

THE CENTER FOR
INTERNATIONAL
ENVIRONMENT &
RESOURCE POLICY

CLIMATE POLICY LAB
THE FLETCHER SCHOOL
TUFTS UNIVERSITY



Clean Energy Policy and Expanding Markets: Insights from Corporate, Labor and Investor Leaders

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Abstract

This research project sought to explore what corporate, labor and investor leaders across the U.S. economy believe they need, in terms of adjustments or additions to government policies, programs, finance mechanisms and other tools, to successfully implement business strategies that *both* advance the transition to a low-carbon economy and spur company growth, profits, job creation, shareholder value and investor returns. The 53 in-depth interviews conducted for this research yielded a number of striking areas of consensus among those leaders concerning the nexus of clean energy policy and opportunities to expand markets for zero- or low-carbon products and services or cost-effectively achieve deep greenhouse gas reductions over time. The ten policy findings described in this report reflect those areas of broad agreement, while also noting when there were multiple or divergent views.

Acknowledgements

An ambitious project of this nature could not have been successfully undertaken without the able partnership and participation of many knowledgeable and skilled individuals. We were fortunate to have a highly talented and dedicated Research Team and ad hoc Working Group, as well as deeply knowledgeable outside reviewers. Complete responsibility for the final product rests with us authors.

We wish to express deep gratitude to the following people:

Dr. Kelly Sims Gallagher, Professor of Energy and Environmental Policy and Director of the Center for International Environment and Resource Policy (CIERP), served as our faculty adviser. Dr. Gallagher strongly supported our research from its conception stage through the final report and her guidance and edits strengthened this work at every stage. We are grateful to the Climate Policy Lab at CIERP and the Fletcher School for hosting this work.

David Foster, former special advisor for economic development at the U.S. Department of Energy, served as an invaluable consultant throughout the project, especially through his extensive knowledge of heavy industry and the labor market. Research assistants Stefan Koester and Coralie Harmache, second-year Master's students at the Fletcher School of Law and Diplomacy, worked diligently over many months to conduct basic research, take detailed notes during the interviews and fact check. Stefan's writing talents, indefatigable work, and eye for accuracy bolstered the final report in innumerable ways. Program Coordinator Jillian DeMair provided organizational and logistical support throughout and applied her superb editing skills to ensure a clear and accurate final product. The overall guidance and administrative support from CIERP Associate Director Penny Storey was of critical value, especially regarding budget management and funder engagement. Colleen Neutra of Neutra Design brought her skill and creativity to the design and layout of the final report in both its PDF and print forms.

The following Working Group members lent their valuable time and expansive expertise about the energy economy to reviews of report outlines and drafts through the research process: Dr. Susan Tierney, an expert on energy policy and economics and previously co-chair of the National Commission on Energy Policy; Rick Duke, founder and President of Gigaton Strategies, LLC; and Nora Mead Brownell, co-founder of Espy Energy Solutions, LLC, an energy consulting firm. They helped to advance the research vision and approach at key junctures.

These additional reviewers read and commented on a late draft of the report: Rebecca Henderson, the John and Natty McArthur University Professor at Harvard University who also has a joint appointment at the Harvard Business School in the General Management and Strategy units; David Friedman, the Director of Cars and Product Policy and Analysis for Consumers Union, the policy and advocacy division of Consumer Reports; Melanie Kenderdine, Principal at the Energy Futures Initiative; and Jason Mark, Senior Vice President, U.S. Programs at the Energy Foundation. Their perspectives and suggestions were extremely helpful.

The Energy Foundation, Rockefeller Brothers Fund, William and Flora Hewlett Foundation and BP International Ltd. provided generous financial support, as did individual donors Nancy Stephens, Wilhelm Merck, Glenn Thomas and Peter and Terry Boyer, without which we could not have done this research.

Ashley D. Hicks, an analyst with the Social, Behavioral, and Education Research Institutional Review Board (SBER IRB) at Tufts University provided early and consistent counsel to ensure we understood and closely followed the SBER IRB regulations.

Kevin Knobloch and Barbara Kates-Garnick
May 2018

Executive Summary

This research project sought to explore what corporate, labor and investor leaders across the U.S. economy believe they need, in terms of adjustments or additions to government policies, programs, finance mechanisms and other tools, to successfully implement business strategies that *both* advance the transition to a low-carbon economy and spur company growth, profits, job creation, shareholder value and investor returns.

The 53 in-depth interviews conducted for this research yielded a number of striking areas of consensus among those leaders concerning the nexus of clean energy policy and opportunities to expand markets for zero- or low-carbon products and services or cost-effectively achieve deep greenhouse gas reductions over time. Our analysis of the interviews, reflected in this report, offers a timely perspective from a range of economic leaders that contributes to our understanding of the underlying energy- and climate-related challenges facing the private sector.

This report shares their thinking about how to improve or add to the policies (and programs and investments) at the state, regional, national and international levels, and identifies those policies that are most useful in helping the private sector achieve economic success while also sharply reducing greenhouse gas emissions from their products and operations in the years and decades ahead.

The ten policy findings described in this report reflect areas of broad agreement, while also noting when there were multiple or divergent views.

THE MAIN AREAS OF AGREEMENT INCLUDE:

- 1) An appreciation that the challenge of addressing climate change is a clear economic opportunity for many companies and investors, and could be a significant risk to companies that fail to act to reduce greenhouse gas emissions;
- 2) Overwhelming support for comprehensive, stable and coherent federal policies that provide long-term certainty and help U.S. companies capture first-mover advantage in the growing markets for low-carbon energy;
- 3) Broad advocacy for an economy-wide price on carbon to provide a comprehensive incentive for sustained scale-up of business investment in clean energy and energy efficiency;
- 4) Widespread views that climate change is an issue of global economic competitiveness for U.S. companies as the international market increasingly demands low-carbon technology and services;
- 5) Near universal agreement that the Trump administration's initiation of the U.S. exit from the Paris Climate Agreement is a mistake that puts U.S. business at a global competitive disadvantage;
- 6) An understanding that change in the electricity sector is happening fast, traditional utilities must evolve and innovate to succeed, and public policy must catch up to guide that change to assure that sector's decarbonization while also ensuring continued reliability, security and affordability of electricity;
- 7) Extensive support for government policies and programs that support private sector development and deployment of clean and efficient technologies, including time-limited incentives for emerging technologies;
- 8) Growing awareness that corporate policies and strategies, such as direct purchase of renewable energy by large companies, are moving the clean energy economy forward, often dramatically;
- 9) Recognition that nuclear energy, natural gas and carbon capture, utilization and storage technology remain necessary to achieve deep decarbonization on the needed time-scale;
- 10) Strong support for public investment in clean energy technology innovation (in the national laboratories and through programs such as ARPA-E) and energy infrastructure (such as transmission for renewable energy) as crucial to private-sector progress across all economic sectors.

These core findings shed light on how the United States might amend or add to our clean energy and climate change policies. Policy changes are needed in Washington and in all 50 states to strengthen the abilities of companies and investors so they can thrive in an accelerated transition to a decarbonized economy.

Crafting effective statutes, regulations and practices that make serious inroads toward solving challenges such as building a reliable national energy system or addressing intensifying climate change is never an easy undertaking. Just as economists seek but rarely secure complete information in designing economic policy, this report was not intended to be exhaustive or comprehensive. However, in empirically soliciting contemporary insights directly from leaders representing major sectors of the economy, the information compiled here can help shape energy and climate policy discussions in the months and years ahead.

Context: Private sector efforts to navigate a rapidly changing energy economy

The U.S. energy economy—populated by companies of all sizes that generate or consume energy—is in a state of rapid and dramatic transition. This change is being driven by growing availability of lower-cost renewable energy and advanced efficiency technologies and their increasing deployment, expanding supplies (and exports) of domestic oil and natural gas and electricity generated by combusting natural gas, economic pressure to close coal-fired and nuclear power plants, and expectations to reduce greenhouse gas emissions domestically and across the global economy. Investments in zero- and low-carbon technology innovation and more sophisticated approaches to systems management, by national laboratories, companies and universities, are yielding new abilities to reduce energy demand by using it more efficiently and optimally. So-called “disruptive” technologies and companies are giving energy consumers more control and choices, and large corporate energy users are increasingly bypassing traditional utilities to purchase carbon-free electricity.

Many leaders in the energy field and across the economy believe that these ongoing changes represent the early stages of an economy-wide transition to a lower-carbon energy system. In designing and undertaking this study, we hypothesized that the perspectives of those leaders—about where we are on the transition continuum, what the pace of transition is and should be, how public and corporate policies are affecting that transition, and what economic opportunities and impediments are embedded within that transition—are not well understood by policymakers and other important actors in the energy economy.

In interviewing dozens of corporate, labor, and investor leaders, we learned that there is a broad recognition that a transition to a low-carbon energy economy is underway and that these changes are affecting industry business models, consumer behavior, investment strategies, stakeholder response, and companies’ ability to compete internationally. Along with this recognition is a sharpening appreciation that public policy has and will mold these changes.¹

The economic leaders who participated in this research universally believe that *how* policy is crafted or amended will either incentivize or hinder companies’ ability to economically prosper and reduce the carbon footprint of their operations, products and activities. All participants in our study acknowledged that the public sector has an important role to play in this transition, although views were sometimes divergent on the desired and appropriate elements of that role. Central to the discussions was the strong interest in identifying the appropriate public role(s) to improve opportunities to *both* reduce greenhouse gas emissions and support the growth of companies and associated jobs, profits, investor returns and shareholder value.

Many of the leaders we interviewed sensed that an urgency to deeply and cost-effectively reduce greenhouse gas (GHG) emissions globally is only intensifying with the accelerating pace of climate change and its many impacts. In the face of that urgency, the private sector has made striking progress over the past decade in demonstrating that the path to decarbonization may be less costly than feared, while many companies are finding market opportunities for products, services and activities that reduce greenhouse gas emissions within sectors and across the economy. Businesses of all sizes now incorporate climate risk, greenhouse gas reduction goals, and renewable energy sourcing into their business plans.

Those efforts have been enabled by the significant changes in the energy economy over the past decade. In one of the more striking examples of this shift, the costs of renewable energy and increasingly efficient technologies have dropped considerably with the help of research, development and demonstration (RD&D) activities. Not surprisingly, deployment of those technologies has risen sharply as a result the reductions in cost. The cost of land-based wind generation fell 33 percent between 2008 and 2017.² Installed wind capacity jumped from 25 gigawatts (GW) in 2008 to 82 GW by the end of 2017.³

1 Public policy is defined in this report as actions undertaken by legislative and executive decision makers in the public sector, at the international, national, regional, state and local levels. This report also discusses policy in the context of corporate goals and strategies related to energy and climate change that are established by individual companies and implemented via internal directives by corporate leaders.

2 Wiser, R., & Bolinger, M. (2016), p. 49. 2016 Wind Technologies Market Report. United States Department of Energy. Retrieved from https://www.energy.gov/sites/prod/files/2017/10/f37/2016_Wind_Technologies_Market_Report_101317.pdf

3 Supra note 2.

Similarly, the price of utility-scale photovoltaics (PV) has dropped more than 40 percent since 2008, reaching four to six cents/kilowatt hour by the end of 2017.^{4, 5} Early public debt financing and reductions in technology cost have spurred the construction of more than 50 utility-scale PV plants, along with the first operating utility-scale solar thermal plants.⁶ While the United States had only 1.2 GW of installed solar capacity in 2008, it grew to more than 50 GW by the end of 2017.⁷ The U.S. Energy Information Administration found that half of the 25 GW of new utility-scale electric generating capacity installed in 2017 use renewable technologies, especially wind and solar.⁸

Energy efficient products have become a more accessible consumer option. The cost of light emitting diode (LED) lighting has dropped 94 percent since 2008—with some 60-watt equivalent bulbs selling for \$2 per unit.⁹ The cost of electric vehicle (EV) batteries has decreased by 70 percent, propelling the growth of EVs on American roads today to more than 563,000.^{10 11}

At the same time, major shifts are occurring in the more traditional nuclear and fossil-fuel sectors. Over the last five years, five nuclear reactors have been retired, bringing the total of operating reactors down from a peak of 104 to 99 (at 61 plant sites) in 30 states. Nuclear plant operators have announced the planned retirement of an additional seven reactors at five plants in the coming years.^{12 13}

Between 2007 and 2016, 531 coal-fired generation units, representing 55.6 GW of capacity, were retired across the country, and last year utilities announced planned closure or conversion of another 27 coal-fired power plants totaling 22 GW. Much of that retired capacity has been replaced with the growth of natural-gas generating units and new wind and solar installed capacity. In 2016, natural gas (34 percent of the U.S. energy mix) surpassed coal (30 percent) as the dominant national energy source for electricity generation. The U.S. Energy Information Administration reported that the electricity industry added 11.2 GW from natural gas units in 2017 and will add another 25.4 GW in 2018.¹⁴

Increased domestic production of shale oil spurred the United States to surpass Saudi Arabia in November 2017 in daily production of crude oil, at ten million barrels per day (BPD), and U.S. exports of domestic oil and gas are growing. That increased production in recent years has combined with declining domestic demand for gasoline resulting from improved passenger vehicle fuel efficiency to reduce U.S. imports of crude oil from a peak of 10.1 million BPD in 2005 to 7.87 million BPD in 2016.¹⁵

4 National Renewable Energy Laboratory. (2017, September 12). NREL report shows utility-scale solar PV system cost fell nearly 30% last year. Retrieved from <https://www.nrel.gov/news/press/2017/nrel-report-utility-scale-solar-pv-system-cost-fell-last-year.html>

5 Fu, R., Feldman, D., Margolis, R., Woodhouse, M., & Ardani, K. (2017). U.S. solar photovoltaic system cost benchmark: Q1 2017. National Renewable Energy Laboratory. Retrieved from <https://www.nrel.gov/docs/fy17osti/68925.pdf>

6 The first five utility scale photovoltaic power plants in the U.S. were financed in part with debt financing from the U.S. Department of Energy Loan Program.

7 Supra note 5.

8 Marcy, C. (2018, January 10). Nearly half of utility-scale capacity installed in 2017 came from renewables. U.S. Energy Information Administration. Retrieved from <https://www.eia.gov/todayinenergy/detail.php?id=34472>

9 Comstock, O., & Jarzomski, K. (2014, March 19). LED bulb efficiency expected to continue improving as cost declines. U.S. Energy Information Administration. Retrieved from <https://www.eia.gov/todayinenergy/detail.php?id=15471>

10 McKinsey & Company, (2017). Electrifying insights: How automakers can drive electrified vehicle sales and profitability. Retrieved from <https://www.mckinsey.com/~media/mckinsey/industries/automotive%20and%20assembly/our%20insights/electrifying%20insights%20how%20automakers%20can%20drive%20electrified%20vehicle%20sales%20and%20profitability/how%20automakers%20can%20drive%20electrified%20vehicle%20sales%20and%20profitabilitymck.ashx>

11 International Energy Agency. (2017). Global EV outlook 2017. Retrieved from <https://www.iea.org/publications/freepublications/publication/GlobalEVOutlook2017.pdf>

12 U.S. Energy Information Administration. See: <https://www.eia.gov/tools/faqs/faq.php?id=207&t=3> (Last updated: August 15, 2017)

13 Some new nuclear capacity is coming on line. The Watts Bar 2 reactor near Spring City, Tennessee, owned by the Tennessee Valley Authority, became the newest nuclear reactor when it came on line in October 2016, and two new Westinghouse AP 1000 reactors, Units 3 and 4, are under construction at the Vogtle Electric Generating Plant near Waynesboro, Georgia.

14 Hodge, T. (2017, January 30). Natural gas-fired generating capacity likely to increase over next two years. U.S. Energy Information Administration. Retrieved from <https://www.eia.gov/todayinenergy/detail.php?id=29732>.

15 United States Energy Information Administration. (2018). Crude oil import tracking tool. Retrieved March 30, 2018, from https://www.eia.gov/petroleum/imports/browser/#/?vs=PET_IMPORTS.WORLD-US-ALL.A

These changes in the energy economy have been accompanied by a growing number of jobs in the energy sector overall and in the clean energy sector in particular across the United States. Such shifts in structural economic patterns have not been without pain. Jobs in the thermal coal extraction industries have declined in recent years. Employment in the oil and gas industry, while growing in the last decade, has shown vulnerability to price swings during the last two years. Meanwhile, jobs in renewable energy and energy efficiency sectors have grown more steadily.

For context, the *2017 U.S. Energy and Jobs Report* issued by the U.S. Department of Energy found that in 2016, electric power generation and fuels technologies directly employed more than 1.9 million workers, with 55 percent, or 1.1 million, employed in traditional coal, oil and gas, while almost 800,000 workers were employed in low carbon emission generation technologies, including renewables, nuclear, and advanced/low emission natural gas. A total of 2.2 million Americans were employed (part- or full-time) in the design, installation, and manufacture of energy efficiency products and services; 388,000 in oil and gas extraction; 374,000 in the solar energy industry; more than 259,000 in manufacture and service of alternative fuels vehicles, including natural gas, hybrids, plug-in hybrids, all electric, and fuel cell/hydrogen vehicles; 102,000 in the wind energy industry; and 53,000 in coal mining.¹⁶

One explanation for the increasing shift to cleaner energy across the economy is that low-carbon technology costs have dropped considerably following years of focused investment in basic RD&D by industry, government agencies such as the U.S. Department of Energy, Department of Defense and National Science Foundation, the national lab system and research universities, coupled with targeted public policies at the federal, regional and state levels.

A number of industries have responded to policy with focused technology deployment and commercialization strategies, such as auto manufacturers putting dozens of hybrid-electric and all-electric model choices in their dealer showrooms (already yielding four million hybrids and well over a half million plug-in electric vehicles on American roads today¹⁷) and manufacturers of appliances, industrial equipment, lighting and electronics beginning to respond to the approximately 50 energy efficiency rules strengthened by the U.S. Department of Energy since 2009 by selling more efficient products of all kinds.

Analysis shows that the combination of increased public investments in basic science and early-stage RD&D, public policies that incentivize the reduction of greenhouse gas emissions, and industry leadership has directly helped reduce greenhouse gas emissions to date and is likely to yield even stronger results in the future.¹⁸

In the window during which we conducted our interviews for this research, private sector leaders were adjusting to a sharp shift in federal energy and climate change policies occurring under the Trump administration. The Trump administration's efforts to reverse or weaken President Obama's clean energy and climate change policies, budget priorities, rules, and executive orders have created concern among many private sector leaders that the United States, at least for the time being, does not have a consistent and clear national policy toward energy and climate change. This policy disruption is occurring at a moment when the body of climate science and observed climate impacts continue to document a powerful case that the United States and the global community need to accelerate, not slow or stop, the transition to a low-carbon economy.

That scientific consensus was most recently reflected in the Fourth National Climate Assessment released by the Trump administration in November 2017, which concluded that "it is *extremely likely* that human influence has been the dominant cause of the observed warming since the mid-20th century. For the warming over the last century, there is no convincing alternative explanation supported by the extent of the observational evidence."

16 United States Department of Energy. (2017). U.S. energy and employment report. Retrieved from https://energy.gov/sites/prod/files/2017/01/f34/2017%20US%20Energy%20and%20Jobs%20Report_0.pdf

17 According to the organization Inside EVs, which tracks U.S. sales of plug-in electric vehicles, a record number of electric vehicles were sold in 2017, 199,826, up from the previous high of 158,614 EVs sold in 2016. Source: Loveday, S. (2018, January 3). December 2017 plug-in electric vehicle sales report card. Inside EVs. Retrieved from <https://insideevs.com/december-2017-plugin-electric-vehicle-sales-report-card>

18 White House. (2016). United States Mid-century Strategy for Deep Decarbonization. Washington, DC: Retrieved from https://obamawhitehouse.archives.gov/sites/default/files/docs/mid_century_strategy_report-final.pdf

This authoritative assessment of the science of climate change, conducted every four years by the U.S. Global Change Research Program, as mandated by the Global Change Research Act of 1990, went on to state that “the last few years have also seen record-breaking, climate-related weather extremes, the three warmest years on record for the globe, and continued decline in arctic sea ice. These trends are expected to continue in the future over climate (multi-decadal) timescales.”¹⁹

Even well before the 2016 national election, leaders across the economy were navigating rapid change and related challenges in the energy sector: ongoing disruption in the traditional electricity, transportation and industrial sectors; choices to be made about technology and infrastructure pathways; limitations to the degree of decarbonization achievable by current technologies; hesitation by investors who experienced a lack of success investing in clean energy technology in the late 2000s; and gaps in public policy.

The effects of these new domestic policy shifts and economic dynamics remain to be seen, but the private-sector leaders we interviewed for this research project overwhelmingly said that they expect to continue to pursue strategies to reduce greenhouse gas emissions and energy consumption related to their products and operations. That determination is the result, they said, of seeing such steps as economically fruitful and the failure to act as financially risky. It is also because their many other stakeholders—subnational governments such as states, cities and countries around the world in which they do business or seek market entry, as well as shareholders, investors, customers and employees—expect responsible leadership to address the threat of climate change.

This paper identifies the policies, programs and investments that can support increasingly robust business plans that lead to reduced greenhouse gas emissions and commercial success.

Our analysis of the interviews, reflected in this report, provides an understanding of the underlying challenges facing economic leaders from the corporate, investor, and business-focused non-governmental organization community. This report shares their thinking about how to improve or add to the policies (and programs and investments)—at the state, regional, national and international levels—that are most useful in helping the private sector sharply reduce greenhouse gas emissions while achieving economic success in the years and decades ahead.

The result is both a vivid snapshot of a robust debate at the current moment in time and a virtual, free-ranging conversation from which anyone interested in developing solutions to climate change and a rapidly-changing energy economy can find guidance, ideas and wisdom from those with the responsibility for leadership within the private sector.

Methodology

This research was conducted by a team at the Climate Policy Lab at The Fletcher School, Tufts University, in the Center for International Environment and Resource Policy (CIERP), from July 2017 through April 2018. Led by co-investigators Kevin Knobloch and Barbara Kates-Garnick, the research project set out to provide a timely, accurate and nuanced understanding of the perspectives of key leaders in the U.S. corporate and private equity sectors (along with foreign-based companies doing significant business in the United States) toward energy and climate change policies in the face of what is widely understood will be an increasingly carbon-constrained world.

The research was conducted through hour-long interviews with corporate, labor, investor, and other leaders from a spectrum of companies and organizations engaged with or impacted by energy and associated environmental policies. The interviewees included leaders at the CEO and other senior governance levels across the major sectors that produce energy and/or use energy intensively, along with leaders from the investment community, organized labor, corporate alliances and industry trade groups.

The research process and interviews were conducted according to formal research protocols approved by the Tufts University Social, Behavioral & Educational Research Institutional Review Board. Analysis of the information and data gleaned from the interviews informed the development of the ten policy findings described in this report. A more complete description of the project approach, process and protocol is in Appendix One. Brief descriptions of the participating companies, unions and organizations are in Appendix Two.

19 USGCRP (2017). Climate Science Special Report: Fourth National Climate Assessment, Volume I. Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.). U.S. Global Change Research Program, Washington, DC, doi: 10.7930/JOJ964J6. Retrieved from <https://science2017.globalchange.gov>

Summary of policy findings

The 53 interviews with corporate, labor and investor leaders conducted for this research project yielded a number of striking areas of consensus. The ten policy findings listed below reflect those areas of broad agreement. This section summarizes the policy findings and the topics discussed within each policy finding. The policy findings are discussed in detail in the following section (Policy findings in detail), which also notes when there were multiple or divergent views.

