad due to easier access to fossil energy generation and the ability to build more quickly. What is your plan for incentivizing these companies to build more of these data centers in the U.S. and have them be powered by as much clean energy as possible?

Response: Access to affordable, reliable, and secure energy is essential criteria in attracting and powering data center investment in America. I will work to implement President Trump's important energy agenda to unleash American energy to spur private sector investment and drive U.S. innovation.

Question 6: Over its history, the Department of Energy has funded research, development, and deployment with the private sector that has led to significant breakthroughs in energy technology, made loan guarantees to support innovative energy technologies, and participated in public-private partnerships on energy demonstration projects. These initiatives are critical to our continued global competitiveness and energy security. Will you continue to execute the existing contractual agreements DOE has in place with the private sector?

Response: U.S. global competitiveness and energy security are top priorities of mine and of President Trump and the incoming administration. I will keep these priorities and perspectives in mind on balancing funding priorities that lead to scientific breakthroughs with the other departmental and Administration priorities.

Question 7: This week, NASA confirmed that 2024 was the warmest year on record. Earlier this year, Hurricane Helene killed 104 Americans in many areas thought to be safe from hurricanes. There were 27 individual weather and climate disasters this year with at least $1 billion in damages. This summer, Phoenix, AZ experienced more than 100 days above 100 degrees. And the wildfires in California are ongoing, where the Palisades fire is larger than 23,000 acres and only 17% contained and dozens have been killed. While I'm glad to hear that you've previously recognized the presence of climate change, I am concerned by your view that the federal government should do nothing to address climate change.

- Do you believe the federal government should play a role in avoiding or mitigating the impact of these climate events?
- If no, who should be responsible for the cost and damage?
- If yes, what role can the Department of Energy play?

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

- How would you leverage existing expertise in the agency to make energy access more reliable and to allow families and communities to recover more quickly from the rising frequency of natural disasters that damage the grid and cause blackouts?

Response: These are global challenges that we can and should address. They require relentless innovation driven by cutting edge research from DOE National laboratories and private sector research. My life's passion has been bettering human lives, and I've spent my entire career focused on access to energy sources to lift people out of poverty. If confirmed as Secretary of Energy, I will continue that work to support unlocking all U.S. energy resources that meet criteria as affordable, reliable, and secure for all Americans.

Question 8: According to the First Street Foundation, about 35.6 million properties, or a quarter of all U.S. real estate, are facing higher insurance costs and lower coverage as a result of climate risk. Moreover, as climate change worsens, more than 1.9 million home insurance contracts have been dropped since 2018 in states across the country, like Florida, Louisiana, North Carolina, and New Mexico. Families and businesses now face not only soaring insurance costs, but finding coverage can be difficult or impossible.

- Do you acknowledge that climate change is making natural disasters, like hurricanes and fires, more frequent, intense, and catastrophic?
- With the increasing frequency and severity of extreme weather events exacerbated by climate change, and the consequent rise in home insurance premiums and companies dropping customers every day, do you think the Department should do anything to help avoid or mitigate these impacts to families?
- Rising insurance rates piled on rising electricity costs can break families' budgets. Is there anything you hope to do, as Secretary of Energy, to reduce the financial burden of these rising costs on American families?
- Do you believe rescinding funding from programs, like DOE's Home Energy Rebate Programs, would help families with rising costs make ends meet?

Response: The most important factor regarding extreme weather is the impact that it has on human lives. Wealthier societies with abundant access to affordable energy are far safer places to live than they were a century ago. A large majority of deaths from extreme weather are concentrated in poorer nations with high rates of energy poverty. Spreading energy access to those currently in energy poverty is the key to further driving down deaths from extreme weather. President Trump is committed to driving down the cost of energy and, if confirmed, I intend to evaluate the DOE Home Energy Rebate Program and other DOE efforts focused on supporting American families and businesses.

Question 9: The U.S. insurance sector held $536 billion in fossil fuel related assets in 2019. Greenhouse gas emissions from fossil fuels are exacerbating climate change, causing more frequent and more severe extreme weather events. That means insurance companies are exacerbating the risks to their own investments. They are also refusing to underwrite policies for homes whose risk from wildfires and hurricane catastrophe has increased.

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

- As Secretary of Energy, would you encourage insurance companies to diversify their investments and invest in other energy sources that do not exacerbate climate change, like those that the Department of Energy has long supported through grants and financing?

Response: While this is not generally the purview of the U.S. Department of Energy, I appreciate you sharing your thoughts on this issue with me and I will take them into account if confirmed as Secretary of Energy.

Question 10: In pushing for increased fossil fuel production, you've argued that the benefits of energy access outweigh the impact of climate change. You've said that increased energy production is critical for American prosperity. However, fossil fuels contribute to climate change, leading to extreme weather events. These events, combined with insurance companies abandoning them, leaves Americans exposed to financial hardships trying to protect their homes – often their largest asset.

- Given these challenges, do you think the Department should continue supporting efforts to accelerate the 2,600 gigawatts of batteries and mostly clean generation rather than helping produce more fossil fuels?

Response: I have been an investor and partner with companies in sodium-ion battery technology for decades. My view is that the world needs more energy, achieving this requires contributions from all viable energy technologies. I will review the Department's efforts to support and accelerate battery technology and other energy generation.

Question 11: Do you agree that climate-related financial risks—such as rising costs of natural disasters and withdrawing insurers from high-risk markets—amplify traditional risks like credit, market, and liquidity risks which will impact new energy development?

Response: The greatest obstacles to new energy development are lack of infrastructure, lack of the ability to build infrastructure as well as regulatory uncertainty. President Trump is committed to unleashing American energy, cutting the cost of energy and securing energy independence.

Question 12: Given the increasing challenges in the home insurance market due to climate change, would you support federal initiatives to stabilize insurance availability and affordability, such as the creation of Housing Resilience Agencies or other public-private partnerships? What specific policies would you propose to address this crisis?

Response: While this is not generally the purview of the U.S. Department of Energy, I appreciate you sharing your thoughts on this issue with me and I will take them into account if confirmed as Secretary of Energy.

Question 13: With climate-related disasters threatening the financial viability of insurance providers and raising costs for homeowners, how would you ensure that federal and state deregulatory actions do not exacerbate these vulnerabilities? What role do you see the Treasury and other financial regulators playing in fostering climate resilience in the insurance sector and beyond?

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

Response: While this too is not generally the purview of the U.S. Department of Energy, I appreciate you sharing your thoughts on this issue with me and I will take them into account if confirmed as Secretary of Energy.

Question 14: You said to me at your confirmation hearing that "Globally... in 2023, the last year we have full data, wind, solar, and batteries were 2.6% of global primary energy. In the U.S., they're a little more than 3%, but not wildly higher than the global."

However, consulting the Energy Institute (formerly the BP Statistical Review of World Energy)'s data, it appears that the actual numbers for 2023 are 6.0% (world) and 6.6% (U.S.) for share of primary energy production from wind and solar.[1]

On this same topic, at a speech at Hart Energy given in November,[2] you said: "You hear the number 4[%] and 5[%] all the time in the press, and even from the EIA. What's the difference between my number and their number? The difference is mine is right and theirs is wrong. And the EIA does this funny trick. They take the energy produced from wind and solar, and then they multiply it by two and a half. Well, if you multiply something by two and a half, you make it a lot bigger. You turn 2% into 5%. But it's shameful."

I find this worrisome, given the role you would have overseeing the EIA if confirmed. I understand you to be saying in effect that for fossil fuels we should count the energy embedded within the fuel (some of which is invariably wasted as heat in most practical applications), but for nuclear and renewables we should count only the power in the form of electricity at the output of a plant. Only by comparing inputs to outputs in this fashion can you get a number like 2.6% rather than the Energy Institute's 6.0% number. Your approach would seem to me to systematically undercount the contribution of nuclear and renewable energy to our economy.

I want to pose a simple example to you: suppose a simplified version of the U.S. economy consumed just 2 TWh energy—for the sake of this example in the form of electricity. And suppose that 1 TWh came from a coal plant with 40% thermal efficiency and 1 TWh from a solar farm.

In this simple example (2 TWh of electricity; 1 from solar, 1 from coal), what percentage of U.S. energy would you say came from coal and what percentage from solar?

If your answer is "50% apiece," can you explain how to square that with the numbers you cited at our hearing and your remarks at Hart Energy? If your answer is not "50% apiece," can you explain what you see as the advantages of an accounting system that produces such counterintuitive results?

---

[1] https://ourworldindata.org/explorers/energy?tab=chart&Total+or+Breakdown=Select+a+source&Energy+or+Electricity=Primary+energy&Metric=Share+of+total&Select+a+source=Solar+and+wind&country=USA~OWID_WRL

[2] https://www.hartenergy.com/exclusives/us-energy-secretary-nominee-chris-wright-champions-energy-dug-gas-211134

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

Response: Senator, thank you for raising this important technical issue. The short answer is - it's complicated. The longer answer is best discussed in person with you and your staff. I would welcome the opportunity to discuss my thinking on these issues with you during our next meeting and also hear your perspectives.

Question 15: With electricity demand now projected to increase a staggering 128 GW over the next five years due to AI, a welcome resurgence of domestic manufacturing and other factors, it's clear we're going to need a lot more electrons – as well as a power grid capable of delivering those electrons from where they're produced to where they're consumed. With that in mind, can you speak to your support for building out and modernizing our electric grid – and what steps you think we need to take to meet the urgency of this challenge?

Response: Strengthening, modernizing, and protecting the electricity grid and other critical infrastructure is a top priority. I am evaluating steps to meet the urgency of this challenge and I look forward to sharing more analysis and insight with you and hearing from you in the months ahead if confirmed.

Question 16: The United States private sector is lagging in financing innovative energy solutions. Are you committed, if confirmed, to using the creative financing mechanisms that Congress gave the Department, such as its loan authority, to derisk energy innovations and effectively catalyze private sector investment to bring these solutions to market?

Response: Energy and scientific investments are critical to the Department of Energy's mission. I intend to evaluate DOE programs and other mechanisms to spur energy innovation and private sector investments.

Question 17: The Department of Energy's Loan Programs Office (LPO) recently made its first conditional commitment under the Tribal Energy Financing Program (TEFP) for a solar microgrid on Viejas Band of the Kumeyaay Indians lands. If confirmed, will you ensure that the LPO issues more Tribal Energy Loan Guarantees to help Tribes increase energy development on their lands?

Response: I appreciate the insight you shared with me when we met about the Department's loan guarantee program. I intend to evaluate its efforts to date and all mechanisms to spur energy innovation and private sector investments. Continued Federal engagement with Tribes is important.

Question 18: DOE is the largest federal sponsor of basic research in the physical sciences. DOE's world-leading research in the physical, chemical, biological, environmental, and computational sciences contributes fundamental scientific discoveries and technological solutions that support the nation's primacy in science and innovation, i.e., global competitiveness.

- Can you speak to the contributions of clean energy technologies to securing America's energy security and global competitiveness, as is evident through creating

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

jobs, bolstering domestic manufacturing, and leading to the development of innovative technologies?

- Can you commit to this Committee that as Secretary of DOE that you will not undermine clean energy research, development, demonstration and deployment activities; and will support DOE's "all of the above" energy strategy?
- Can you commit to this Committee that you will not slow or hinder the work of DOE scientists and other employees, including refraining from suppressing climate and related science research and public communications such as reports? \

Response: I am quite passionate about energy innovation and have been my entire life. The company I founded is an investor and partner with companies in next-generation geothermal energy, small modular nuclear reactors, and sodium-ion battery technology. A thriving society must be energized by affordable, reliable, and secure technologies. While in modern history and for the foreseeable future hydrocarbons have been and are essential to this goal, innovation and scientific breakthroughs in energy research abound and DOE has an important role in fostering this innovation as well as accelerating breakthroughs that benefit America and the rest of the world.

Question 19: One of the U.S. Department of Energy's (DOE) primary forums for assisting state and local governments in implementing cost-effective and productive energy systems for American homes, communities, businesses, and industries is the Office of State and Community Energy Programs (SCEP). Established in 2022 through the Bipartisan Infrastructure Law, SCEP extends the capacity and capabilities of states, tribes, local governments, schools, and community-serving organizations to instill high-impact, self-sustaining clean energy initiatives focusing on low-income and disadvantaged communities. This is accomplished through managing and overseeing formula grants, competitive grant awards, consumer rebate grants, and technical assistance.

- Programs like the DOE Weatherization Assistance Program (WAP), housed within SCEP, have made significant progress in reducing energy costs for low-moderate income households by providing cost-effective building shell improvements such as insulation and air sealing; heating, ventilation, and air conditioning systems; lighting; and appliances. Home weatherization has several other major benefits beyond making homes more energy efficient. For example, they also support household health and quality of living by improving indoor air quality, improving safety by removing energy-related hazards like carbon monoxide leaks, creating stable jobs in the local community, and lowering household carbon emissions.
- Do you agree that we should utilize every tool in our toolbox to help everyday Americans lower their energy bills – including through WAP investments designed to improve energy affordability?
- Can you assure this Committee that under your leadership, DOE will not slow or hinder access to WAP and other SECP assistance programs designed to aid Americans save money on energy, especially those living in rural, Tribal, energy transition, and other disadvantaged communities?

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

Response: I look forward to learning more about the Office of State and Community Energy Programs and the Weatherization Assistance Program at the Department. President Trump has set an ambitious goal to lower American energy costs, and I intend to evaluate all tools across the Department to meet this objective. All communities must be reached with this important objective.

Question 20: Do you agree that climate-related financial risks—such as rising costs of natural disasters and withdrawing insurers from high-risk markets—amplify traditional risks like credit, market, and liquidity risks which will impact new energy development?

Response: The greatest impact today to new energy development is a lack of access to affordable, reliable, and secure energy and necessary infrastructure. Companies evaluate and report risk today in their annual disclosures.

Question 21: Given the increasing challenges in the home insurance market due to climate change, would you support federal initiatives to stabilize insurance availability and affordability, such as the creation of Housing Resilience Agencies or other public-private partnerships? What specific policies would you propose to address this crisis?

Response: While this is not generally the purview of the U.S. Department of Energy, I appreciate you sharing your thoughts on this issue with me and I will take them into account if confirmed as Secretary of Energy.

Question 22: With climate-related disasters threatening the financial viability of insurance providers and raising costs for homeowners, how would you ensure that federal and state deregulatory actions do not exacerbate these vulnerabilities? What role do you see the Treasury and other financial regulators playing in fostering climate resilience in the insurance sector and beyond?

Response: While this too is not generally the purview of the U.S. Department of Energy, I appreciate you sharing your thoughts on this issue with me and I will take them into account if confirmed as Secretary of Energy.

Question 23: This week, NASA confirmed that 2024 was the warmest year on record. Earlier this year, Hurricane Helene killed 104 Americans in many areas thought to be safe from hurricanes. There were 27 individual weather and climate disasters this year with at least $1 billion in damages. This summer, Phoenix, AZ experienced more than 100 days above 100 degrees. And the wildfires in California are ongoing, where the Palisades fire is larger than 23,000 acres and only 17% contained and dozens have been killed. While I'm glad to hear that you've previously recognized the presence of climate change, I am concerned by your view that the federal government should do nothing to address climate change.

- Do you believe the federal government should play a role in avoiding or mitigating the impact of these climate events?
- If no, who should be responsible for the cost and damage?
- If yes, what role can the Department of Energy play?

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

- How would you leverage existing expertise in the agency to make energy access more reliable and to allow families and communities to recover more quickly from the rising frequency of natural disasters that damage the grid and cause blackouts?

Response: Climate change is a real and global challenge that we can and should address. It requires relentless innovation driven by cutting edge research from DOE National laboratories and private sector research. My life's passion has been bettering human lives, and I've spent my entire career focused on energy sources to lift people out of poverty, and I'll continue that work if confirmed as Secretary of Energy to support unlocking all U.S. energy resources that meet criteria as affordable, reliable and secure for all Americans.

Question 24: According to the First Street Foundation, about 35.6 million properties, or a quarter of all U.S. real estate, are facing higher insurance costs and lower coverage as a result of climate risk. Moreover, as climate change worsens, more than 1.9 million home insurance contracts have been dropped since 2018 in states across the country, like Florida, Louisiana, North Carolina, and New Mexico. Families and businesses now face not only soaring insurance costs, but finding coverage can be difficult or impossible.

- Do you acknowledge that climate change is making natural disasters, like hurricanes and fires, more frequent, intense, and catastrophic?
- With the increasing frequency and severity of extreme weather events exacerbated by climate change, and the consequent rise in home insurance premiums and companies dropping customers every day, do you think the Department should do anything to help avoid or mitigate these impacts to families?
- Rising insurance rates piled on rising electricity costs can break families' budgets. Is there anything you hope to do, as Secretary of Energy, to reduce the financial burden of these rising costs on American families?
- Do you believe rescinding funding from programs, like DOE's Home Energy Rebate Programs, would help families with rising costs make ends meet?

Response: The most important factor regarding extreme weather is the impact that it has on human lives. Wealthier societies with abundant access to affordable energy are far safer places to live than they were a century ago. A large majority of deaths from extreme weather are concentrated in poorer nations with high rates of energy poverty. Spreading energy access to those currently in energy poverty is the key to further driving down deaths from extreme weather. President Trump is committed to driving down the cost of energy and, if confirmed, I intend to evaluate the DOE Home Energy Rebate Program and other DOE efforts focused on supporting American families and businesses.

Question 25: The U.S. insurance sector held $536 billion in fossil fuel related assets in 2019. Greenhouse gas emissions from fossil fuels are exacerbating climate change, causing more frequent and more severe extreme weather events. That means insurance companies are exacerbating the risks to their own investments. They are also refusing to underwrite policies for homes whose risk from wildfires and hurricane catastrophe has increased.

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

- As Secretary of Energy, would you encourage insurance companies to diversify their investments and invest in other energy sources that do not exacerbate climate change, like those that the Department of Energy has long supported through grants and financing?

Response: While this is not generally the purview of the U.S. Department of Energy, I appreciate you sharing your thoughts on this issue with me and I will take them into account if confirmed as Secretary of Energy.

Question 26: In pushing for increased fossil fuel production, you've argued that the benefits of energy access outweigh the impact of climate change. You've said that increased energy production is critical for American prosperity. However, fossil fuels contribute to climate change, leading to extreme weather events. These events, combined with insurance companies abandoning them, leaves Americans exposed to financial hardships trying to protect their homes – often their largest asset.

- Given these challenges, do you think the Department should continue supporting efforts to accelerate the 2,600 gigawatts of batteries and mostly clean generation rather than helping produce more fossil fuels? partner with companies in sodium-ion battery technology for decades.

Response: My view is that the world needs more energy, better energy and achieving this requires contributions from all viable energy technologies. I will review the Department's efforts to support and accelerate battery technology and other energy generation.

Question 27: While the federal government has substantially invested in the commercialization of novel energy technologies, there are some solutions like fusion that are undervalued and underinvested in by the U.S. The US stands to lose its lead in fusion energy in the race against China who is currently investing $1-1.5 billion annually. The U.S. spends $800 million annually on its fusion program but less than half of that is dedicated toward commercialization. If confirmed, how will you work to ensure that DOE moves additional money into commercializing fusion so that the U.S. is the first country to realize the benefits of fusion power?

Response: I intend to evaluate fusion technologies and related work underway at the Department of Energy in its innovation and commercialization if confirmed.

Question 28: It is clear that the development of emerging technologies, like artificial intelligence, can unlock groundbreaking advancements for public health, energy security, national defense, and our economy. Whoever leads in the development of emerging technologies will gain a significant edge in driving broader scientific and technological innovation. Our adversaries, such as China, have publicly pledged to invest tens of billions of dollars in emerging technology research and development.

- Do you believe the United States should increase their investment in emerging technology research and development? What role should the Department of Energy play in the development of these technologies?

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

Response: Artificial intelligence is changing the face of industries, leading to scientific breakthroughs and a host of other societal advancements. If confirmed, I look forward to identifying ways to support our national laboratories in leading the world in emerging technology research and energy innovation.

Question 29: The DOE and the Labs are uniquely positioned to carry out work in detecting and mitigating emerging technological threats related to biotechnologies and nuclear security. As Energy Secretary, how will you provide strategic direction to the Department and Labs in addressing safety and security concerns of the technology?

Response: Security and protection of the critical work of DOE's National laboratories from foreign intervention will be a top priority of mine. Given the role of Los Alamos and Sandia National Laboratories in New Mexico, I look forward to working closely with you on this issue of national importance.

Question 30: There is an undeniable financing gap called the "missing middle" for first-of-a-kind energy technologies looking to commercialize and deploy at scale. These types of companies are looking to demonstrate their tech at pilot- or large-scale have outgrown venture capital investors but are too risky for traditional infrastructure investors. If confirmed, what will you do to ensure that the federal government closes this gap and helps to fast track the solutions that need to get to market now to meet growing electricity demand and national security concerns?

Response: I will evaluate the work of DOE programs and efforts such as ARPA-E, which was established to foster, support, and demonstrate technology solutions to meet growing electricity demand and national security.

Question 31: Through the Bipartisan Infrastructure Law, the federal government has invested in the demonstration of next generation energy technologies across the United States. If confirmed, will you commit to ensuring these demonstrations are successful and eventually deployed at commercial scale to bring new jobs and industries across America?

Response: I support the demonstration of next generation energy technologies and will look for all ways to meet our shared goal of bringing new jobs and industries to America through access to affordable, reliable and secure American energy.

Question 32: The demand for skills in AI, cyber security, and data science has surged in recent years, yet the supply of skilled workers remains inadequate. Bridging these skills gaps is crucial for securing the future of the American workforce. What would you do as Energy Secretary to develop the world's best STEM workforce?

Response: America's strength is fueled by the most innovative and skilled workforce in the world. Bridging the skills gap is a priority as we seek to lead the world in innovation. This is not just in our universities and high schools, but trade schools and apprentice programs.

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

Fostering future leaders with a passion for science, technology, engineering and mathematics is crucial for U.S. competitiveness, security and innovation in this century and beyond.

Question 33: Next-generation geothermal is an emerging energy source with immense potential. The DOE's Commercial Liftoff report estimates that next-generation geothermal could provide 90 GW of clean, firm energy by 2050, and up to 300 GW depending on the development of storage capabilities and other emerging technologies. Geothermal energy is also 24/7 firm energy produced in the US, building on innovations from the US oil and gas industry. This represents an opportunity for the US to lead the world in energy innovation while producing huge amounts of power. However, next-generation geothermal is an emerging technology that needs support to reach commercial scale. There is emerging bipartisan support in Congress and on this committee to take action to accelerate geothermal energy. Will you commit to prioritizing geothermal energy, and if so, how?

Response: I have had a front row seat to the potential of advanced geothermal technology. I am optimistic about advancing geothermal technology deployment and will examine ways to accelerate it.

Question 34: Presently, transmission and generation constraints across the country are restricting economic growth, including data center development. What actions are you prepared to take to support increased energy development and alleviate the burdens of permitting processes for energy infrastructure?

Response: President Trump campaigned on unleashing American energy at home and abroad to restore energy dominance. To compete globally, I will evaluate every path to increase energy production, including commercial nuclear and liquified natural gas, and cut the cost of energy. I will also work with my colleagues to examine the permitting process to reduce barriers for building critical infrastructure. Such barriers make energy more expensive and less reliable.

Question 35: With electricity demand now projected to increase a staggering 128 GW over the next five years due to AI, a welcome resurgence of domestic manufacturing and other factors, it's clear we're going to need a lot more electrons – as well as a power grid capable of delivering those electrons from where they're produced to where they're consumed. With that in mind, can you speak to your support for building out and modernizing our electric grid – and what steps you think we need to take to meet the urgency of this challenge?

Response: Strengthening, modernizing, and protecting the electricity grid and other critical infrastructure is a top priority. I am evaluating steps to meet the urgency of this challenge, and I look forward to sharing more analysis and insight with you and hearing from you in the months ahead if confirmed.

Question 36: The industrial and manufacturing sector has been the backbone of American economic growth and development. Over the last several years, U.S. companies—often with the support of the Department of Energy—have led the world in industrial innovations to modernize our factories to make them more efficient, resilient, and competitive in the global marketplace.

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

DOE funding and partnership are vital to accelerating the commercialization and deployment of these technologies and maintaining American leadership in critical sectors like steel, cement, and chemicals.

- If confirmed, can you commit that DOE will continue administering programs supporting industry and manufacturing across the technology development spectrum, including the Industrial Demonstrations Program supporting over 30 manufacturing projects across the country? Will you commit to ensuring there is adequate leadership and coordination within the Department across technology and program offices supporting industry and manufacturing to promote efficient, practical private sector engagement? If confirmed, will you direct the Department to work with private sector producers and buyers of industrial goods to ensure these innovations can scale and be widely adopted?

Response: The onshoring of energy-intensive manufacturing is critical to the future of our country. A critical component of manufacturing investment is access to affordable, reliable and secure energy and critical infrastructure and I commit to working to elevating these energy priorities at the Department of Energy if confirmed.

Question 37: My home state, New Mexico, is at the heart of US nuclear energy innovation, with a legacy of national laboratory leadership and now, key activities under the Advanced Reactor Demonstration Program or ARDP. The Kairos Power demonstration, as well as the Pathway 1 demonstrations of TerraPower's and X-energy's technologies, will pave the way for clean energy deployment, high-paying energy jobs, and US global energy leadership to counter the growing influence of our adversaries, including China. Getting these demonstrations across the finish line is essential and will require continued federal investment and partnership. How do you plan to continue moving the ARDP projects forward, particularly to ensure they can meet their ambitious timelines of operation by 2030?

Response: I look forward to learning more about the Advanced Reactor Demonstration Program and its importance in countering the growing influence of overseas adversaries. I look forward to discussing the program's ambitious timeline and partnering with you if confirmed as Secretary of Energy.

Question 38: Clean hydrogen technologies will play an important role in not only decarbonizing hard-to-abate sectors of our economy, such as industry and heavy-duty transportation, but also maintaining US competitiveness in these key sectors while providing tangible economic benefits to Americans. Will you ensure and support the continued leadership of DOE on the development of such technologies, so that they are successfully implemented and allow the private sector to succeed?

Response: I will work to foster the continued leadership of DOE in supporting the development and successful implementation of energy technologies that deliver all forms of affordable, reliable and secure American energy.

Question 39: The Department of Energy is responsible for implementing programs to support innovation in industrial manufacturing. Through partnerships with leaders in the private sector,

these programs are anticipated to create and maintain tens of thousands of high-quality jobs across the country and help accelerate the development and adoption of emerging industrial technologies – technologies that can help America regain a competitive edge in the production of materials like steel and aluminum that are critical for our defense industrial base. What will you do to ensure the successful implementation of these important programs and the long-term viability of key manufacturing sectors?

Response: I will support innovation in industrial manufacturing through the work of DOE's national laboratory network.

Question 40: Major sectors of the U.S. economy are experiencing shortages and delays with delivery of capital equipment – especially power generation and distribution equipment – and materials. Specifically, the lead times for transformer orders, particularly distribution transformers, increased from three to six months in 2019 to 12 to 30 months in 2023 (U.S. DOE, Office of Electricity, "DOE and Industry Team Up to Keep the Lights On for America"). What actions are you prepared to take to increase domestic manufacturing capacity, diversify sourcing options, and foster collaboration between government, industry, and research institutions to help alleviate supply chain constraints for critical electrical infrastructure?

Response: Strengthening the supply chain for critical electrical infrastructure will be part of my planned review of America's electricity grid and goal of outlining steps for modernization. To protect Americans against cyber and other attacks and account for new sources and improved efficiencies, we must tackle the challenges that come with aging electricity infrastructure and if confirmed, I will focus on this important task.

Question 41: In the last Congress, we saw extensive bipartisan support for investments into US nuclear fuel availability to reduce our dangerous reliance on Russia. A robust supply of high-assay low-enriched uranium or HALEU for the next generation of advanced nuclear reactors allows us to secure this essential energy source and regain US leadership in the nuclear space from Russia, the only commercial supplier of HALEU globally. How will you strengthen US nuclear fuel enrichment capabilities, and how will you speed implementation of federal commitments to ensure advanced reactors are fueled on time to commercialize?

Response: America's domestic supply of enriched uranium is essential for the United States. I will evaluate the Department's current plans and our approach to the HALEU program to ensure this program is successful.

Question 42: You have said that if confirmed, you will step down from the board of Oklo, a nuclear company with business before the Department of Energy. Will you also divest and recuse yourself from decisions concerning this company?

Response: Upon confirmation, I will resign from my position with Oklo, Inc. I will forfeit my unvested restricted stock units upon my separation from Oklo, Inc. Pursuant to the impartiality regulations, for a period of one year after my resignation, I also will not participate personally or substantially in any particular matter involving specific parties in which I know Oklo, Inc., is a

party or represents a party, unless I am first authorized to participate by the Department's designated ethics official.

Question 43: There is widespread bipartisan agreement our supply chains, including for batteries and minerals, need to be more secured. Industries working on battery recycling and alternative battery chemistry are vital to that effort, not to mention they are huge job creators and are far more sustainable than primary extraction. DOE has been essential to battery recycling and creating more efficient and sustainable batteries. Do you support continuing investments and work at DOE on methods such as a circular economy and alternative battery chemistries?

Response: Innovation is at the center of DOE's national laboratories and I will evaluate investments and the work underway at DOE, such as advancing a circular economy and alternative battery chemistries.

Question 44: During Trump's first administration, the presidential budget request showed the administration's resolve to retreat from a federal role in advancing a clean energy economy and maintaining global leadership in the growing energy markets. For example, the first Trump administration repeatedly proposed slashing funding for DOE's Office of Energy Efficiency and Renewable Energy and eliminating the Advanced Research Projects Agency-Energy (ARPA-E) program. These recommended funding cuts would have crippled support for a myriad of novel and promising technologies. Congress rejected these presidential proposals, recognizing that the greatest successes in reducing climate emissions and creating a cleaner, more affordable, and more reliable energy economy can be attributed to the transformational role of federal renewable energy innovation programs such as EERE and ARPA-E.

- Will you commit to this Committee that you will oppose proposals to cut DOE's budget and staffing from current levels? Will you commit to oppose layoffs? Reductions in DOE's workforce through attrition? Will you commit to opposing efforts to traumatize staff into quitting? Will you commit to maintaining civil service protections and reject replacing career professionals with political appointees?

Response: I will evaluate the work of ARPA-E, which was established to foster, support and demonstrate technology solutions and I look forward to working with you and your staff on advancing all domestic forms of affordable, reliable and secure energy.

Question 45: Established in 2021, the Office of Clean Energy Demonstrations (OCED) was created with bipartisan support and plays a critical role in efforts to reduce emissions, foster U.S. leadership in the global clean energy innovation landscape and strengthen our domestic industrial base. By supporting large-scale demonstrations, the office fills an essential and longstanding gap within DOE's portfolio for clean energy technologies and energy innovation that hindered the commercialization of new clean energy solutions coming out of lab or pilot scale. Specifically, OCED helps solve critical issues around how to build markets and demand for new clean energy technologies, essential to their widescale deployment and to spurring private sector investments. OCED's current portfolio is focused on scaling and commercializing technologies such as clean hydrogen, carbon capture and removal, and grid-scale energy storage. As a core pillar of our nation's efforts to reduce emissions while providing opportunities for American leadership, jobs,

and foreign competitiveness, OCED helps to ensure that U.S. communities receive a return on public investments in research, development, demonstration, and deployment. This type of innovation is crucial to establish the U.S. at the cutting edge of valuable and globally exportable technologies.

- OCED's foundation is still nascent, and its workforce is steadily growing to expand the program's capabilities and expertise as selected awarded and proposed projects scale. Will you commit to this Committee that you will continue to support the program's strategic workforce planning needs, which includes aligning human capital needs with mission and programmatic goals?
- Do you commit to supporting OCED's awarded projects?

Response: If confirmed, I will evaluate OCED's awarded projects and the program's strategic workforce planning and I look forward to working with you and your team on ways to spur private sector investments.

Question 46: The Office of Energy Efficiency and Renewable Energy recently published a report titled "2024 EERE Investment Snapshot: Advancing Energy Innovation Across America." This report detailed EERE's impressive investment portfolio, including a map of EERE's almost 2,000 active awards across the country – including an active award in every state. The report also details the longstanding relationship that EERE-funded national labs have with universities, research institutions, tribes, and the private sector. These partnerships create a holistic approach to research and development, engaging various stakeholders throughout the process to provide technological breakthroughs that keep the U.S. on the cutting edge of global innovation.

- How will you approach DOE's longstanding role in fostering energy innovation through investments across the research, development, and demonstration learning curve to ensure the United States remains globally competitive?
- As you know, DOE has invested in an all-of-the-above approach to energy technologies. As Secretary, will you continue to support all of DOE's applied energy offices, including those under the Energy Efficiency and Renewable Energy (EERE) portfolio?
- What will you do as Secretary to protect and foster the longstanding relationships between DOE's applied energy offices and our national labs with non-governmental actors such as universities and other research institutions, state and local governments, tribes, and the private sector?

Response: DOE national laboratories are the crown jewel of our nation's scientific research and technology innovation. I look forward to fostering their important work in all forms of affordable, reliable and secure energy and evaluating their partnerships with non-governmental organizations, such as universities and other research institutions, state and local governments, tribes, and the private sector as well as trade and apprenticeship programs.

Question 47: I have immense respect for this nation's National Labs, which the Energy Secretary has the great honor of overseeing. It is critical that we have these rigorous and apolitical scientific institutions to inform our policy and keep our nation safe and prosperous.

- Can I expect that you will share my respect for science and the work of these labs?

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

- If your National Labs were to put out a study, would you trust it and ensure that DOE policy is informed by the evidence the study contains

Response: I share your perspective on the great national asset we hold in DOE's national laboratories and would be honored to foster and support the research they produce if I am confirmed as Secretary. I look forward to working with you and your team on DOE policies in the years ahead.

Question 48: Globally, we are beginning to see markets emerging based on the emissions intensity of industries, such as the European Commission's carbon border adjustment mechanism and the ICAO CORSIA Sustainable Aviation Fuel mandate. How will you approach DOE's role in ensuring the United States can stay globally competitive in these emerging markets through investments in lower-emitting technologies?

Response: I share the president's goal to shepherd U.S. leadership in technology innovations and energy solutions to unleash all forms of affordable and reliable energy. I look forward to working with you and the Committee to ensure the U.S. fosters global competitiveness and leadership in emerging energy markets through policy solutions and the work of U.S. national laboratories.

Question 49: In a 2023 video you posted to LinkedIn, you denied the existence of a climate crisis and disputed a global transition to clean energy. Even though you've claimed not to question the existence of climate change, you have publicly criticized policies aimed at tackling the climate crisis, including DOE's goal to reach net-zero carbon emissions by 2050, labeling such policies as misguided and alarmist. You've also claimed that any negative impacts of climate change are "clearly overwhelmed by the benefits of increasing energy consumption." Such assertions are in strong contradiction with national and global scientific data. Your previous comments lead me to question your preparedness to lead DOE, a federal scientific agency that actively develops clean energy technologies and solutions to combat the climate crisis through its various national laboratories and research programs. Thus, the agency is a key player in the fight against climate change within the federal government.

- If confirmed, do you commit to not undermining the scientific integrity of the DOE?
- If confirmed, do you commit that your decisions on the agency's behalf are rooted in sound science?
- Can you commit to ensuring that DOE's clean energy programs have the resources they need to continue the vital research, development, demonstration, and deployment of next-generation technologies?

Response: I call myself a science geek turned tech nerd turned energy entrepreneur, and I respect and will continue to respect scientific innovations and varying viewpoints. Throughout my lifetime, technology and innovation have immeasurably enhanced the human condition. We must protect and accelerate the work of the Department's national laboratory network to secure America's competitive edge and its security.

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

Question 50: You currently own a $50 million stake in Liberty Energy, the fracking company that you founded and led. As the Energy Secretary, you will be responsible for decisions that could further enrich companies like Liberty Energy.