1. [An accelerated transition to a low-carbon economy would create welcome economic opportunity.](#)

- A) The challenge of addressing climate change is a clear economic opportunity for many companies and could be a significant risk if companies fail to act.
 - B) The clean energy transition is continuing despite the Trump administration's deregulatory and budget cutting actions.
 - C) Maximizing job quality is key to an effective transition to a low-carbon economy.
 - D) Significant investment capital is looking at clean tech from the sidelines but has not committed yet at scale.
-

2. [Overwhelming support exists for consistent federal policies on energy and carbon to provide long-term certainty and allow businesses to invest with confidence.](#)

- A) If a more comprehensive, stable and urgent approach is used, government can create economic opportunity and help U.S. companies and labor capture first-mover advantage.
 - B) Companies prize policy predictability—and a holistic, coherent and consistent national policy—over a fragmented patchwork of state and local policies.
 - C) Outcome-based policies are preferred by some over technology mandates.
-

3. [A stable, economy-wide carbon price is widely seen as an essential policy step; design preferences differ.](#)

- A) Carbon pricing would provide the most comprehensive basis for sustained scale up of business investment.
 - B) Some prefer a cap-and-trade system, others sectoral approaches.
 - C) Border-adjustment fees are complex but worth considering for energy-intensive trade-exposed (EITE) industries as part of future carbon price policy.
-

4. [Climate change is an issue of global economic competitiveness for U.S. companies.](#)

- A) U.S. companies are competing in an international market which is demanding low-carbon technology.
 - B) In a carbon-constrained world, trade rules can help or hurt U.S. companies competing globally.
 - C) Leaders are concerned that Trump administration policies will weaken U.S. standing globally and sacrifice competitive edge to China, India and the European Union.
-

5. [Initiating the U.S. exit from the Paris Agreement on climate change is a mistake that puts U.S. business at a global competitive disadvantage.](#)

- A) In interviews, support from the private sector for staying in the Paris Agreement is nearly universal.
-

6. [Change in the electricity sector is happening fast and policy must keep pace.](#)

- A) To survive and flourish, utilities must evolve, adapt and innovate.
- B) For utilities, the expectation that they provide for reliability, security, safety, resilience and affordability can compete with the need to reduce greenhouse gas emissions.
- C) The Clean Power Plan provided a focusing mechanism to think about a carbon-constrained future, and many utilities will meet or exceed its original requirements.
- D) Competitive electricity markets are more attractive to direct power purchasers, renewable developers and investors.
- E) Regional Transmission Operators and State Public Service Commissions could step up to address fragmented policy across their regions as a means to incorporate clean energy.
- F) Department of Energy's Reliability Notice of Proposed Rulemaking (NOPR) was seen by many as inappropriate, with exceptions.
- G) Strengthened federal appliance and equipment efficiency standards are highly effective.
-

7. [Federal and state policies and programs that support private sector development and deployment of clean technology have strong support.](#)

- A) Broad support exists for time-limited incentives for emerging technologies that enable innovation, demonstration and early deployment—and also provide certainty.
- B) Expanding existing energy tax policies to be more inclusive would yield more carbon reduction.
- C) Ending or curbing subsidies for fossil fuels will level the playing field for renewables energy, some contend.
- D) Investors prefer that companies and technologies not be reliant on public policy for financial success, but value government's investments in discovery science to help young technologies take root.
- E) Support for Obama-era federal vehicle fuel economy standards is strong; some seek changes.
- F) State renewable portfolio standards are seen as economic development policy and have a strong record of catalyzing new markets.
- G) Renewable energy developers seek to streamline permitting and environmental review at the federal and state levels.
-

8. [Corporate policies and strategies are moving the clean energy economy forward, often dramatically.](#)

- A) Direct purchase of renewables by large companies is a new pathway to meet corporate electricity needs and clean energy goals.
 - B) Companies that set ambitious GHG-reduction targets improve their company environmental performance, often irrespective of government policy.
 - C) Energy-intensive industries have a natural incentive to reduce energy use.
 - D) Climate-related financial disclosure, assessment of climate risk and data tracking are helping change company cultures; goal-setting produces results.
 - E) Corporate and investor stakeholders want action on climate change, resulting in changes in how corporations look at sustainability.
-

9. [Nuclear energy, natural gas, and carbon capture, utilization and storage \(CCUS\) are essential pieces of the carbon reduction puzzle.](#)

- A) Nuclear energy and CCUS are needed for deep decarbonization.
 - B) Concern exists that accelerating closure of existing nuclear reactors adds to the carbon-reduction challenge.
 - C) Nuclear energy should be properly valued as a zero-carbon source.
 - D) Natural gas remains a critical part of the transitional puzzle.
-

10. [Public investment in early-stage clean-energy technology innovation and energy infrastructure is crucial to private-sector progress across all economic sectors.](#)

- A) Government investment in energy research, development and demonstration has delivered huge benefits in the past and deserves strong support going forward.
 - B) Government programs that assist U.S. companies in advancing innovation and opening new markets have many fans in the private sector.
 - C) Investing in energy infrastructure (such as transmission for renewable energy) should be a priority.
 - D) Interest in electrifying the economy is significant among some utilities, motor vehicle manufacturers and investors, but attention needs to be paid to the economics.
-

POLICY FINDINGS IN DETAIL



Policy Finding 1: An accelerated transition to a low-carbon economy would create welcome economic opportunity.

A) The challenge of addressing climate change is a clear economic opportunity for many companies and could be a significant risk if companies fail to act.

A wide number of respondents saw significant economic opportunity for companies and investors who develop and deliver technologies, strategies and business practices that reduce greenhouse gas emissions. For some companies, this view has evolved over time, as awareness about the harmful impacts of climate change and pressures to reduce energy costs have inspired development of more sustainable business models.

Sustainability has become a bedrock principle over the past decade inside **ArcelorMittal**, the world's largest steel producer, which is headquartered in Luxembourg with U.S. operations in Ohio and Indiana. "Ten years ago, we really made the mental switch from...looking at it as reducing our carbon footprint meant reducing profits, and it was a game we could only lose," said Alan Knight, **ArcelorMittal's** General Manager for Corporate Responsibility. "We're now looking for opportunities to focus on sustainability in a way that really impacts steel in our operations, which would reduce our footprint and allow increased profits for our company and value for society."

"Ten years ago we really made the mental switch from... looking at it as reducing our carbon footprint meant reducing profits, and it was a game we could only lose. We're now looking for opportunities to focus on sustainability in a way that really impacts steel in our operations, which would reduce our footprint and allow increased profits for our company and value for society." ALAN KNIGHT, ARCELORMITTAL

For an energy-intensive industrial steel producer like **ArcelorMittal**—which is active in the automotive, construction, household appliances and packaging markets—that was not a simple or automatic transformation.

"Our vision is to make steel the product of choice for our customer at the lowest carbon footprint," Knight said. "The biggest challenge is reducing our carbon footprint, while recognizing that steel is a fantastic and sustainable material. Let's make steel the material of choice for making the low-carbon economy of the future."

That change in approach required that the company gain a more sophisticated understanding of the life-cycle of its primary product. Knight said "this requires that people think one step ahead. We need to think about future uses, life-cycle, synergies between sectors. A more collaborative approach between sectors will only help to reduce emissions."

For example, in recycling steel, there is no downgrading of the material, he said, and it uses less carbon. "The carbon we use in the primary process can have a second life. If you look at the whole life-cycle analysis of the product you see that steel is a really efficient product and that we've reduced the greenhouse gas emissions."

As far back as the early 2000s, the **Goldman Sachs Group**, a global investment banking, securities and investment firm headquartered in New York City, set a long-term clean energy investment target, said Kyung-Ah Park, Managing Director and Head of Environmental Markets at **Goldman Sachs**, and the investment firm's commitment to "helping the transition to low carbon energy" has continued to grow through to the present.

"In 2005, when we published our Environmental Policy Framework, we had a \$1 billion investment goal," Park said. "In 2012, when the clean energy markets were looking volatile, we set a \$40 billion financing and investment target over a ten-year period to underscore our long-term conviction in the sector. In 2015, as we updated our...framework, effectively establishing a more ambitious roadmap, we expanded that target to \$150 billion by 2025."

One element essential to the success of **Goldman Sachs'** investments in environmental markets has been a hard-nosed business approach that sets the same expectations as for any other investment portfolio and buy-in from the leadership of all of the firms' business divisions.

Park said that when the company began to look at investing in clean energy “the economic value wasn't necessarily as clear, but...now our environmental initiatives are embedded across each of our business divisions. It's not just about reacting, it's about being responsive and leaning in and leveraging our market know-how.”

A stand-alone environmental market unit would not be as successful, she said. “When we established this target, we discussed and got buy-in from all the relevant businesses. These teams provide a view on where they think the growth opportunities are and they have to believe that the various investments are sustainable and aren't just one-hit wonders. The key thing is that these are owned and executed by our businesses and in a way to better serve our clients.”

Where the early visionaries in the companies on the vanguard of environmental sustainability and action on climate change might once have felt a bit lonely, economic leaders interviewed for this project said that many companies that generate or are big users of energy now sense business opportunity along with a recognized responsibility to contribute toward the transition to a low-carbon economy.

Aron Cramer, President and CEO of **BSR**²⁰, a global organization with a network of more than 250 member companies, including **Unilever, Nissan Motor Co., Boeing, Qualcomm, Morgan Stanley, Johnson & Johnson, Pfizer** and **Hewlett Packard**, said that corporate leadership understands that a transition to a low-carbon economy is now underway: “Most businesses are smart enough to realize we're in the early stage of a massive shift in the economy. The direction of where we're traveling is clear.”

For many companies and investors, this is not a begrudging recognition, but rather one born of successful business models that are helping companies grow, expand into new markets and generate profits and investor returns. The commitment to addressing climate change is important to many private sector leaders, they say, but the business proposition has to work for deep progress to be made across the economy.

“Solar and wind are now big business, they're now price competitive with coal, and this doesn't have anything to do with policy now,” said Gabriel Kra, a managing director at **Prelude Ventures**, a San Francisco-based venture capital firm founded by Nat Simons and Laura Baxter-Simons. “It's cheaper to build, own, and operate a wind or solar plant than a coal plant, and increasingly so with natural gas. You don't have to have a carbon constrained future vision in order to see that.”

Kra told of listening in on an investor call a number of months ago hosted by **NextEra Energy**, a wholesale electricity supplier based in Juno Beach, Florida that is North America's largest owner of wind and solar electricity generating assets. “They said, ‘We build wind and solar and soon combined with storage, because it's the cheapest way to generate electricity’. Those tax credits and tools were great policy. These are now the most economic ways to make money in electricity generation.”

The more than 100 companies that make up the **Northeast Clean Energy Council**—including major companies **General Electric** and **Lockheed Martin Energy**, clean energy developers **EDP Renewables, NRG, Ørsted** and **Solar City**, and energy services companies **Veolia North America, Utilidata** and **Oracle**—would not be focused on clean energy and technology if the business model didn't make sense, said Executive Vice President Janet Besser.

“A carbon constrained world is really a business opportunity for our companies. Clean energy companies are coming up with solutions to these constraints,” she said. “Many of the leaders of these companies are in these businesses because they are driven to address climate change. They are well positioned as businesses to take advantage of a carbon constrained future.”

²⁰ BSR was formerly Business for Social Responsibility.

These leaders see their companies' products and services as having a positive impact across the economy, because, "the energy sector is a major economic sector, but it is also an input into every other sector," Peter Rothstein, President of the **Northeast Clean Energy Council**, said. "The goal for our clean energy companies is not just to reduce carbon. It is to reduce carbon and create a platform for a growing economy."

Similarly, **Altus Power America**, a Connecticut-based company that builds, owns and services solar photovoltaic arrays for institutional clients such as schools and municipalities across the United States, makes the case that they are primarily incentivized by the positive economics.

"This is a capital-intensive business," said **Altus** Managing Partner and Co-Founder Gregg Felton. "We like the green aspect and social benefits of solar, but without question, both our investors and customers are incentivized by the economics of our projects and our business. The economics of our business model are a significant driver for everyone involved."

One development that caught the attention of corporate and investment leaders is the positive economic performance demonstrated by the recent rapid growth of utility-scale solar photovoltaic and thermal energy generation facilities, which the U.S. Energy Information Administration says grew at an average rate of 72 percent per year between 2010 and 2016, "faster than any other generating technologies."²¹

Bill Weil, a Sustainable Finance Strategist at **Tempest Advisors**, a San Francisco-based firm that provides consulting services to charitable funders in the energy and climate domain, recalled that "20 years ago when I started working on (clean energy), there was no hint of a utility-scale project. A 20-megawatt (solar) plant was considered a huge plant. Now we have gigawatt factories of solar capacity. Fifty percent of all new energy globally for the last three years has been renewable."

This economic success foreshadows, in many peoples' minds, even more robust growth in the years ahead.

"I'm convinced that we're in the third inning of renewables. We're going to see huge deployments of this in the next few decades," said Michael Skelly, President of **Clean Line Energy Partners**, an interstate clean energy transmission developer. "I am bullish on the long-term prospects of renewables in America. It's going to be costs that drive this shift."

A range of investment firms have centered their organizing principles and activities on advancing the low-carbon energy economy, believing that "the climate impact goal and financial returns are not in conflict," said David Miller, Co-Founder and Managing Director of the **Clean Energy Venture Group**, a Boston-based venture capital firm specializing in seed and early stage investments. "I think they are self-reinforcing."

He added, "(T)he world is clearly going in this direction. The energy future is low carbon or no carbon. That's where corporations are going. So, companies that support that path, we believe, have a great chance of being very profitable and very strong investments."

Prelude Ventures puts the concept of prospering in a carbon constrained future "front and center", Gabriel Kra said. "We are venture capital investors and we invest in early stage, privately held companies, with the belief that we can find compelling startups and businesses. We are looking for companies that, when successful, will reduce CO₂ or CO₂-equivalents in the atmosphere." Prelude invests in solar, wind, wave, geothermal and nuclear, "because nuclear is zero-carbon."

Kra added that within that mission frame, **Prelude Ventures** is as hard-headed as any other venture capital enterprise: "Once something is considered within our mandate, we then look at it with a traditional investor profitability mind-set. Does this company make VC-investor sense? Will this company multiply our investment by ten, fifty, or a hundred times? We are investing in incredibly risky companies. We need those really big winners. That requires technology, disruption and a strong team."

21 Sukunta, M. (2017). Utility-scale solar has grown rapidly over the past five years. Today in Energy. U.S. Energy Information Administration. Retrieved from <https://www.eia.gov/todayinenergy/detail.php?id=31072>

Daniel Goldman, Co-Founder and Managing Partner at the **Clean Energy Venture Group**, said that people often ask if the investments his firm makes in early stage technology is “philanthropic” capital or if they are serious about earning a healthy return. “We see this as 100 percent compatible since these companies must grow to scale and be profitable to survive and therefore be in a position to address climate change.”

In fact, investors say, we are at the front end of a major new growth wedge of our economy that could overshadow other more traditional sectors. “How often in history do you have completely new markets opening up, creating new jobs and a fundamentally new economy?” Goldman asked. “I would love to see less partisan views on this and see more as business economics. This is only good for America; there is no downside.”

Breakthrough Energy Ventures, an investor-led fund created by the Breakthrough Energy Coalition²² to build new, cutting-edge companies in the energy domain, sees this new clean energy economy as a chance to raise standards of living in the developing world without replicating the carbon polluting activities that drove the industrial revolution.

Eric Toone, **Breakthrough’s** Executive Managing Director, said that a low-carbon energy future is an unprecedented opportunity to “bring prosperity to huge parts of the world that lack the prosperity of the OECD²³ world, but to get there in a completely different way than we did—in a sustainable way that doesn’t contribute anthropogenic GHGs. We very much see that transition as an opportunity.”

Several leaders cited concerns that companies that are slow to act on this opportunity face financial, physical and reputational risk.

The well-known manufacturer and marketer of branded consumer foods, **General Mills**, sees the need to address climate change as an imperative. “Our business depends on mother nature and farming communities to operate well,” said Jerry Lynch, Chief Sustainability Officer at **General Mills**. “In our business model, we take the output of natural systems and farming communities and transform them into food products that meet consumers nutritional needs for their busy lives. If the front end of our business model breaks down we face the potential of increased costs or even in extreme cases, interruption of our supply chain.”

The company’s ability to continue to thrive is dependent on managing climate change and its impacts, Lynch said. “Being able to thrive as a business is dependent on managing many risks, including climate change. It’s an innovation challenge like many others we tackle as a consumer food company: produce the food consumers need in a way that both de-risks the supply chain and earns consumer trust.”

BSR’s Aron Cramer said, “For a wide range of reasons—economic, politics, social expectations—a strong, clear climate strategy is an essential element of basic business strategy for every company.” In the context of the climate change threat, he said, “we believe companies have to avoid the unmanageable and manage the unavoidable.” In the challenge of climate change, **BSR** sees “massive economic possibility for innovation.”

Lance Pierce, the President of **CDP North America**²⁴, which operates a global carbon disclosure system used by hundreds of companies, investors and governments globally, said, “I don’t think we can neglect the cost of inaction. If we had 100 years to wait the market would make the energy transition by itself. But the fact is that the cost of inaction on climate change and the danger of catastrophic risk and loss to people is creating the urgency that makes the push make sense.”

22 The Breakthrough Energy Coalition was mobilized by former Microsoft CEO Bill Gates and announced on November 30, 2015, in Paris as part of the launch of Mission Innovation, an initiative of the leaders of 20 nations plus the European Union to commit to doubling public investment in clean energy research and development over five years.

23 Organization for Economic Cooperation and Development, an intergovernmental organization with 35 members countries—including the United States, Japan, most of Europe and new members like Mexico and South Korea—founded in 1961 to stimulate economic progress and world trade.

24 Formerly the Carbon Disclosure Project.

Respondents identified a number of specific economic opportunities within their sectors to make and sell technologies into a growing market for zero- and low-carbon technologies.

Brian Mormino, Executive Director for Environmental Strategy and Compliance at the Columbus, Indiana-based vehicle engine-manufacturer **Cummins**: “How we’ve grown over the last 15 years is by producing cleaner, more efficient products. This has led to more complex and efficient engine systems. Being a leader in efficiency which reduces greenhouse gas emissions is tied directly to our business success.”

“How we’ve grown over the last 15 years is by producing cleaner, more efficient products. This has led to more complex and efficient engine systems. Being a leader in efficiency which reduces greenhouse gas emissions is tied directly to our business success.” BRIAN MORMINO, CUMMINS

An executive of an **industry trade group**: “Several of our member steel companies are interested in the wind turbine industry. Others make pipeline so the natural gas available in the U.S. is an appealing market. Upgrading leaky pipes is a big market.”

Stephen Harper, Global Director of Environment and Energy Policy for Santa Clara-based **Intel Corporation**, a leading manufacturer of semiconductor chips and computer microprocessors: “In a carbon-constrained world our company is a big winner. Our handprint is how our technology helps others reduce greenhouse

gas emissions...intelligent transportation, energy management systems, the internet of things. One of the cheapest ways to reduce carbon in most industrial and residential settings is to improve energy efficiency. Energy efficiency that has the biggest bang for the buck tends to involve information technology in one form or another.”

“We are starting to be very active in industrial efficiency, with our hardware and software combined with partners like **General Electric**. We think a seriously carbon constrained world will grow our markets significantly,” Harper added.

John Donnan, Executive Vice President for Legal, Compliance and Human Resources at **Kaiser Aluminum**, a manufacturer of semi-fabricated specialty aluminum mill products headquartered in Lake Forest, CA, and Spokane Valley, Washington: ““We view aluminum products as being part of the solution. The light-weighting in the automotive sector is good for our business. We continue to see that in the aerospace industry as well. Our aerospace customers continue to pursue lighter-weight aircraft and increased fuel efficiency. With an increased focus on reducing emissions and carbon footprints, manufacturers are being driven toward increased aluminum content. That continues to be good for us.”

Prelude Ventures’ Gabriel Kra: “We will also invest in industrial efficiency. We see huge amounts of inefficiencies and redundancies that could be improved, simply through better controls and software. By improving those processes we’re reducing the energy inputs required to manufacture. We’re looking at transportation and EVs, and also investing in shipping and logistics. An example: the shipping industry hasn’t benefitted from software and IT progress as much as many other industries, essentially since the advent of container shipping. Increased efficiency reduces customer costs and reduces carbon.”

Leaders conveyed a sense of urgency, especially as the competition for clean energy/technology markets accelerates domestically and globally.

“We’re losing precious time to innovate on policy and technology,” said Alan Knight of **ArcelorMittal**. “Compare the industrial sector with the automotive sector. Now electric vehicles are seen as the future, but ten years ago that was a crazy idea. Good policy focuses on innovation.”

Danny Kennedy, Managing Director of the **California Clean Energy Fund**, a private equity and venture capital firm that invests in early stage and startup companies, said, “We have to get real about how we (accelerate) this transition. At a higher level, there is a time constraint, we need to stop thinking about an incremental change process. This needs to be done by 2030. We need something of a war mentality.”

Once a company places a bet on products that have a greatly reduced carbon footprint, then the focus turns to establishing a strong presence in the clean energy market ahead of competitors. That includes advocating for the strongest possible climate policies.

A **clean energy executive** reflected that urgency: “All we care about is finding ways to get there quicker than the competition. So, we want scalable carbon prices, policies that get to zero emissions faster than anybody else, because we only have products that are zero emission products.”

The new race to design, build and sell electric vehicles is an example of how the competition is swiftly intensifying. “Pretty much every major OEM²⁵ has announced plans to electrify either significantly or fully sometime in the next five to ten years,” another **executive with the same company** said. “And, that’s not even mentioning the fact that in China there are 600 companies that are interested in electrifying vehicles. So, the competition is coming.”

Ben Foss, Vice President of Public Partnerships at **Volta Charging**, a San Francisco-based company that provides a nationwide network of Level 2 electric vehicle charging stations and partners with brands to sponsor free charging for electric vehicle drivers, said he saw China’s aggressive commitment to electric vehicles as a positive market push. “Hopefully, the market will solve this problem for us,” he said. “China is increasing its EV deployment. We can expect that... five percent of cars sold by 2020 in China will be EVs.”

B) The clean energy transition is continuing despite the Trump administration’s deregulatory and budget cutting actions.

In its first year, 2017, the new Trump administration set out to reverse or significantly change a number of Obama administration policies on climate change, energy and environment. Actions included beginning the process to revise the Clean Power Plan, initiating the withdrawal of the United States from the Paris Climate Agreement, canceling the moratorium on new licenses to mine coal on public lands, and proposing deep cuts in budgets for basic science and technology research and programs designed to support private-sector commercialization of new technologies, such as the U.S. Department of Energy’s (DOE) ARPA-E and Loan Program.

“We are committed to our greenhouse gas reduction goals and some of the changes in the federal policy landscape in the last year are not going to change our goals. So, while we look at what the federal government is doing, they will not change what we said we would do.”

EXECUTIVE WITH AN INDUSTRIAL CORPORATION

While Congress for the most part has not taken action to slow or halt the deregulatory efforts, it solidly refuted the administration’s efforts to cut spending in these accounts when it voted to approve Fiscal Year 2018 omnibus appropriations legislation and sent it to the President, who signed it on March 23, 2018. For example, while the administration requested that Congress deeply cut DOE’s applied energy programs and the Office of Science (which funds basic R&D at the national labs) and eliminate ARPA-E and the Loan Program, Congress funded all those programs with substantial budget increases, compared to DOE’s Fiscal Year 2017 enacted budget.

While a few of the leaders interviewed cited specific Trump initiatives that they favored in the energy domain—such as efforts to streamline permitting for wind and solar siting and its related transmission infrastructure—not a single leader who spoke to this issue felt that efforts to reduce greenhouse gas emissions that are underway would be slowed by the Trump administration’s actions. There was also little support for most of the deregulatory efforts and no support for the proposed budget cuts in clean energy innovation research and development programs.

Noting significant resistance to the Trump administration’s policies in the energy and climate change domains, Dan Goldman at the **Clean Energy Venture Group** said, “The capital markets, major fund managers, large

²⁵ OEM refers to “original equipment manufacturer,” a company that makes components that it or another company uses to make or assemble a finished good or piece of equipment.

corporations like **Unilever** and **Walmart** and tech companies are all doing what they said they were going to do. These companies see Trump's policies as a short-term blip and are not reversing course because they recognize that on a global scale, the transition to a low carbon economy will not be slowed down."

"Utilities, corporate purchasers, and municipalities are continuing their trajectory or speeding up to buy renewables—saying all right, we don't have a Clean Power Plan, but we know that over the long term we will be decarbonizing."

TOM KIERNAN, AMERICAN WIND ENERGY ASSOCIATION

An **executive with an industrial corporation** exemplified what Goldman is seeing across the economy. "We are committed to our greenhouse gas reduction goals and some of the changes in the federal policy landscape in the last year are not going to change our goals," the executive said. "We remain committed to meeting them. So, while we look at what the federal government is doing, they will not change what we said we would do. We feel as though between now and 2020 we are way ahead of other companies in terms of (reducing) carbon."

Tom Kiernan, Chief Executive Officer of the **American Wind Energy Association**, the largest U.S. wind energy advocacy group, said, "Utilities, corporate purchasers, and municipalities are continuing their trajectory or speeding up to buy renewables—saying

'all right, we don't have a Clean Power Plan, but we know that over the long term we will be decarbonizing.'"

"Initially the business community would have said that (with Trump's policies) it is 'game over,'" Aron Cramer at **BSR** said, "but there's been a mind shift, with many recognizing that the Trump administration is a speed bump and not a brick wall on the way to an energy transition."

The new reversal of federal leadership is being replaced by stepped-up leadership at the regional, state and municipal levels.