- How will you address and eliminate any conflict of interest between your stake in Liberty Energy and your ability to carry out the position of Energy Secretary. What will you do to ensure that you are putting the best interests of the American people above your personal financial gain? And will you agree to be fully transparent regarding DOE decisions that impact Liberty Energy or other companies in which you hold a financial stake?

Response: Upon confirmation, I will resign my position with Liberty Energy and divest my interests in Liberty Energy as soon as practicable but no later than 90 days after my confirmation. In the interest of ensuring the highest standards of integrity, I have taken all actions recommended by the Office of Government Ethics – as are outlined in form OGE-278e – to ensure impartiality and reduce any conflicts of interest – real or perceived – to best serve the President upon confirmation as Secretary of Energy.

Questions Senator James E. Risch

Question 1: Idaho National Laboratory in my home state is the global leader in nuclear energy research and development, which is key for our energy and national security. Will you continue to support this critical nuclear research and development at the Department and our national labs?

Response: Senator, I enjoyed visiting with you about the Idaho National Laboratory (INL) and discussing its long history in nuclear energy research and development as well as other missions, including cybersecurity. I will continue to support INL's important mission. I am a strong believer in the essential nature of nuclear energy and research in advanced nuclear solutions for America's long-term competitiveness, energy independence and national security.

Question 2: As authorized by Congress, the federal dams in the Northwest provide a tremendous amount of power to ratepayers in my state, as well as transportation of various products and other benefits. This electricity is affordable, clean, reliable, and dependable and should not be used as a political football as millions of people in our region face affordability, resource adequacy, and grid reliability challenges. Despite this, hydropower dams in the Northwest were constantly targeted by the last administration. Are you supportive of our hydropower resources and can I count on the opportunity to engage with you on how to correct the numerous ill-conceived promises of the Biden Administration when it comes to Northwest hydropower as it relates to the Department of Energy?

Response: I look forward to working with you and your staff on hydropower and learning more about your views on the appropriate role of the Department of Energy in fostering all forms of affordable, reliable and secure energy and necessary infrastructure in the Pacific Northwest.

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

Question 3: The future of the American economy is rooted in our technological dominance, including advanced AI and semiconductor research and production. If we are going to stay competitive, we need a reliable, cost-effective, and safe electricity grid. What should we do to ensure we can meet the electricity demands of America's technology industry and should nuclear energy play a role?

Response: President Trump is committed to unleashing all forms of affordable and reliable energy and cutting the cost of energy. In 2019, under President Trump's leadership, U.S. nuclear energy production was the highest on record. Nuclear energy will play an important role in the rapidly increasing demand for electricity from data centers and artificial intelligence. Strengthening, modernizing, and protecting the electricity grid and other critical infrastructure is a top priority.

Questions from Senator Ron Wyden

Question 1: The experts at DOE and the National Labs have worked in partnership with the Department of the Treasury to implement and administer energy tax credits. Do you commit to letting this technical, scientific work continue without interference?

Response: I look forward to learning more about the Department of Treasury's energy tax credits and the Department of Energy's expertise, including at its national laboratories, in supporting this work.

Question 2: The energy tax credits passed in the Inflation Reduction Act embrace technological neutrality in energy policy because we don't know where the low-carbon fuels of the future will come from. How will you work with the National Labs to innovate new ways to reduce carbon emissions from the energy sector?

Response: If confirmed, I look forward to identifying ways to support our national laboratories in leading the world in emerging technology research and energy innovation.

Question 3: According to a new analysis, repeal of the Inflation Reduction Act would raise energy prices by an average of 10% for consumers across the country–in some states it would be much higher - over $250/year for households in four states, for example. How will you ensure Americans continue to enjoy the clean energy and energy-saving benefits that will lower costs while ensuring cleaner air and water? In what ways will the administration advance the development of low-carbon and low-cost energy sources?

Response: America is blessed with abundant resources to power our economy. Yet today regulatory and permitting uncertainty has hastened investments in all sources of affordable, reliable, and secure American energy, which means higher inflation and higher energy costs. President Trump is committed to unleashing U.S. energy resources and spurring investments in necessary infrastructure to attract manufacturing supply chains back to America. If confirmed, I will work across the Department of Energy to support unleashing all forms of affordable and reliable energy – including clean energy – and fostering technology innovations.

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

Question 4: If confirmed, will you work with my office and the Bonneville Power Administration (BPA) to ensure the Department of Energy prioritizes investments in modernizing and expanding BPA's transmission system to meet growing demands and support the Pacific Northwest's economic and clean energy goals? As part of DOE's oversight of BPA, will you commit to working with my office to ensure BPA has the resources and tools needed to meet the region's infrastructure and energy challenges effectively?

Response: Strengthening, modernizing, and expanding transmission systems and other critical infrastructure is a top priority. I look forward to working with you and your staff to better understand the region's infrastructure and energy challenges and support the Bonneville Power Administration.

Question 5: Wildfires today are not your grandfather's wildfires, regardless of what one thinks causes them. Can you clarify that you will continue the work at DOE to increase the resilience of the electricity grid to extreme weather such as wildfires?

Response: The most important factor regarding extreme weather is the impact that it has on human lives. Increasing the resilience of the electricity grid and other critical infrastructure is essential to better human lives and secure America's economic competitiveness and energy independence and I will evaluate all work underway on this important priority.

Question 6: Oregon and many states across the nation are charting their own energy futures, with ambitious goals to reduce carbon emissions. If confirmed as Secretary of Energy, will you respect the decisions Oregon and other states have made to move toward renewable energy and overall lower carbon-emitting energy sources?

Response: In President Trump's first term in office, without sacrificing any economic gains, American energy became cleaner than ever before. The United States led the world in greenhouse gas emissions reductions, having cut energy-related CO2 emissions by 12 percent from 2005 to 2018 while the rest of the world increased emissions by nearly 24 percent. I look forward to learning more about the Department's efforts in clean energy research and development and ways states are deploying energy technology.

Question 7: Congress appropriated funds to DOE specifically to establish four regional Direct Air Capture (DAC) Hubs around the country. DOE's work on the DAC Hubs must not be interrupted at this critical juncture, or we will risk falling behind to other countries, notably foreign countries of concern. Under your leadership, will DOE continue to fund the DAC Hubs program, as required by law, and allow the current DAC Hubs Notice of Funding Opportunity to proceed as intended?

Response: If confirmed, I look forward to learning more about DOE's work on Direct Air Capture Hubs and understanding your views on the best ways to lead the world in energy innovation and technology breakthroughs.

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

Question 8: The DOE Loan Program Office has the loan guarantee program which supports jobs, domestic manufacturing, and U.S competition with China when it comes to innovation. Would you support the DOE loan guarantee program as the Secretary of Energy? Will you be expanding the program for domestic producers of minerals and expediting acceptance for their projects?

Response: I look forward to learning more about DOE's Loan Guarantee program and other DOE programs directed by Congress.

Question 9: The current 'meaningful consultation' standard isn't working for many tribes. Federal projects that have impacts on tribes are approved with minor or no changes as a result of tribal input. Do you support the Administration's adoption of Free, Prior, and Informed Consent for impacted Indigenous communities, especially for DOE financed projects?

Response: I support meaningful engagement with native American tribal councils and will seek to accommodate their preferences where feasible and appropriate.

Question 10: Our supply chains, including for batteries and minerals, need to be more secure. Industries working on battery recycling and alternative battery chemistry are vital to that effort, not to mention they are huge job creators and are far more sustainable than primary extraction. DOE has been essential to battery recycling and creating more efficient and sustainable batteries. Do you support continuing investments and work at DOE on methods such as a circular economy and alternative battery chemistries?

Response: Innovation is at the center of DOE's national laboratories, and I will evaluate investments and the work underway at DOE, such as advancing a circular economy and alternative battery chemistries.

Question 11: The Energy Secretary has the great honor of overseeing this nation's National Labs, which are rigorous and apolitical scientific institutions that inform our policy. Will you maintain a respect for science and findings provided by scientists? If the National Labs were to publish a study, would you trust the results and ensure that DOE policy is informed by the evidence the study contains?

In December, the DOE released a study on the impacts of LNG exports, informed by rigorous scenario-based analysis performed by the National Labs on the economic, environmental, and security implications of additional LNG export authorizations. Can you confirm that you will take this study into account when determining whether additional LNG exports are in the public interest of the American people?

Response: I share your perspective on the great national asset we hold in DOE's national laboratories and am honored for the potential opportunity to foster and support the research they produce. I look forward to working with you and your team on DOE policies in the years ahead.

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

Question 12: The Department of Energy has already permitted LNG exports equal to 50% of U.S. gas production, and President-elect Trump has promised that his energy department will rubber-stamp large volumes of additional capacity as one of his first acts in office. The recent DOE report found that approving additional authorizations would raise gas costs for Americans by 30%, while also raising electricity prices and the costs of manufactured goods. Will you approve additional volumes of LNG exports at the expense of American households struggling with the costs of natural gas, electricity, and consumer goods? Are there any limits on exports you would support to protect American families, for example in times of gas or electricity price spikes?

Response: I will ensure that DOE considers reliable and accurate information related to LNG export applications consistent with its legal obligations, including whether the exports proposed by the applicant are in the public interest as required by the National Gas Act.

During his first term in office, President Trump's energy revolution put the U.S. among the top three LNG exporters in the world. The Trump administration streamlined LNG permitting and allowed long-term LNG export authorizations to be extended through 2050. President Trump granted more than 20 new long-term approvals for LNG exports to non-free trade agreement countries. LNG exports increased five-fold since January 2017, reaching an all-time high in January 2020, while delivering low domestic natural gas prices. LNG exports reduced the American trade deficit by over $10 billion.

Question 13: The clean energy investments being made in the US have led to a major manufacturing renaissance - hundreds of billions of dollars in private investments helping create jobs in cities, suburbs and rural communities across the country. How will you continue to support this trend? Do you agree that homegrown clean energy must be a part of delivering American energy dominance? Do you support President Trump's vow to claw back these investments even though it would mean the loss of hundreds of thousands of jobs, with a high proportion in Republican districts?

Response: The security of our nation begins with energy. If confirmed, I will focus on unleashing American energy at home and abroad to restore energy dominance. Some policymakers have viewed energy as a liability instead of the immense national asset that it is to the United States. It is a priority for President Trump to expand energy production from all affordable, reliable, and secure U.S. sources and cut the cost of energy for all Americans.

Question 14: The devastating impacts of extreme weather are all around us and are harming communities and costing taxpayers tremendously–with science making it clear that climate change is worsening these disasters. Do you think taxpayers or polluters should be paying for the damage being wrought by climate change-fueled extreme weather?

Response: The most important factor regarding extreme weather is the impact that it has on human lives. The best path to address extreme weather is to make massive improvements in energy technologies that can deliver low-carbon energy that is also low cost, reliable and secure.

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

Question 15: For the first time in a number of years, utilities are seeing increased demand for electricity, thanks to the explosive growth and electrical needs of data centers, electrification of the transportation fleet and buildings, and reshoring of manufacturing projects. The fact that we've seen sizzling-fast deployment of solar and wind in the past few years has blunted price increases, given that clean energy is the cheapest and fastest source of energy to bring online. What would you do to ensure that clean electricity projects continue to ramp up production and drive down energy costs for families? In order to avoid rolling brown and black outs, we must invest in critical transmission infrastructure, and new generation. What do you think the Federal Government's role is in updating critical energy infrastructure?

Response: Private investment is critical to strengthening and updating our critical infrastructure. If confirmed, I intent to evaluate opportunities to unlock private investment, including by making government more efficient for the American people. Updating our nation's energy infrastructure is imperative for providing affordable and reliable energy to the American people, and for America to remain at the global forefront of technology.

Question 16: Will you follow the laws that dictate your service and the mission of the Department or Office you are being considered to run? And will you uphold those laws even when pressured by President Trump to disregard them in order to score political points? Will you commit to refuse illegal orders, follow the law, and serve the public, not just the president's personal interests?

Response: My practice is to follow the law.

Question 17: Expanding transmission capacity is essential to interconnecting new electric generating resources to the grid and meeting growing electricity demand. Through its Coordinated Interagency Authorizations and Permits (CITAP) Program, DOE has made good progress in streamlining the permitting process for building critical transmission infrastructure. CITAP allows the Department to serve as a lead agency in environmental reviews and sets a 2-year timeline for the completion of such reviews. If confirmed, do you commit to using this program to expedite transmission corridor buildout? And do you have thoughts now about how can DOE further reduce the average time it takes to site and permit transmission projects?

Response: I agree that expanding transmission capacity is important to securing and modernizing a resilient electricity grid to meet growing electricity demand. I commit to learning more about the Department's work and programs on this important priority.

Question 18: Since the passing of the Bipartisan Infrastructure Law, the US has established itself as a global leader in the hydrogen space, thanks in large part to the establishment of the Regional Clean Hydrogen Hubs program. This DOE program establishes seven clean hydrogen hubs that demonstrate how hydrogen technologies can be a significant value-add for multiple sectors of the economy. The Boston Consulting Group found a global market size of $3 trillion for clean hydrogen, and programs like the Regional Clean Hydrogen Hubs will put the US in a much stronger position to compete against rivals like China by demonstrating the commercial viability of clean hydrogen and its use in various sectors. According to a recent Rhodium Group

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

analysis, the hydrogen hubs program also has the potential to create tens of thousands of long-term, good quality jobs for everyday Americans working in multiple sectors of the US economy. Five of the seven selected hydrogen hubs have finalized agreements to receive their first tranche of DOE funding. Will you commit to protecting the Regional Clean Hydrogen Hubs program and ensure that this program and the resources that Congress has provided is implemented sufficiently under your leadership?

Response: I will work to foster the continued leadership of DOE in supporting the development and successful implementation of energy technologies that deliver all forms of affordable, reliable and secure American energy – including hydrogen. If confirmed, I look forward to learning more about DOE's work on Hydrogen Hubs and understanding your views on the best ways to lead the world in energy innovation and technology breakthroughs.

Questions from Senator Steve Daines

Question 1: Mr. Wright, as we discussed during the hearing, protecting and expanding baseload power is critical for meeting our country's and the world's growing energy demand. Do you agree that baseload energy sources like the Colstrip Power Plant in Montana and the Lower Snake River Hydropower dams should continue to operate and supply affordable, reliable and secure power to Montanans and the Pacific Northwest as a whole?

Response: Yes.

Question 2: Mr. Wright, the Calumet Refinery and Montana Renewables in Great Falls is now working with DOE to expand renewable fuels capacity and build jobs in Montana. As we discussed in the hearing, I believe the best way to reduce emissions is through innovation, not regulation. Do you agree that the Department of Energy should promote innovative solutions like carbon capture, small modular nuclear reactors, and sustainable and renewable fuels?

Response: Yes. I support innovation as a solution to the majority of energy challenges.

Question 3: Mr. Wright, hydropower makes up a large percentage of Montana's energy production. Do you agree that we should protect and continue to expand hydropower development, whether that's through traditional hydropower resources, or next generation technology such as in-stream hydrokinetic?

Response: I support hydropower in Montana. I look forward to learning more about in-stream hydrokinetic and working with you.

Question 4: Mr. Wright, do you agree that we should increase domestic critical mineral development in order to meet increased demand in all sectors, including energy development and transmission?

Response: Yes.

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

Questions from Senator Maria Cantwell

Question 1: Hanford Nuclear Cleanup Mission

Mr. Wright, thank you for your remarks about the federal government's moral obligation to clean up the Hanford nuclear reservation. I wanted to follow up on our discussion about the Tri-Party Agreement. On April 11, 2024, the U.S. Department of Energy, Washington state Department of Ecology and the U.S. Environmental Protection Agency finalized a wholistic agreement that includes the January 8, 2025 Order Amending Consent Decree in the State of Washington v. the Department of Energy, et al. Case No. 08-5085-RMP and the January 3 and January 7, 2025 amendments to the Hanford Federal Facility Agreement and Consent Order.

- Will you commit to upholding this holistic and hard won agreement?

Response: As a general matter, it is my belief that legal agreements should be honored. If confirmed, I will familiarize myself with the Hanford Settlement Agreement and would be happy to meet to discuss the agreement and the critical importance of cleaning up the Hanford Site.

The Tri-City community near Hanford has been working for decades to leverage assets such as DOE's Pacific Northwest National Laboratory, Washington State University Tri-Cities, Energy Northwest's Columbia Generating Station, and the local skilled workforce to become a leading clean energy hub nationally, with a particular focus on nuclear energy and decarbonized industrial production. Additionally, there are countless opportunities for beneficial reuse of DOE land, facilities, and materials such as the Strontium 90 at Hanford's Waste Encapsulation Storage Facility.

- Can you please share your thoughts on what you envision DOE's role to be in supporting economic growth and diversification in communities near DOE sites?

Response: I am a great supporter of cooperation with local communities to support economic growth and diversification.

Question 2: Bonneville Power Administration

Mr. Wright, the Bonneville Power Administration provides electric power, transmission, and efficiency services over a 300,000 square mile area that includes Oregon, Washington, Idaho, western Montana, and parts of northern California, Nevada, Utah, and Wyoming. DOE recently changed BPA's reporting structure, but this has not worked well for BPA.

- Will you commit to reviewing this structure and consider restore having power marketing administrations like BPA report to the Deputy Secretary or the Under Secretary for Science and Innovation?

Response: I commit to the review you suggest and would be pleased to report my thoughts and observations.

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

Question 3: **Pacific Northwest National Laboratory**
Mr. Wright, the national laboratories bring tremendous capabilities and intellectual horsepower in key areas of energy and national security including grid reliability, energy storage and cybersecurity. One example is the cutting-edge capabilities associated with PNNL's Energy Infrastructure Operations Center, which has supported efforts like the Department's North American Energy Resilience Model (NAERM); as well as bringing the Department's AI capabilities to emerging topics of importance including wildfire risk, preparedness, and response.

- How do you plan to fully engage and utilize national labs to improve the reliability, affordability and security of our energy system?

Response: National labs are an essential feature of DOE's extraordinary cutting-edge research and abilities. I am looking forward to visiting the PNNL as one of our outstanding examples.

There are considerable challenges, especially out west, to maintain grid reliability and affordability driven by large increases in demand, including data centers, increased renewable with inverter-based devices like solar and wind and lack of regional planning integrating transmission and distribution. All of this is happening against the very real backdrop of increasing wildfire threat to our infrastructure.

- How do you plan to ensure the Department will engage regional stakeholders and national laboratories to improve the grid reliability, security and affordability of our country's energy system?

Response: Although I have not been briefed yet, it is my view that grid reliability remains an essential element of our nation's infrastructure. It is the backbone for essential services, economic growth and basic reliability for homes and businesses. It is key to have robust engagement with a myriad of stakeholders to make sure all data points and perspectives are taken into account as we work together to improve and expand the capacity and reliability of our grid.

Last year I attended the dedication of the Grid Storage Launchpad (GSL) at Pacific Northwest National Laboratory. As you may know, GSL is a grid energy storage research and development facility that will help accelerate development of next-generation grid energy storage technologies.

- How will you as the leader of the Department utilize GSL to advance America's energy storage competitiveness to eliminate/reduce our reliance on foreign owned critical minerals and foreign supply chain risks?

Response: I have not yet been briefed on this subject, but I believe energy storage is essential for these types of projects, and I support the concept and look forward to learning more.

Starting in the first Trump Administration, DOE has invested in advancing the role of energy innovation in the blue economy—ports, maritime, marine energy and ocean observation—and advancing our nation's energy security. Some of those key investments have been made at the Department's Marine and Coastal Research Laboratory at PNNL-Sequim.

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

- Will you commit to continuing DOE's support for these investments, and visit PNNL-Sequim?

Response: I have not been briefed on this subject yet. I look forward to learning more about the laboratory at PNNL-Sequim and understanding the advantages of this technology.

As you know, DOE has a key role to play in AI. In my home state for example, PNNL is a leader in applying AI to grid modernization, advancing scientific discovery in chemistry, and national security. It is critical that DOE is properly included as the Trump Administration approaches AI, including utilizing national laboratory assets.

- How will you ensure that DOE's capabilities are brought to bear in AI, across the Trump Administration and for the nation? How will you ensure that DOE and its national labs can continue advancing AI work?

Response: Public private partnerships are essential for developing future energy sources. If confirmed, I stand ready to support such efforts.

Question 4: Fusion
Mr. Wright, one of the great energy successes we have had in recent years is in fostering public-private partnerships. These partnerships are especially critical for supporting the rapid expansion of newer energy technologies.

- Can you talk about how you believe the Department of Energy can continue to support the development of public-private partnerships to help the commercial deployment of emerging technologies such as fusion energy.

Response: Throughout its history, the Department of Energy has funded research, development, and deployment with the private sector that has led to significant breakthroughs in energy technology and participated in public-private partnerships on energy demonstration projects. I look forward to evaluating existing public-private partnerships in technology innovation to strengthen U.S. competitiveness and energy security.

As the US looks to lead on the development of next generation power technologies, like fusion, but also advanced nuclear, and enhanced geothermal, what role do you envision the DOE in helping bring these new technologies to the market?

- In particular, what role do you see the DOE Loan Programs Office (LPO) in helping financially support new generation technologies not yet at commercial scale?
- What other actions do you believe the Department of Energy should take to ensure the U.S. remains the world leader in fusion technology?

Response: I look forward to learning more about DOE's Loan Guarantee program and other DOE programs directed by Congress to accelerate emerging technology demonstration and scalability. I also intend to evaluate fusion energy research, innovation, and related work underway at the Department of Energy's national laboratories, and if confirmed, I look forward to working with your office on this and other promising technologies.

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

Question 5: Smart Grid Grants
Mr. Wright, this Committee authored provisions in the 2021 Bipartisan Infrastructure Law to make the U.S. power grid more resilient, adaptive, and efficient. So far, DOE has invested more than $14 billion of the dollars Congress provided to boost the U.S. power grid. Funding that has been matched many times over by the private sector in all 50 states.

Many states have received support through important programs like the Grid Resilience and Innovation Partnerships (or GRIP program) that I originally authored back in 2007.
These investments will have tangible benefits and cost savings of nearly $100 million for electric ratepayers in my State.

- Will you commit to seeing these important investments through to completion?
- And ensure that all remaining funding in these important grid-enhancing programs from the Bipartisan Infrastructure Law are deployed by the Department of Energy?

Response: Strengthening, modernizing, and protecting the electricity grid and other critical infrastructure is a top priority. I look forward to learning more about the GRIP program and other efforts and investments underway at the Department to meet the urgency of this challenge.

Question 6: Hydrogen Hubs
Mr. Wright, one of the most widely supported energy investments by Congress has been figuring out how we can accelerate the use of hydrogen.

DOE selected the Pacific Northwest Hydrogen Hub - which was a joint application from entities in Washington, Oregon, and Montana –to serve as a national model of how an integrated, totally emission free hydrogen network. I understand you agree that hydrogen is a promising fuel for the future.

- Will you work with Congress to continue the strong bipartisan support for scaling up clean and affordable hydrogen, including championing DOE's hydrogen hub program?

Response: If confirmed, I will work with you to foster the continued leadership of DOE in supporting the development and successful implementation of energy technologies that deliver all forms of affordable, reliable, and secure American energy. If confirmed, I look forward to learning more about DOE's work on Hydrogen Hubs and understanding your views on the best ways to lead the world in energy innovation and technology breakthroughs.

DOE's input to Treasury and the White House will continue to play a major role in implementing the hydrogen 45V production tax credit.

- Do you support the hydrogen tax credit that the hubs have said is necessary for their success and for standing up the national hydrogen economy?

Response: I will work with the Congress and the Treasury Department in developing appropriate levels of support for hydrogen.

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

Question 7: Advanced Nuclear & Fuel Supply
Mr. Wright, my home state of Washington is a key epicenter of advanced nuclear energy in the United States.

TerraPower, based in Bellevue, WA, is leading the way with Natrium, an advanced reactor being built in Wyoming as part of a public-private partnership with the Department of Energy under the Advanced Reactor Demonstration Program, or ARDP. X-Energy, the other ARDP demonstration awardee, is also looking to build a future reactor in Washington.

- Do you agree that we should continue to fully fund ARDP and ensure that the U.S. leads the way on advanced nuclear reactor technology?

Response: I support the goals of the Advanced Reactor Demonstration Program and its efforts in countering the growing influence of overseas adversaries. I look forward to discussing the program's ambitious timeline and partnering with you if confirmed as Secretary of Energy.

I understand the advanced nuclear energy community is anxiously waiting for the Department of Energy to advance its plan to establish a domestic uranium enrichment supply chain right here in the United States and move away from dependence on countries like Russia and China. High-assay, low-enriched uranium, or HALEU, is set to power the future fleet of advanced Generation 4 reactors.

- Will you commit to continue to support DOE's HALEU availability program?

Response: America's domestic supply of enriched uranium is essential for the United States. I will evaluate the Department's current plans and our approach to the HALEU program to ensure this program is successful.

Question 8: Transmission
Mr. Wright, FERC estimates that electricity demand will grow by 128 GW nationwide in the next five years, more than 15% from today's levels from a variety of sectors including manufacturing, data centers, and electrification. In Washington State we are expecting demand growth of 30% over the next decade.

Even if we built enough generation tomorrow to meet this new demand, we don't have sufficient transmission to transport it. It currently takes at least 7-11 years to build new large transmission in the United States, so how will DOE help address the urgent transmission bottlenecks today that are inhibiting economic growth and American leadership on AI?

Response: Lack of electric transmission capacity is one of the biggest barriers to economic growth, including growth led by manufacturing and AI. The United States has of late failed to build much new large scale transmission projects: only 55 miles of new high-voltage transmission were built in 2023. Permitting bureaucracy and red tape, myopic electricity system planning processes, and interstate disagreements on how to calculate who benefits from (and thus who pays for) a transmission line have ground new construction largely to a halt.

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

- How can DOE help address these market barriers to getting new steel in the ground to drive economic growth?

Response: I welcome the opportunity to work with you and your staff to strengthen, modernize, and protect America's electricity grid and other critical infrastructure to meet growing demand.

Question 9: Transmission Facilitation Program
Mr. Wright, Congress created the DOE's Transmission Facilitation Program (TFP) in the Bipartisan Infrastructure Law to help build out new interregional transmission lines across the country. The TFP is a revolving fund program to provide Federal support to overcome the financial hurdles in the development of large-scale new transmission lines and upgrading existing transmission.

- Do you think the bipartisan Transmission Facilitation Program has been a success?
- Will you commit to supporting it as a tool to facilitate investment in major new transmission lines all across the U.S. at no additional cost to taxpayers?

Response: I have not yet been briefed on this program, but I will be happy for the Department to share an analysis at the appropriate time.

Question 10: U.S. Oil & Gas Production
Mr. Wright, in 2023, the U.S. produced more crude oil than any country, ever, according to the U.S. Energy Information Administration.

- Can you describe the steps taken by the Biden Administration to achieve this record level of production?

Response: Today's record U.S. oil production is largely due to investment decisions and policy decisions made under previous administrations – including President Trump's first term in office – and American industry's focus on innovation, such as fracking. In fact, the Biden administration increased the cost of U.S. oil and natural gas leases by 50% and reduced the available acreage for responsible development by 80%. Today's record production is largely in spite of Biden administration policies to halt critical pipeline infrastructure, reduce onshore and offshore resources and urge foreign nations to increase their oil production.

Question 11: Wind Power
Mr. Wright, earlier this month President-elect Trump declared "We are going to have a policy where no windmills are being built promised that "no new windmills" would be built in the United States when he takes office.

- What role would you have as Secretary of Energy in fulfilling incoming President Trump's promise?

Response: Historically wind energy is among the most expensive forms of energy and provides intermittent power. Under President Trump's administration, we intend to unleash all forms of affordable, reliable, and secure American energy..

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

Question 12: Surplus DOE Lands
Mr. Wright, I represent communities that support development of advanced reactors as well as critical parts of the nuclear fuel cycle and supply chain. In some cases, surplus DOE lands might be suitable for these nuclear facilities.

- Will you commit to reviewing and supporting where appropriate the use of surplus non-contaminated federal land for new energy development?

Response: Yes, I look forward to reviewing and discussing this further with you and your staff.

Question 13: Battery Supply Chains
We need to continue to onshore and diversify American energy and ensure are we not dependent on unstable or adversarial nations. The Washington state battery industry, including companies like Group14 and Sila, have worked with DOE and PNNL for the past decade to do just that, while also providing economic opportunities in our rural communities by building advanced silicon battery material factories in Eastern Washington. Unfortunately, the vast majority of lithium-ion batteries and energy storage technologies depend on graphite, and 95% of the world's battery-grade graphite is controlled by China. As China further restricts exports to the U.S., the urgency to strengthen domestic battery supply chains, including through these key Washington State factories, only grows.

- Given the rapidly increasing demand for energy storage solutions to support the grid, data centers, and other critical infrastructure, what steps would you take to continue fostering growth and resilience for U.S. battery supply chains, particularly for raw materials and silicon battery manufacturing, that can help end our dependence on Chinese graphite?

Response: Secure and reliable supply chains for critical materials, including critical minerals, are key to a prosperous and internationally competitive economy. Under President Trump's leadership, the security of our nation's critical mineral supply chains was made a priority for the Federal government. If confirmed, I look forward to evaluating ways for the United States to further enhance our supply chains, increase private sector investment, create jobs, and strengthen our national security.

Industries working on battery recycling are also vital to securing our supply chain, as well as being big job creators and more sustainable than primary extraction. DOE has been essential to battery recycling and creating more efficient and sustainable batteries.

- Do you support continuing investments and work at DOE on battery recycling and alternative battery chemistries?

Response: I support the concept of battery recycling.

Questions from Senator Bill Cassidy, M.D.

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

Question 1: Liquefied natural gas (LNG) exports are incredibly important to the state of Louisiana, as two-thirds of current LNG exports and two-thirds of the non-FTA applications subject to the pause call Louisiana home. Given your experience on the upstream side of natural gas, how do you view the importance of the U.S. LNG industry?

Response: Natural gas has already proven to be a key component of efforts to reduce emissions both domestically and globally. Natural gas is also a low-cost fuel for reliable, dispatchable electricity generation. In addition, the vast amounts of natural gas deposits in the United States are large enough to supply domestic and international demand for years to come without material increases in the cost. Natural gas production, transportation and distribution already support an estimated 4 million jobs. As the U.S. and countries around the world increasingly electrify their economies, natural gas will play a key role in providing secure, clean, affordable energy for developed and, equally important, developing countries. LNG exports and the natural gas industry are vital to our national economy and national security because it supports the continually increasing demand for electricity, helps secure and maintain U.S. energy independence, is a contributor to decreasing our trade deficit, and provides reliable, secure energy to our international allies, There are few domestic exports that provide more benefits across the nation's economic, domestic, and international security than LNG.

Question 2: The Department of Energy (DOE) plays a pivotal role in the approval of non-FTA export applications. I hope that the incoming Trump administration reverses the current pause and resumes the consideration of LNG export applications as soon as possible. Have you considered creative solutions to provide business certainty, such as conditional authorizations for LNG projects that would be granted pending completion of the Federal Energy Regulatory Commission's review? What additional opportunities do you see for DOE to help leverage U.S. LNG to achieve energy dominance?

Response: There is no reason to continue the pause on review of non-FTA export applications. DOE already has the personnel, procedures, and rules to efficiently complete the review of both pending and future applications and to do so in way to provides regulatory certainty to applicants. The first thing that needs to happen is to support the very capable program staff to actually do their jobs, and DOE's decisions on the export applications will soon follow. Regulatory certainty and efficient, expeditious evaluation of export applications will naturally attract interest within the investment community to developing additional export capacity where it makes economic sense

Question 3: U.S. energy producers and manufacturers adhere to some of the highest environmental standards of anywhere in the world. However, they do not compete on a level playing field as many foreign competitors operate with little or no regard to environmental stewardship. Access to data on comparative product emissions intensity is crucial to crafting trade countermeasures to check countries that illegally subsidize their industry through lax environmental standards, enforcement, and compliance. As Secretary, will you commit to direct the Department of Energy to conduct a comprehensive study comparing the emissions intensity of specific goods produced in the United States with that of the same goods produced in other countries?

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

Response: As the EU and other countries develop regulations requiring the measurement of GHG intensity for imports, it is vital that the U.S. demonstrate through reliable data how its energy industries are leading the world in environmentally friendly and low emissions production and manufacturing processes. Doing so will support trade negotiations and help influence the rule-making process thatprotect American interests and avoid unfair discrimination against our exports.

Questions from Senator Mazie K. Hirono

Question 1: Will you commit to complying with federal ethics rules and divest yourself of all stocks that would pose a conflict of interest, even if President Trump offers you a waiver to keep your investments?

Response: In the interest of ensuring the highest standards of integrity, I have taken all actions recommended by the Office of Government Ethics – as are outlined in form OGE-278e – to ensure impartiality and reduce any conflicts of interest – real or perceived – to best serve the President if confirmed as Secretary of Energy. Upon confirmation, I will resign my position with Liberty Energy and other companies and divest my interests as soon as practicable but no later than 90 days after my confirmation.

Question 2: Do you believe the federal government should regulate and limit emissions of carbon dioxide and other greenhouse gas pollutants from power plants?

Response: While regulating emissions is not the purview of the U.S. Department of Energy, I appreciate your question and look forward to discussing it further if confirmed as Secretary of Energy.

Question 3: Hawaii is uniquely vulnerable to energy disruptions. It is the most isolated island chain in the world with the highest dependence on petroleum of any state. All of the petroleum is imported, contributing to the highest power prices in the country. Hawaii's energy vulnerability affects our people, our economy, and the Department of Defense installations in our state. With the help of the Department of Energy, Hawaii is working to move from relying on imported oil for most of its power to using 100 percent renewable power by 2045. Companies in Hawaii are also seeking locally sourced, lower-carbon fuels for aviation and providing power for military installations. If you are confirmed, will you support Hawaii's efforts to become energy independent?

Response: Every region has unique resources and infrastructure that informs the best mix of energy sources to support its people, economy and security. A diverse mix of baseload and intermittent energy sources is important to avoid an undue reliance on one or only a few sources that could face disruption. I look forward to learning more about Hawaii's efforts, and efforts of every state and region to develop the best mix of energy resources to provide the most affordable reliable, secure energy to power their needs.

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

Questions from Senator Cindy Hyde-Smith

Question 1: Our country is developing new energy technologies that have the potential to add significant base-load power to the grid.

1a) Can you talk about how, as Secretary, you would support the commercialization of fusion energy?

Response: I intend to evaluate fusion energy research, innovation and related work underway at the Department of Energy national laboratories, if confirmed, and I look forward to working with your office on this nascent technology.

Question 2: For decades, the Department of Energy has been a key supporter of new energy research. In particular, the Department has played a key role in supporting fusion research. However, I understand that the innovative fusion sector is approaching a working fusion energy machine – as soon as this year – and we are rapidly approaching the point where we need to prioritize commercial applications of this technology.

2a) Can you talk about how, as Secretary, you will balance the need to transition new technologies out of the research and development phase and to the deployment phase?

Response: Getting through the valley-of-death from basic research to commercialization has long been a challenge for new and emerging technologies. I look forward to learning more and sharing with you the status of fusion energy research, innovation and related work underway at the Department of Energy national laboratories if confirmed.

Question 3: One of the great energy successes we have had in recent years is in fostering public-private partnerships. These partnerships are especially critical for supporting the rapid expansion of newer energy technologies. One emerging technology I am especially excited about is fusion energy.

3a) Can you talk about how the Department of Energy can better support the development of public-private partnerships to support the commercial deployment of emerging technologies such as fusion energy?

Response: Throughout its history, the Department of Energy has funded research, development, and deployment with the private sector that has led to significant breakthroughs in energy technology and participated in public-private partnerships on energy demonstration projects. I look forward to evaluating existing public-private partnerships in technology innovation to strengthen U.S. competitiveness and energy security.

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

Question 4: We have seen time-and-again the United States develop a new technology – solar panels and batteries being just the latest iterations – only for China to build out the supply chain and dominate the deployment of the technology. We are at a critical juncture right now where American companies are on the verge of building working fusion energy machines in the very near future.