CDP North America's Lance Pierce called the "We Are Still In" initiative—launched by corporations, governors, mayors and others in reaction to President Trump announcing his intent to withdraw the United States from the Paris Climate Agreement—"in many ways unprecedented in modern American political history."²⁶

"The President made an announcement on a Thursday in the Rose Garden. By the following Monday, nearly half the U.S. economy—hundreds of companies, a huge number of cities, investors, universities and a number of states—had come together over the weekend and speaking from the C-suite publicly repudiated the policy of a sitting President," Pierce said. "This reflects the seriousness with which those actors in our economy regard the threat of dangerous climate change. CEOs don't stand up and casually take a stance against the President. To have a few hundred of them do so in a matter of a few days is unheard of," Pierce said.

"These aren't just the usual suspects that you'd imagine like **Patagonia**," said Andrew Shapiro, founder of the New York investment firm **The Broadscale Group**, which works with leading corporations (**ENGIE**, **General Electric**, **Johnson Controls**, **National Grid**, **Panasonic** and **Statoil**) and other strategic partners to invest in and commercialize promising market-ready innovations. "Some of the biggest polluters rejected the Trump administration effort to pull out of Paris. It's heartening to see some business consensus on supporting staying in the Paris Agreement. Some of the policies (the Trump administration) are trying to roll back go all the way to President Nixon. Many were signed into law by Republican presidents."

Leaders cited little evidence of retrenchment or shifting of course by their own company and other companies in their sectors.

Kevin Self, Senior Vice President for Strategy, Business Development and Government Relations at **Schneider Electric**, a French-based multi-national global engineering and energy systems manufacturing company, said he has not seen any companies pulling back on climate commitments amid the Trump administration's shift in policies. "I think it's simple. Those students graduating now know more about their impact on the environment and they're starting to choose between companies that are moving

²⁶ For more information and a listing of participants, see <https://www.wearestillin.com/states-tribes>

towards carbon neutral or are more carbon heavy,” he said. “We’re also working with large companies that are demanding 100 percent clean energy. If that doesn’t start to drive behavioral change for states, then those states will start losing residents and businesses over the coming decades.”

Alan Knight of **ArcelorMittal** said, “As someone on the global side of the company, I must say that despite the current climate posture from the U.S., global companies’ ambition to reduce carbon has not gone down. They think this can’t be long term. We haven’t seen a single business, globally, use this as a reason to pull back from carbon measures.”

An **executive with an industrial corporation** saw the same lack of backsliding by companies that he works with. “There is a general perception that due to the changes in federal policies over the last year that some companies have put the brakes on policies and programs and internal goals,” he said. “But for us we haven’t changed course at all. We have commitments out there in the public domain. We are going to continue on that path. And we have not uncovered any cynical backtracking (among other companies).”

C) Maximizing job quality is key to an effective transition to a low-carbon economy.

The rapidly changing energy economy has caused dramatic changes in employment in this sector, with growth in jobs in renewable energy, energy efficiency and natural gas, while workers in the coal industry have lost jobs. New technologies in domestic shale oil and gas production—horizontal drilling and hydraulic fracturing—led to a boom in employment and productivity that, despite a low-price environment and some job loss between 2014-16, has resulted in the U.S. becoming the world’s largest oil producer again.

Leaders of organized labor were understandably concerned about those impacts. Corporate leaders expressed similar concerns about helping workers navigate the ongoing transition, now and looking ahead. One concern that was voiced: In the transition to date, some well-paying, high quality jobs have been lost and some of the newer jobs have been of lower pay and lower quality.

Retaining and strengthening those jobs in the U.S. and caring for those caught in the transition are important priorities for companies and labor unions.

“Overall, what we need is for there to be lots of high quality and well-paying jobs, and those should include jobs in the clean energy sector and those outside the clean energy sector, so that when people transition away from fossil fuel jobs they know they’re coming into a good well-paying job,” said Brad Markell, the Executive Director of the Industrial Union Council at the **American Federation of Labor and Congress of Industrial Organizations (AFL-CIO)**, a federation of 60 national and international labor unions representing more than 13 million women and men.

That principle was echoed by Josh Nassar, Legislative Director at the **United Auto Workers Union**:²⁷ “What really needs to happen is a more forceful argument that we need to address climate change and it needs to be good for workers and the economy.”

Graham Richard, who from March 2012 to January 2018 served as Chief Executive Officer of **Advanced Energy Economy (AEE)**, a national association of business leaders working to make the global energy system more secure, clean, and affordable, said that **AEE** is structured “as a clean energy Chamber of Commerce” and that helping Governors and other leaders across the country understand the dramatic growth in clean energy jobs is part of their job. “Conservative governors don’t want to hear about climate change, they want to hear about jobs and local, state investment. Indiana didn’t realize how many clean energy jobs they had in the state,” he said. **AEE’s** member companies include **Apple, General Catalyst, Johnson Controls, Siemens, Microsoft, General Electric, Veolia, AES, Cummins** and **Schneider Electric**.

²⁷ The United Auto Workers’ full formal name is the International Union, United Automobile, Aerospace and Agricultural Implement Workers of America.

A **utility executive** said that as the energy sector navigates one of the most disruptive periods in its history, companies must thoughtfully manage the impact of economic impacts on employees and jobs.

“There is a reality that moving from coal to gas, you’re employing 1000 to 100 (people), coal to wind is 1000 to ten. The reality is that these technologies don’t require as many people,” he said. “This is one of the reasons these renewable resources are so cheap. You’re lowering costs. This is one of the big challenges we face as a company and industry. How we deal with the employment transition issue is a of crucial importance to this transition.”

The rapid changes in the utility sector has created challenges for workers. Michael Langford, President of the **Utility Workers Union of America**, which represents workers in the electric, gas, water, nuclear, call center, professional/technical, public, and renewable energy sectors, brings home this point when considering the future of the power industry: “It’s no more business as usual. We are trying to understand what the future of the utility worker will look like. What type of training will they need?”

“Overall, what we need is for there to be lots of high quality and well-paying jobs...so that when people transition away from fossil fuel jobs they know they are coming into a good well-paying job.” BRAD MARKELL, AFL-CIO

Langford said his union is helping to create a new offshore wind training center in New Bedford, Massachusetts, in partnership with Bristol Community College in New Bedford, the offshore wind developer **Ørsted North America** and the utility **Eversource**, “trying to literally prepare ourselves for the future and get ahead of the curve so that we can say we have what we need when people need us to work with them.”

Striving to adjust to the changing energy mix, with its sometimes-harsh impacts on employees and their families, the **Utility Workers Union of America** has embraced workers in renewable facilities as well as fossil fuel plants. “The new thing as well is that we are now representing a new wind farm in addition to the older energy sources like at nuclear and coal plants,” Langford said. “People in coal plants don’t like to hear that, but we are in a changing time in the history of the utility and every day something new is coming up.”

“A lot of our growth is with workers at natural gas plants,” he continued. “These gas plants are like turning on a furnace. We’re doing everything we can to prepare our union members for the changes that are inevitably coming.”

The quality of the new generation of jobs matters, leaders say, and one point of focus should be ensuring that public policies on energy and environment insist on strong worker standards.

“We have to figure out a way to make clean energy jobs high quality and that often gets missed in the overall debate,” Brad Markell of the **AFL-CIO** said. “There have been lots of opportunities to put in place high labor standards in environmental policy and they’ve been missed. For example, there was nothing in the **Volkswagen**-EPA settlement that required any kind of labor or good jobs requirements. They could have required that Volkswagen use union labor to install the EV infrastructure. We need to think about job outcomes when we’re talking about climate policy.”

Some investors and others see the emphasis on protecting coal mining jobs as misplaced at the expense of appreciating the dramatic new job growth in the clean energy sector.

While it is essential to honor pension, health insurance and other obligations of coal miners, Bill Weil of **Tempest Advisors** said, “We have seen the growth of an industry in the U.S. in wind, solar, and energy efficiency that represents millions of jobs.”

“We also need to honor what is going to be the next growth industry for our country, with its jobs that can’t be exported or offshored. You have to be here to put up a wind farm and solar farm, or do an energy efficiency retrofit. These industries and sectors are not being supported properly. We have a huge opportunity here from a jobs perspective.”

Those points were echoed by Alex Laskey, founder and former President of **Opower**,²⁸ a provider of customer engagement and energy efficiency cloud services to utilities. “There are 2.1 million people employed in the energy efficiency business and three million people overall in advanced energy in storage, wind, EV, solar and so on. For an administration that is sincerely concerned about job growth, this is an industry twice as big as the airline industry,” he said.

Laskey continued, “It’s very legitimate to be concerned about coal workers, but the reality is that in Virginia there are twice as many jobs in energy efficiency as there are in coal. So yes, let’s not abandon coal miners, let’s help them. But today Virginia imports 40 percent of its energy from natural gas and coal from out of state. But if they moved to zero percent of net imports, **Advanced Energy Economy** has reported they would create 12,600 new jobs in the state.”

D) Significant investment capital is looking at clean tech from the sidelines but has not committed yet at scale.

While investors have been central to driving the dramatic growth of renewable energy, respondents said that the scale of investment in the U.S. remains relatively modest and much more is urgently needed. One source of caution is that many investors in clean energy technology recall the notorious period of 2006–2010 when a number of venture capital firms that had success investing in so-called dot.com and biomedical companies lost significant money when they applied the same short-term, venture capital (VC) approach to the clean energy sector.

Kyung-Ah Park of **Goldman Sachs** described that period: “In the early stage, investment came from venture capital markets, and VC model didn’t work (for clean energy). Clean energy is a different investment with large incumbents with legacy investments, highly dependent upon regulation, and can be more capital intensive.”

Investors have a better appreciation of the clean energy investment opportunity today, she said, because key factors have changed. “More recently, with greater maturation of clean technologies, private equity and pension funds are coming into clean energy because they see it as mainstream and a long-term sustainable infrastructure play. Returns are getting compressed, but that drives greater efficiency,” she said.

“In the early stage, investment came from venture capital markets, and the VC model didn’t work (for clean energy). Clean energy is a different investment with large incumbents with legacy investments, highly dependent upon regulation, and can be more capital intensive.”

KYUNG-AH PARK, GOLDMAN SACHS

Some venture capital funds are creating opportunity by “looking at energy tech and storage opportunities and providing financial solutions and new ways of monetizing value from these technologies,” Park said. “Energy storage solutions being paid back through reduced peak demand charges, for example. We’re also seeing now more strategic incumbent companies who have set up their own VC-type funds in order to invest in new disruptive technologies.”

Significantly more capital is needed, however, and from the perspective of one power generator, an influx of shareholder capital will help keep electric rates in check. Abe Silverman, Vice President and Deputy General Counsel at **NRG Energy**, an integrated power company with headquarters in West Windsor Township, New Jersey and Houston, Texas, said, “Every decision that is made in the energy space ought to consider whether or not we are bringing in more shareholder capital into this market. This transition (to clean energy) will be an expensive process and companies will be spending billions of dollars. If we can do it in a way that puts risk on shareholders, rather than ratepayers, then this will be a much better outcome. I don’t think this kind of thinking is going on at the regulatory level.”

28 Opower was acquired by Oracle, a global provider of enterprise cloud computing, in 2016.

Put simply, “we need to leverage massive financial markets,” said Graham Richard, formerly of **Advanced Energy Economy**.

Business leaders are seeing much greater clean energy investment activity abroad than they are seeing in the United States.

As companies look for investment capital around the world, Richard said he is “seeing massive investment, both public and private, from China, India, and the EU and we don’t see that at the pace that is needed in the U.S.”

An executive with a major corporation agreed with that picture. “We do see greater capital availability for clean energy investments in Europe than we do here. There are a whole bunch of capital providers in Europe who are willing to make a capital investment for you and share the returns on energy efficiency and clean energy investments, and seem to be better established, than companies in the U.S. Unless you can take advantage of a specific tax credit (here in the U.S.), you’re on your own.”

The executive said that companies looking to upgrade to more energy efficient equipment and low-carbon technologies have the dual challenge of raising capital funds and training core staff to effectively operate the new equipment—and that an approach developed in Europe helps companies address both needs simultaneously. “You have to make sure that technology will work and that it’s highly reliable. You have to invest more in people in the plant to deal with the technology. Europe has an interesting intermediate layer of technical operators that their policy structure has enabled, who come into a company and provide both capital and operational support,” he said.

Investors with longer-term investment horizons are seen as the most logical source of clean energy capital.

Institutional investors, such as large government employee pension funds, sovereign wealth funds and university endowments, are optimal investors in clean energy because they often seek a healthy and steady but not excessive return and they invest more patiently and over longer timelines. However, while some have engaged, many are still considering their options from the sidelines, respondents said.

“One of the biggest problems clean energy investors face is getting more institutional capital deployed. Pension and endowment money has been sitting on the sidelines,” Dan Goldman of the **Clean Energy Venture Group** observed. “There is a real need to drive home the need for institutional capital in the sector, both as a hedge against conventional energy investments and to enable more capital injection in clean energy technologies and projects.”

“One of the most appealing things about solar is that its foundation is a technology that has been around for 30 to 40 years and there isn’t as much of a perceived degree of risk. You end up having a very predictable project and product. You can predict how much a solar project will produce in a given location, on average, over the life of the project.” GREGG FELTON, ALTUS POWER AMERICA

Altus Power America’s Gregg Felton expanded on this matchmaking. “The right types of investors are those with pools of capital that have long investment horizons, like life insurance companies, pensions, endowments and sovereign wealth funds. Those are the largest sources of capital coming in.”

In a positive development, interest is rising among individual investors and the family funds that often represent them, Felton said, “and there are funds being developed to pull money into this sector for individual investors. Large pools of capital are

starved for yield and these are seen as safe long-term assets. If we can generate a steady, substantial return in what is considered a safe asset, then investors are going to flock to solar.”

Felton said that solar energy projects are ideal for investment because solar is now a well-established technology with only modest investment risk. “Our founders all left careers on Wall Street. One of the most appealing things about solar is that its foundation is a technology that has been around for 30 to 40 years and there isn’t as much of a perceived degree of risk. You end up having a very predictable project and product. You can predict how much a solar project will produce in a given location, on average, over the life of the project. Unlike other technologies, there is less variability in the cash flow and this leads to a lower cost of capital. All of this has made solar an attractive place to put capital and this has led to a significant increase in capital coming into this sector.”

Sovereign wealth funds are interested in investing in solar only if the projects are large, Felton said. “Unless you’re dealing with massive desert projects, (sovereign funds) are not interested in distributed generation projects. We’re doing small scale solar projects of \$5 to \$50 million per project. While the returns are attractive, the investment size per project is relatively small for some investors. Some (sovereign funds) want to invest \$1 billion at a time. Anything less is too small for them. It would take considerable time to aggregate a portfolio of \$1 billion of solar.”

For some venture capital investors, the dominant forms of renewable energy—wind and solar power—have graduated from their early stage lives and have fallen out of the venture capital mission space.

“We likely won’t invest again in wind and solar because they are no longer early stage and are no longer venture plays,” Gabriel Kra of **Prelude Ventures** said. “Other investors will build and invest in wind and solar, but we won’t. New electricity generation is all wind and solar. We should now be focusing on storage. When someone cracks battery storage, it’s game over.”



Policy Finding 2: Overwhelming support exists for consistent federal policies on energy and carbon to provide long-term certainty and allow businesses to invest with confidence.

A) If a more comprehensive, stable and urgent approach is used, governments can create economic opportunity and help U.S. companies and labor capture first-mover advantage.

A wide range of respondents said that government leadership—through targeted investment in research and development, thoughtfully-crafted policies and regulations, supportive programs, and collaboration with the private sector—is a key component to creating the conditions for new or expanded markets and robust economic activity.

Much of the discussion centered around the relationship between governmental leadership and investment and the natural workings of market economics—with a widespread appreciation that government action can help create new markets for goods and services while also addressing market failures or shortcomings.

“The role of government in clean energy is critical. There are some things that will happen due to market economics, like the drop in the price of renewables, but that was also the result of policies put in place, like tax credits. I don’t think anything has or would happen in this area if it were not for government pricing signals.” STEPHEN HARPER, INTEL

“The role of government in clean energy is critical,” said Stephen Harper of **Intel**, in a common observation among the leaders interviewed. “There are some things that will happen due to market economics, like the drop in the price of renewables, but that was also the result of policies put in place, like tax credits. I don’t think anything has or would happen in this area if it were not for government pricing signals.”

He added, “Even if you take a very free market approach—a University of Chicago market failure—you need a market-pull on the demand side once the product is developed. In the efficiency realm, there are so many market failures that

keep landlords and tenants from investing to the extent that they should. You need policy to break through and correct those market failures.”

The **Northeast Clean Energy Council**’s Janet Besser said, “Clear policies help to create markets for our member companies. Markets don’t work in isolation. They work within a policy framework. Even the stock exchange is regulated. The role of government is to address market failures and imperfections.”

Alex Laskey, formerly of **Opower**, offered the example of public investment in research and development for more efficient appliances. “(W)hen governments set ambitious goals and provide enough incentives in the form of financial incentives, companies do a remarkable job. The energy efficiency of appliances is a great example. The R&D dollars that were spent to improve appliances paid off big time.”

California is a prime case study of a state that created robust markets for renewable energy and more efficient appliances, industrial equipment and lighting by setting out consistent, long-term policy direction on clean energy and climate change going back four decades, according to Danny Kennedy of the **California Clean Energy Fund**.

“Policy has been a big mover that makes markets. In California, since the 1970s, energy efficiency...has been clear-minded, consistent, and bipartisan,” Kennedy said. “Since the 70’s energy efficiency has been a key strategy for the state, and it’s delivered in spades. We have this incredible phenomenon where we’ve doubled the population, doubled the economy, brought in companies like Google and Facebook and startups, and all the while kept energy consumption flat. We’ve decoupled energy consumption from economic growth and activity.”

Mindy Lubber, President of **Ceres**, a sustainability nonprofit organization which includes a business network that includes **Ford Motor Co., General Motors, Bank of America, General Mills, PG&E, National Grid,**

Baxter and the Walt Disney Corporation, as well as an investor network with 146 institutional investors, said “Policy matters for innovation, employment, and investment, and that’s why companies have stood up to support energy and environmental policy.”

A common market failure cited by leaders is the failure of government and the private sector to understand and address externalities, such as pollution.

“What we are dealing with is a global commons problem with extreme externalities,” said Kevin Kennedy, Deputy Director of the **U.S. Climate Initiative** at the **World Resources Institute (WRI)**. Kennedy assists WRI’s **Corporate Consultative Group**, which includes among its corporate members nearly 40 Fortune 500 companies, including **Cargill Corp., Caterpillar, Colgate-Palmolive Co., Dow Chemical Co. Statoil, and Weyerhaeuser Co.**²⁹ “Without a strong hand from government steering policy in the right direction and making sure those externalities are dealt with, the private sector is on its own and won’t be able to get us where we need to go.”

Josh Nassar of the **United Auto Workers** agreed that there needs to be a role for government because of its ability to take a broader view. “That role needs to take into account the economics of the impact of this transition (to a low-carbon economy) and the broader societal concerns and goals, such as reducing our carbon footprint.”

Public investment in research and development for new technologies has wide acceptance as an appropriate and valuable government role.

This view was reflected by Eric Toone of **Breakthrough Energy Ventures**: “A valid and important role for government is to fund the fundamental scientific breakthroughs necessary for the development of impactful technologies. Government is the appropriate vehicle for that early stage work because the risk/reward ratio is too high for the private sector.”

Creating those opportunities has led to large benefits to the private sector, **BSR’s** Aron Cramer said. “Governments set investment priorities and enable early stage investment in technology, and the U.S. has reaped the benefits of that for the past 75 years—areas where that basic research is hugely valuable to individual companies.”

Many respondents see government as a partner or make efforts to work closely with government to assure clear and helpful outcomes.

In particular, regulated utilities have long worked within a government-designed framework and are often comfortable doing so, even if they do not agree with every requirement placed upon them, or might have taken a different approach. In many instances, they feel as though they have appropriate avenues for input.

“Being a California based company, it’s comforting that we are operating in an environment that is very supportive of creating greenhouse gas policies,” said Nick Stavropoulos, President and Chief Operating Officer of **PG&E** (whose formal name is **Pacific Gas and Electric Company**), a San Francisco-based utility that is one of the largest combined natural gas and electric energy companies in the United States.³⁰ “We feel very comfortable building that into our long-term vision of our company.”

Skiles Boyd, Vice President for Environmental Management and Resources at **DTE Energy**, a Detroit-based diversified energy company serving 3.5 million customers in Michigan, said, “Our policy is to work closely with our government regulators at the state and federal level in order to shape policy. We’ve had good working relationships in doing this. With the Clean Power Plan (CPP), we made a decision to work with the past administration so that we could have something workable. I understand the legal questions in regard to the CPP, and we had some issues there, but our policy was to work with the EPA to shape the regulations. If you’re a regulated utility these policy decisions need to be considered.”

29 See full corporate member list at <http://www.wri.org/business/join-corporate-consultative-group-ccg>

30 Source: <https://www.pge.com>

Alex Laskey, formerly of **Opower**, cited the utility industry “as one really good example of where government and policy makers can create a real financial structure that incentivizes businesses to pursue the common good.”

“Now the common good issue of our time is to reduce carbon. The states and countries that have prioritized that among their utilities have seen tremendous results. It’s not just utilities but the ecosystem of large and emerging companies to help them meet this new obligation,” he said.

Often companies must work effectively with governments at multiple levels, and consequently they welcome manageable and clear processes and rules of engagement. “In our industry, we have communities, local, state, and federal governments, regional groups and other stakeholders. We deal with them all. The more streamlined and transparent the process, the better it is for us,” said Thomas Brostrøm, President of renewable energy developer **Ørsted North America**, whose parent company is headquartered in Denmark.³¹

“From my perspective, the government has to play a role in energy and infrastructure,” Brostrøm said. “I’m a firm believer in a diversified portfolio, which lowers overall societal risk. While private businesses are responsible for building projects, we need both the state and federal governments’ involvement to manage leasing and permitting, to ensure nascent technologies have an opportunity to expand in the market, and to set targets for the energy portfolio.”

International companies find themselves with the additional challenge of doing business in many different countries with numerous different regulations and policies, and they say it comes with the nature of their global business.

“We’re a global company,” said Tom Dower, Senior Director of Government Relations at **ArcelorMittal**. “We have industrial facilities in over 20 countries. We are regulated on energy and environmental issues in all the markets in which we operate, to varying degrees.”

Noting that “there is absolutely an appropriate government role in those areas,” Dower said **ArcelorMittal** takes compliance with environmental, health and safety laws extremely seriously, and pursues a collaborative approach with the host governments. “We try to work with regulators at all levels, from the supra-national to the local. And we want to help make sure that the policy outcomes are achieved at lowest expense.”

Some caution against the idea—heard in various corners of the private sector, think tanks and business trade organizations—that government should step back and allow the business to take care of business.

That instinct troubles Alex Laskey, formerly of **Opower**. “I think one of the things that really concerns me is there has long been a notion among business people that government’s role is to get out of the way and business will solve problems. That’s been true among the (political) right, let’s say. But now, even among the center and center left folks who are like me and highly skeptical of the intentions or capabilities of this government, there is an even louder answer that business will just police itself. Business without regulation or clear requirements is only focused on near term corporate interests and shareholder interest.”

Aron Cramer of **BSR** echoed that concern. “The problem with some parts of the U.S. business community and one place I’d qualify the support of the private sector for climate action, is that some have conflated action on climate as undue interference by government in free markets.”

However, the economy is highly complex and diverse, Cramer said, and typically some players in a sector take an anti-government view, while others understand the need for government to set and enforce standards. “There’s a big divide between large and small businesses and globally integrated and more domestic companies,” he said. “The opposition by the U.S. Chamber of Commerce is driven largely by the fact that the Chamber’s members are smaller- and medium-size companies and they don’t like regulation.”

Cramer gave the example of federal rules aimed at reducing methane leaks at oil and gas drilling operations: “Large oil and gas companies are okay with them, smaller players oppose (them).”

31 Until November 2017, Ørsted was DONG Energy, whose acronym stood for Danish Oil and Natural Gas.

B) Companies prize policy predictability—and a holistic, coherent and consistent national policy—over a fragmented patchwork of state and local policies.

Throughout our interviews, a common and consistent refrain was that knowing and understanding what government policy is—and being able to rely on that policy for a significant period of time—is essential to companies and investors’ ability to leverage those policies to design business models that will succeed in generating profits, manage costs, and create jobs, shareholder value and investor returns.

A strong desire for certainty and clarity versus frequent change and inconsistency. The current fragmented state of U.S. energy policy is costly and not good for business.

While companies will almost always have a point of view about a regulation that will affect their business domains, several leaders argued that they can manage almost any regulation or policy if it comes with clarity and predictability. And, they say, policy approaches that take a coherent economy- or sector-wide approach and operate from a clear sense of vision are most welcome of all.

“I firmly believe the utility industry needs to decarbonize over time, and it’s already changing today. But we need long-term policy that is agreed upon in a bipartisan manner, policy that will be around for 30 years. Administrations are around for four or eight years and we’re making investment decisions for assets that have lifespans of 25, 30 or 40 years.” RALPH LAROSSA, PSEG POWER

Abe Silverman of **NRG Energy**, captured this view:

“What fascinates me in the energy sector is the amazingly unnecessary complexity that has been built into this system over time. The U.S. electric sector is really lacking a vision. Uncertainty is much more of a risk to business rather than regulation.”

Tom Kiernan of the **American Wind Energy Association** said, “I think fundamentally we need a clear national carbon strategy, if not a price (on carbon). It feels like we are heading towards a patchwork approach where we will end up with an impressive hodgepodge of carbon policies throughout the country that are inefficient.” An executive with a **clean energy manufacturer** reflected on the difficulty of operating without a clear, overarching carbon

policy: “In the absence of that, we are dealing with second and third best policy levers and design. We’re in the constant process of trying to figure out what we like best of the worst.

“I’d like to see a national carbon policy that makes sense and doesn’t disadvantage U.S. manufacturers and employees,” said John Donnan of **Kaiser Aluminum**. “I don’t think it’s in our best interest to have 50 states with 50 different policies. Effective collaborative engagement to develop a national carbon policy that takes into account leakage and has long term and realistic goals and recognizes best-practices for business would be something we would see as a better alternative than what we see happening now.”

Many others voiced similar frustration. “Energy policy is one thing we lack in this country because it’s all over the board. People like certainty, they like a road map,” said Michael Langford of the **Utility Workers Union of America**.

Altus Power’s Gregg Felton said, “In the absence of clarity, to a great degree, there is a lot of uncertainty. Financial incentives are nice, but what’s better is a clear set of policies that require state and local involvement.” The states that have adopted thoughtful policies to encourage the build-out of solar energy in their states are most likely to attract investment in the businesses that manufacture, transport, install, repair and maintain solar photovoltaic panels and associated hardware, Felton said.

“Markets look for a predictable framework and the more clarity it has, the easier, cheaper, and more efficiently it will build solar,” he said. As a result of the solar energy policy infrastructure that is in place at both the

federal level and in a number of states, he said that **Altus Power** is “optimistic about the continued investment in solar over the next few years.”

Eric Toone of **Breakthrough Energy Ventures** said that all of the major oil companies are anticipating that Congress will eventually adopt a carbon price of some form and thus include a carbon tax in their internal projections as a hedge against uncertainty: “Major oil companies are fine with a carbon tax. The only thing they can’t deal with is uncertainty. They just want to know what the rules are. The only thing that makes it hardest for industry to work with is uncertainty.”

One **executive with an industrial corporation** observed that the simple knowledge that a policy is emerging, as in the long-time discussion about instituting carbon pricing in countries around the world, allows companies to anticipate and plan—and to make the case for harmonization of those prices.

A central challenge that comes with the electoral turnover in U.S. democracy is the accompanying change in governing philosophy, policies and regulations.

“Part of the challenge of doing business in the U.S. is the changing of policies with administrations,” said John Donnan at **Kaiser Aluminum**. “The U.S. doesn’t provide a lot of regulatory certainty. With Kaiser specifically, we do think that there is an opportunity to engage more effectively for those interested in a sincere and collaborative dialogue.”

Lance Pierce of **CDP North America** emphasized a similar point. “What is nerve wracking is when policy incentives are likely to come and likely to go in any given Congress. This breeds uncertainty, and business thrives on certainty.”

“Companies can’t get bounced around (by frequent shifts in government policy),” said Mindy Lubber of **Ceres**. “They don’t like being whipsawed by changing regulations. Companies know that some kind of carbon regulation is coming, maybe not in the next few years, but it’s coming. For example, it takes seven years to conceive of a car and get it on the assembly line. What President Trump is doing is incredibly complicated for the economy and for individual sectors such as the automotive or the utility sectors.”

A commonly cited example of shifts in government energy policy that harmed some businesses and slowed economic growth was the unpredictable extensions of the federal Production Tax Credit (PTC) for wind power development and the Investment Tax Credit (ITC) for solar power development.

The PTC is widely credited with incentivizing rapid deployment of wind energy across the country over recent years. Initially authored by Sen. Chuck Grassley (R-IA) and enacted by the U.S. Congress in 1992, the PTC has been renewed and expanded a number of times by Congress (with periodic lapses in between)—most recently in December 2015 when Congress put the PTC and ITC on a five-year phase down glide path.³² The ITC, first adopted by Congress in 2005 and extended and expanded in 2008, 2009 and 2015, is available for solar, fuel cells, small wind turbines, geo-thermal, micro-turbines and combined heat and power installations.³³

“The on-off again of (the renewable energy) tax credits was a huge problem, and I’m thinking all the way back to solar thermal markets,” said **Northeast Clean Energy Council** Executive Vice President Janet Besser. “That was going to be the solution, (but then) those credits disappeared and all those companies failed. Tax credits are a good mechanism but the way they were done was an impediment because lots of money

32 According to the U.S. Department of Energy, “Wind facilities commencing construction by December 31, 2019...can qualify for this (PTC) credit. The value of the credit for wind steps down in 2017, 2018 and 2019. The federal renewable electricity production tax credit is an inflation-adjusted per-kilowatt-hour (kWh) tax credit for electricity generated by qualified energy resources and sold by the taxpayer to an unrelated person during the taxable year. The duration of the credit is 10 years after the date the facility is placed in service for all facilities placed in service after August 8, 2005. Originally enacted in 1992, the PTC has been renewed and expanded numerous times, most recently by the *American Recovery and Reinvestment Act of 2009* (H.R. 1 Div. B, Section 1101 & 1102) in February 2009, the *American Taxpayer Relief Act of 2012* (H.R. 8, Sec. 407) in January 2013, the *Tax Increase Prevention Act of 2014* (H.R. 5771, Sec. 155) in December 2014, the Consolidated Appropriations Act, 2016 (H.R. 2029, Sec. 301) in December 2015, and the Bipartisan Budget Act of 2018 (H.R. 1892 Sec. 40409). See <https://www.energy.gov/savings/renewable-electricity-production-tax-credit-ptc>

33 For details on how the ITC applies to a range of technologies, see: <https://www.energy.gov/savings/business-energy-investment-tax-credit-itc>

was invested and then lost.... Regulatory policy and certainty always help. Will the policy be there over a reasonable amount of time to attract investment?"

Former Massachusetts Governor Deval Patrick, now the Managing Director of **Bain Capital's** Double Impact business, gave an appreciative nod to the renewable energy industry for flexibly navigating the multiple changes in clean energy policies: "To me the alternative energy industry has to be seen and credited as the most resilient types of companies. Policies keep changing so much but they keep adapting to changes in the policy environment. I admire that."

Calls for a comprehensive national clean energy policy: A preference for uniform federal policies over multiple, differing state policies, or at least better alignment among the levels of government.

A large number of respondents called for the President and Congress to develop a comprehensive national energy policy that would guide the transition to a low-carbon economy and serve as an overarching framework. Those views arise in part from a perspective that the U.S. and global economies will be increasingly carbon constrained in the coming years and a proactive, skillfully-designed national policy would maximize the ability of the private sector to flourish as the economy is decarbonized.

"In the U.S., we've never had a coherent energy policy," Tom Dower of **ArcelorMittal**, said, in a remark that was echoed by other leaders. "To the extent that there were high level government policy goals, this would be helpful for the private sector, rather than trying to dictate at the granular level every particular action."

Jennifer Kelly, Research Director of the **United Auto Workers**, said, "To me what is missing in the U.S. is a holistic industrial policy that would bring together the tax, environmental, labor, R&D, infrastructure, and education policies that would be supportive of a domestic, manufacturing industry. That is a big hole from a policy perspective and something that will leave us handicapped when it comes to foreign competition."

For some, their desire for a strong national energy policy is in reaction to what has emerged as a patchwork of state and local statutes, regulations and policies that are

challenging to manage in the absence of federal direction.

"The Feds and the states are on completely different policies," Abe Silverman of **NRG Energy**, said. "The Feds really want to talk about regional markets approach and states are concerned about what investment is going on in their state."

"We need to fundamentally re-create the energy market," he elaborated. "The states have decided that utilities know better than the consumers. If we were to take those resources and deploy them in a competitive way, we'd get a bigger carbon reduction than mandating certain technologies. If we want to incorporate carbon constraints into our economy, then let's do it and let's let the market get to the cheapest, least-cost path."

"We should favor federal policies because it's a headache to deal state-by-state," said a **utility executive**. "We'd be a lot better off with a federal policy on many environmental issues. Within the political debate, folks love to say we should do this locally or state by state, but this really goes against the interest of any large organization that has operations in multiple states."

That said, some believe clear state policies are better than no policy at all. A **utility executive** described this state-of-play. "Having some policy provides certainty for long-term investments for utilities. Sometimes it's better to have something in place, rather than just have all federal policy up in the air. So, states have to come up with some state-based solutions. Congress is supposed to come up with our climate policy, yet Congress has a hard time doing this. The long-term solution is clear guidance from Congress."

"What fascinates me in the energy sector is the amazingly unnecessary complexity that has been built into this system over time. The U.S. electric sector is really lacking a vision. Uncertainty can be much more of a risk to business rather than regulation." ABE SILVERMAN, NRG ENERGY

The dilemma of conflicting national and state policies can be especially acute when the state policy is stronger than the national policy. In 2017 and into 2018, California went from being in concert with most of the policies of the Obama administration to being out of sync with the Trump administration.

Nick Stavropoulos of **PG&E** said, “We were quite comfortable when federal policy resembled state policy here in California. With the new administration going in a new direction we are scratching our head a bit. As you all know California’s reaction has been, not exactly a doubling down, but a really aggressive approach to pursuing climate change issues and resiliency. We feel a little alone here and that the federal policies we’re seeing may be not as supportive as before.”

“I think the one thing we take comfort in is that we do operate in only one state. I think we are less conflicted than companies that operate across multiple states who will find themselves faced with many different positions,” he said.

Even when a state policy is clear and effective, there can be a need for regional or national policy to complement that state policy to ensure a complicated system will work well.

“Just because you have a robust Renewable Portfolio Standard in place doesn’t mean that everything else will fall into place,” said Kyung-Ah Park of **Goldman Sachs**. “The reality is that as you ramp up you have challenges with grid integration, so you need to think of grid access issues. There are credit financing challenges (as a result).”

She added, “How do you integrate electric vehicles and new technologies into the grid with the grid, storage, and reliability? All this requires a more holistic integration approach rather than piecemeal policy.”

Long-term policies allow for thoughtful planning and smart capital investments.

For a number of leaders, especially in the utility and heavy-industry sectors, setting long-term policy is essential because they operate on decadal investment timelines.

Ralph LaRossa, President and Chief Operating Officer of **PSEG Power**³⁴, an independent power producer that generates and sells electricity in the PJM³⁵, New York and New England wholesale power markets, said “I firmly believe the utility industry needs to decarbonize over time, and it’s already changing today. But we need long-term policy that is agreed upon in a bipartisan manner, policy that will be around for 30 years. Administrations are around for four or eight years and we’re making investment decisions for assets that have life of 25, 30 or 40 years. We need long-term policy certainty. We can deal if we have certainty.”

One **executive with an industrial corporation** explained that as companies like his consider where to invest their capital, the longer investment time frames—six to eight years, for example—allow more thoughtful investments that can tackle systemic or more challenging problems, while shorter two- or three-year time frames are less desirable because they come with pressure for quicker returns.

Consistent, long-term commitment is especially important in basic science and technology research and development programs, **Cummins’** Brian Mormino said. “The challenge with private-public R&D is that the programs can change. A change in priorities is disruptive to the development of technology. Uncertainty about R&D is problematic if you’re a company that is making decisions to invest millions of dollars and years of time.”

This is especially true during tough economic times, he said. “If we’re moving forward with an R&D project and the government stops the funding, but the economy is doing well, we might invest our own money. But if the economic conditions are down and there are shareholder pressures and the government is unclear about their priorities, then you could stop in the middle of project.”

34 Prior to being named President and COO of PSEG Power in October 2017, LaRossa was the President and CEO of the Public Service Electric and Gas Company (PSE&G).

35 PJM Interconnection is a regional transmission organization (RTO) that coordinates the movement of wholesale electricity in all or parts of Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia and the District of Columbia. Source: <http://www.pjm.com/about-pjm/who-we-are.aspx>

That perspective is equally understood by investors. “Policy, technology and markets have to work in concert. The challenge with policy is certainty and longevity of these policies,” said Kyung-Ah Park of **Goldman Sachs**. Bill Weil of **Tempest Advisers** added, “We need a consistent, long-term policy framework, within which capital actors can make decisions. That’s the key.”

C) Outcome-based policies are preferred by some over technology mandates.

Government should be technology neutral, some argue.

Alex Laskey, formerly of **Opower**, emphasized that designing and implementing policies that are outcome-based will maximize the power of the market “to do what the market does best, which is compete and make space for new and innovative solutions.”

“The biggest movers are outcome-based policies,” he added. “I’d be much more excited about an energy efficient standard that is measured on outcome of measured and verified energy efficiency achievement, than I am on inputs where the utility is mandated to use LED bulbs, for example—although that requirement is not bad in itself.”

NRG Energy’s Abe Silverman echoed the view of a number of other private sector leaders in saying that government is needed to establish policy parameters, but it should not put its thumb on the scale in favor of one company or one technology over another.

“I’m a strong supporter of an important role for government and regulation to play in organizing a balanced system,” Silverman said. “At the same time, we don’t want the government to pick winners and losers. The market is efficiently moving us toward a low-carbon future. We need a right balance between regulatory guardrails, but let’s not let government lay down the tracks.”

“One of the biggest challenges is that we really should embrace this idea of tech neutrality within the framework of reducing carbon. Because if your tech works, it works.”

MIKE LANGFORD, UTILITY WORKERS UNION OF AMERICA

Michael Langford of the **Utility Workers Union of America** agreed: “One of the biggest challenges is that we really should embrace this idea of tech neutrality within the framework of reducing carbon. Because if your tech works, it works.”

Part of the rationale for such neutrality is that innovation is driving rapid and complex technological change, and making choices about technologies and approaches prematurely may thwart the best solutions.

“We don’t know what technologies will look like 20 years from now, so we need to have a portfolio of approaches,” said Kathryn Clay, former Vice President for Policy at the **American Gas Association**, an industry trade group representing more than 190 companies that deliver natural gas to homes, businesses, and industries throughout the U.S. “We can’t bet on just one solution like electrifying everything. I don’t bet against technology because it changes. Don’t try to pick winners.”³⁶

Laskey said most state energy efficiency standards are written with an outcome framework, while a few are more directive, sometimes accidentally. He described a recent situation in Nevada in which a state energy efficiency standard was crafted to credit utilities for energy efficiency measures that are “installed.”

“So it had, almost by virtue of accident, a requirement that in order for the utility to get credit, it had to install something which involves hardware,” he said. “(A)s a consequence, as a software company which doesn’t install hardware but just gives consumers new information, we were ruled out an efficiency vendor in Nevada and we couldn’t do work there.”

³⁶ At the time of our interview with Kathryn Clay (and Dave McCurdy), Clay was the Vice President for Policy at the American Gas Association. In March 2018, she became the President of the International Liquid Terminals Association.

At least one respondent felt strongly that the Obama administration crossed the line from neutral arbiter to favoring some technologies over another. “Government’s role in the previous administration was picking winners and losers while its job should be providing a framework and a level playing field,” said Colin Marshall, Chief Executive Officer of **Cloud Peak Energy**, a major coal producer in the Powder River Basin in Wyoming and Montana, said. “The role of government should be to take a step back and say that there is a bigger goal here. They shouldn’t be picking winners and losers.”

David Miller of the **Clean Energy Venture Group** made the case that when one is attempting to design policies that address complex problems and have complex features, it is best to start out modestly on day one and phase in more stringent requirements after the regulators and regulated parties have built experience with the new policy. “In designing public policies, it’s good in general to start light, to have minimal impact from day one, and then further strengthen (the policy) and gradually increase it so that it has its desired effect. RGGI,³⁷ which has been great, is an example. It initially set carbon prices low, and now it’s being strengthened, which will enable it to be more beneficial.”

Concern that policy is increasingly being driven by ideology and not analysis and economics.

Several people expressed concern that it is increasing difficult to deploy rigorous analysis or understanding of climate science in public efforts to shape energy and climate policy.

“I wonder if we’re in an environment where policy (is not driven) by analysis or economics anymore,” a **utility executive said**. “Are we in an age where the propaganda machine is so effective that the people who do good analysis are not in the room and aren’t welcome? The policy is now so ideologically driven.”

“We’re not dealing with the technical and economic problems of climate change, and this is because there is a political game being played,” said Colin Marshall of **Cloud Peak Energy**. “That we have one party on one side and another party on the other is not very helpful due to the nature of these complex challenges.”

37 The Regional Greenhouse Gas Initiative (RGGI) was the first mandatory market-based program established in the United States to reduce greenhouse gas emissions by capping and reducing CO2 emissions from the power sector. The currently participating states are Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont. New Jersey was an original participating state until then-Governor Chris Christie withdrew the state from RGGI in 2012. Newly-elected New Jersey Gov. Phil Murphy signed an executive order in January 2018 directing the state to rejoin the RGGI. For more information, see <https://www.rggi.org>.



Policy Finding 3: A stable, economy-wide carbon price is widely seen as an essential policy step; design preferences differ.

A) Carbon pricing would provide the most comprehensive basis for sustained scale up of business investment.

Business leaders participating in this research consistently acknowledged that government has an appropriate and vital role in setting public policy parameters for energy and climate change. As described in the findings earlier in this report, however, they also expressed strong preferences for energy and climate policies that were comprehensive, coherent, long-term in outlook, clear in expectations, flexible in terms of implementation, and supportive of a level playing field between companies and technologies. These leaders argue that they can best meet policy mandates if they have the certainty of knowing what is expected and that policy will not change abruptly.

Against that backdrop, it was striking that a large number of the interviewees—across economic sectors—spoke explicitly in favor of putting a price on carbon as the most effective and efficient public policy for reducing GHG emissions. Many said they believed that a well-crafted carbon price that endured as long-term policy would meet the above requirements. Unsurprisingly, there was a range of views on how such a carbon price should be structured and implemented.

A strong price on carbon is preferable to a hodgepodge of carbon policies.

For many respondents, setting an economy-wide price on carbon would be a welcome cornerstone of a national energy and climate change policy.

“At some point, a more transparent cost of carbon would be of value. Right now, there is clearly a cost of carbon, but it is not transparent,” said Skiles Boyd of **DTE Energy**, the Michigan-based utility. “In the long term, a more visible price on carbon would be helpful. This would help our decarbonization process along.”

“At some point, a more transparent cost of carbon would be of value. Right now there is clearly a cost of carbon, but it is not transparent. In the long term, a more visible price on carbon would be helpful. This would help our decarbonization process along.” SKILES BOYD, DTE ENERGY

Ralph LaRossa of **PSEG Power** concurred that a carbon price would be helpful in guiding policy but emphasized that its structure must be carefully considered. “We are in favor of a carbon tax. There are lots of design questions that need to be thought of, such as the fairness issue.”

Kevin Self of **Schneider Electric** said his company believes in the need for a national emissions policy in the U.S. and in the other countries in which it operates and “we work with other stakeholders and organizations to drive climate policy forward.”

The foundation of climate policy should be a price on carbon, he said, and to demonstrate its commitment to that path, **Schneider Electric** became a “proud founding member” of the **Climate Leadership Council (CLC)**, an initiative launched in June 2017 by James A. Baker III and George P. Shultz, both former Republic Secretaries of the U.S. Departments of State and Treasury. The CLC includes among its four pillars a gradually rising tax on carbon dioxide emissions applied upstream at the refinery stage or “first point where fossil fuels enter the economy.”³⁸

³⁸ The Carbon Leadership Council's plan includes four pillars: 1) A gradually rising tax on carbon dioxide emissions implemented at the refinery or the first point where fossil fuels enter the economy, meaning the mine, well or port, and beginning at \$40 a ton and increasing steadily over time; 2) Carbon dividends from the carbon tax would be returned to the American people on an equal and monthly basis via dividend checks, direct deposits or contributions to their individual retirement accounts; 3) Border carbon adjustments for the carbon content of both imports and exports to protect American competitiveness and punish free-riding by other nations, encouraging them to adopt carbon pricing of their own; and 4) Regulatory simplification that would eliminate regulations that are no longer necessary upon the enactment of a rising carbon tax whose longevity is secured by the popularity of dividends. Source: <https://www.clcouncil.org/our-plan/>

In addition to **Schneider Electric**, the other founding corporate members of the **Climate Leadership Council** are **BP, Exxon Mobil, General Motors, Johnson & Johnson, P&G, Shell, Santander, PepsiCo, Total**, and **Unilever**.

A **utility executive** believes “the long-term solution could be a carbon tax,” but that his company isn’t convinced that the Climate Leadership Council’s approach is the best one. “We’d like to have certainty with the right policy. We’re not terribly fond of the carbon tax policy of Secretary Baker.³⁹ You would put a tax on all of our carbon emissions rather than the marginal carbon above some level. This is great for individuals who might get a carbon dividend, but you’ll see huge increases in commercial and industrial rates.”

Research that David Miller of the **Clean Energy Venture Group** conducted for his doctorate degree concluded that, after studying different classes of policies, the superior policy option would be “a federal price on carbon across the economy.” He elaborated: “Subsidies being one class. Addressing the market was another class. Price on carbon was a third class. The price on carbon blew away the other alternatives, because it’s leveling the playing field. You get these network effects, you accelerate the success rate, the growth rate.”

“What we’d like to see is a scenario where you have a price on carbon that takes account of every step of the chain, upstream, downstream, and then we’d like to see all subsidies taken away for oil, gas, and renewable energy sources.” EXECUTIVE WITH A CLEAN ENERGY COMPANY

Because “fossil fuels have had such an advantage from government policies”, Miller said, a price on carbon is needed to allow renewable energy to compete fairly. “It works across the economy. It’s a very free market solution as well. The best low-carbon ideas win.”

Other leaders observed that a cost of carbon already exists in the economy, either through policies that favor clean energy over fossil fuels or as climate impacts such as drought, storm surges, flooding, forest fires and loss of property values accumulate expensive liabilities on balance sheets. This cost is just not formally recognized.

Stephen Harper of **Intel** said that existing public policies are a de facto price on carbon. “I say we already have a price on carbon; everything that the government does to make it more difficult to use coal is putting a price on carbon. It’s not elegant, but it still serves as a price on carbon.”

Agreeing that “carbon pricing is already here in many respects,” **CDP North America’s** Lance Pierce said that an increasing number of companies are adopting an internal price of carbon even in markets in which carbon pricing has not been mandated. “The number of companies putting an internal price on carbon to build their resiliency to price fluctuations in the outside world, to toughen their exposure to markets in which carbon might already be priced, to fund a clean energy transition within the company, is growing.”

Some are skeptical that a price on carbon can be fair or workable.

“If you look at our operations, putting a carbon tax on us makes the playing field un-level to the extent we compete with other manufacturers that are not subject to the same carbon tax,” said John Donnan of **Kaiser Aluminum**. “Beyond the direct impact of a carbon tax, we are also concerned about unintended consequences and indirect impacts of a carbon tax. We’re in markets where competition is increasing and we expect to have less ability to pass along price increases to consumers in the future as competition continues to increase and those competitors are not subject to the same regulatory environment. Over time, there is a real risk that could make our products less competitive, impact our sales and profitability and make investments in our business more difficult to justify.”

Another strong voice of skepticism came from the **California Clean Energy Fund**, whose Managing Director Danny Kennedy said he is not a big backer of a carbon price. His doubts arise from watching “the debate for two decades in Australia and elsewhere. Of course, a market signal (like that) would be smart, but

³⁹ Referring to the carbon tax approach advocated by the Climate Leadership Council, an initiative launched by former Secretaries of State James Baker and George Schultz and other Republican leaders.

we're not smart and there are massive market failures. We need to do what we know we need to do without the political mine-field of taxation.”

“A carbon tax may become very important later on,” he expanded. “I think a lot about when energy cost is close to zero. In that world, a carbon price would be important for speeding the decline of fossil fuels. I don't know if it is necessary, we just need to deploy the technology we have at scale. Of course, a price would be good, but I don't think it is politically pragmatic. I don't think a trading mechanism works that well either.”