4a) Can you talk about the steps you would take to ensure new technologies, such as fusion energy, that are developed in the United States also have sufficient domestic supply chains and markets?

- **Is how these technologies will remain American dominated in order to not lose the race to commercialization to China?**

Response: Strengthening America's supply chains and identifying industries and markets for new technologies is essential to protect U.S. competitiveness and intellectual property. If confirmed, I look forward to identifying ways to support our national laboratories in leading the world in emerging technology research and energy innovation. We must maintain US competitiveness in these key sectors while providing tangible economic benefits to Americans.

Question 5: I am very concerned about China moving to lock up key supply chains that are critical for our energy producers. Not only is this a significant national security threat but it also limits our ability to dominate innovative technologies.

5a) Can you discuss how, under your leadership, the Department of Energy will work individually – and on an inter-agency basis – to support the expansion of the domestic energy supply chain?

Response: I agree that the integrity and security of our nation's supply chains is an important and pressing issue of economic and national security. If confirmed, I intend to evaluate opportunities to strengthen our nation's supply chains for critical materials, increase private investment, and create economic opportunities for Americans. I intend to work closely with my colleagues under President Trump's leadership and would look forward to engaging with this committee on this issue in the future.

Question 6: We have seen a lot of coverage on reducing burdensome regulations that are slowing down energy projects.

6a) Can you talk in more detail about the specific actions you plan to take as Secretary to speed up the deployment of energy projects and reduce regulatory delays?

Response: America is blessed with abundant resources to power our economy. Yet today regulatory and permitting uncertainty has hastened investments in all sources of affordable, reliable, and secure American energy, which means higher inflation and higher energy costs. President Trump is committed to unleashing U.S. energy resources and spurring investments in necessary infrastructure to attract manufacturing supply chains back to America. If confirmed, I will work across the Department of Energy to support unleashing all forms of affordable and reliable energy – including clean energy – and fostering technology innovations.

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

Question 7: The United States is an energy superpower and a key producer of both traditional and innovative energy sources. However, we face key supply chain challenges – particularly from China – in supporting the rapid development of new energy technologies.

7a) Can you talk in more detail about how the Department of Energy can better support emerging energy technologies and build out the requisite supply chains?

I agree that supply chain integrity is a serious issue. Our nation has an abundance of domestic natural resources, a dedicated workforce, and an entrepreneurial spirit. If confirmed, I intend to examine the Department of Energy's policies and programs for opportunities to support the strengthening of critical supply chains, particularly through innovation and private investment.

Question 8: The U.S. Department of Energy (DOE) has already approved 48 billion cubic feet per day (Bcf/d) of LNG exports, a volume equal to 50.5 percent of 2023 net supply and substantially more than exports of gasoline and crude oil. The U.S. only exports 10 percent of its gasoline, only 23 percent of crude production and imports an equivalent of 44 percent of production. For crude oil and gasoline, the U.S. has a Strategic Petroleum Reserve. There is no alternative for natural gas. Consumers are completely exposed and do not have an alternative.

EIA data proves that LNG export volumes are highest during our winter peak heating season and puts upward price pressure on natural gas and electricity. This is especially a problem when U.S. inventories are low. This happened during the winter of 2021/2022 and natural gas prices increased over 300 percent, and what is happening right now and as prices are skyrocketing.

LNG exports are insensitive to price. We both know that if a country needs natural gas to keep the lights on, there is no limit to how much they will pay. As exports increase, they import global market volatility- a phenomenon that the US market has been insulated from historically, especially when inventories are low. It seems to me that we should place the American consumer first by implementing a policy to insulate the consumer from the potential impacts of rising LNG exports. The IECA has proposed an 'LNG Inventory Policy' that has no cost to the taxpayer.

8a) Would you agree that it makes common sense to ensure that the US consumer is protected from high prices as we export more LNG? If confirmed, can I count on you to advance such as policy?

Response: Yes, and I will ensure that DOE considers reliable and valid information related to LNG export applications consistent with its legal obligations, including whether the exports proposed by an applicant are not in the public interest as required by the Natural Gas Act. Our experience has not shown that additional exports have not increased domestic prices.

Question 9: Last January, the Biden administration paused pending decisions to export liquefied natural gas (LNG) to countries with which the United States has not entered into a free trade agreement (FTA). The pause continued as the Department of Energy (DOE), which is authorized to approve the export of LNG, updated its analyses on whether LNG exports to non-FTA countries are in the "public interest." On December 17th, DOE released its updated

macroeconomic study on LNG exports and provided a 60-day comment period to inform the Department's possible utilization of the study's findings to its public interest analysis of export applications going forward.

9a) Does the U.S. have a fundamental interest in advancing the infrastructure needed to match our country's abundant natural gas supply with the international demand for energy?

Response: The vast natural gas deposits in this country cannot reach consumers, both domestic and international, without the necessary infrastructure. As natural gas is one of our country's most vital natural resources, developing that infrastructure is among our most important fundamental interests. Private investment in critical infrastructure has been suppressed in large part by the significant cost and delays of securing the dozens of permits required to even reach a final investment decision, These extraordinary costs and delays are caused by a combination of onerous rules, lengthy bureaucratic reviews, and litigation challenges not faced by investors in any other developed countries. Permitting reform is essential to the development of the sorely needed new infrastructure.

Question 10: LNG terminal on Elba Island in Chatham, Georgia is a bidirectional facility that has delivered natural gas capacity, which otherwise would not have been available, on a short-term basis during peak demand periods for the reliability and resiliency of electricity generators/utilities and LDCs.

10a) Did DOE's pause impact the reliability contributions of LNG export facilities and other interstate pipeline infrastructure to transport domestic natural gas supply during winter events?

Response: DOE's pause in considering LNG export applications created unnecessary regulatory uncertainty and undoubtedly slowed or even stopped investment decisions for new facilities under consideration, including development of both LNG export facilities and the domestic pipeline infrastructure necessary to supply the natural gas to the export facilities. New pipeline infrastructure, even when developed primarily to supply an LNG facility, interconnects with the wider natural gas pipeline system. Where there are LNG export facilities co-located with LNG import facilities, there would be opportunities to import natural gas during periods of severe domestic shortages.

10b) How did this regulatory delay further complicate the speed and certainty of natural gas infrastructure permitting processes that allow for export capabilities?
Response:

Response: Although it is difficult to know and measure the full extent of the DOE's decision to pause its consideration of pending and new applications, there is no doubt that the regulatory uncertainty essentially paralyzed the progress of certain projects, likely led investors to seek different opportunities, and prevented or delayed new sale and purchase agreements with international LNG customers.

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

10c) Don't natural gas infrastructure permitting delays also hinder the ability for project developers and operators to keep workers under contract?

Response: There is no question that permitting delays hinder and even prevent project developers from entering contracts with equipment suppliers and contractors necessary to complete a project. Generally, workers do not get paid if they are not working, particularly skilled tradesmen, and they will seek reliable work elsewhere.

10d) In addition to building new infrastructure capacity, aren't workers needed to maintain and update existing assets to ensure safe transportation of natural gas?

Response: Yes - while a construction workforce will exceed in numbers the operations workforce, operating jobs at LNG facilities and pipelines require a skilled workforce with high-paying jobs that provide significant economic development often in relatively rural parts of the country.

Question 11: Administration Efforts

11a) How does the incoming administration plan to assess comments submitted on DOE's 2024 study, which contains findings that align with those in the Department's 2018 economic report, to inform policy decisions, and more importantly, resume review of LNG permits?

Response: I will ensure that DOE considers reliable and valid information related to LNG export applications consistent with its legal obligations, including the information submitted during the public comment period, to determine whether the exports proposed by an applicant are not in the public interest as required by the Natural Gas Act.

11b) What measures will DOE implement to ensure the legal durability of LNG export permits? And how do you plan to address potential legal challenges that may arise?

Response: By complying with the statutory requirements for DOE's consideration of export applications, including under the Administrative Procedure Act, the Natural Gas Act, and National Environmental Policy Act, export authorizations granted by DOE will be durable to potential legal challenges.

11c) How do you intend to reconcile the growth of LNG exports, which the International Energy Agency (IEA) forecasts will exceed the all-time high in 2024 later this year, with the necessity of maintaining a stable and resilient domestic electricity grid?

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

Response: I am not aware of any forecast that suggests domestic natural gas supplies cannot meet demand for both domestic consumption and LNG exports, including the projected increase in LNG exports. Should I be confirmed and there be future events where LNG exports risk short-term price spikes, I would consider any appropriate, lawful, and proportional use of powers available to the Secretary of Energy to mitigate those effects.

Question 12: Global Energy Markets

12a) Didn't DOE's pause harm sources of international energy supply that are competitive, accessible, and environmentally favorable?

Response: Although it is difficult to know and measure the full extent of the DOE's decision to pause its consideration of pending and new applications, there is no doubt that the regulatory uncertainty essentially paralyzed the progress of certain projects, likely led investors to seek different opportunities, and prevented or delayed new sale and purchase agreements with international LNG customers, some of whom looked to alternative suppliers from different countries.

12b) How does the administration plan to monitor global market dynamics related to LNG exports and adjust policies or permits to maintain a competitive edge?

Response: If I am confirmed as Secretary, I will ensure that DOE constantly monitors global market dynamics and regularly evaluates is permitting policies to ensure DOE export authorizations, to the extent legally feasible, do not disadvantage U.S. LNG exporters in the highly competitive global market.

12c) What long-term strategies does the Department envision taking to maintain a strong and sustainable LNG export market?

Response: The key to maintaining a strong and sustainable LNG export market is an efficient and predictable permitting process, with reliable and sustainable long-term permits that will withstand legal challenges, which I will ensure. Armed with predictable regulatory certainty, the U.S. entrepreneurial spirit, ingenuity, and commercial sophistication will make U.S. LNG highly competitive in global markets.

12d) How will the administration ensure that efforts to strengthen the LNG export market do not compromise domestic energy needs or grid reliability, particularly during critical supply periods?

Response: I will ensure that DOE considers reliable and valid information related to LNG export applications consistent with its legal obligations, including whether the exports proposed by an applicant are not in the public interest as required by the Natural Gas Act, which would include the potential effects of exports on domestic uses of natural gas.

Question 13: Mr. Wright, the magnitude of energy demand that we are experiencing is extraordinary. We are going to need every arrow in the quiver to meet that demand if we hope to

stay competitive globally, and that seems to me that it would include all types of nuclear energy, most especially large nuclear reactors. I also understand that partnerships between developers, customers, and the federal government will be key to getting the next handful of large nuclear units built.

13a) Do you agree that development of new nuclear plants is critical to secure protect America's national and financial security?

Response: Yes.

13b) Are you prepared to work with Congress on ways to mitigate the risk of new nuclear development?

Response: Yes.

Question 14: In January 2024, the Biden Administration enacted its misguided LNG export permitting pause, putting the energy security of the U.S. and our allies at risk. In the year following this pause, our allies in Europe bought record amounts of Russian LNG and the Middle East became the leader in greenlighting new LNG projects.

14a) Do you plan to continue this pause?

Response: There is no reason to continue the pause on review of non-FTA export applications and if I am confirmed DOE will immediately begin the regular and efficient consideration of all pending and new applications for LNG exports.

14b) What do you believe the role of U.S. LNG is in ensuring global energy security?

Response: Natural gas has already proven to be a key component of efforts to reduce GHG emissions both domestically and globally. Natural gas is also a low-cost fuel for reliable, dispatchable electricity generation. In addition, the vast amounts of natural gas deposits in the United States are large enough to supply domestic and international demand for years to come without material increases in the cost. Natural gas production, transportation and distribution already support an estimated 4 million jobs. As the US and countries around the world increasingly electrify their economies, natural gas will play a key role in providing secure, clean, affordable energy for developed and, equally important, developing countries. LNG exports and the natural gas industry are vital to our national economy and national security because it supports the continually increasing demand for electricity, helps secure and maintain U.S. energy independence, is a contributor to decreasing our trade deficit, and provides reliable, secure energy to our international allies, There are few domestic exports that provide more benefits across the nation's economic, domestic, and international security than LNG.

14c) As a longtime leader in the U.S. oil and gas industry, what role do you believe U.S. LNG plays in maintaining U.S. leadership on the world stage?

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

Response: As stated in the previous answer, natural gas contributes to U.S. energy independence, with strengthens its position on the world state, is a leading contributor to decreasing GHG emissions both domestically and globally, offers a low-cost fuel for reliable, dispatchable electricity generation, particularly important to developing countries, provides a reliable, low-cost, clean energy source for our allied countries. and is a major contributor to decreasing our national deficit. To repeat, there are few domestic products and exports that provide more benefits across the nation's economic, domestic, and international security than LNG.

Question 15: Mr. Wright, commercial refrigeration manufacturers form an important part of our nation's economy, including billions in economic output and value-add. Beyond the manufacturing jobs associated with commercial refrigeration equipment, the products themselves support key industries like independent commercial grocers that play an important role in the daily lives of Mississippians.

Response: Unfortunately, at the end of last year, DOE established new energy conservation standards for commercial refrigeration equipment over the objections and significant concerns submitted by a broad array of industry stakeholders. According to data and analysis submitted by industry groups, the new "energy efficiency" standards are not technologically feasible nor are they readily available to implement within the mandated time period. The new standards will impose a substantial cost to manufacturers and ultimately grocers and American consumers.

15a) Mr. Wright, if you are confirmed to be Secretary of Energy will you commit to working with me and members of this committee to re-assess and rollback unreasonable and harmful regulations promulgated in the name of "energy efficiency," including DOE's standards for commercial refrigeration equipment?

Response: Yes, I will work with you and your staff on this.

Question 16: The 2nd Trump Administration will usher in a new era of American energy dominance fueled by innovative technologies, including carbon capture that can be used for enhanced oil recovery and manufacturing other fuels and energy products. Carbon capture has also been an opportunity for bipartisanship in Congress, including the 45Q tax credit as well as historic investments and regulatory support in the Bipartisan Infrastructure Law.

16a) As Secretary and National Energy Council Co-Chair, do you commit to working with Congress and industry to continue supporting the carbon capture industry, including the DOE's DAC Hubs Program, and improving the permitting process for American energy projects?

Response: If confirmed, I look forward to learning more about DOE's work on Direct Air Capture Hubs and understanding your views on the best ways to lead the world in energy innovation and technology breakthroughs.

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

Question 17: Mr. Wright, the need for more effective, reliable energy sources is critical for continued economic growth. Having access to all energy sources and having a resilient grid are vital to the success of our communities.

17a) How do you view the role of the Department of Energy in ensuring states have a good partner for energy system buildouts and grid resiliency?

Response: I am committed to working with the states to ensure a smooth and efficient buildout for grid resiliency.

Questions from Senator Angus S. King, Jr.

Question 1: As a first step in addressing the spent nuclear fuel (SNF) storage issue, would you consider re-establishing the Office of Civilian Radioactive Waste Management (OCRWM) and the position of Director of OCRWM, as required in the Nuclear Waste Policy Act?

Response: I will consider that option and look forward to discussing your views on this further.

Question 2: Are there additional changes to the Nuclear Waste Policy Act currently under discussion that would lead to a more integrated and collaborative siting effort for the ultimate disposal of all the nation's nuclear waste forms – including new nuclear – with a priority for SNF stranded at decommissioned reactor sites, like Maine Yankee in Wiscasset Maine?

Response: If confirmed, I will examine this siting issue to see if there are efficiencies that can be achieved.

Question 3: What are your thoughts on Congress providing sustained annual access to the nearly $50 billion dollars in the Nuclear Waste Fund that was collected from the nation's electric ratepayers for the intended purpose of funding a national integrated nuclear waste management program?

Response: I intend to seek further legal and policy analysis to determine whether the funds could be used for this purpose since the funds were collected and intended for the development of final disposition of the waste.

Questions from Senator Catherine Cortez Masto

Question 1: During the hearing, you refused to acknowledge the failures of the Yucca Mountain Project and recognize it as an unworkable site for our nation's nuclear waste – despite President-Elect Trump's opposition to the Project.

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

If confirmed, would you continue efforts at the Department to establish a consent-based siting solution for our nation's nuclear waste? If so, would you honor the definition of consent that was recommended by the Blue Ribbon Commission on America's Nuclear Future and my Nuclear Waste Informed Consent Act?

Response: Thank you for your question. As we discussed when we met, the people of Nevada are not in favor of Yucca Mountain, and thus President Trump and I do not support Yucca Mountain as a waste repository. I believe we need local support to open a long-term waste storage site.

If the State of Nevada is opposed to Yucca Mountain, would you proceed with the siting process?

Response: As the President has stated, he will not pursue the Yucca Mountain project.

Question 2: Mr. Wright – It has been reported that your company, Liberty Energy, Inc., has been sued a handful of times in federal court by current or former employees who alleged racial discrimination or harassment. Can you please provide a description of these allegations, as well as any actions that you or your company have taken to ensure the future safety and equity of your employees?

Response: As a lifelong entrepreneur, I have started several companies and led a 5,000+ workforce and culture that is committed to equal treatment for all and a workplace free of racial, sexual and all harassment. At Liberty Energy, we had personnel that acted outside of our company's code of ethics, and we took immediate action to remove them. I intend to actively cultivate a positive and supportive culture at the Department of Energy to ensure the success of the President's energy mission.

Question 3: Mr. Wright, in addition to your nomination to lead the Department of Energy, you have also been chosen to co-lead the newly dubbed "National Energy Council" with the nominee to lead the Secretary of the Interior, Governor Doug Burgum.

Can you commit to providing transparency on the potential conflict of interests of any participant in the Council's activities?

Response: I will follow the guidance of the Department's designated ethics officer to remove any real or perceived conflicts of interest.

Question 4: Mr. Wright – you have said that one of your priorities is lowering costs for working families. Nevada has received $3.3 million in early-stage R&D funding via ARPA-E since 2009. Further, DOE's Office of State and Community Energy Programs has invested nearly $15 million in the state since 2015.

Do you think cutting or eliminating funding for these government programs would lower energy costs for Nevada families?

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

Response: I have not been briefed on this issue, and I believe it needs to be analyzed.