Some contend that a carbon price alone would be insufficient and that sectoral policies are needed in tandem.

While some supporters of a carbon price envisioned that a well-crafted tax or similar pricing program would eliminate the need for other more narrow, sectoral policies—a view held by the **Climate Leadership Council**, for example—others were clear that while a price signal was necessary, it must be accompanied by regulatory activity in specific sectors to achieve the necessary greenhouse gas reductions.

“I've often heard the argument that if we have a carbon price, then we won't need all these command and control regulations and policies that are inefficient and complex,” said Kyung-Ah Park of **Goldman Sachs**. “I don't think we're going to get there solely with carbon pricing if we're trying to address the urgency of climate change. Politically you're not going to get a high enough price signal in the near-term.” Price signals also would not address certain market barriers, she said, such as “efficiency and transportation, where standards and regulations can be helpful.”

Kevin Kennedy of the **World Resources Institute** agreed, “We're going to need complimentary policies. We don't think that a price on carbon by itself will solve the climate problem. It's necessary but not sufficient.”

An **executive with a clean energy company** said he would at least trade an elimination of subsidies for all sources of energy for a comprehensive price on carbon applied comprehensively across the economy: “If we were to tear up everything as it currently exists—the tax code etc.—what we'd like to see is a scenario where you have a price on carbon that takes account of every step of the chain, upstream, downstream, and then we'd like to see all subsidies taken away for oil, gas, and renewable energy sources. That of course is very difficult given the political realities today. But if we were to design from the ground up that's what we would do.”

A number of important design and accounting questions need careful thought when crafting a carbon price approach.

Proponents of a carbon price, however, realize that getting the details of such a policy right would be challenging and likely controversial. Many found themselves using the longstanding saying, “the devil is in the details.”

Gabriel Kra of **Prelude Ventures** said he would “love to see the social and economic cost of carbon priced into our economy because it is not done,” which creates a “problem of the commons...of free riders.” However, “All of the finer details of a carbon price are important.” **Goldman Sachs's** Kyung-Ah Park said that “scope is important and many carbon pricing regimes are narrowly targeted. Carbon pricing policy can be helpful, but the devil is in the details.”

The question of fairness is a concern shared by Skiles Boyd of **DTE Energy**. Policy designers must ensure that any carbon tax or pricing program does not transfer costs from low income people to those who are better off, he said. “The devil is in the details. We want to make sure there is not a cost transfer. We want to see a reduction in emissions rather than a cash transfer from poorer households to wealthier ones.”

In terms of designing the elements of a price on carbon, the comments of David McCurdy, President and Chief Executive Officer of the **American Gas Association** were indicative of many participants: “The devil is in the details. It is hard to express an overall view because it is so difficult and there are so many assumptions made to even come up with the framework for a carbon price. It's all in the design.”

McCurdy expressed concern that “if the design is based on which party is in political control, I don’t think I’d be comfortable with that, and if it got rid of all other regulations that would be problematic too.” He added, “We’d have to have a clearing of the political landscape for us to develop a strong position on this. One way of policy is prescriptive, command-and-control such as the electrification of everything. Compared to that, a carbon tax is philosophically closer to what our industry would want to see.”

Among the design questions is what David Miller of the **Clean Energy Venture Group** calls “a very nice problem, which is what you do with the revenue? Well, maybe you use it to offset tax cuts. Maybe you rebate it back to consumers. Maybe you use it to reduce the deficit. You are lowering pollution, which has economy-wide benefits, and then you have this revenue source that could be very beneficial.”

Andrew Shapiro of the **Broadscale Group** said that while he agrees that “the one most important policy would be an appropriate price on carbon,” properly pricing carbon is a question of appropriate accounting. “To get businesses to properly account for carbon we need an accounting system that addresses the externality of carbon emissions. Across the matrix of industries, this would provide a common framework.”

Skeptical that the President and U.S. Congress could come together to design and adopt a thoughtful carbon pricing policy in the near-term, given the challenging politics, Ralph LaRossa of **PSEG Power** said that starting at the regional level may be an option.

“It’s (an as yet unreachable) dream that it would happen at the national level, so it needs to take place at the ISO⁴⁰ level. If we get PJM to implement a (carbon tax) policy and it’s not in ERCOT⁴¹, that’s not going to be fair.”

Danny Kennedy of the **California Clean Energy Fund** explained that it is this very complexity that is at the root of his opposition to a carbon tax. “The complexities of the carbon markets are huge. Carbon markets require full information in order to properly function and that is impossible,” he said. “Every tailpipe, every smoke stack needs to be monitored; the hurdles are huge.”

Calling himself an outlier in his home state of California, where the state’s carbon cap-and-trade program generates revenue from auctioning carbon pollution permits to emitters, Kennedy conceded that the program “kind of works at raising revenue, but I don’t think it does much to reduce carbon emissions. Emission reductions have happened from regulations, energy efficiency standards and the economy shifting. The history of carbon emissions reductions through carbon pricing is limited.”

B) Some prefer a cap-and-trade system, others sectoral approaches.

An **auto industry executive** said he favors a cap-and-trade system over an economy-wide carbon tax because “you want to try to put the policies in place that will have the maximum carbon reducing impacts at the lowest costs.” From the sectoral perspective of this executive, “automobiles are one of the most expensive sector to reduce emissions from and there are much more cost-effective sectors that are less expensive.”

“What system are you using to measure CO₂? Is it just transportation, or do you expand it out to the system and include generation for electricity?” he asked, citing questions that policymakers contemplating a price on carbon will need to consider. “Why not do cross-trading or sharing among sectors and industries? We haven’t gotten outside our chimneys. There are much more cost-effective sectors to reduce emissions. That’s why flexible mechanisms make sense because they reduce the overall societal cost.”

Some leaders of energy-intensive, trade-exposed industries that do business domestically and around the world call for a uniform global sectoral approach. Support for pricing carbon for many companies in this domain is contingent on how it is structured, additional regulations in play, and global considerations. Sectoral carbon pricing that is truly global makes more sense in this sector.

40 Electricity Reliability Council of Texas.

41 Independent system operator.

“It may be better to design policy around sectors, and the more global it is the more fair it is and the more it is about creating incentives and rewards, then it will be more popular with industries,” said **ArcelorMittal’s** Tom Dower. “The trade-exposed industries will always have a problem at the unilateral country level with carbon policy. For those sectors, it would be better to think about global sector agreements rather than national or regional approaches.”

Dower hailed the historic agreement negotiated by the **International Civil Aviation Organization** among government, industry and civil society representatives, announced in October 2016, to control CO₂ emissions from international aviation as an example of such a successful approach.⁴²

His colleague Alan Knight said that national pricing of carbon without global reciprocity can trigger consequences that hurt domestic production. “A unilateral tax will shift carbon production to China or another part of the world. They start by punishing you and you need to pay a penalty and then you just switch or lose out to (production) overseas.”

C) Border-adjustment fees are complex but worth considering for energy-intensive trade-exposed (EITE) industries as part of future carbon price policy.

Instituting a carbon border adjustment fee as part of a carbon price is especially appealing to the steel and aluminum industries.

Leaders from domestic energy-intensive, trade-exposed industries⁴³ such as steel and aluminum production make a case that natural financial incentives to reduce their carbon footprint over time has given them an advantage over their competitors in other countries. That advantage, the result of significant capital investments in smelters, rolling mills, on-site power plants and other components of industrial infrastructure, has led to growing interest in the establishment of a carbon border adjustment among a number of these U.S. companies.

“The trade-exposed industries will always have a problem at the unilateral country level with carbon policy. For those sectors, it would be better to think about global sector agreements rather than national or regional approaches.”

TOM DOWER, ARCELORMITTAL

“The nature of steel production is still very carbon intensive. But (U.S. steel manufacturers) recognize that their technology is world class and cleaner than a ton of steel you’d get from the developing countries,” said an **executive of an industry trade group**. “The idea of a border adjustable carbon fee is something that has a lot of appeal. Carbon is a global challenge, so an emission in China has an impact here. There should be both incentives for U.S. manufacturers and there should be costs for our competitors. I don’t think it’s the only solution, but I think it’s an equitable one.”

Tom Dower of **ArcelorMittal** said that unilateral steps by national governments—such as a national carbon tax—makes it harder for multinational companies like his to compete, and that a border adjustment tax or similar mechanism could address that dilemma in a helpful way.

“Whenever a government tries to do something about climate change, that often puts us at a competitive disadvantage. It is very hard for us to compete in places with carbon pricing, because it would tax process emissions, and we are a carbon-intensive industry,” Dower explained. “It’s very hard to get it right with globally competitive industries like steel. Perhaps a border adjustment or exemption from any carbon tax for

42 International Civil Aviation Organization. (2016). Historic agreement reached to mitigate international aviation emissions. Retrieved from <https://www.icao.int/Newsroom/Pages/Historic-agreement-reached-to-mitigate-international-aviation-emissions.aspx>

43 Energy-intensive, trade-exposed (EITE) industries are generally defined as steel, aluminum, pulp and paper, glass, brick, chemicals, cement, and foundries, and their trade associations.

exposed industries would help. But let's put the revenue into a fund that helps companies do energy efficiency upgrades that they might not be able to afford on their own."

That said, John Donnan of **Kaiser Aluminum** cautions that crafting an effective carbon border adjustment is a highly complex undertaking.

"The proposed carbon border adjustment tax 'is on our radar,'" he said. "While I've heard ideas like this, I would expect the implementation to be incredibly complex and the unintended consequences difficult to anticipate. If you're going to bring aluminum and aluminum products into the U.S., then we need (a mechanism) that equalizes the playing field. The concept sounds good on the surface, but we're competing in global markets that I would expect to make effective implementation very difficult to achieve."

Leo Gerard, International President of the **United Steelworkers**, the largest industrial union in North America, noted that a carbon border adjustment tax was included in the American Clean Energy and Security Act of 2009, also known as Waxman-Markey, which the U.S. House of Representatives approved on June 26, 2009 by a vote of 219-212. The U.S. Senate failed to bring Waxman-Markey or a comparable bill to the floor for a vote.

"We're having all our basic industries challenged and threatened by unfair foreign competitors: tires, aluminum, steel, glass," Gerard said. "The U.S. and Canada steel industry met and exceeded the Kyoto Protocol (targets) more than ten years ago. Places like South Korea, Malaysia, China, Vietnam did not. They have more carbon per unit of production, by up to three, four, five times more than the U.S. It would be to the domestic industry's advantage to have a carbon reduction tax. You shouldn't get an advantage by polluting the air."



Policy Finding 4: Climate change is an issue of global economic competitiveness for U.S. companies.

A) U.S. companies are competing in an international market which is demanding low-carbon technology.

The current void of U.S. leadership on clean energy and climate change is creating an economic void that other nations are aggressively moving into, several leaders said, and the United States is at serious risk of falling behind in the multi-trillion-dollar global market for low-carbon technologies.

“Getting the policy right is just as important as getting the technology right, and if we don’t get that right then other countries will step up and take advantage of our absence,” an executive with **an industrial manufacturer** said.

“I think the foreign markets are capitalizing on our indecisiveness and our stalled decision-making process as well as our pull-back from the Paris Accord. I think (foreign competitors) are creating domestic markets and will use that scale to export at a much lower cost than our domestic manufactures are able to achieve,” said Dan Goldman of the **Clean Energy Venture Group**. “The U.S. will lose a huge technological competitive edge if we don’t move forward with a low carbon economy.”

Goldman cited the example of the once robust domestic solar manufacturing capacity in the U.S. “That has all migrated to China now and not because of lower labor costs. And now with battery storage, we have a one-gigawatt storage facility here and China has five gigawatts. We will lose manufacturing jobs because of it. It’s not because we can’t compete—we have advanced manufacturing—it’s just the uncertainty of the market. It’s very clear that the uncertainty of the market is driving manufacturing to China.”

“I think the foreign markets are capitalizing on our indecisiveness and our stalled decision-making process as well as a pull-back on the Paris Accord. I think they are creating domestic markets and will use that scale to export at a much lower cost than our domestic manufactures are able to achieve.”

DAN GOLDMAN, CLEAN ENERGY VENTURE GROUP

Unclear policy and market signals from the U.S. can have the very real impact of discouraging capital investment from companies and investors abroad.

“For our investors and foreign multinationals, if the market is not great here they won’t bring their billions of dollars here,” the **American Wind Energy Association’s** Tom Kiernan said. “I was talking to some investors after the five-year extension of the PTC. They were moving significant investments here, upping from half a

billion dollars to \$2 billion. But now, after (the Trump administration) is rescinding the Clean Power Plan and pulling out of the Paris Accord, they are taking some of their dollars and going abroad. The market is liquid and they will take the money where they see the market as working well.”

Josh Nassar of the **United Auto Workers** said the absence of a comprehensive, far-sighted national approach to designing and manufacturing the increasingly efficient and affordable vehicles of the future puts us at a disadvantage with other more assertive countries—especially in terms of investing in a highly-trained workforce capable of working with advanced technologies.

“Where we are missing the boat as a country is that we really don’t have any planned, well thought out policies to make vehicles of the future more efficient, better, cheaper,” he said. “On public policy, there has been a big failure. We’re not seeing any real commitment from this (Trump) administration on this enhancing the U.S. workforce. Look at what other countries are doing in investing in their workforce. There is no comparison with the U.S.”

For Eric Toone at **Breakthrough Energy Ventures**, which has a global investment focus, there is a strong link between investment in the U.S. and other developed countries in basic science and technology R&D, and the number and quality of successful technology companies that take root and grow. That will matter, he says,

because developing countries are rapidly becoming enormous markets for clean energy technologies and the U.S. will be unable to compete if it slashes investments in innovation research.

“The real impact in anthropogenic carbon in the next 50 years is going to be in India and China and later in Africa. Many of the technologies deployed in those places will be developed in OECD⁴⁴ countries. The fundamental science for those technologies happens through support from public sector agencies. To the extent that those resources diminish there will be a diminution in the level of output of fundamental science and product value. To the extent that those resources shrink in the U.S., the proportion of the companies that are ready to be funded and try to make money off these new technologies will shrink. It’s just that simple. This...will have an impact on American competitiveness.”

Markets for clean tech in China, India and other emerging economies are competing with investment opportunities in the U.S.—and in the view of some, transcending the U.S. opportunities in terms of importance.

“I’d argue that what China and India do is way more important than what the U.S. is doing today,” Toone said. “The vast majority of new cars are going on roads not in the U.S.”

He asked, “At various times has the rest of the world looked to the U.S. for leadership? Absolutely. I think it would be great if the U.S. would exercise leadership, but...it is going to be a lot more important what China and

India do in this space, than just the U.S. I wish the U.S. could show the way, but what is going to matter from a deployment perspective is what happens in the developing world.”

Some believe there is danger of U.S. companies being blocked out of emerging clean energy technology markets.

“I think we may have trouble accessing these (developing) markets as China and India pursue industrial policy to target places like Southeast Asia—Indonesia, Philippines, Myanmar,” said Danny Kennedy of the **California Clean Energy Fund**. Africa and Indonesia will be two of the next biggest markets for renewable energy and highly-efficient appliances and equipment, he said. “We forget about

Indonesia for example. It doesn’t make sense to build central generators on an archipelago. Nigeria has 200 million people and is projected to grow to 300 million by 2050.”

While the U.S. market is very robust “from a capital allocation and intermediary perspective,” **Goldman Sachs** is among those that see attractive investment opportunities abroad.

“For example, we’re a big investor in India, where we’ve backed a company that has done more than two gigawatts of renewables there,” Kyung-Ah Park with **Goldman Sachs** said. “They were early in the market in India, and now with policy and competitive economics, we’ll see that continue to grow. In Japan, we’re also seeing growth in clean energy, post-Fukushima. In Europe, one of our investments has been with **Ørsted** and they have divested entirely from oil and gas and are now a global leader in off-shore wind.”

“I think we may have trouble accessing these (developing) markets as China and India pursue industrial policy to target places like Southeast Asia—Indonesia, Philippines, Myanmar. We forget about Indonesia for example. It doesn’t make sense to build central generators on an archipelago.” DANNY KENNEDY, CALIFORNIA CLEAN ENERGY FUND

44 Organization for Economic Cooperation and Development, an intergovernmental organization with 35 member countries—including the United States, Japan, most of Europe and new members like Mexico and South Korea—founded in 1961 to stimulate economic progress and world trade.

For global companies and investors, the U.S. policy landscape is but one of many to navigate.

“We have a very large and global footprint. We’re in 190 countries and we’ve been in China since the 1970s and India since the 1960s. Many partnerships and joint ventures,” said Brian Mormino of engine manufacturer **Cummins**. “There are some countries that don’t have any emissions requirements and others that have very stringent requirements. China, India, Brazil, Mexico and others are all developing more stringent standards right now.”

Schneider Electric, headquartered in France but with significant operations in Asia, the U.S. and elsewhere, is a similar global company that must be attuned to the policies and business cultures of many different nations.

“Working in a company not (headquartered) in the U.S., we’re answering questions from 140 other countries,” said Kevin Self of **Schneider Electric**. “We can’t allow the occasional adverse policies of one country affect our overall outlook. We see solving this problem from a global basis, rather than a country-by-country basis. We can leapfrog in much of the world, such as in Africa and Southeast Asia, to better, smarter technologies and we’re helping them get there. So, we’re really thinking globally here.”

An executive with a **major industrial manufacturer** said, “There is a tremendous convergence of policies around the world. Different regulatory structures but the same technologies. Technologies are ubiquitous. Every country is looking at a new world order of smart mobility. The U.S. is not a quick innovator; other countries are better innovators. Look at EV technology. China can move more quickly (on something like autonomous vehicles).”

B) In a carbon-constrained world, trade rules can help or hurt U.S. companies competing globally.

Trade agreements with strong environmental standards can help U.S. industry and reduce CO₂ emissions.

The U.S. aluminum and steel industries say that their decades-long efforts to improve the energy efficiency and reduce the greenhouse gas footprint of their carbon-intensive companies positions them well to compete internationally in an increasingly carbon-constrained world.

Those efforts to reduce energy consumption and greenhouse gas emissions were inspired by the constant pressure to reduce costs in order to compete internationally in a trade-exposed sector and the requirements of U.S. environmental statutes that they reduce pollution from their industrial activities. However, that positive performance can become an impediment, U.S. industry leaders say, when they are competing against countries such as China that do not have comparably tough environmental laws.

“One of the challenges our industry is facing relates to the fact that aluminum is a global industry and it is a global market,” Heidi Brock, President and Chief Executive Officer of the **Aluminum Association** said. “When other companies in other countries don’t have the same environmental stringency as the U.S. then we have competitive issues and we’re being penalized in the market. The Chinese aluminum industry would be the 16th largest emitter of greenhouse gas emissions if it was

its own country, and it has been allowed to expand in an unregulated way. It’s not a level playing field, from both a trade and environmental regulatory sense.”

Brock said that her trade organization has been making the case that China’s government should be directing its indigenous industry to decarbonize aluminum production. “We are more trade facing, and we don’t look

“The lens we view everything through is the trade question—how any carbon constraint regime is going to tilt the competitive playing field for the industry. There might be one or two that are close to us, but we are the most energy efficient, carbon efficient steel industry in the world.” TOM GIBSON, AMERICAN IRON & STEEL INSTITUTE

at policies from just a U.S. perspective.” she said. “We’re asking for a negotiated government-to-government agreement with China to reduce their (aluminum production) overcapacity and there might be a chance to insert carbon measures there to address Chinese pollution issues. Until we have something that is enforceable with China, then we don’t have a level playing field.”

“The lens we view everything through is the trade question—how any carbon constraint regime is going to tilt the competitive playing field for the industry,” said Tom Gibson, President and Chief Executive Officer of the **Iron & Steel Institute**, an industry trade group with 21 member companies, including **Nucor**, **ArcelorMittal USA** and the **United States Steel Corporation**.⁴⁵ “There might be one or two that are close to us, but we are the most energy efficient, carbon efficient steel industry in the world. We are the benchmark around the world and companies have done that to stay competitive. Energy is a very large component of winning in a competitive world of steel.”

As a consequence, he said, “The carbon issue will always start with a trade overlay for us. Carbon constraints are trade constraints.”

Several leaders from energy-intensive, trade-exposed companies expressed concern that poorly-crafted policies, in their minds, that do not take into account the carbon-reduction progress of U.S. industrial companies risks making them less competitive globally. That would yield the world economic stage to commodity metals and other industrial materials produced with larger carbon footprints.

“There are groups that (advocate for) reducing carbon without thinking how this will impact industry and leakage,” John Donnan from **Kaiser Aluminum** said. “This is a challenge for manufacturers, particularly manufacturers like Kaiser that compete domestically and

globally. We’re trying to operate a global business, and it’s hard to make decisions without long-term certainty, and frankly, it seems like there can often be a lack of pragmatism and rationality when defining objectives and policies, which is to reduce overall emissions.”

Donnan said that in weighing in on government regulations on climate pollution, Kaiser seeks a level playing field, and if they can secure that, they will succeed. “We believe that our operations are efficient, have a smaller carbon footprint, and that our people can compete with anyone in the world. When we have inconsistency in state and federal regulations, we can become less competitive, domestically and also internationally.”

He expanded on his point: “We are confident our products will be made. We believe they should be made the U.S. and by us in the states where we operate including Washington (state). If our products are not made here there is a very good chance they will be made in China or other places with less regulation and manufacturers with larger carbon footprints.”

Leo Gerard of the **United Steelworkers** observed that the steel manufacturing process cannot escape carbon emissions. “You can’t make steel without making carbon. But you can make steel in a way that manages the carbon and carbon reductions. This is the same issue in all basic industries. Even with wind farms, they require lots of steel, coal, and fossil fuels to produce, make, and ship. We have to utilize lots of energy and carbon.”

Asia is a growing market for U.S. coal.

As domestic demand for American-mined coal has declined along with the closure of coal-fired power plants in the U.S., one coal industry leader pointed out that Asia has emerged as a voracious customer for U.S. coal, and that much of that coal is being burned in power plants with state-of-the-art efficiency and pollution controls.

“We believe that our operations are efficient, have a smaller carbon footprint, and that our people can compete with anyone in the world. When we have inconsistency in state and federal regulations, we can become less competitive, domestically and also internationally.” JOHN DONNAN, KAISER ALUMINUM

45 For full list of AI&SI’s member companies, see: <http://www.steel.org/about-aisi/members.aspx>

“Internationally, we’re seeing what the International Energy Agency says: a lot of coal being burned in modern plants,” said Colin Marshall of **Cloud Peak Energy**. “They need the power and will deal with the climate question second.” Transporting domestic coal through West Coast ports “is almost impossible” because of local opposition to building those export facilities, he said. As a consequence, “We currently plan to export about five million tons per year through British Columbia to Asian nations such as South Korea, Japan, and Taiwan.”

Specific concerns about the new solar trade tariff being implemented by the Trump administration.

A number of leaders from the renewable energy and investment sectors were opposed to the steep tariff on imports of solar energy cells announced by the Trump administration on January 22, 2018, and said that the President’s decision to go ahead with the tariffs will slow down the deployment of solar energy in the U.S. while providing scant benefit to American solar cell manufacturers. As announced, those tariffs will be in place for the next four years, with the first-year tariff starting at 30 percent and falling to 15 percent in the fourth year. The tariff directive exempts the first 2.5 gigawatts of imported solar panels cells each year.⁴⁶

The administration was responding to a trade complaint filed with the International Trade Commission (ITC) by **Suniva**, a Georgia-based manufacturer of photovoltaic solar cells and modules, and later joined on the petition by Oregon-based **SolarWorld**, the largest U.S. manufacturer of solar panels. The ITC determined there was validity to the claim that solar imports were hurting domestic production and made a number of recommendations for addressing the situation, including the possibility of the U.S. instituting tariffs.

One American solar company was unequivocal that the new tariffs would harm its business and the broader domestic solar industry, which has been expanding dramatically over the past decade, adding thousands of new American jobs, expanding the tax base and diversifying the energy economy. “The tariff...would absolutely be an impediment to our business,” said Gregg Felton of **Altus Power America**. “One of the things that makes solar work is that the costs of the modules have come down so substantially. Putting a big tariff on solar modules would be an impediment to increased deployment.”

“Yes, it might be nice to have some of these solar module manufacturing jobs here in the US, but a lot of other jobs in the solar sector will be threatened by these tariffs,” Felton said.

Bill Weil of **Tempest Advisors** said the tariffs “will have a massive negative impact on the bottom line for any solar developer in the U.S. and it won’t materially help any domestic solar manufacturer.”