Question 5: Companies across Nevada represent vital parts of our supply chains – contributing to our national defense and energy independence. Accordingly, the Department has invested over $5 billion into Nevada companies in recent years, from lithium processing to battery recycling and manufacturing, in order to help strengthen our domestic industries and global competitiveness.
Your written testimony mentioned the importance of U.S. innovation and American manufacturing success – so would you categorize these Nevada investments as critical and important?

Response: Yes.

The Department of Energy's Manufacturing and Energy Supply Chains Office (MESC) and Loan Programs Office (LPO) have played a major role by supporting these efforts in Nevada through grants and loans. If confirmed, will you commit to maintaining investments in these key DOE programs?

Response: Manufacturing and energy supply chains are critical to our economy. I support efforts that will allow for the continued growth and restoring of manufacturing jobs in America.

As you do so, can you please describe whether, and how, your department will continue to implement strong labor standards on investments the department is making in manufacturing and energy projects?

Response: Yes.

Upon learning about the local benefits of these DOE programs to projects in Nevada, can you commit to be an honest and direct advocate for DOE programs and their recipients during discussions of cutting or eliminating programs or funding at the department?

Response: The State of Nevada is important, and I will do my best to appropriately balance the interests at stake in any such discussions that may occur.

Question 6: Per the DOE's assessment, in response to concurrent transformations in technologies – such as artificial intelligence (AI), data center expansion, new domestic manufacturing, and electrification in different sectors, the United States is returning to a period of sharply rising electricity demand.

If confirmed, how would you look to tackle this challenge – in terms of scientific innovation, China and global competition, and energy demand needs? Would you prioritize this issue at the Department, and as part of the National Energy Council?

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

Response: This is an important issue, and I believe that large baseload power, such as nuclear energy, can help meet our energy demands.

Are there ways that DOE can better leverage existing assets, such as its 17 national labs and partnerships with external organizations, to support building the national AI capability?

Response: Developing the nation's AI capacity is an important issue. If confirmed, I intend to examine ways that the Department can assist our nation's competitiveness in this important global industry.

How would you work with utilities to prioritize the development and deployment of solutions to meet growing energy demand from data center expansion while maintaining affordability for U.S. consumers?

Response: This is an important subject, and I intend to work to appropriately balance these interests while emphasizing the need to ensure energy is affordable throughout the country.

Would you be supportive of data center flexibility through on-site power generation and storage solutions, so data centers can be a grid asset rather than a burden?
Response: Yes.

Given the unprecedented growth in electricity demand and the lack of transmission needed to serve that energy use, what should the Department do to accelerate the use technologies, such as carbon composite core advanced conductors, that will increase the capacity and efficiency of the existing grid along the current rights of way?

Response: Yes, that is one potential solution but there are additional opportunities which should be investigated.

Question 7: Clean transportation plays a pivotal role in achieving energy independence by significantly reducing reliance on foreign fossil fuels, allowing the nation to source more of its transportation energy domestically through alternative fuels and efficient vehicles.

As of January 1, 2024, there were over 286 million passenger cars and light trucks in the United States. At that time, alternative fuel vehicles (EVs and hybrids) accounted for nearly 12.5 million vehicles in use.

Is EV and hybrid technology enhancing energy security and decreasing vulnerability to price fluctuations in the global oil market?

Response: I do not believe that finding is consistent with the data.

Question 8: If confirmed, how will you ensure that your agency respects the federal trust responsibility to Tribes, particularly through prioritizing budget requests and federal funding allocation, staffing, and policy implementation?

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

Response: I fully respect the federal trust obligations to tribes and Department of Energy, should I be confirmed, will work with them as partners.

Additionally, how will you measure and report progress in advancing the needs of Native communities, and how will you ensure that these efforts are transparent and accountable to Congress and to the communities you serve?

Response: I have not yet been briefed on these issues, but I appreciate the importance of the goals you are referencing.

Questions from Senator John W. Hickenlooper

Question 1: Over the past four years, the Office of Fossil Energy and Carbon Management, the Manufacturing and Energy Supply Chains Office, and the Loan Programs Office have made significant progress in supporting domestic critical mineral projects essential for securing supply chains currently dominated by China. This includes investigating financial mechanisms and price support to ensure domestic mineral processing projects get off the ground. If confirmed, how do you plan to build on this progress, and what role do you see for the Department of Energy in bolstering American critical mineral supply chains? The current Administration has been advancing a "Mines of the Future" initiative - partnering with best in class academic institutions like Colorado School of Mines - which would be informed by industry input and designed to responsibly recover minerals that are deeper or harder to extract economically and with minimal impact. Will you work with me to make sure this program is maintained and ideally expanded?

Response: You have outlined some important goals, and I am glad to work with you to implement and enhance the efforts as you describe.

Question 2: DOE's Advanced Research Projects Agency-Energy (ARPA-E) has funded the development of next-generation energy companies in the areas of advanced nuclear, fusion, and enhanced geothermal. Many companies have directly benefited from this program including three that you have invested in. How will you support ARPA-E going forward?

Response: I will evaluate the work of ARPA-E, which plays an important role in helping to commercialize new technologies, and I look forward to working with you and your staff on advancing all domestic forms of affordable, reliable and secure energy.

Question 3: DOE's Loan Programs Office has financed over a $50 billion portfolio of innovative energy projects, including for advanced fossil, nuclear, and critical materials projects. The office has a fantastic track record of creating jobs while minimizing financial losses.
Will you continue to advance LPO's mission and honor the commitments that have already been made? What role do you envision the DOE in helping bring these new technologies to the market?

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

Response: We will be examining and analyzing the efforts of LPO to ensure that loans are furthering statutory objectives in the interests of the American people.

Question 4: We are facing increasing electricity demand from datacenters, manufacturing, and electrification. Whether you support gas, renewables, or nuclear, we must update our grid to keep the lights on and costs low. An advanced grid should not be a partisan issue – oil and gas needs it, AI companies need it, Americans need it. DOE has made great progress investing in transmission projects through the bipartisan infrastructure law. Will you commit to honoring the financial commitments that have already been made?

Response: We will be examining and analyzing the efforts of LPO to ensure that loans are furthering statutory objectives in the interests of the American people.

Question 5: FERC estimates electricity demand will grow by 128 GW nationwide in the next 5 years. Even if we build enough generation tomorrow to meet this demand, we don't have sufficient transmission to transport it. Permitting red tape, convoluted planning processes, and disagreements on who pays for transmission lines have ground new construction to a halt. It currently takes 7-11 years to build new large transmission lines in the United States. How will DOE help address the urgent transmission bottlenecks today that are inhibiting economic growth and U.S. leadership on AI?

Response: This is an important issue that I intend to be briefed about in order to determine how to meet the growing needs and demands on the grid due to growth in data centers, AI and other elements.

Questions from Senator Alex Padilla

Question 1: From coast to coast, extreme weather events have increased in both frequency and intensity, making power outages more and more common. Whether it be extreme heat in the summer or freezing temperatures in the winter, our nation's electric grid is frequently tested, and in many cases, it has not been able to weather the storm. Grid instability disrupts the lives of millions of Americans and costs the U.S. economy billions of dollars by not only impeding emergency services and temporarily closing schools and businesses, but in some cases causing massive and dangerous wildfires. This is a bipartisan issue, and as we discussed yesterday, I worked with Senator Cornyn to successfully include billions of dollars for grid hardening in the Bipartisan Infrastructure Law. Mr. Wright, this is an issue I've been working on since I got to the Senate. Will you commit to prioritizing grid hardening and continuing the funding through the Grid Deployment Office?

Response: Strengthening, modernizing, and protecting the electricity grid and other critical infrastructure is a top priority. I support the objective of grid hardening and look forward to learning more about efforts underway at the Department of Energy or other ways to accomplish this important goal.

U.S. Senate Committee on Energy and Natural Resources
January 15, 2025 Hearing: *The Wright Nomination*
Questions for the Record Submitted to Mr. Christopher A. Wright

Question 2: Last year, DOE announced the results of the most comprehensive analysis to date quantifying the domestic lithium resources in California's Salton Sea region. This analysis conducted by Lawrence Berkeley National Laboratory found that with expected technology advances, the Salton Sea region's total resources could produce more than 3,400 kilotons of lithium. The analysis confirms what we've long known in California - the Salton Sea region has significant potential as a domestic source of the critical minerals needed for batteries. California's Lithium Valley will deliver economic benefits to not only California, but to the entire nation by reducing our reliance on foreign countries, particularly China, for critical minerals. Mr. Wright, what is your plan to develop domestic sources of lithium and ensure we are not reliant on foreign sources? Will you join me on a tour of Lithium Valley?

Response: Critical minerals are essential to American innovation and infrastructure. The company I started made investments in sodium-ion battery technology and I know firsthand the importance of developing domestic supplies of minerals to protect our national security and global competitiveness. I look forward to working with you and your staff on this issue and learning more and visiting Lithium Valley with you.

Question 3: One of the issues all of us agree on is that our nation is going to need to generate significantly more electricity in the coming years, and we are going to need more transmission capacity to transport those electrons to where we need them. To meet this demand, our grid will need to meet 21st-century challenges with 21st-century solutions, like reconductoring. Rewiring our existing transmission lines with state-of-the-art carbon fiber or aluminum alloy materials has the potential to deliver twice the current of same-sized conventional steel and aluminum transmission cables. And that's all without having to build brand new lines. Mr. Wright, how will you work to ensure DOE uses every tool in its tool box, including grid-enhancing technologies like reconductoring, to meet growing demand, and if confirmed will you commit to working with me on this issue?

Response: I welcome the opportunity to work with you and your staff to strengthen, modernize, and protect America's electricity grid and other critical infrastructure to meet growing demand.

Question 4: California was the first state to officially launch a Hydrogen Hub (ARCHES), which will facilitate a network of hydrogen production sites to catalyze the use of hydrogen throughout California. California's hub is part of a larger initiative to accelerate the development and deployment of hydrogen projects across the country in an effort to increase our energy independence and develop entirely new industries and technologies. Mr. Wright, if confirmed, will you continue to support funding for this critical hub that is essential for the development and advancement of hydrogen technology in the United States? Also, how will you ensure that the department can continue funding projects, like ARCHES, that are vital to our global energy competitiveness?

Response: I will work to foster the continued leadership of DOE in supporting the development and successful implementation of energy technologies that deliver all forms of affordable, reliable and secure American energy – including hydrogen. If confirmed, I look forward to

learning more about DOE's work on Hydrogen Hubs and understanding your views on the best ways to lead the world in energy innovation and technology breakthroughs.

Question 5: DOE's Tribal Energy Finance Program has the potential to continue to drive energy development in rural parts of the country. The Loan Programs Office is currently evaluating approximately $5 billion in Tribal Energy Finance Program applications. Mr. Wright, if confirmed, will you commit to maintaining the Tribal Energy Finance Program to ensure that Tribes can utilize the financing tools to lower energy costs, create jobs, and attract businesses to its reservations and Tribal lands? Also, despite the potential of this program, many applicants have been frustrated with the pace of loan approvals. Will you commit to working to improve the program and accelerate the approvals issued?

Response: I believe tribes and other groups with good ideas should be eligible for the program. I understand your frustration with the pace of approvals, and I would be glad to work with you to determine how decisions could be accelerated.



January 13, 2025

The Honorable Mike Lee
Chairman, U.S. Senate Committee on Energy and Natural Resources
304 Dirksen Senate Office Building
Washington, D.C. 20510

The Honorable Martin Heinrich
Ranking Member, U.S. Senate Committee on Energy and Natural Resources
304 Dirksen Senate Office Building
Washington, D.C. 20510

Dear Chairman Lee and Ranking Member Heinrich:

The American Chemistry Council (ACC) strongly supports Mr. Chris Wright's nomination and confirmation to be incoming President Trump's Secretary for the Department of Energy (DOE or "Department"). As Founder and CEO of Liberty Energy, Mr. Wright has a longtime proven track record of success in the energy sector. We are confident that Mr. Wright will ably and effectively lead the Department toward its mission to ensure America's security and prosperity by addressing its energy and environment challenges through transformative science and technical solutions.

The ACC represents more than 190 companies engaged in the business of chemistry. It represents the people and companies creating the groundbreaking products that are improving the world all around us by making it healthier, safer, more sustainable and more productive. Simply put, American energy relies on American chemistry.

As an energy-intensive industry, U.S. chemical manufacturers and the ACC strongly support an energy abundance platform and approach expected to be executed by Mr. Wright and the Department that embraces an "all-of-the-above" energy approach and energy sources that are affordable, abundant, reliable, secure, safe and sustainable while ensuring environmental progress and safety.

The ACC looks forward to working with Mr. Wright on retaining and growing domestic energy production, while improving energy efficiency, creating jobs and growing the U.S. economy.

The Committee and Senate should move swiftly to confirm Chris Wright's nomination and unleash the power of American innovation through chemistry for years to come.

If you have any questions or require additional information, please do not hesitate to contact me.

Sincerely,



Chis Jahn
President and CEO
American Chemistry Council

ACEC
American Council of Engineering Companies

January 21, 2025

The Honorable Mike Lee (R-UT)
Chair
Senate Committee on Energy & Natural Resources
304 Dirksen Senate Office Building

The Honorable Martin Heinrich (D-NM)
Ranking Member
Senate Committee on Energy & Natural Resources
304 Dirksen Senate Office Building

Dear Chairman Lee and Ranking Member Heinrich,

On behalf of the American Council of Engineering Companies (ACEC) – the business association of the nation's engineering industry – I am writing to strongly support the confirmation of Chris Wright as the next U.S. Secretary of Energy. Mr. Wright is well equipped to lead the Department of Energy at this important time in our history.

With his experience as a CEO of an energy company, Mr. Wright understands the importance of America's leadership to meet the global demand for energy. Moreover, as an engineer, Mr. Wright understands the role of the engineering industry at the forefront of making energy investments successful.

The energy markets are facing historic changes in addressing the impacts of increased power demand stemming from data centers and AI as well as grid reliability and electricity affordability. We believe nuclear energy is a power source that could help our national grid, and we support policies that promote nuclear technologies like Small Modular Reactors (SMRs). To build upon the momentum, nuclear technologies require robust domestic supply chains that include increasing mining of key resources like uranium. ACEC also supports the development of Liquefied Natural Gas (LNG) facilities vital to deliver reliable and safe energy. To unlock the full potential of America's energy, we believe permitting reform is essential to facilitate interstate transmission, meet storage needs, and advance alternative and renewable sources to achieve the benefits of expanded energy infrastructure for all Americans.

We are confident that Chris Wright will be an effective leader as Secretary of Energy. We thank you for scheduling this committee hearing so early in the new year, and we look forward to a prompt confirmation process.

Sincerely,

Linda Bauer Darr
President and CEO

American Exploration & Mining Association
EST. 1895

16201 E. Indiana Ave., Suite 3280
Spokane Valley, WA 99216
(509)624-1158 - www.miningamerica.org

January 15, 2025

The Honorable Mike Lee
Chairman
U.S. Senate Committee on Energy and Natural Resources
304 Dirksen Senate Office Building
Washington, D.C. 20510

The Honorable Martin Heinrich
Ranking Member
U.S. Senate Committee on Energy and Natural Resources
304 Dirksen Senate Office Building
Washington, D.C. 20510

Re: AEMA Letter of Support for the Nomination for Mr. Chris Wright to be Secretary of Energy

Dear Chairman Lee and Ranking Member Heinrich:

On behalf of the 1,800 members of the American Exploration & Mining Association (AEMA), we urge your support for the appointment of Chris Wright as Secretary of the Department of Energy (DOE). Mr. Wright is highly qualified for this position as the CEO of a company in the energy sector.

Mr. Wright has been a proponent of "energy abundance" as a way to raise the standard of living for many in poverty around the world. His background in natural resource industries includes mining, which gives him an understanding of energy from multiple perspectives. In addition to his industry experience, Mr. Wright is well-known for describing himself as a "science geek" and a "tech nerd," attributes which will serve him well as he manages DOE's 17 national laboratories and their various research and development missions. We urge your support and a swift confirmation.

AEMA is a 130-year-old national association representing the minerals industry with members residing in 46 U.S. states. AEMA is the recognized national voice for exploration, the junior mining sector, and maintaining access to public lands, and represents the entire mining life cycle, from exploration to reclamation and closure. Our members work closely with DOE to responsibly develop the mineral resources our society requires.

Thank you for your time and consideration.

Yours truly,

Mark Compton
Executive Director

AGA
American Gas Association

January 14, 2025

The Honorable Mike Lee
Chairman
Committee on Energy and Natural Resources
United States Senate
Washington, DC 20510

Dear Chairman Lee:

The American Gas Association is pleased to support the nomination of Chris Wright to be the U.S. Secretary of Energy.

AGA represents more than 200 local energy companies committed to the safe and reliable delivery of clean natural gas to more 189 million Americans and 5.8 million businesses in all 50 states. Natural gas has been and will continue to be the cornerstone of America's economy and America's energy independence. Our natural gas industry is committed to investing, building and innovating for the families and businesses who depend on us every minute of every day. Natural gas is reliable and affordable; households that use natural gas for heating, cooking and clothes drying save an average of $1,132 per year compared to homes using electricity for those applications.

As you know, the Department of Energy plays a crucial role in areas of importance to AGA and our customers, including setting of efficiency standards for home appliances, establishing energy guidelines for federal facilities, and providing crucial research and development for natural gas, hydrogen, and renewable natural gas technologies. AGA has a long history of closely collaborating with DOE on appliance standards, building codes, the ENERGY STAR program, and research and development efforts. We look forward to working with the new Secretary of Energy on advancing the increased use of clean natural gas as well as creating energy and efficiency policy on behalf of natural gas residential, commercial and industrial customers nationwide.

Thank you for the opportunity to offer our support for Mr. Chris Wright's nomination. Please let us know if we can provide any additional information or answer any questions.

Kind Regards,

George Lowe

George Lowe
Vice President, Governmental Affairs and Public Policy
American Gas Association

George Lowe, *Vice President of Government Affairs and Public Policy* **E: Glowe@aga.org**

From: Jack Cramton <CramtonJ@api.org>
Date: January 14, 2025 at 5:24:14 PM EST
To: "Crofts, Sam (Energy)" <Sam_Crofts@energy.senate.gov>, "McCurdy, Jacob (Energy)" <Jacob_McCurdy@energy.senate.gov>
Subject: Statements of Support- DOI & DOE

Good evening,

Please see below statements of support for the Burgum and Wright nominations. Please let me know if you have any questions.

Secretary of Interior
"As Governor of a top production state, Doug Burgum has long been a champion for American energy leadership. We are pleased to support his nomination and look forward to working with him once confirmed to implement a pro-American energy approach to federal leasing, starting with removing barriers to development on federal lands and waters and developing a new five-year offshore program." –**API President and CEO Mike Sommers**

Secretary of Energy
"Chris Wright's experience in the American energy sector gives him an important perspective that will inform his leadership of the Department of Energy. We are pleased to support his nomination and look forward to working with him once confirmed to bolster American geopolitical strength by lifting DOE's pause on LNG export permits and ensuring the open access of American energy for our allies around the world." –**API President and CEO Mike Sommers**

Best,

Jack Cramton
Vice President
Federal Relations
o: 202.682.8160
e: cramtonj@api.org
www.api.org

Senator **Bo Biteman**
President of the Senate
Wyoming Senate **Senate District 21**

address P.O. Box 283 • Ranchester, WY 82839
mobile (307) 751-6178
email Bo.Biteman@wyoleg.gov

January 23, 2025

Senator Mike Lee, Chairman
Senator Martin Heinrich, Ranking Member
U.S. Senate Energy & Natural Resources Committee
United States Senate
304 Dirksen Senate Office Building
Washington, DC 20510

Dear Chairman Lee and Ranking Member Heinrich,

We, the undersigned members of Wyoming's legislative leadership, write to express our strong support for the confirmation of Mr. Chris Wright as Secretary of the United States Department of Energy. We believe Mr. Wright brings the exact blend of private sector experience and leadership that makes him the ideal person to lead the Department of Energy at this pivotal moment in history.

Chris Wright has a distinguished career in the energy industry, marked by his innovative approach. As the CEO of Liberty Oilfield Services, he has demonstrated a deep understanding of the complexities of energy production and the importance of balancing economic growth with stewardship, which has positioned him as a premier thought leader in the energy sector.

Wyoming is a leader in energy production and in developing our vast natural resources. Wyoming produces 12 times more energy than it consumes, making it the third-biggest net energy supplier among the states and the largest exporter of energy. Wyoming has been the top coal-producing state since 1988, accounting for two-fifths of all coal mined in the United States in 2023. Additionally, Wyoming was the eighth-largest crude oil-producing state and the tenth-largest natural gas producer in the nation in 2023. Wyoming is the leading producer of uranium. Wind power generation in Wyoming has more than doubled since 2019. We know all types of energy here.

Moreover, Wyoming is home to a significant amount of other natural resources, including large deposits of critical minerals. The Department of Energy can help spur more growth in energy development and Wyoming is ready to continue to partner with the DOE under Mr. Wright's leadership.

We are confident that Chris Wright's vision and experience create efficiencies in the delivery of service and unleash American prosperity. We believe his knowledge of the West is also a valuable trait and help make him the best choice to lead the DOE.

We respectfully urge you to support Chris Wright's confirmation and look forward to the positive impact he will have in this critical role.

Sincerely,

Bo Biteman
President, Wyoming State Senate

Tim Salazar
Vice President, Wyoming State Senate

Tara Nethercott
Majority Floor Leader, Wyoming State Senate

CITIZENS FOR RESPONSIBLE ENERGY SOLUTIONS

January 15, 2025

The Honorable Mike Lee
Chairman
U.S. Senate Committee on
Energy and Natural Resources
304 Dirksen Senate Office Building
Washington, D.C. 20510

The Honorable Martin Heinrich
Ranking Member
U.S. Senate Committee on
Energy and Natural Resources
304 Dirksen Senate Office Building
Washington, D.C. 20510

Dear Chairman Lee and Ranking Member Heinrich:

On behalf of Citizens for Responsible Energy Solutions (CRES), I write in strong support of the nomination of Mr. Chris Wright to be our nation's next Secretary of Energy and encourage the Committee to advance his nomination. CRES is a nonprofit organization dedicated to supporting conservative solutions to address our nation's energy, economic and environmental security while ensuring the United States retains its global competitive edge.

Mr. Wright understands the energy and national security challenges facing our country. He is an accomplished energy and business leader with a proven track record of supporting an all-of-the-above energy strategy – from oil and gas to geothermal and advanced nuclear technologies. This sensible approach will help keep energy prices low for American families and businesses while creating good-paying jobs. His innovation-minded leadership and energy industry background equip him with the experience necessary to help marshal our country's ingenuity and resources to meet America's growing energy demands.

We are confident that under the leadership of President Trump and Mr. Wright, the United States can reduce our reliance on adversarial supply chains, reinvigorate our manufacturing sector, encourage private-sector development and reduce global emissions. Through smart investments in the U.S. Department of Energy's fundamental science, National Laboratories, applied research and development, commercialization and deployment activities, we can seize the moment and promote U.S. energy dominance.

CRES encourages the Commitee to favorably advance Mr. Chris Wright's nomination to be the 17th Secretary of Energy.

Sincerely,

Heather Reams

Heather Reams
CRES President

CLARIOS

January 21, 2025

The Honorable Mike Lee, Chairman
U.S. Senate Committee on Energy & Natural Resources
304 Dirksen Senate Office Building
Washington, D.C. 20510

The Honorable Martin Heinrich, Ranking Member
U.S. Senate Committee on Energy & Natural Resources
304 Dirksen Senate Office Building
Washington, D.C. 20510

Dear Chairman Lee and Ranking Member Heinrich,

On behalf of Clarios, a Wisconsin-based global leader in advanced energy storage solutions, I am writing to express strong support for Chris Wright's nomination as Secretary of Energy. Mr. Wright's extensive leadership in the energy sector as an innovator positions him to guide the Department of Energy in securing America's energy and mineral future.

At Clarios, we manufacture and recycle batteries that power nearly every vehicle on the road today—from cars, tractors, and trucks to emergency response vehicles, tanks, and construction equipment. These starter batteries are essential components for the safety, reliability, and efficiency of all vehicle types. Our batteries enable critical safety features such as hazard lights, airbags, and crash-avoidance systems, ensuring the personal security of millions of Americans.

Mr. Wright understands the pivotal role of technologies like ours in achieving energy abundance, economic resilience and national security. His track record demonstrates a commitment to fostering innovation and ensuring the United States retains its leadership in critical industries.

Our company recognizes the urgent need for policies that support domestic manufacturing and reduce reliance on foreign suppliers, particularly in the face of China's efforts to dominate global battery markets. We are confident that under Mr. Wright's leadership, the Department of Energy will:

- Champion energy independence by prioritizing domestic manufacturing and recycling of battery technology and reducing reliance on foreign critical minerals and battery materials.
- Advance policies to secure the supply chain for energy storage, ensuring America's economic and national security amid a growing threat from China.
- Promote innovation to maintain the United States' position as a leader in battery technology and sustainable energy solutions.

We urge the committee to approve Chris Wright's nomination and advance it to the full Senate for confirmation. His leadership will ensure a balanced approach to energy policy that supports critical domestic industries, strengthens our energy independence, and safeguards America's economic and national security.

Thank you for considering this vital nomination. Should you have any questions or require further information, please do not hesitate to contact me.

Respectfully,

Adam Muellerweiss
Chief Sustainability Officer
Clarios

DEPA
DOMESTIC ENERGY PRODUCERS ALLIANCE

January 14, 2025

Chairman Mike Lee
363 Russell Senate Office Building
United State Senate
Washington, DC 20510

Dear Chairman Lee,

The Domestic Energy Producers' Alliance (DEPA) is proud to support the nominations of **Chris Wright**, CEO of Liberty Energy and DEPA Board Member, as Secretary – Department of Energy (DOE).

Chris Wright is a visionary, energy leader, and humanitarian. Mr. Wright, a self-described "tech nerd turned entrepreneur," has dedicated his career to bettering human lives by expanding access to abundant, affordable, and reliable energy. As the CEO of Denver-based Liberty Energy, Wright has demonstrated a visionary approach to energy development, combining cutting-edge technology with a steadfast commitment to social responsibility. Additionally, with an education and background in nuclear energy, renewables and fossil fuels he will be the most qualified Secretary of Energy since the creation of the DOE.

Through initiatives like the *Bettering Human Lives Foundation*, Wright has championed efforts to combat global energy poverty by providing clean cooking fuels to households in underserved regions, reducing harmful emissions that claim millions of lives annually. Wright's annual *Bettering Human Lives* report underscores the essential role of hydrocarbons in modern society, from supporting global food production to enabling advancements in medicine and infrastructure.

Chris Wright's leadership has consistently shown that energy development and environmental consciousness can go hand in hand. He is uniquely qualified to guide the Department of Energy in implementing policies that ensure energy independence and economic vitality for all Americans.

DEPA is a nationwide collaboration of 39 coalition associations – from California to West Virginia, Texas to Montana – representing individuals and companies engaged in domestic onshore oil and natural gas exploration and production. DEPA is a non-partisan association seeking common ground, and in common sense solutions to the challenges facing American oil and natural gas production through educating policymakers on the vital role of domestic oil and gas production in supporting the U.S. economy, energy independence, and global leadership.

We urge the Senate to confirm, without hesitation, Mr. Wright's nomination.

Sincerely,

Jerry R. Simmons
CEO/President
Domestic Energy Producers' Alliance

PO BOX 33190 TULSA, OK 74153 405.669.6646 WWW.DEPAUSA.ORG

Hispanics In Energy

January 13, 2025

The Honorable Mike Lee
United States Senator
Chairman, Senate Energy and
Natural Resources Committee

Re: Mr. Chris Wright, Nomination for Secretary of Energy

Dear Chairman Lee,

Hispanics In Energy, a national non-profit organization designed to propel Hispanic inclusion in the energy sector, supports Mr. Chris Wright's confirmation as Secretary of Energy.

Mr. Wright has pioneered hydraulic fracturing and led the industry through innovations that advanced commercial shale gas production and hydraulic fracture mapping. His business acumen led his company, Liberty Energy, to become North America's second-largest hydraulic fracturing firm, emphasizing technological advancements and operational efficiency.

He has championed improving human lives by expanding access to abundant, affordable, and reliable energy. He has been recognized as the "Wildcatter of the Year," acknowledging his business success and humanitarian efforts within the energy industry.

Hispanic Americans represent 20% of America's population. Our mission is to increase Hispanic American participation in energy jobs, business, and executive-level positions in a legal and fair play manner while respecting all other communities' rights and aspirations.

Equal opportunities for Hispanics in the energy sector have been elusive. Few Hispanics hold key positions within the federal government, especially in the Department of Energy, Federal Energy Regulatory Commission, and Nuclear Regulatory Commission. The Department of Energy can help promote equal opportunities for all Americans in the energy sector.

We believe Mr. Wright is the right choice and urge his Senate confirmation.

Respectfully Submitted,

Jose L. Perez
President & Chief Executive Officer
jose@hispanicsinenergy.com

IndependentWomen®

Independent Women Supports the Confirmation of Chris Wright as Secretary of Energy

January 15, 2025

Dear Senators,

Independent Women, which advances policies that enhance opportunity and well-being, fully supports the confirmation of Chris Wright to serve as Secretary of Energy. President Trump deserves the team he wants so that he can carry out the directive given to him by the American people.

There is no question that Mr. Wright is incredibly qualified to serve as Secretary of Energy.

Through his work in the fracking industry, coupled with his experience with nuclear power and minerals, Mr. Wright recognizes the importance of using our natural resources and regaining energy independence. His private sector experience makes him uniquely qualified for the role of encouraging continued, responsible innovation to enhance the American energy sector, and with it the safety and security of the world.

Independent Women is proud to support the nomination of such a qualified nominee to serve as Secretary of Energy. We urge senators to provide Chris Wright with a fair and respectful hearing and to confirm him as Secretary of Energy.

Respectfully,

Heather R. Higgins
CEO
Independent Women's Voice

Carrie Lukas
Vice President
Independent Women's Voice

Industrial Energy Consumers of America (IECA)
The Voice of the Industrial Energy Consumers

1050 Connecticut Avenue, NW, Suite 500 • Washington, D.C. 20036
Telephone (202) 223-1420 • www.ieca-us.org

January 22, 2025

The Honorable Mike Lee
Chairman
Senate Committee on Energy and Natural Resources
Washington, DC 20510

The Honorable Martin Heinrich
Ranking Member
Senate Committee on Energy and Natural Resources
Washington, DC 20510

Re: IECA Supports Nomination of Mr. Chris Wright to be Secretary of Energy

Dear Chairman Lee and Ranking Member Heinrich:

On behalf of the Industrial Energy Consumers of America (IECA), we support the nomination of Mr. Chris Wright to be Secretary of Energy. Mr. Wright brings a wealth of knowledge in the energy field coupled with his technical background.

During his confirmation hearing, Mr. Wright was asked if he would protect domestic consumers from the impacts of increasing volumes of LNG exports. He said that he would. We urge the Committee to keep him at his word.

According to the Energy Information Administration,[1] LNG exports are maximized during winter months, which puts upward pressure on natural gas and electricity prices. As our inventories become depleted, prices increase. This is basic supply versus demand.

This is exactly what happened during the winter of 2021-2022 where Henry Hub monthly prices rose from $2.00 per MMBtu to $8.20 per MMBtu and electricity prices also increased 30 percent.

This same phenomenon is playing out right now as the U.S. finds itself in a winter freeze and inventory is falling precipitously (see Figures 1 and 2). Some parts of the country are already paying $18 per MMBtu.

[1] Wave of LNG Exports to Exacerbate Structural Reliability and Price Volatility Risks for U.S. Natural Gas & Electricity Markets, IECA, https://www.ieca-us.org/wp-content/uploads/04.17.24_LNG-Exports-Do-Impact-U.S.-Prices.pdf

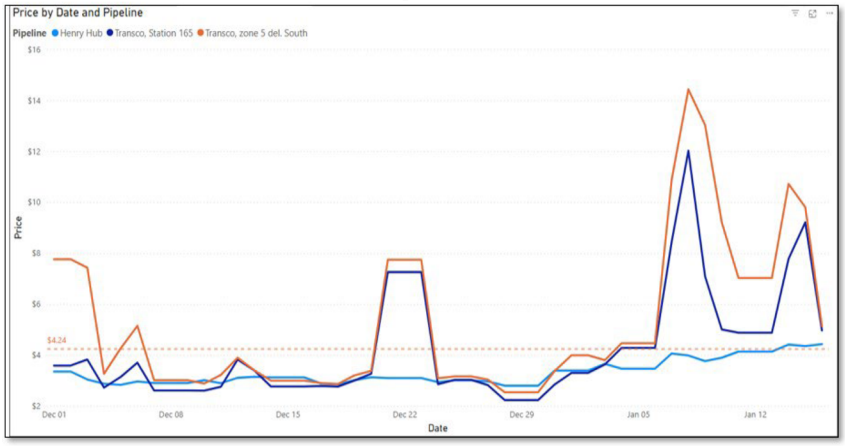
It is for this reason we urge you to put our LNG Inventory Policy in place to insulate U.S. consumers from the impacts.[2]

Sincerely,

Paul N. Cicio
Paul N. Cicio
President & CEO

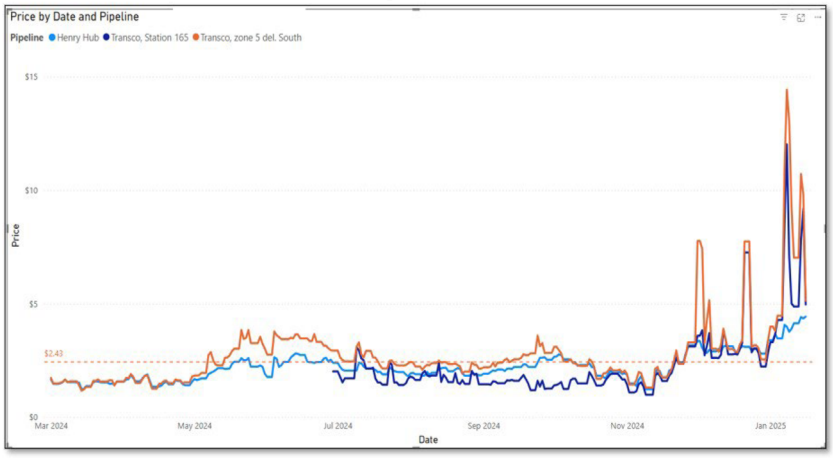
cc: U.S. Senate
Senate Committee on Energy and Natural Resources
House Committee on Energy and Commerce

Figure 1



[2] IECA America First LNG Inventory Policy, https://www.ieca-us.org/wp-content/uploads/LNG-Inventory-Policy-to-Insulate-the-US-Market-from-LNG-Export-Impacts.pdf

Figure 2


Price by Date and Pipeline
Pipeline Henry Hub Transco, Station 165 Transco, zone 5 del. South
$15
$10
$5
$2.43
$0
Price
Mar 2024
May 2024
Jul 2024
Sep 2024
Nov 2024
Jan 2025
Date

INSTITUTE OF MAKERS OF EXPLOSIVES
SAFETY. SECURITY. STEWARDSHIP.

January 13, 2025

The Honorable Mike Lee
Chairman
Committee on Energy and Natural Resources
U.S. Senate
Washington, DC 20510

The Honorable Martin Heinrich
Ranking Member
Committee on Energy and Natural Resources
U.S. Senate
Washington, DC 20510

Dear Chairman Lee and Ranking Member Heinrich,

On behalf of the Institute of Makers of Explosives (IME), I write in support of Mr. Chris Wright to be Secretary of the U.S. Department of Energy (DOE). Mr. Wright's deep knowledge of the U.S. energy industry and strong business acumen makes him well-positioned to lead the department.

The commercial explosives industry, including manufacturers, distributors and users, is vital to the U.S. economy, contributing more than $19 billion annually to the U.S. economy and creating 15,000 direct industry jobs and more than 60,000 total jobs.