Julia Hamm, President and Chief Executive Officer of the **Smart Electric Power Alliance**, an organization whose more than 1,000 members include **Appalachian Power Co., El Paso Electric Co., Florida Power & Light, Bonneville Power Administration, Dominion Virginia Power** and **Southern California Edison**, said that while the tariffs may potentially slow down the momentum of solar market development, “this would be a temporary effect and would slow down rather than stop the momentum.”

Gregg Felton of **Altus Power America** was also optimistic that “regardless of policy, we don’t think the Trump administration will dramatically slow down the development of solar.” That was because, in part, the uncertainty of whether the administration would proceed with tariffs is over and the “clarity, even with this adverse change” of the new policy will allow the solar industry “to plan around this new environment.”

The solar tariffs found favor with at least one respondent.

One **executive with an industry trade group** supported the imposition of solar tariffs because “a big miss is that if we’re greenlighting large scale renewable projects these should be made in America. Having a domestic manufacturing presence is key.”

⁴⁶ Office of the United States Trade Representative. Section 201 cases: Imported large residential washing machines and imported solar cells and modules. (Fact Sheet). Executive Office of the President. Retrieved from <https://ustr.gov/sites/default/files/files/Press/fs/201%20Cases%20Fact%20Sheet.pdf>

C) Leaders are concerned that Trump administration policies will weaken U.S. standing globally and sacrifice competitive edge to China, India and the European Union.

Failure of U.S. leadership gives China and other nations a big edge.

To a number of economic leaders, China stands out as a competitor nation that is developing clearer and more effective policies and public investments, spurring clean technology innovation and exporting those technologies around the world. Unless the United States sharpens up its approach to this rapidly growing economic sector, it is at great risk in both the near- and long-term to lose this market to the Chinese and other countries, they said.

“We’re the biggest economy in the world. We want to build things here. We need a major push from our government. We should be driving this, not sitting back and waiting for China, India, and Europe to develop and deploy new technologies first and move economies of scale. This is true across the board: rail, shipping, all of it.”

LEO GERARD, UNITED STEELWORKERS

“China is investing so much into their domestic solar sector and this makes it difficult to compete here,” Leo Gerard of the **United Steelworkers** said. “We’re seeing lots of other countries moving faster than us. We’re behind in investment and research. Our labs aren’t positioned to help us dominate in energy.

“We’re the biggest economy in the world. We want to build things here,” Gerard continued. “We need a major push from our government. We should be driving this, not sitting back and waiting for China, India, and Europe to develop and deploy new technologies first and move economies of scale. This is true across the board: rail, shipping, all of it.”

Danny Kennedy of the **California Clean Energy Fund** at the time of our interview had recently returned from a trip to China, and he said the difference between the Chinese government’s bullish approach to clean energy and the current U.S. administration was dramatic.

“In President Xi’s speech to the National People’s Congress, he didn’t say anything about fossil fuels,” Kennedy said. “He mentioned wind, solar, energy storage, climate action. The Chinese are very clear on this. This signal is good for investment. They’re about to ban the internal combustion engine, for example. China will triple their solar PV targets in this (new) Five Year Plan and they will probably exceed this.”

He said that unless the U.S. steps up, “China will leave us in the dust as a result of these four years. Lots of technology that was largely created in America will be captured by China’s manufacturing base at scale in ways that we won’t be able to catch up. They’ll take automobile manufacturing, as they’ve already taken wind and solar manufacturing from the rest of the world. The U.S. will suffer from lack of leadership.”

One technology area in which there is still a chance for the U.S. to compete for leadership is advancing development and manufacturing of electric batteries.

“The Gigafactory will massively increase the global supply of batteries over the next five to ten years,” said Ben Foss of **Volta Charging**, referring to a new manufacturing facility for electric vehicle batteries **Tesla** is building in phases in Sparks, Nevada after breaking ground in June 2014.⁴⁷ “This is a sea change. Just watch the price of batteries. We’re in a technology race. Ten years from now, it is likely that federal fuel standards won’t matter merely due to the saturation of the EVs.”

California Clean Energy Fund’s Danny Kennedy expanded on that point: “The Gigafactory is just the beginning. We could make America great again through battery technology. We’d probably need 20 giga factories across the automobile supply chain in order to keep up with conservative estimates of EV growth.”

To achieve such an ambition, Kennedy said a technology and workforce development plan is underway, inspired partly because of a situation highlighted when the Giga Factory in Reno, Nevada “had to import Japanese workers because of a lack of skilled, domestic workers.”

⁴⁷ See <https://www.tesla.com/gigafactory>

“Missing this opportunity is a huge blunder. We’ll be importing batteries from China and shipping them across to be installed on the U.S. grid. At this point of technology inflection, we’ve just taken a step off while everyone else in the world has started to step on.”

“Massive investments from China are dwarfing us,” Graham Richard, formerly of **Advanced Energy Economy** said. “Trump’s policies are going to undermine our competitive policy for decades and generations to come. We have given up our competitive edge. Companies are going to Canada, China to get their money. The U.S. is going to fall behind.”

Our position as a global leader in innovation is at risk.

A number of respondents were concerned that proposed budget cuts by the Trump administration, especially in the areas of basic science and technology research and development, would result in the U.S. yielding competitive ground to other countries.

“The Trump administration’s (proposed budget cuts are) putting at risk government’s role as a funder of innovation,” Peter Rothstein of the **Northeast Clean Energy Council** said. “That is a huge concern for early stage investors and entrepreneurs. It has called into question whether the new innovations that are needed over the next several decades to fully decarbonize electricity while electrifying most of transportation and buildings will be new technologies invented, commercialized and brought to global markets by the U.S. or by other countries.”

The **Nuclear Energy Institute**, which advocates for resources to assist the U.S. nuclear energy industry to be viable domestically and competitive for international contracts to construct reactors abroad, was concerned when the Trump administration’s first proposed federal budget cut the Department of Energy’s Office of Nuclear Energy Budget deeply.

“China will leave us in the dust as a result of these four years. Lots of technology that was largely created in America will be captured by China’s manufacturing base at scale in ways that we won’t be able to catch up.”

DANNY KENNEDY, CALIFORNIA CLEAN ENERGY FUND

“The administration’s Fiscal Year 2018 budget for DOE nuclear was a step backward,” John Kotek, Vice President for Policy Development and Public Affairs at the **Nuclear Energy Institute** said. “Fortunately, the House and Senate bills largely fixed the damage.⁴⁸ We hear that the FY 2019 request will be much stronger. We’re talking *Mission Innovation* numbers for the nuclear program.⁴⁹ They realize their FY 2018 budget was a mistake and there is reason for optimism, but the ink is not dry.”

Robust funding levels for nuclear energy R&D are important, he said, because “lots of developers are depending on federal government capacity being there to support project

development if they choose to do so in the near future,” Kotek explained.

Similarly, in the domain of public research on carbon capture, utilization and storage (CCUS) technologies, Colin Marshall of **Cloud Peak Energy** applauded that the administration’s FY 2019 budget “includes some increased funding for fossil fuel research over the FY 2018 request.”

“That said, funding for large-scale pilot and demonstration projects, in addition to early stage research, is needed to get sensible CCUS projects going.”

48 The Fiscal Year 2018 omnibus appropriations bill approved by the Congress and signed by the President in March 2018 included increased funds for the U.S. Department of Energy’s Nuclear Energy Program that were 71 percent above the Trump administration’s FY18 budget request and 19 percent above Fiscal Year 2017’s enacted appropriations.

49 Mission Innovation is an initiative of the leaders of 20 nations plus the European Union that committed each participating country to doubling public investment in clean energy research and development over five years. It was launched on November 30, 2015 in Paris on the first day of the United Nations Conference of the Parties annual climate change meeting that led to the adoption of the Paris Climate Agreement.



Policy Finding 5: Initiating the U.S. exit from the Paris Agreement on climate change is a mistake that puts U.S. business at a global competitive disadvantage.

A) In interviews, support from the private sector leaders for staying in the Paris Agreement is nearly universal.

With only a single (off the record) exception, all of the economic leaders who remarked in their interviews about the Trump administration's actions to withdraw the United States from the Paris Climate Agreement stated disapproval with that decision.

The Paris Climate Agreement was adopted on December 12, 2015 at the 25th Conference of the Parties to the United Nations Framework Convention on Climate Change in Paris, France. All but a small handful of countries at the time committed to individual commitments to reduce the greenhouse gas emissions of their nation—known as Nationally Determined Contributions or NDCs—by the year 2025 or 2030. The Paris

Agreement entered into force on November 4, 2016, when, according to the Framework Convention's rules, at least 55 countries, accounting for at least 55 percent of the world's total greenhouse gas emissions, ratified the agreement. To date, 175 of the 197 parties to the Framework Convention have done so.

President Trump announced on June 1, 2017 that his administration will begin the process of withdrawing the U.S. from the agreement—which, if that ultimately happens, will make the U.S. the only country in the world that is not part of the agreement, after Syria and Nicaragua decided to join the agreement late last year. Article 28 of the Paris Agreement prohibits signatory countries from withdrawing until four years after the agreement came into force.

“I’m on the record saying we should stay in the Paris climate accord and have a seat at the table to change what the previous administration attempted to implement as part of its anti-fossil fuel agenda.... I got criticized for it by some in the industry for my view on the Paris accord, (but) I believe it’s better to be inside the deal than outside and being ostracized.” COLIN MARSHALL OF CLOUD PEAK ENERGY

Leaders of companies from **Cummins** to **Cloud Peak Energy** opposed the announced withdrawal of the U.S. Even those who would have preferred the agreement was drawn up differently, at least in some of its provisions, said they felt that it was important that the U.S. remain part of the agreement as a member of the international community and a major carbon emitter.

“We are strongly pro-Paris Agreement,” Stephen Harper of **Intel** said. “We think all the work that was done by lots of folks...to get the U.S. and China to sign a bilateral agreement and the momentum that created for the Paris Accord, it is far from perfect, but it’s the first time that anyone has established a workable framework that over time leads to more ambition. Hopefully the U.S. won’t formally withdraw.”

Dave McCurdy of the **American Gas Association**, was emphatic: “It was a mistake to withdraw from the Paris climate agreement even though we didn’t agree with everything in that agreement.”

Mars Hanna, Senior Lead for Global Energy Policy and Markets at **Google**, said that his company has consistently supported strong international action to address climate change, “particularly in the years leading up to and including the 2015 Paris Agreement.” Google’s view is that “the agreement is a guiding force, a North Star that creates an important framework for countries to collectively address this global challenge. As our CEO Sundar Pichai expressed, we were very disappointed with the administration’s decision to begin initiating withdrawal or renegotiation of the Agreement,” Hanna said.

A number of leaders said they are not hearing disagreement from colleagues across the economy. “I haven’t seen a single CEO or C-suite executive who feels good about or privately supports leaving the Paris Agreement or supports any of the Trump administration’s efforts to slow down decarbonization,” said

Graham Richard, formerly of **Advanced Energy Economy**. “I’ve yet to find an executive who says ‘we agree with what Trump is doing.’”

Even those leaders who are concerned about excessive regulation on fossil fuels argue that it is better for the United States to be at the international table than not. “I’m on the record saying we should stay in the Paris climate accord and have a seat at the table to change what the previous administration attempted to implement as part of its anti-fossil fuel agenda,” said Colin Marshall of **Cloud Peak Energy**.

“It’s quite clear that a lot is going to happen with national commitments. A lot of countries won’t be able to meet their commitments. But it would be much better to be at the table, rather than being on the outside. The rest of the world is waiting for this current administration to leave and other countries will gladly welcome the U.S. back in with a new administration. I got criticized for it by some in the industry for my view on the Paris accord, (but) I believe it’s better to be inside the deal than outside and being ostracized.”

Much of the concern about U.S. withdrawal comes from the belief that the U.S. is emerging as an international leader in the invention, design and manufacture of zero- and low-carbon technology and approaches, and withdrawal from the agreement will impede the country’s ability to compete against other nations in exporting these goods and services into the rapidly growing clean technology global market. These leaders also feel that the advances the U.S. has made over the past decade in reducing our country’s greenhouse gas emissions and the growth of a domestic clean energy sector makes it likely that the U.S. will meet its NDC commitment under the Paris Agreement.

“The withdrawal from the Paris Agreement shows such a tremendous lack of leadership, especially when we’re making a lot of technological progress where the private sector is an active partner in this,” an **executive of an industry trade group** said. “This was a stunning retreat. Technology in the private sector will continue to do what it does. I think this is a real missed opportunity and doesn’t get at the challenges faced by US manufacturing.”

DTE Energy’s Skiles Boyd said, “As a company, we did not think that withdrawal from the Paris Agreement was the best way to go. It’s amazing why the country would pull out of something that we could have probably easily achieved.”

Global companies with significant business in the U.S. and other countries around the world say the announced U.S. withdrawal from the Paris Agreement only creates troubling uncertainty for them, with little benefit.

“Pulling out of Paris and giving signals that we’re undoing climate policies may feel good to some in the short term, but as a global company that has to deal with these issues, it creates a terrible amount of uncertainty,” Tom Dower of **ArcelorMittal**, said. “It raises the likelihood that the next president will not just swing the pendulum back in the other direction but rather throw it back to make up for ‘lost time’. If that happens too fast we won’t have time to develop new technologies. If these policies are known well in advance and we know they’re coming, that gives us the incentive to invest in new technologies. We can plan for it.”

As sub-national actors such as companies, states and cities have stepped up carbon reduction commitments in the wake of the Trump administration’s withdrawal announcement—as reflected by the *We Are Still In* initiative⁵⁰—Stephen Harper of **Intel** offered a creative idea to turn those carbon reduction commitments into something even more concrete and influential. “I would love to see some serious thinking about practical ways to turn the *We Are Still In* movement into new carbon reductions, and see if that could be turned into a nominal NDC⁵¹ with an auditor to keep us honest. That might be a good way to turn a bad situation into a better situation.”

“I think you would be able to create some real competition in the industrial sectors. I think you could create competition that would be a real powerful driver of emissions reductions.”

50 See <https://www.wearestillin.com/us-action-climate-change-irreversible>

51 Nationally Determined Contribution, the individual national greenhouse gas emission reduction commitments of the signatories to the Paris Climate Agreement.



Policy Finding 6: Change in the electricity sector is happening fast and policy must keep pace.

A) To survive and flourish, utilities must evolve, adapt and innovate.

The leaders of the utility sector interviewed for this research, along with other stakeholders who affect or are affected by this sector, universally agreed that the U.S. electricity market is undergoing significant disruptive changes in terms of their business model, generation sources, relationships with customers, and technologies. Respondents agreed that these changes are coming fast and that traditional distribution utilities in particular are faced with myriad decisions about how to adjust their approaches to flourish in the emerging electricity markets.

“We’re talking to utilities that are not considered leaders on this but they’re saying that the world is changing and they need to change as well in order to stay alive.” KEVIN SELF, SCHNEIDER ELECTRIC

Relevant public policies, they said, must also get ahead of those changes to ensure that electricity providers can continue to provide reliability, security, safety, resilience and affordability at the same time they reduce greenhouse gas emissions from power generation. Their emphasis upon the significance of the changes often depended upon where the interviewee sat in the electricity sector value chain. The specific changes cited included the movement away from centrally planned distribution utilities to more dispersed generation, changes tied to growing mandates for clean energy, the digital and smart system

transformation that is reaching into customers’ homes or businesses, the specifics of regulation and the opportunities and challenges involving the grid.

“We’re talking to utilities that are not considered leaders on this but they’re saying that the world is changing and they need to change as well in order to stay alive,” said Kevin Self of **Schneider Electric**. “If I were a betting man I’d say that the traditional electric business model would be on the losing side if they don’t evolve.”

Julia Hamm of the **Smart Electric Power Alliance**, whose organization promotes distributed clean energy and grid modernization by making connections among technology, customer engagement, strategy and planning, said that designing regulation to foster accelerated innovation is an essential element for future success in the electricity generation and distribution industries.

“We are thinking about the long term strategic models that will serve electric utilities and third parties, how the electric power grid is regulated in order to speed up the time necessary for innovation,” Hamm remarked. “We would like to foster a culture of innovation, speed up the time it takes to innovate. The regulatory structure has constrained innovation to a large degree.”

Kevin Leahy, Managing Director of Energy and Environmental Policy at **Duke Energy**, offered an example of two dilemmas related to managing wholesale power prices that has emerged from the successful introduction of wind and solar energy in these early stages of the transition to a low-carbon electricity sector.

“We are going to have some days where the wind is blowing and it’s sunny and all our energy needs are met by renewables, so wholesale power prices will collapse to zero,” he said. “But in those instances, baseload power plants like nuclear or geo-thermal or concentrated solar plants won’t be getting any returns and they are zero emitting too. So, they become less economical and can be pushed to retire if this happens a lot. At low renewables percentages, this doesn’t matter so much, but if standards push renewables more and more, there will be more and more days where they meet the entire energy demand—this happens long before you’ve driven all the emissions out of the energy system.”

Those low wholesale power prices erode incentives for utilities to assertively push energy efficiency within their service areas as well, he said. “The energy you conserve has to be more valuable than the investment you’re making in efficiency. So, the incentive to invest in energy efficiency is lower when wholesale energy prices are lower. If you’re in a world where renewables are entering the system to meet a high mandate then they can end up working against more investments in energy efficiency.”

Regulatory approaches and public policies are needed to manage those new challenges in a way that does not slow down or derail the decarbonization of the electricity sector, he said. For example, an economy-wide price on carbon, would not produce “these sorts of problems.”

In the “utility of the future,” customers will want more options and control of their energy choices.

Meanwhile, Hamm noted that the growing customer interest in clean energy providing the electricity flowing into their homes and businesses, along with the proliferation of information and control technology, is giving power customers more capabilities and leading them to insist on more choice.

“(W)e need to do more for...how changing customer expectations plays into the equation—not only their desire for clean energy, but also with all the technological changes, customers have changing expectations of what they can control with their smart phones,” Hamm said. Utilities on the vanguard are getting to work, she said. “Some utilities now have these whole teams of people, whose functional name is ‘sales operations’. But really what they are doing is preparing all these programs and partnerships that really move the utility into the home, beyond the meter. They will be looking to really turn over what is inside the home that benefits both the customer and the utility.”

First among the choice options, people who track consumer priorities said, is choice of energy supply, especially the capability to access clean energy. In the words of Abe Silverman of **NRG**, “Every consumer in the country should have the right to purchase clean energy from the supplier of their choice. Many of today’s regulations protect antiquated notions of what a utility is. Most of these policies were established over 50 years ago.”

Utilities are investing heavily in smart meters and sensors, leading to innovative approaches such as time-of-use rates that can give price signals and reduce demand.

One of the major changes in terms of survival and adaptation for the utility industry, as with other sectors of the economy, is the ability to collect, analyze and utilize data related to use of electricity by residential, business, institutional and industrial customers—including consumption patterns throughout the day and night. One promise of the proliferation of smart meters, sensors across the electricity grid, and data analytical capacity is that this emerging real-time information infrastructure will enable utilities and their regulators to better manage supply and demand in a way that contributes to reducing greenhouse gas emissions.

For example, a more sophisticated understanding of high- and low-demand periods that smart meters provide is informing, in some states, the design of time-of-use rate pricing for electricity. That, in turn, coupled with outreach and education, can incentivize optimized appliance use (e.g. dishwashers, clothes washing machines, and clothes dryers) during low-demand time periods that are priced low accordingly. And customers who permit two-way interactions facilitated by the internet can allow the utility to turn those appliances on remotely at the lowest-cost times.

“We are thinking about the long term strategic models that will serve electric utilities and third parties. We would like to foster a culture of innovation, speed up the time it takes to innovate. The regulatory structure has constrained innovation to a large degree.” JULIA HAMM, SMART ELECTRIC POWER ALLIANCE

To Alex Laskey, formerly of **Opower**, the long-anticipated transition to time-differentiated prices for electricity makes this an exciting moment. He recalls attending the Consumer Electronics Show in January 2001 in Las Vegas, and hearing that “they were saying we would all live in smart homes. We will have smart refrigerators and dishwashers etc. It’s nearly 17 years later

and nobody has a refrigerator that tells them when they are out of milk. So it’s been in the works for a long time that we will all have smart homes. But I think that will change when there are substantial and significant price incentives to use different energy at different times of the day and different times of the year.”

Laskey said that California is on the vanguard of time-of-use rate pricing. “In California in 2019 every customer will be moved to time and use rate pricing. The savings are on the order of \$60 billion a year if we moved all customers to time-varied pricing. I think these kinds of savings would dwarf energy efficient incentives in place today.”

Manufacturers who equip appliances with software that allows them to automatically take advantage of real-time pricing would open up new markets for their products. “All of the sudden maybe now the cost of replacing a broken hot water heater, the economics change—there are people knocking on your door trying to replace your hot water heater because there is a business case to be made,” Laskey said.

Energy-thirsty pool pumps, abundant in California and across the warmer swaths of the country, is another example, Laskey said. “I can imagine in southern California and other parts of the country pool pumps are a pretty large use of energy for customers and there are more efficient pumps out there...but the replacement cost is too high. But as soon as you have a pool pump that only pumps when savings are high maybe there is an interesting business model for replacing old pool pumps with newer, cost-saving pumps.”

The proliferation of electricity usage data does not automatically translate into superior demand management performance, however, since many utilities do not yet have the capacity to leverage big data and communicate effectively with their customers about that data.

“The American Recovery and Reinvestment Act bought smart meters but didn’t build out the back-office systems to put the data to use. (Utilities) are already behind in digital transformation,” said Janet Besser of the **Northeast Clean Energy Council**, which works closely with utilities and their corporate customers.

A number of utility leaders acknowledge this situation, while pointing to the many complexities related to big data: customer concerns about secure and confidential handling of their usage information, government and utility regulation, the need to build systems to appropriately manage the data and resulting analysis.

“We have had the smart meters a number of years before I came to **PG&E**...but it takes a while to figure out how to use the data,” said Nick Stavropolous of **PG&E**. “The (California Public Services Commission) approved the investment, we made the investment. We are really starting to use this information to make better decisions.”

Customers concerns about privacy and state law require careful handling of the data, he added. “In California law, the same way it was in Massachusetts (and other states), the customer data is proprietary and should only be shared when people give permission. We are following the rules and regulations regarding the sharing of that information. So it’s not widely distributed.”

Gabriel Kra of **Prelude Ventures** said this new challenge of effectively utilizing collected data extends to the manufacturing industry. “The modern manufacturing and production environment has lots of physical assets...and most of these assets are highly sensed. Companies have sensors on and data flowing from virtually every piece of machinery,” he said. “Big companies are good at getting data on the performance of these machines, but they don’t know...how to make decisions with that data.”

B) For utilities, the expectation that they provide for reliability, security, safety, resilience and affordability can compete with the need to reduce greenhouse gas emissions.

The traditional compact in which utilities provide electricity that is reliable, safe and efficient in return for a regulated rate of return remains the basis of regulation in the electricity sector. As new regulatory mandates or expectations come into force, especially related to greenhouse gas and other pollutant reduction (e.g. mercury and other air toxics, soot-forming particulates, smog-forming ground-level ozone), and increasing

amounts of renewable energy entered the electricity supply, leaders of utilities who still function under established rules say they must balance the newer environmental demands with the age-old priorities of reliability, security, safety, resilience and affordability.

“We really talk about multiple goals that we’re trying address at the same time,” said Nick Stavropoulos of **PG&E**. “Safety is the first and foremost concern for the over 5.5 million customers we serve here in California. It’s what they expect us to do. Reliability of our networks is critical. The affordability is critical. We need to provide those services...while reducing our carbon footprint and helping the state achieve its carbon goals over the foreseeable future. We have been able to do that and achieve those objectives.”

Keeping an eye on the affordability of electricity for homeowners and businesses is key to maintaining support for carbon reduction policies.

For incumbent utilities, restraining cost hikes for their customers are an important part of the regulatory compact, and dealing with new mandates that will increase costs often creates a dilemma for these traditional power companies. In a regulated environment, most cost increases get passed along to the customer, so the utility as the “cost watch dog” is sensitive to raising its rates. Moreover, lower energy costs have often been a boon to economic development. Even though utilities have the advantage of socializing their costs over a larger customer base, utility leaders said they remain reticent about incurring costs that raise rates, especially for those customers who can least afford them.

“Our company starts everything with the customer in mind. When we look at our fuel mix, our infrastructure investment and our support for any policy issues, it all starts with the customer and what the customer can afford,” said Ralph LaRossa of **PSEG Power**. “Historically, you can come up with a fair percentage of disposable income that the consumer is willing to spend for utility services. We look at that and we think we could go 100 percent carbon-free tomorrow, but there would be an extreme cost to this. What can a consumer’s pocketbook afford?”

Skiles Boyd of **DTE Energy** described a similar mindset in his utility. “We think about what is best for our customers, whether those policies are driving things that are going to hurt our customers. If they can’t deal with them financially, then that’s bad.”