Commercial explosives play a vital role in ensuring our nation has a diverse energy supply that is both abundant and affordable. This includes the development of traditional sources of energy like coal, oil, and natural gas. Commercial explosives also play a significant role in sourcing the critical minerals necessary for the manufacture of modern renewable energy technologies that are part of a low-carbon economy.

We believe Mr. Wright will take a balanced approach to ensuring our nation continues on a path to energy independence by supporting innovation and working to streamline the permitting process and building a resilient energy grid.

I strongly encourage the committee to approve Mr. Wright for the position of Secretary of the U.S. Department of Energy and favorably report his nomination to the full Senate for confirmation.

Sincerely,

J. Clark Mica
President

1212 New York Avenue, NW, Suite 650, Washington, DC 20005, USA, (202) 429-9280

Rich Nolan
President & CEO

January 13, 2025

The Honorable Mike Lee
Chairman
Senate Committee on Energy and Natural Resources
304 Dirksen Senate Office Building
Washington, D.C. 20510

The Honorable Martin Heinrich
Ranking Member
Senate Committee on Energy and Natural Resources
304 Dirksen Senate Office Building
Washington, D.C. 20510

Dear Chairman Lee and Ranking Member Heinrich:

As President and CEO of the National Mining Association (NMA), I want to express NMA's support for Mr. Chris Wright's nomination to serve as Secretary of Energy. His experience, knowledge, and embrace of "all of the above" energy make him well-suited to lead the department during this important time for our nation.

The NMA is the only national trade organization that serves as the voice of the U.S. mining industry and the hundreds of thousands of American workers it employs before Congress, the federal agencies, the judiciary, and the media, advocating for public policies that will help America fully and responsibly utilize its vast natural resources. We work to ensure America has secure and reliable supply chains, abundant and affordable energy, and the American-sourced materials necessary for U.S. manufacturing, national security, and economic security, all delivered under world-leading environmental, safety, and labor standards. The NMA has a membership of more than 280 companies and organizations involved in every aspect of mining, from producers and equipment manufacturers to service providers.

Mr. Wright's background includes a clear understanding of the permitting challenges faced by mining and energy companies. As CEO of Liberty Energy, he has direct experience with regulatory processes and has supported efforts to improve domestic energy production and operations.

101 Constitution Ave. NW / Suite 500 East / Washington, D.C. 20001 / Phone: 202. 463. 2600

We believe that Mr. Wright will be an effective Secretary of Energy. His approach to leadership and commitment to energy reliability and affordability will benefit the department and the nation. I respectfully urge the Committee to approve Mr. Wright's nomination and move it forward without delay. We look forward to supporting the Committee throughout this important confirmation process.

Sincerely,

Rich Nolan

101 Constitution Ave. NW / Suite 500 East / Washington, D.C. 20001 / Phone: 202. 463. 2600

NRECA
America's Electric Cooperatives

Jim Matheson

January 14, 2025

The Honorable Mike Lee
Chairman
Senate Committee on Energy and Natural Resources
Dirksen Senate Office Building
Washington, DC 20510

The Honorable Martin Heinrich
Ranking Member
Senate Committee on Energy and Natural Resources
Dirksen Senate Office Building
Washington, DC 20510

Dear Chairman Lee and Ranking Member Heinrich,

On behalf of the nearly 900 not-for-profit electric cooperative members of the National Rural Electric Cooperative Association (NRECA), I write to express NRECA's support for Chris Wright to serve as Secretary of the U.S. Department of Energy (DOE).

America's electric cooperatives comprise a unique sector of the electric industry. These not-for-profit entities are independently owned and governed by the people they serve. From growing urban regions to remote farming communities, electric cooperatives provide power to 42 million Americans across 48 states.

Locally, electric cooperatives are focused on powering and empowering their communities. Nationally, electric cooperatives are focused on advocating for smart energy policies that keep the lights on at a price our consumer-members can afford. America's economic growth and national security depend on energy production from all sources to power our Country's homes and businesses with reliable and affordable electricity. This is more important than ever as electric demand grows driven by data centers and the onshoring of manufacturing.

NRECA and our electric cooperatives have a longstanding relationship with DOE and we look forward to working with Mr. Wright in prioritizing programs that ensure the ability of electric cooperatives to supply affordable, reliable, and safe electricity. We are eager to continue our partnership with DOE to make effective and efficient use of federal infrastructure programs to invest in our electric infrastructure, enhancing grid reliability and resiliency.

Mr. Wright's extensive experience and leadership in the energy industry makes him well-suited to lead DOE and address the many challenges and opportunities facing the sector. NRECA is proud to support Chris Wright's nomination as DOE Secretary, urges the Committee on Energy and Natural Resources and the full Senate to swiftly approve his nomination, and looks forward to working with him to advance U.S. energy security.

Sincerely,

Jim Matheson
CEO, NRECA

4301 Wilson Blvd. | Arlington, VA 22203-1860 | Tel: 703.907.5500 | electric.coop | @NRECANews

NSSGA®
NATIONAL STONE, SAND & GRAVEL ASSOCIATION

January 15, 2025

The Honorable Mike Lee
Chair
Committee on Energy and Natural Resources
U.S. Senate
363 Russell Senate Office Building
Washington, D.C. 20510

The Honorable Martin Heinrich
Ranking Member
Committee on Energy and Natural Resources U.S. Senate
709 Hart Senate Office Building
Washington, D.C. 20510

Dear Senators Lee and Heinrich,

As the Committee on Energy and Natural Resources prepares to vote on Mr. Chris Wright's nomination, as Secretary of Energy, the National Stone, Sand & Gravel Association (NSSGA) would like to express our unwavering support for his confirmation.

As a distinguished business leader, Mr. Wright understands how energy policy impacts businesses nationwide. His understanding of the challenges and opportunities within the aggregates industry, including NSSGA's industrial sand division, will enable him to empower our industry to succeed in the upcoming years. His vision for the Department of Energy aligns with our goals that energy laws and regulations should be based on sound scientific, engineering and medical research and established scientific, engineering and medical principles.

NSSGA represents stone, sand and gravel producers who are responsible for the essential raw materials found in every building, road, bridge and public works project. NSSGA looks forward to working with an Energy Secretary who understands the harmful repercussions of overregulation. NSSGA members believe that wise environmental stewardship is good business. Aggregates operations around the country recognize that the Earth's resources, upon which all life depends, are finite. Wise environmental stewardship is necessary today to preserve the potential for a quality life for future generations.

We respectfully urge you to confirm Chris Wright as the next Secretary of Energy. Thank you for considering our position. Please contact me if you have any questions or would like any additional information.

Sincerely,

Michele Stanley
Interim CEO
National Stone, Sand & Gravel Association

66 Canal Center Plaza, Suite 300
Alexandria, VA 22314 **nssga.org**

Representative **Chip Neiman**
Speaker of the House
Wyoming House of Representatives **House District 01**

address P.O. Box 116 • Hulett, WY 82720
mobile (307) 290-0366
email Chip.Neiman@wyoleg.gov

January 21, 2025

US Senator Mike Lee
Chair of US Senate Energy & Natural Resources Committee
US Senator Martin Heinrich
Ranking Member of US Senate Energy and Natural Resources Committee
United States Senate
304 Dirksen Senate Office Bldg
Washington, D.C. 20510

Dear Chairman Lee and Ranking Member Heinrich,

We, the undersigned members of Wyoming's legislative leadership, write to express our strong support for the confirmation of Mr. Chris Wright as Secretary of the United States Department of Energy. We believe Mr. Wright brings the exact blend of private sector experience and leadership to that makes him the ideal person to lead the Department of Energy at this pivotal moment in history.

Chris Wright has a distinguished career in the energy industry, marked by his innovative approach. As the CEO of Liberty Oilfield Services, he has demonstrated a deep understanding of the complexities of energy production and the importance of balancing economic growth with stewardship, which has positioned him as a premier thought leader in the energy sector.

Wyoming is a leader in energy production and in developing our vast natural resources. Wyoming produces 12 times more energy than it consumes, making it the third-biggest net energy supplier among the states and the largest exporter of energy. Wyoming has been the top coal-producing state since 1988, accounting for two-fifths of all coal mined in the United States in 2023. Additionally, Wyoming was the eighth-largest crude oil-producing state and the tenth-largest natural gas producer in the nation in 2023. Wyoming is the leading producer of uranium. Wind power generation in Wyoming has more than doubled since 2019. We know all types of energy here.

Moreover, Wyoming is home to a significant amount of other natural resources, including large deposits of critical minerals. The Department of Energy can help spur more growth in energy development and Wyoming is ready to continue to partner with the DOE under Mr. Wright's leadership.

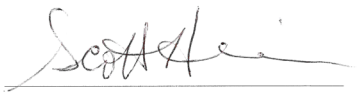
We are confident that Chris Wright's vision and experience create efficiencies in the delivery of service and unleash American prosperity. We believe his knowledge of the West is also a valuable trait and help make him the best choice to lead the DOE.

We respectfully urge you to support Chris Wright's confirmation and look forward to the positive impact he will have in this critical role.

Sincerely,



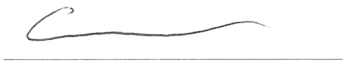
House Speaker Chip Neiman



House Floor Majority Leader Scott Heiner



House Speaker Pro Tempore
Jeremy Haroldson



House Majority Whip Ocean Andrews

Portland Cement Association
200 Massachusetts Ave NW, Suite 200
Washington D.C., 20001
202.408.9494
www.cement.org

January 15, 2025

The Honorable Mike Lee
Chairman, Energy & Natural Resources
U.S. Senate
Washington, D.C. 20510

The Honorable Martin Heinrich
Ranking Member, Energy & Natural Resources
U.S. Senate
Washington, D.C. 20510

Dear Chairman Lee and Ranking Member Heinrich:

The Portland Cement Association (PCA), which represents cement manufacturers across the country, expresses its support for and the Senate's expedient consideration and approval of the nomination of Mr. Chris Wright to serve as Secretary of the Department of Energy (DOE).As cement is critical to economic growth and a strong quality of life for Americans, the choice of DOE Secretary is critical at this time of global and domestic environmental and economic challenges.

As you may know, PCA is the premier policy, research, education, and market intelligence organization serving America's cement manufacturers. PCA's members represent the majority of the U.S. cement production capacity and have facilities in all 50 states. Our members manufacture cement, the primary ingredient in concrete, an essential construction material, and a fundamental component of our nation's transportation infrastructure. Cement is used to construct highways, bridges, tunnels, mass transit systems, airports, runways, and sidewalks. Cement and concrete product manufacturing, directly and indirectly, employs approximately 600,000 people across the United States, and our collective industries contribute over $130 billion to our economy.

DOE has a vital role in our nation’s energy policies and in the research & development of technologies for manufacturers. Well-thought-out energy policies are imperative to the United States’ energy dominance and the competitiveness of domestic manufacturers.

PCA and the cement industry are committed to sustainability, protecting human health & the environment, and maintaining the U.S. cement industry as the global standard. Meeting these goals will require increased energy production and access in the U.S. and reducing regulatory barriers to increased energy production and the implementation of facility upgrades. Mr. Wright, as DOE Secretary and member of the newly formed National Energy Council, will be critical towards achieving these goals.

As the 119th Congress gets underway, PCA is ready to work with Congress and the Trump Administration on policies critical to our nation's cement manufacturers. If you have any questions, please do not hesitate to reach out to me at soneill@cement.org.

Sincerely,

Sean O’Neill
Senior Vice President
Government Affairs

Cc: All members of the U.S. Senate

December 17, 2024

The Honorable Chuck Schumer
Senate Majority Leader
U.S. Senate

The Honorable Mitch McConnell
Senate Minority Leader
U.S. Senate

The Honorable Mike Johnson
Speaker
U.S. House of Representatives

The Honorable Hakeem Jeffries
Minority Leader
U.S. House of Representatives

The Honorable John Thune
Majority Leader-Elect
U.S. Senate

Dear Leader Schumer, McConnell, Speaker Johnson, Leader Jeffries Leader-Elect Thune:

As representatives of 75 innovative energy companies with projects across the United States, many of whom are creating thousands upon thousands of jobs, we write to encourage Congress to maintain current funding levels and loan authority for the U.S. Department of Energy's Loan Programs Office (LPO).

The LPO[1] provides loans and loan guarantees to support energy infrastructure and manufacturing projects in America that spur innovation and job creation. Originally enacted under the Energy Policy Act of 2005 and signed into law by former President Bush, the LPO's supported projects have generated, on aggregate, over 127 million MWh of clean energy (enough to power over 11 million homes) and created more than 47,000 permanent jobs.[2] We believe the LPO continues to have the potential to be the economic engine for the country to manufacture and deploy American-made energy technologies—such as direct air capture, hydrogen, advanced nuclear, critical minerals, renewables, energy storage, transmission, innovative hydropower, carbon utilization, biofuels, renewable chemicals and biobased products.

As of September 2024, the LPO has issued $43.9 billion in loans and loan guarantees to support innovative energy and supply chain projects, America's energy infrastructure and advanced technology vehicle manufacturing facilities across the country. To date, the LPO's portfolio has demonstrated strong financial performance, with interest payments by borrowers to the U.S.

[1] Which includes and manages the Title XVII Innovative Clean Energy Loan Guarantee Program ("Title XVII"), Title XVII Energy Infrastructure Reinvestment Program ("EIR"), Advanced Transportation Vehicle Manufacturing Program ("ATVM"), Tribal Energy Loan Guarantee Program ("TELGP") and Carbon Dioxide Transportation Infrastructure Finance and Innovation Program ("CIFIA"),
[2] According to DOE, through Q4 FY24

Treasury exceeding actual and estimated losses by over $4 billion.[3] As of November 2024, the LPO has a robust and growing pipeline of projects interested in accessing LPO's loan authority, with 212 active applications that have been formally submitted to LPO representing $324.3 billion in financing. In the case of advanced nuclear for instance, LPO has nearly $65 billion in advanced nuclear project applications--$12 billion in Title XVII and $53 billion in EIR.[4] These programs are a critical tool for advanced nuclear projects to come online.

The companies included in this letter represent significant additional potential for loan requests. We know firsthand the challenges of bringing innovative and American-made energy and manufacturing technologies onto the marketplace. We also know that the LPO is one of the federal government's best tools to reinvest in energy infrastructure, re-industrialize rural communities, and keep the American homeland secure for the energy economy of the future. The LPO program promotes innovation, secures American manufacturing capability and reduces the importance of finished goods from Asian markets thereby strengthening US supply chains and US leadership at a global scale.

Thank you for your continued leadership on American clean energy and innovation issues, and we urge you to support maintaining current funding and loan authority at the LPO.

Sincerely

280 Earth
Aequor Inc.
Alfa Green Solutions
Allotrophe Partners
Alternative Fuels & Chemicals Coalition
Ambient Photonics
American Battery Factory, Inc.
Antora Energy
Assured Partners
Bia Energy Operating Company, LLC
Brightmark Energy
Budderfly, inc.
Calysta
Captis Aire
CapCO2 Solutions
Carbon Asset Solutions
Cerilon Inc.
Citroniq Chemicals
CJ Biomaterials
Clariant
CleanFiber
Coalition for Renewable Natural Gas
Crysalis Biosciences, Inc.

[3] https://www.energy.gov/lpo/portfolio
[4] According to DOE as of September 30, 2024

Current Hydro
Danimer Scientific, Inc.
DG Fuels LLC
Distributed Sun LLC
DMC Biotechnologies
Ecostrat
Element Fuels Holdings, LLC
Energy ETI
ENODA Ltd.
Ethos Connected
Federal Funding Services
Fervo Energy
Fidelis New Energy, LLC
Garrison Alley
Gevo, Inc.
Greeley Renewable Fuels
Heartwell Renewables
HIF Global
Highland Materials, Inc.
HYCO1
International Flavors & Fragrances (IFF)
Itaconix Corporation
Joby
King Energy
Louisiana Green Fuels LLC
Manus Bio
Modular Genetics
Nacero, Inc.
Natural State Renewables
Nexus Development Capital
Nordic Carbon Low
Northwest Advanced Bio-Fuels LLC
Nostromo
Origin Materials
Peak Power
Plasma Development
Raizen
Solugen
Strategic Biofuels
Synonym
TETRA Technologies, Inc.
Texas Renewable Fuels LLC
Twelve
U.S.A Bioenergy
Ubiquitous Energy
Velocys

Verde Clean Fuels, Inc.
Vertimass, LLC
Virentis Advisors
Viridis Chemical
Yilkens
Yosemite Clean Energy

U.S. Chamber of Commerce

1615 H Street, NW
Washington, DC 20062-2000
uschamber.com

January 27, 2025

To the Members of the United States Senate:

As the U.S. Senate considers the nomination of Chris Wright to be Secretary of the U.S. Department of Energy (DOE), the U.S Chamber of Commerce offers the following observations. As demonstrated during his confirmation hearing, Mr. Wright is a distinguished leader with a proven track record in the energy sector and a clear vision for enhancing America's energy security and economic growth. We urge quick consideration by the Senate of Mr. Wright's nomination and look forward to working with him upon his confirmation.

During his testimony before the Energy and Natural Resources Committee, Mr. Wright outlined a pragmatic approach to energy policy that earned strong bipartisan support. He emphasized the importance of expanding domestic energy production to ensure affordable and reliable energy supplies and advance U.S. economic competitiveness—priorities that are well aligned with the needs of American families and businesses.

Mr. Wright also underscored the role of innovation and technology in driving progress. His commitment to advance the work of the Department's national laboratories reflects a forward-looking strategy to ensure America remains a global leader in energy technology and competitiveness.

Finally, Mr. Wright addressed the critical need to reduce regulatory barriers and streamline federal policies to accelerate infrastructure development. By prioritizing private-sector investment and cutting red tape, his leadership will foster an environment where energy resources and technologies can be unleashed to strengthen the American economy.

We look forward to working with Mr. Wright to advance his vision for a secure and prosperous energy future. Thank you for considering his nomination.

Sincerely,

Neil L. Bradley
Executive Vice President, Chief Policy Officer,
and Head of Strategic Advocacy
U.S. Chamber of Commerce