“Safety is the first and foremost concern for the over 5.5 million customers we serve here in California. Reliability of our networks is critical. The affordability is critical. We need to provide those services...while reducing our carbon footprint and helping the state achieve its carbon goals over the foreseeable future.” NICK STAVROPOULOS, PG&E

Clean energy policies are moving in the right direction, Boyd said, but it is important to keep an eye on pacing and cost to retain customer support. “One thing that sets us back is that if people try to drive it way too fast and you get cost increases, then people will come to resist these changes. The details are important. We want to move people in the right direction without scaring people off.”

PG&E’s Nick Stavropoulos said he thinks the affordability issue is going to become even more important. “I think we are generally lucky the economy is reasonably healthy. If something were to happen to change that, then the affordability piece would move up and go to the front burner and we need to be aware of that.”

Another **executive from a regulated utility** said a successful navigating of decarbonization strategies and cost management can be successful. “Whatever we do has to be both cost effective and approved by regulators. Any investment has to be useful and prudent. We think we’ll prosper by a policy set that is efficient and that doesn’t (lead to) step-changes in costs for our customer (that) prevents any dramatic economic changes.”

Beware policies that have low- to moderate-income people subsidizing the affluent (i.e. cross subsidization).

New approaches to promoting low-carbon technologies and reducing carbon emissions, such as net metering laws, community choice aggregation and electric vehicle tax credits, are giving rise to concerns by some executives about cross subsidization, with the more affluent who choose to purchase clean energy technology benefiting from rate and tax benefits that the less affluent are less likely to be able to take advantage of.

So-called net metering laws that have been widely adopted by states across the country are held up as one area in which cross-subsidization commonly occurs. Such laws allow residential and commercial customers who generate their own electricity from distributed solar, wind or geothermal to sell the portion of electricity they do not need back to their host utility. As the home meter runs backwards, the customer receives a credit for the electricity that is in excess of that consumed on the premises.

Thirty-eight states plus the District of Columbia have net metering laws, with another seven states employing a statewide distributed generation compensation structure of some kind.⁵²

From the perspective of some utility leaders, net metering customers impose costs on a system built to serve on a centralized basis and customers who do not participate in the net metering benefit are essentially subsidizing those who do.

“One of the big challenges we have is this impasse on net-metering,” said an **executive with an electric and natural gas utility** with customers in multiple states. “Net-metering is a subsidy and you can’t ignore that

fact. It’s a huge subsidy for solar homeowners. We can provide customers with cheaper solar, but we need to make sure we get the pricing right for the customer. We want to put the money into the most cost-effective carbon reduction technology. You can’t put non-participating customers into the same box as participating.”

“We need to figure out how to take this cross-subsidization issue on because it can’t continue to grow,” said Nick Stavropolous of **PG&E**. “We need to have an adult conversation of how to phase out this cross subsidization and stop it from getting bigger.”

“This is the double-edged sword we are dealing with. For all the right reasons, the rate structure that California adopted for customers that adopted rooftop solar is based upon this net energy metering approach,” he said. “Based on all the analysis, we clearly believe the non-rooftop solar customers are subsidizing the solar customers. (B)ecause so many (solar panels) are being adopted, we are approaching a half billion dollars annually of cross-subsidization and it’s the low-income people that are subsidizing the high-income people.”

An **investor** had this counter view: “I’m hard pressed to see how private capital to build solar is a transfer from the rich to the poor. I disagree with the conclusion that net metering is bad. You’re either being paid for your energy or you’re offsetting some costs to the grid. You’re decreasing the denominator over who is paying for the fixed cost of the grid. I love utility death spiral arguments, but they’re overblown.” He said the answer to this situation is “to move to smarter policy: Time of use rates.”

Another phenomenon which has led Stavropolous to be concerned about cross-subsidization is the growth of Community Choice Aggregations (CCA). Also known as municipal aggregation, a CCA is a form of group purchasing by local communities in which the buying power of individual customers is aggregated and then leveraged to secure alternative energy supply contracts or lower costs (or both) from centralized power generators. A small group of states, including Massachusetts, Ohio, California, Illinois, New York and New Jersey, allow CCAs.

“The social equity question is important. Can we enable more democratization of these clean technologies to underserved markets? How can we address the social equity issues for those who will lose out?” KYUNG-AH PARK, GOLDMAN SACHS

52 National Conference of State Legislatures. (2017). State net metering policies. Retrieved from <http://www.ncsl.org/research/energy/net-metering-policy-overview-and-state-legislative-updates.aspx>

However, Stavropoulos believes that in California CCAs are creating economic inequity. “Under California law, these communities are required to cover the cost of our generating capacity to meet the needs of their customers, but the way it’s being applied through the (Public Service) Commission, they are only taking 65 percent of the cost with them, so it’s causing cross-subsidization for those not part of the CCAs,” he said. “So it turns out the people not in community aggregation are being penalized. And the penalization of non-affluent people by affluent people needs to stop.”

One solution, he said, is to make expanding utility-scale renewable projects a higher priority than distributed roof-top solar. “(W)e know that utility-scale solar projects are about half the price on a per megawatt hour basis than putting a solar panel on peoples’ roofs. So maybe that is something we could do in order to get the product to that lower income customer base and have everyone pay for it.”

Community Choice Aggregations had their fans among our interviewees, among them Ben Foss of **Volta Charging**, who called CCAs “groundbreaking market formation” that “could be a strategic engine for driving down the carbon footprint of the household.” He added that more “CCAs would be great to see. They’re popping up all over California. Their profits are capped at five percent. Once they reach that they have to reinvest, which many will invest into encouraging EVs.”

Tax credits to lessen the cost of purchasing electric vehicles was also spotlighted as a cross-subsidy issue by an **auto industry executive**: “Tesla is an expensive vehicle.⁵³ Using tax incentives for the rich is going to get some pushback. California now has an income test for their EV tax credit. Tax credits for the rich is not good public policy.”

To Kyung-Ah Park of **Goldman Sachs**, the cross-subsidization matter is a call to design corrective solutions that open up access to clean energy across socio-economic lines without slowing the pace of clean energy adoption. “The social equity question is important. Can we enable more democratization of these clean technologies to underserved markets?” she asks. “How can we address the social equity issues for those who will lose out? How do we address those who feel like they’re being displaced in the clean energy transition?”

C) The Clean Power Plan provided a focusing mechanism to think about a carbon-constrained future, and many utilities will meet or exceed its original requirements.

One of the policies that had a large impact on the utility sector, especially for those that control generation assets, was the Obama administration’s Clean Power Plan (CPP). Promulgated by the Environmental Protection Agency (EPA) under the authority of the Clean Air Act, the CPP was designed to lower the carbon dioxide emitted by power generators by 32 percent by 2030 relative to 2005 levels. The plan set flexible approaches for states to submit plans to the EPA for review and approval.

While legal challenges from a number of states are working through the courts, President Trump issued an Executive Order in March 2017 that directed EPA Administrator Scott Pruitt to begin the process of withdrawing from the Clean Power Plan—to “review, and if appropriate, determine whether to suspend, revise or rescind” the CPP. In December 2017, the EPA issued an Advanced Notice of Proposed Rulemaking and began soliciting comments on options for creating a replacement rule.⁵⁴

53 Tesla offers customers three versions of its 2018 Model S. The base 75D model retails for \$74,500, and Tesla calculates a consumer cost of \$61,700 after deducting a \$7,500 federal tax credit, \$1,000 state tax credit (using Massachusetts as an example), and an estimated \$5,500 in savings at the gas pump over five years. The highest-end option, the P100D, retails for \$135,000, with a consumer cost of \$122,200 after adjusting for the tax credits and gas savings. Source: <https://www.tesla.com/models/design>. Tesla is now manufacturing a more affordable Model 3, which it lists at \$35,000 before adjusting for tax credits and gas savings. Source: <https://www.tesla.com/model3>

54 United States Environmental Protection Agency. (2017). EPA, DOT open comment period on reconsideration of GHG standards for cars and light trucks. Retrieved from <https://www.epa.gov/stationary-sources-air-pollution/electric-utility-generating-units-advance-notice-proposed>

The utilities and other companies that use large amounts of electricity that we interviewed brought different priorities and considerations into discussions with the Environmental Protection Agency while the Clean Power Plan was being developed and finalized. A number of leaders said that the process of debating and writing the rule forced them to do more expansive thinking and planning about their business model and operations in an increasingly carbon-constrained future. Some expressed concern about the Trump administration's efforts to overturn or recast the rule, but nearly all we spoke with said they believed that most U.S. utilities are on a track to meet or exceed the requirements of the CPP.

The Clean Power Plan (CPP) was a positive and useful focusing mechanism for utilities, and its rollback is a negative. Many utilities will meet or exceed the CPP's targets and otherwise move forward.

"We felt good about the Clean Power Plan by the time it was finalized," said Skiles Boyd of **DTE Energy**. "Drafting the CPP helped us get our plan in place. The original draft CPP would have had a dramatic negative effect with its steep emissions reduction slope, but the final plan was very achievable." He added that "the country will suffer for not having the CPP in place, and it probably would not have hurt."

Some utility leaders had their issues with how the CPP was designed and especially the administrative workload, but they said they were on track to meet or exceed the requirements of the CPP.

"We've done so much more than the CPP required," said one **utility executive**. "It wasn't going to drive big costs. We were concerned about the bureaucracy." Skiles Boyd of **DTE** said with respect to the final plan's targets, "in the early years our reductions are in line with where the CPP would have taken us." Bruno Sarda, Vice President of Sustainability at **NRG**, added, "The Clean Power Plan had regulatory overhead and some of it was unnecessary, but we're going beyond where CPP would have taken us." And Kyle Isakower, Vice President for Regulatory and Economic Policy at the **American Petroleum Institute**, an industry trade group that represents 625 companies⁵⁵, said, "We're almost all the way to the goals of the CPP. Market forces are getting us there."

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Intel's Stephen Harper summed up the state of play this way: "Interestingly enough, I think despite the fact that Trump has started to unwind the CPP, in most of the states, the states are even beyond their requirements or are going to go beyond those requirements before those limits are hit."

A central tension is that utilities have a long-term investment perspective, while President Trump's tenure is relatively short term.

"I think the reversal of the Clean Power Plan is troubling, but on the other hand if you're a utility CEO and you're deciding to make asset investments that last 20, 30, 40 years there's no way rationally that you can't believe there will not be some sort of constraint on carbon in the coming years and you will end up with stranded assets," said Alex Laskey, formerly of **Opower**. "I think that most of (the utility leaders) will say to themselves, 'we have this temporary reprieve, but we don't want to have stranded assets.'"

A key question: What's the alternative?

Some of the respondents who supported the CPP or felt they could live with the final version promulgated by President Obama's EPA are now looking for an alternative that gives their company policy certainty going forward.

⁵⁵ API's membership includes large integrated companies and exploration, production, refining, marketing, pipeline, marine, service and supply businesses. See <http://www.api.org/membership>

“I would argue that the CPP actually did what it needed to do,” Kevin Self of **Schneider Electric** said. “Now that the plan is in question, we’re looking for other mechanisms.”

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KEVIN SELF, SCHNEIDER ELECTRIC

Google, a strong supporter of the Clean Power Plan through its rulemaking process and upon completion because the company thought it would incentivize bringing new renewable energy online to power its operations, is equally eager to know what the alternative is if the Trump administration remains determined to walk away from the rule. “Federal action to address climate change and mitigate greenhouse gas emissions will continue to be an important issue that needs to be addressed—if it’s not through the CPP, then through some other mechanism,” said Mars Hanna.

Some leaders see in the retreat from the CPP a lost opportunity to creatively improve it in a way that would expand economic opportunity. “We would really like to see the resurrection of the Clean Power Plan” and to promote energy efficiency programs as among the compliance options, said Stephen Harper of **Intel**. “We are actively working with **ACEEE**⁵⁶ to develop protocols for states and industry to use allowing energy efficiency savings to be credited as part of compliance plan (with the CPP). We thought that the CPP was going to be a huge driver for that market.”

Even those who questioned EPA’s authority to regulate carbon believe a replacement rule is required.

Donnie Colston, the Director of the Utility Department at the **International Brotherhood of Electrical Workers**, which represents workers in the utilities, construction, telecommunications, broadcasting, manufacturing, railroads and government sectors, said his union took the position “from the start” that EPA had exceeded its authority under the Clean Air Act’s Section 111(d) and that it should have been returned to EPA for reconsideration. “We are in the replacement debate right now. We are all in agreement that unless you’re going to challenge the Supreme Court decision, then something has to take its place. This should be inside-the-fence regulation. We’re still working through what we’d like to see.”

The **American Petroleum Institute** opposed the Clean Power Plan because it “was based on an improper reading of the Clean Air Act”, according to Kyle Isakower. “We disagree with the Supreme Court’s endangerment finding of carbon as a pollutant under the Clean Air Act.” Instead, Isakower said, “It would be much better policy to create a new law, if policy makers decided that greenhouse gases have to be addressed.”

Weighing the situation from another angle, Abe Silverman of **NRG** said that because the CPP’s requirements fell far short of what is needed to combat climate change, its repeal will not have much of a harmful impact. Rather, he said, we should be designing a more comprehensive, longer term policy that assures successful decarbonization.

“My view was that the CPP wasn’t impactful, even before it was repealed,” Silverman said. “That is because pure economics are driving down emissions already. The goals of the CPP will be met and exceeded, which means they weren’t stringent enough. We’re nowhere near the level of decarbonization we need to be by 2050. Hitting the 2030 carbon emissions targets will be (relatively) easy, 2050 will be hard.”

He elaborated: “If we take the 2 degrees Celsius scenario⁵⁷ seriously, then we need to take the carbon emissions from the electric sector far below what they are today. Even if you could replace all coal plants today with a combined cycle natural gas plants—which is what the CPP would have encouraged—we’ll

⁵⁶ American Council for an Energy Efficient Economy.

⁵⁷ The origin of the 2 degrees Celsius target is explained by Oxford Research Encyclopedias: “International climate negotiations seek to limit warming to an average of two degrees Celsius (2°C). This objective is justified by the claim that scientists have identified two degrees of warming as the point at which climate change becomes dangerous. Climate scientists themselves maintain that while science can provide projections of possible impacts at different levels of warming, determining what constitutes an acceptable level of risk is not a matter to be decided by science alone, but is a value choice to be deliberated upon by societies as a whole.” Source: <http://climatescience.oxfordre.com/view/10.1093/acrefore/9780190228620.001.0001/acrefore-9780190228620-e-15>

still blow through our 2-degrees emissions scenario. When you have a policy that is essentially setting you towards long-term failure, then that's clearly not the right policy. I don't support throwing out the whole plan (CPP), but we need to fundamentally remake our energy markets to achieve deep decarbonization."

The Trump administration shift is inspiring a lowering of ambition by some companies.

While it appears that many power generators were moving forward to reduce their carbon footprint even before the CPP took effect, some are concerned that the Trump administration's efforts to overturn or replace the CPP and other environmental rules is already catalyzing changes of plans by some companies.

"We are certainly seeing impacts from Trump's policy decisions," said Gabriel Kra of **Prelude Ventures**. "They respond to cues on how to best make money. If you know there is or isn't going to be a certain regulatory framework, you make investment and capital expenditure plans around these regulatory policies. We've seen fossil companies that were making plans to comply with the CPP and other regulations, that are now shifting. 'We no longer have to comply.'"

D) Competitive electricity markets are more attractive to direct power purchasers, renewable developers and investors.

The notion of what constitutes competition in energy markets is central to the future of the utility industry. U.S. policymakers and regulators have led the electricity sector on a long march toward more open competition, dating back to the 1978 passage of the Public Utilities Regulatory Policies Act (PURPA). Largely a response to the energy crisis of the 1970s created by global oil shortages and other vulnerabilities in the energy system, PURPA significantly changed the electricity landscape by creating a market for non-utility power producers, spurring energy conservation and laying the foundation stones for the end of monopoly for multiple utilities.

First in 1996 with Orders 888 and 889⁵⁸ and then in 1999 with Order 2000⁵⁹, the Federal Energy Regulatory Commission (FERC) took concrete steps to open wholesale markets and promote competition. Orders 888 and 889 required that utilities separate their generation and transmission functions and guarantee open access to their transmission capacity, established the Open Access Same-Time Information System (OASIS) and set ground rules for sharing data about the transmission system. Order 2000 authorized and advanced the formation of Regional Transmission Organizations.

Abe Silverman of **NRG** gives great credit to the people who formulated those policies for creating the competition that allows a merchant generator like his company to engage and thrive in the electricity sector. "The competitive electric sector was created by Betsy Moler⁶⁰ and the FERC team and Order 888, 20 years ago, which gave rise to competitive generators."

58 See <https://www.ferc.gov/legal/maj-ord-reg/land-docs/rm95-8-0aj.txt>

59 See <https://www.ferc.gov/legal/maj-ord-reg/land-docs/RM99-2A.pdf>

60 Elizabeth Anne Moler was a member of the Federal Energy Regulatory Commission from 1988 to 1997, serving as chair from 1993 to 1997. Her long career as a lawyer, government official and utility executive included service as Deputy Secretary at the U.S. Department Energy from 1997 to 1998 and Acting Secretary for a period of time in 1998.

Competitive “free markets” help drive down costs and spur clean energy development.

Google’s Mars Hanna said that genuine competition in state and regional electricity markets is key to achieving his company’s clean energy goals. “Policy-wise, the most central driver we’ve found that enables corporate purchases of renewable energy is electricity market competition, both in wholesale and retail markets. In 2015, of all the renewable energy deals purchased by corporates, over 90 percent of those deals happened in a competitive ISO market or a competitive retail market. That is no accident.”

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“Our preferred approach is to source a deal on the open market and sign a contract directly with a renewable developer,” Hanna added. “We’re really only able to do that with the speed, scale and agility in competitive markets.”

Google’s experience with traditional utilities has been less successful. “Our experience working to purchase renewable energy in utility markets that are very centrally planned, highly regulated, and in a vertically integrated environment has been challenging. In these environments, there are high transaction costs and long lead times that make it difficult to do innovative renewable energy deals,” Hanna said. “For example, in some of these markets we’ve spent two to three years simply asking for the ability to purchase a clean energy resource, which has

resulted in a handful of deals that are in the tens of megawatts in size. By contrast, in 2015 alone we purchased over 800 megawatts of renewable energy on open, competitive markets.”

Hanna holds up the example of Texas, where “traditional hands-off economics combined with strong wind resources has driven rapid scaling up of renewable energy resources.”

“There is an innovation case for competitive markets as well,” he said. “With competitive markets, you allow a wide variety of experiments to occur that allow for more rapid innovation—quicker development that you wouldn’t get in a more tightly controlled market.”

Lack of competition and choice drives up costs

The fact that some states have such open competition for electricity and the remainder still have regulated utilities with monopolistic control over their service territories underscores that the U.S. electric sector is still far from a free and open market, some leaders said, and that contributes to keeping the cost of electricity, including for renewable energy, higher in the U.S. than many other parts of the world.

“Electricity policy is so balkanized in the U.S., and the need to operate in 50 states is a relic of past policy (means) this is not a competitive market,” said Danny Kennedy of the **California Clean Energy Fund**. “The self-belief that America has something called capitalism at work is nonsense. I’m not a free-marketer, I think we just regulate this market very poorly.”

Among other drawbacks, this lack of universal competition keeps the costs of renewable energy higher than it would otherwise be, Kennedy said. “This is probably the most expensive country in the world to do roof-top solar due to red tape. Most countries are at \$1 or \$1.3 a watt. In America, we’re at \$3.5 or \$2.5 a watt in good places. That’s due to soft costs from local jurisdictions and other unnecessary protections, in addition to customer acquisition costs.”

An element of true competition is consumer choice of electricity supplier, which is important to a merchant generator such as **NRG**. “On the retail side, it’s all about consumer choice. Without choice, it is incredibly hard to compete against regulated utilities,” said Abe Silverman. “We’ve spent a lot of time trying to complete the retail choice experience in the east because deregulation is incomplete in the Northeast.”

On the other hand, a barrier to competition is government policy that favors or subsidizes one energy source or another, Silverman said. “We have to compete against resources that are being subsidized by the state. For example, New Jersey is about to give away hundreds of millions of dollars to utilities to keep their nuclear plants operating and profitable. **PSE&G**... want(s) to make sure they continue to keep their nuclear plants online, even though the market is saying otherwise. The state is willing to undermine competitive energy markets to keep nuclear plants open.”

New York’s policy to support nuclear energy as zero-carbon electricity is another unwise subsidy, Silverman said. “In New York, if you took the same money that will be used to support aging nuclear and instead invest it in a green bank, then you could generate two times more truly clean, renewable energy in the state. Politicians are more concerned about keeping these jobs there. Do we really want to rent existing nukes for the next ten years or do we want to build the green infrastructure for the next 40 years? I think we should do the latter.”

States are also starting to subsidize offshore wind, Silverman said, by mandating its purchase at what could be “incredibly high prices in Massachusetts.” Further, “Canadian hydropower for New England is exactly the wrong way to go. This is shipping jobs to Canada and destroying the competitive energy markets in Massachusetts.” He concluded: “If you’re going to green the economy, let’s do it smart and auction renewable contracts competitively.”

E) Regional Transmission Operators and State Public Service Commissions could step up to address fragmented policy across their regions as a means to incorporate clean energy.

Access to reliable and affordable electricity is a central foundation of the U.S. economy and an essential component for companies of all sizes and in all regions. Economic leaders point to the challenges created in the electricity markets by fragmented authorities across federal, regional, state and local agencies, especially as the availability of renewable energy grows and seeks to compete with more traditional energy sources on the basis of price and reliability. Regional Transmission Operators (RTOs) that span markets in multiple states are showing promise as entities that can clarify that fragmentation of responsibilities with initiatives that provide competitive, market-based solutions. Similarly, some state Public Service Commissions are demonstrating the ability to offer fresh, future-oriented thinking and work cooperatively among neighboring states in their region.

RTOs are well placed to advance cleaner electricity generation and transmission.

The seven RTOs that operate bulk electric power systems across the U.S. (with another three operating in Canada) “are independent, membership-based, non-profit organizations that ensure reliability and optimize supply and demand bids for wholesale electric power”, according to the U.S. Energy Information Administration.⁶¹ Formed as the result of directives from the Federal Energy Regulatory Commission, the seven U.S.-based RTOs are ISO New England (ISO-NE), New York ISO (NYISO), Midcontinent ISO (MISO), Southwest Power Pool (SPP), Electric Reliability Council of Texas (ERCOT), California ISO (CAISO), and the PJM Interconnection (PJM).⁶²

61 United States Energy Information Administration. (2011). About 60% of the U.S. electric power supply is managed by RTOs. Retrieved from <https://www.eia.gov/todayinenergy/detail.php?id=790>

62 Independent System Operators (ISOs) are similar entities operating in either single or multiple states. ISOs are often loosely grouped under the RTO umbrella (as EIA does above), but there are some distinctions between the two types of organizations. According to the Federal Energy Regulatory Commission (FERC), Independent System Operators such as ISO New England and the Midcontinent ISO grew out of FERC Orders Nos. 888/889, in which the Commission “suggested the concept of an Independent System Operator as one way for existing tight power pools to satisfy the requirement of providing non-discriminatory access to transmission.” In a follow-on directive, Order No. 2000, FERC “encouraged the voluntary formation of Regional Transmission Organizations to administer the transmission grid on a regional basis throughout North America (including Canada)”, laying out 12 characteristics and functions that an entity must satisfy to an RTO. Source: <https://www.ferc.gov/industries/electric/indus-act/rto.asp>

“All the RTOs play an important role with their policies and market design mechanisms. Those can be very helpful or harmful (to the deployment of wind energy), depending on how they are designed,” said Tom Kiernan of the **American Wind Energy Association**. “We are in discussions about how much to advocate for additional new state Renewable Portfolio Standards, increasing in their targets, or working with RTOs to create a more competitive market pricing design.”

Seeking to ensure the reliability of electricity service was one of the primary goals FERC had in mind when it imagined the formation of RTOs, and Kiernan said that his industry is encouraging RTOs to think about the reliability benefits of wind energy in a way they might not have thought about it. Wind industry leaders are in discussion with RTOs to expand understanding of “the different reliability benefits of wind capacity and have those compensated by an RTO as essential reliability services in a competitive way. Wind can effectively compete with other reliability services at low cost.”

RTOs have the capacity to “create the wholesale market” and “a competitive pricing of electricity,” Kiernan said. “How those markets are designed is really important. And from our point of view you can design it in a way that is just more or less competitive. How you bid for and how you provide your electrons onto the grid matters. That is important to us long term—very important.”

State energy commissions are starting to drive more clean energy policy, but possibly not looking sufficiently to the future.

The role of the states in setting energy policy was cited by some respondents as an important place to look for fresh leadership in guiding the growth and pace of the clean energy electricity markets, especially in the absence of a more federally-focused policy.

“It seems likely that the states will be the core drivers of this transition,” said Julia Hamm of the **Smart Electric Power Alliance**. “Just an observation that I’ll make is that the state energy commissions historically have had a very narrow role in terms of executing on their policy priorities, but we are starting to see a transition to them driving the development of a vision for their state.”

Hamm said that New York’s Reforming the Energy Vision (REV) strategy under the leadership of Governor Andrew Cuomo and Richard Kauffman, Chair of Energy and Finance for New York, as an example of that fresh, future-oriented thinking.⁶³ “It is interesting to see commissioners take a much more active role in this energy transition than we’ve seen in the past. In addition to California, Massachusetts and New York, other states that are driving these changes are Maryland, Connecticut, Washington, D.C., and Hawaii.”

But Bill Weil of **Tempest Advisors** points to the limits of Public Utility Commission rules that do not allow regulators to project future prices in a more sophisticated way when identifying future cost trends. “I get frustrated when I see at the PUC level they’re trying to forecast pricing for different technologies, and the regulations are set so that they have to look backwards at historic prices. If there were some way to give them the flexibility to consider the price trends, whether that is a seven percent learning curve or 27 percent learning curve. Set the pricing at that level rather than solely calculating based on out of date prices in such a dynamic market.”

In regulated markets, one utility leader says it is important that regulators allow utilities to be reimbursed for investments in grid modernization.

Grid modernization is a broad concept that encompasses a range of activities by utilities and RTOs to update the country’s aging electrical grid infrastructure. Modernization steps can make the grid more resilient to storms and other events that cause power outages and better able to restore service more rapidly when it’s knocked out. It can make the grid infrastructure more energy efficient, harden the distribution system against criminal cyber intrusion, increase integration of renewables, and strengthen consumers ability to manage

63 See <https://rev.ny.gov>

their electricity consumption through information technology that allows two-way communication between households and utilities and grid managers.

The ability of utilities to assertively invest in grid modernization in their service territories is often dependent on whether their state public service commission is willing to approve reimbursements of part or all of those expenditures, utility leaders said. Public service commissions should look favorably upon such investments, they said, because they provide a range of important benefits.

“One of the important things that has happened in California is that the regulators have been generally supportive of reasonable rates of return for investor-owned utilities and encouraging of investments in grid modernization so that they will be able to operate with many more renewables on the grid and in a much more distributed way,” said Nick Stavropoulos of **PG&E**.

“We hear from some of our electric utility counterparts, how are they going to get their 15 percent (from renewables)? They think the world is going to fall apart. But it’s been through California’s support that we have been able to install smart meters in all of our customers locations. That gives us amazing insight and... amounts of information about our customer’s actual usage. It facilitates a greater view into the operational network.”

Regional policies are needed to ensure regional transmission infrastructure.

Building transmission infrastructure is always challenging, from landowner concerns about high-voltage transmission lines crossing their property to securing permits from myriad authorities at the federal, regional, state and local levels. The need to transmit renewable electrons to urban markets from the wind fields in rural states like Oklahoma or the Dakotas or from solar fields of the American southwest has created new challenges for the transmission development sector.

“What has been disappointing on the transmission side has been the lack of federal leadership on how regional transmission and interconnection can be developed. The rules of the road for regional integration has been poorly done, particularly the cost sharing.” ED KRAPELS, ANBARIC

Ed Krapels, founder and Chief Executive Officer of **Anbaric**, a Wakefield, Massachusetts-based developer that specializes in large-scale electric transmission systems and smaller-scale microgrid projects, applauds the “emphasis by the FERC and by federal legislation on competitive electric markets” and singles out the Northeast as great region to operate in due to the competitive market structure. “What has been disappointing on the transmission side has been the lack of federal leadership on how regional transmission

and interconnection can be developed. The rules of the road for regional integration has been poorly done, particularly the cost sharing.”

“There is no way to develop interregional transmission, unless one region is willing to absorb close to 100 percent of the costs,” Krapels said. “The nation would be better off if we had regional transmission. If you think about the Interstate Highway System, this required a lot of federal leadership. Because President Eisenhower was behind this project, it got done. Nothing like that has been done with regional transmission. ISOs and RTOs are their own domain. They look at other ISOs and RTOs as complicating, rather than helpful entities.”

From an investor perspective, a federal role is clearly needed to incentivize companies to enter the transmission space with technologies that solve system problems at low cost.

Daniel Goldman of **Clean Energy Ventures** said that in his experience FERC has not been technologically oriented, but he hopes FERC will focus more on technology because of the potential benefits. “We have seen technologies orientated towards transmission which can alleviate transmission constraints at very low cost and are radically less expensive than building new transmission lines. I think it’s incumbent for the federal government to try and induce companies to do things at the lowest cost possible.”

F) The Department of Energy's Reliability Notice of Proposed Rulemaking (NOPR) was seen by many as inappropriate, with exceptions.

In September 2017, U.S. Secretary of Energy Rick Perry invoked a rarely-used authority to issue a Notice of Proposed Rulemaking (NOPR) that directed FERC to write a rule that would provide “cost recovery” relief for struggling coal-fired and nuclear power plants. In so doing, he made a case that the anticipated closures of nuclear and coal power plants would threaten the reliability of U.S. power markets.⁶⁴

Four months later, on January 8, 2018, FERC unanimously voted (5-0) to reject that directive, saying that DOE and utilities supporting the proposed rule had failed to make its case under the relevant rules. Instead, FERC initiated a new proceeding “to specifically evaluate the resilience of the bulk power system in the regions operated by regional transmission organizations (RTO) and independent system operators (ISO).”⁶⁵

At the time of the interviews for this research project, FERC had not yet ruled on Secretary Perry's request for it to promulgate a reliability NOPR to generate subsidies for coal-fired and nuclear power plants. The following quotes reflect the perspectives of our interviewees while the proposed NOPR was still being considered by FERC.

In reflecting the view of a number of energy leaders with whom DOE's proposed NOPR was unpopular, one **utility executive** said, “We don't think the cost of subsidizing coal and nuclear plants should be socialized to our customers. It upends decades of policy towards markets and efficiency. It upends any pretext of not picking winners. We understand the need to keep nuclear plants online. But if you keep an uneconomic coal unit online and are subsidizing it then it's not in the interest of the customer or the environment.”

Bill Weil of **Tempest Advisors** was even more pointed: “The idea that we need to subsidize baseload power is absolutely shambolic nonsense. The DOE NOPR is simply dressed-up subsidies for a failing industry. There are lots of ways to support the grid and account properly for variable generation.”

“The DOE NOPR is a great example of policy trying to stop something that is inevitable,” said Janet Besser of the **Northeast Clean Energy Council**. “It doesn't serve industries that are no longer competitive and the people that work in them well. It may delay changes for a year or two, while making things more expensive in the future.”

“Sometimes policy is a control or checkpoint that moderates a pace of change, but you have to be careful about that or it can become a bottleneck,” Besser added.

“We don't think the cost of subsidizing coal and nuclear plants should be socialized to our customers. It upends decades of policy towards markets and efficiency. It upends any pretext of not picking winners.” UTILITY EXECUTIVE

DOE's decision to limit the cost recovery relief to power plants that have more than 90 days of fuel on site drew criticism as an artificial and somewhat irrelevant metric. “Reliability and resilience are extremely important for the grid. But after making the premise that reliability and resilience are important, (DOE) jumps to the conclusion that those that have more than 90 days of fuel on site need more subsidies because they are more reliable,” said Tom Kiernan of the **American Wind Energy Association**. “But that is not accurate.”

Some leaders saw benefit in Secretary Perry's attempt to raise the reliability issue. Even though DOE was unsuccessful in its effort to convince FERC to write a new reliability rule, it “served a valuable purpose by starting a broader public discussion on what type of grid we want and at what costs, uncertainties and risks we're willing to live with,” Colin Marshall of **Cloud Peak Energy** said. “There will be consequences if we continue to flood the grid with subsidized intermittent power sources while closing down baseload generation.”

64 Perry, R. (2017). Letter to the Federal Energy Regulatory Commission. Retrieved from <https://www.energy.gov/sites/prod/files/2017/09/f37/Secretary%20Rick%20Perry%27s%20Letter%20to%20the%20Federal%20Energy%20Regulatory%20Commission.pdf>

65 See <https://www.ferc.gov/media/news-releases/2018/2018-1/01-08-18.asp#.Wrp1hRiZNOs>

John Kotek of the **Nuclear Energy Institute** agreed that, irrespective of FERC’s position, the DOE NOPR “shines a light on the fact that market conditions are such that nuclear plants are shutting down and this is not the direction that we want to go given our climate commitments.”

Kotek said that in the absence of federal action a number of states are taking action to retain the zero-carbon baseload energy of the nuclear reactors operating in their jurisdictions. “New York, Illinois and Connecticut have passed provisions (to support nuclear plants) and there is similar debate in Ohio, Pennsylvania and New Jersey. Some of the RTOs and ISO-New England and PJM are inclined to go in that direction.”

G) Strengthened federal appliance and equipment efficiency standards are highly effective.

President Obama’s Climate Action Plan set the goal of achieving the reduction of three billion tons of carbon emissions reduction by 2030 as the result of strengthening energy efficiency standards for appliances, industrial equipment, electronics, and lighting. By the end of the second Obama term, the U.S. Department of Energy had finalized some 50 more stringent energy efficiency standards, including for clothes dryers, electric motors, industrial air conditioning, central air conditioning, heat pumps, furnaces, lighting, water heaters and compressors. DOE projected that when fully implemented, the new rules will save consumers and businesses a projected \$550 billion in utility bills by 2030.⁶⁶

Because of a DOE requirement that final draft energy efficiency rules must sit for a 45-day waiting period before they can be published in the Federal Register—which must happen for the rules to be considered final and in force—five efficiency standards failed to make it across the finish line before President Obama left office in January 2017. President Trump promptly froze those rules shortly after taking office and their

fate remains uncertain. Those rules cover portable air conditioners, swimming pool pumps, walk-in coolers and freezers, commercial boilers and “uninterruptible power sources” (electrical devices that provide emergency power to computers and other equipment during power outages).⁶⁷

Many leaders applauded the progress in strengthening federal efficiency rules and looked forward to the introduction into the economy (and their own enterprises) of the more efficient technologies over time.

“Obama-era regulations like lighting will be highly effective in the long term,” Ralph LaRossa of **PSEG Power** said. The lighting rule, in particular, had “such an effect on the system load; it was negative from a peak standpoint, but positive from a service standpoint.” Skiles Boyd of **DTE Energy** agreed that the lighting standards are contributing to

system-wide efficiency gains. “Those standards help in and of themselves (in reducing emissions). Part of our state’s efficiency program allows us to offer incentives that will help reduce costs for consumers.”

He cautioned about complacency. “These standards will help for a while, but you have to watch as the low hanging fruit disappears. I think the programs that have been implemented to date have been pretty good. You never know how far technology will be able to take you.”

“We’ve also seen compelling technologies to... reduce the amount of energy necessary to heat the water without sacrificing consumer use and at the same time providing an important demand response mechanism to utilities to manage electricity loads at peak times of the year.”

DANIEL GOLDMAN, CLEAN ENERGY VENTURE GROUP

⁶⁶ United States Department of Energy. (2017). Saving energy and money with appliance and equipment standards in the United States. Building Technologies Office. Retrieved from https://www.energy.gov/sites/prod/files/2017/01/f34/Appliance%20and%20Equipment%20Standards%20Fact%20Sheet-011917_0.pdf

⁶⁷ Mooney, C. (2016). Obama’s government just issued five new energy rules — but Trump’s will have to finish them. The Washington Post. Retrieved from <https://www.washingtonpost.com/news/energy-environment/wp/2016/12/29/the-energy-department-just-issued-five-new-regulations-that-trump-could-try-to-cancel>

David Miller with the **Clean Energy Venture Group** said that objections to more stringent energy efficiency standards, especially those that worry about the costs involved, are commonly overstated, and called California's standards a great case study. "This is a classic case where industry players said it would be too expensive, but companies not only met the standard but actually lowered costs at the same time. If you have efficiency policies that enable lower demand then you save everyone money on energy rates."

Concerns about a slow rollout of the more efficient appliances and equipment.

Some lamented the fact that the pace of the introduction of the newer, more efficient appliances and equipment by manufacturers and the adoption by consumers and industries would take longer than is ideal.

An executive with a major corporation observed that in factories and other industrial facilities changing out dated, inefficient equipment is a large capital investment that happens infrequently. "Companies make these investments every 20 to 25 years. Updating energy-efficient equipment in manufacturing is very slow, unless there are significant cost savings. The energy efficiency rules will be helpful, but will take a while (to have an impact)."

"Companies make these investments every 20 to 25 years. Updating energy-efficient equipment in manufacturing is very slow, unless there are significant cost savings. The energy efficiency rules will be helpful, but will take a while to have an impact." AN EXECUTIVE WITH A MAJOR CORPORATION

The same phenomenon is in play in the consumer market, in which a homeowner is unlikely to replace large appliances like refrigerators or washing machines unless their current ones break down and cannot be repaired, primarily because they are expensive items. Many utilities have incentive programs to inspire homeowners with cash payments to replace inefficient appliances with new more efficient ones. But those programs do not exist everywhere.

"For fridges and many other appliances, it's a replacement market," said David Miller of the **Clean Energy Venture Group**. "So it's a little harder and takes time. The appliance market sounds much more

challenging to accelerate unless you build in clear incentives for consumers."

Stephen Harper of **Intel** said that the progress in improving appliance efficiency can be multiplied many times over by advancing the idea of "intelligent efficiency", which he said is "deep decarbonization driven by the digitization of the economy.

He recalled that in the administration of President George W. Bush, a senior scientist in the Building Technology and Urban Systems Division at Lawrence Berkeley National Laboratory, Alan Meier, raised concerns about so-called "vampire loads." Also known as standby loss or phantom power, this refers to the phenomenon of appliances and other electronic equipment wasting energy while being plugged in, even if idle. Dr. Meier was so successful that he "got Bush to give a speech at DOE and Bush launched the one-watt initiative and that took over the world," Harper said.⁶⁸ He said attention is now turning to the "budding 'zero watt' movement pertaining to Internet of Things devices."

Another example of intelligent efficiency was offered by Daniel Goldman at **Clean Energy Venture Group**: "We've also seen compelling technologies to control electric hot water heaters to reduce the amount of energy necessary to heat the water without sacrificing consumer use and at the same time providing an important demand response mechanism to utilities to manage electricity loads at peak times of the year."

⁶⁸ In July 2001, President Bush issued an executive order that mandated that agencies across the federal government, when they purchase "commercially available, off-the-shelf products that use external standby power devices, or that contain an internal standby power function, shall purchase products that use no more than one watt in their standby power consuming mode." Source: Bush, G. W. (2001). Executive order: Energy efficient standby power devices. Retrieved from <https://georgewbush-whitehouse.archives.gov/news/releases/2001/07/20010731-10.html>



Policy Finding 7: Federal and state policies and programs that support private sector development and deployment of clean technology have strong support.

Many of the respondents supported government incentives—in the form of public investment in basic science and technology research and development, tax credits, low-interest loans, grants and targeted government programs like the U.S. Department of Energy’s Advanced Manufacturing Institute—as a way of to demonstrate young technologies in the market place and deploy those technologies to the point of commercialization.

For the most part, economic leaders felt that an active government role at this early stage was especially important because the corporate sector does not perform that function well in a targeted and efficient way. Most individual companies invest at some level in new technology and systems R&D, but it tends to be focused narrowly on each company’s expertise and priorities and news of any progress or setbacks are typically held closely under the protection of proprietary information.

Government, on the other hand, has the responsibility and ability to take a landscape view of the technological needs and potential options. The results of basic R&D conducted with taxpayer dollars—much of it at the U.S. Department of Energy’s 17 national laboratories—is typically published in peer reviewed journals and presented at science and engineering conferences. Breakthroughs and discoveries at the national labs are in turn often patented and then made available via licenses to companies for commercial development.

In a different governmental sphere, states have long acted as laboratories for public policies, often well before the U.S. Congress or a President is ready to begin discussing their national equivalents. This allows for trying out “novel social and economic experiments without risk to the rest of the country,” as Justice Louis D. Brandeis famously wrote in 1932.⁶⁹

The first experiments to establish mandates for securing new renewable energy and savings from energy efficiency were in the states, with Iowa first adopting a renewable portfolio standard in 1983 and Texas adopting the first energy efficiency standard in 1999. Those first experiments have led to waves of other states learning from the first adopters and crafting innovative and ambitious standards of their own. No equivalent standards have yet been put in place at the federal level, but if a future President or Congress is so moved to act, they would have an enormous reservoir of learned experience to draw on when they sit down to write national standards.

A) Broad support exists for time-limited incentives for emerging technologies that enable innovation, demonstration and early deployment—and also provide certainty.

Early market incentives have strong support, but should not be turned into ongoing subsidies—especially if a carbon price is in place.

Many of those who expressed support for incentives such as tax credits felt equally as strongly that the incentives should be focused on early stage technology development and should not be ongoing as any particular technology matures and begins to stand on its own—that is, rise or fall—in the marketplace. Economic leaders favored the reasonable phase out of such subsidies so companies and investors can plan with foresight and certainty.

69 Sutherland, G. (1932). *New State Ice Co. v. Liebmann*. Cornell Law School Legal Information Institute. Retrieved from <https://www.law.cornell.edu/supremecourt/text/285/262>

Curt Magleby, Vice President of U.S. Government Relations at **Ford Motor Co.**, headquartered in Dearborn, Michigan, voiced this widely-held view: “Incentives are a way to accelerate early market adoption and introduction, but should not be turned into subsidies because of all the unintended consequences.”

Breakthrough Energy Ventures’ Eric Toone agreed. “Tax policy is there to help technologies down the learning curve and shouldn’t be there for the long-term.”

“Incentives to emerging renewable and vehicle technology are important for early adoption,” said Kevin Self of **Schneider Electric**. From there, “the industries will evolve to satisfy customer need and there are enough customers demanding a cleaner, more electrified world.” He asked, “The question is how long do these subsidies need to be around before technologies take off?”

Gregg Felton at **Altus Power** said he is not “a huge proponent of subsidies,” but could see instances in which they had value to incentivize changes needed to advance public goals. “(Y)ou often think about subsidies in the way of changing behavior. For example, the incumbent utilities don’t really have an incentive to allow continued deployment of renewables. There isn’t an incentive to change behavior.”

Former Massachusetts Governor Deval Patrick of **Bain Capital** said, “I think what we learned from Germany was that feed-in tariffs created the market for renewable energy. History has shown that subsidies can stimulate behavior and they have. The question we have to ask ourselves is when subsidies have outlived their usefulness.”

Electric vehicle tax credits are helping to spur a new market.

The electric vehicles that many motor vehicle manufacturers are beginning to make and sell—by one estimate, 45 choices of battery electric vehicles and plug-in hybrids are now available in showrooms around the world—are seen by a number of leaders as an ideal candidate for federal and state tax credits because EVs are a new technology that the driving public is largely unfamiliar with and the measurable public benefits, especially reduced or eliminated tailpipe pollution, justify the application of public dollars.

“Incentives are a way to accelerate early market adoption and introduction, but should not be turned into subsidies because of all the unintended consequences.”

CURT MAGLEBY, FORD MOTOR CO

The federal government offers a tax credit to purchasers of all-electric vehicles and plug-in hybrid vehicles of between \$2,500 and \$7,500, depending on size of the vehicle and battery capacity.⁷⁰ The statute setting up the tax credit directed that each vehicle manufacturer will benefit from the tax credit for the first 200,000 qualified EVs that it sells in the United States. When a manufacturer reaches the 200,000-vehicle threshold, its customers can no longer use the tax credit for one of their EVs.

A significant majority of states also offer tax credits or other incentives for their residents who purchase electric vehicles. According to the National Conference of State Legislatures, 45 states and the District of Columbia “currently offer an incentive for certain hybrid and/or electric vehicles, which can range from tax credits or rebates to fleet acquisition goals or exemptions from emissions testing.”⁷¹

While demand for electric vehicles is growing at an impressive pace—the total number of electric vehicles on the road in the United States numbers more than 765,000 as of December 2017, with three million sold internationally—they still constitute only a modest percentage of overall vehicle sales. Industry experts say that is in part because prospective car buyers have anxiety about the limited range on a single charge of many of the EV models, as well as concern about the availability of recharging stations and the multiple hours needed to recharge the battery pack.

⁷⁰ United States Department of Energy. Office of Energy Efficiency & Renewable Energy. Electric vehicles: Tax credits and other incentives. Retrieved March 30, 2018, from <https://www.energy.gov/eere/electricvehicles/electric-vehicles-tax-credits-and-other-incentives>. To find out specific tax credit amounts for individual vehicles, visit FuelEconomy.gov’s page on Federal Tax Credits for All-Electric and Plug-in Hybrid Vehicles: <https://www.fueleconomy.gov/feg/taxevb.shtml>

⁷¹ To search all laws and regulations relevant to EVs, including businesses, visit the Alternative Fuels Data Center’s Laws and Incentives database: <https://www.afdc.energy.gov/laws/search>

One solution, said Curt Magleby of **Ford Motor Co.** is to encourage consumers to start with a plug-in hybrid, which has both significant battery storage, enabling its driver to go some distance powered by electricity alone, and a combustion engine that kicks in when the battery runs out of power. “Plug-in hybrids are a key bridge to full battery electric vehicles,” Magleby said. “It’s a more affordable option for many, especially if you’re a one-car household. We like the plug-in option, because a large portion, if not all, of your driving can be done with electric miles. If you can have consumers get into a plug-in at a lower price point and then optimize how they use their electric miles, then that’s a win-win.”

Governor Deval Patrick of **Bain Capital** wondered whether the major automobile manufacturers will continue to need EV subsidies on an ongoing basis as demand for these vehicles grow. “I think they have helped spur the development of the electric vehicle market. Government will also have to ask whether they can continue to afford that subsidy. But exciting to see the demand for EVs growing.”

Differing views on the cap on each EV manufacturer

The cap on EV tax credits that Congress put in place for each vehicle manufacturer to limit the overall cost of the program inspired two contrary views on this policy design element.

An **executive with a major motor vehicle manufacturer** said his company likes that the Federal tax credits for electric vehicles are capped, by statute, at the first 200,000 units sold per manufacturer. He noted that **Tesla** is expected to trigger the 200,000 cap in the first quarter 2018, and **General Motors** will likely trigger it later in 2018. It is anticipated that **Ford** and **Nissan** will trigger in late 2019.

A **clean energy executive** with a different company felt the opposite, making the case that a tax credit program for an emerging technology should have as a priority the early and rapid deployment of that technology and thus be crafted to incentivize and reward companies that sell into the market most swiftly.

“I’d want to see a policy that incentivizes first movers rather than a policy that creates a playing field in the out years that will be tilted towards latecomers into the industry,” this executive said. “I think there are merits in the current policy—to have caps on each manufacturer—but as currently designed every manufacturer has the ability to come in whenever they want to and get a federal tax credit for their customers or for themselves.”

The rules create a situation in which a vehicle manufacturer can delay aggressive sales of its electric vehicle models and benefit from the tax credits years down the road, he said. “If I could wave my wand I would say, let’s have a pool of these credits—three million cars or five million cars or whatever—and anyone that wants to access those credits can get them until they run out. So, it’s a race to see how many EV’s you can deploy.”

Clean energy tax credits have helped expand markets for renewables, diversify sources of electricity, add new jobs and increase financial investment in technology and communities.

A varied number of companies and investors have taken advantage of the federal Production Tax Credit (PTC) and Investment Tax Credit (ITC) to reduce the carbon footprint of their energy use. As one **industry trade group executive** said, the PTC for wind is popular with steel manufacturers because it has driven more demand for wind energy components that are made with steel.

This comment by Mars Hanna of **Google** reflected a widely held view among those interviewed: “The PTC and ITC have been instrumental over the last several decades in providing a mechanism to bring renewable energy technologies to market. A **utility executive** suggested that the impact of the tax credits has been especially high in the absence of a comprehensive clean energy policy. “The tax credits for renewables have been good. I think we need to keep those alive until we have a national carbon policy,” he said.

“The tax equity market created by the PTC and ITC has been an important part of the economic value of solar,” according to Kyung-Ah Park of **Goldman Sachs**. “The 2015 five-year extension for the ITC and PTC was huge in providing greater certainty versus the stop and go nature of tax credit policy we’ve had prior to then. At that time, Bloomberg New Energy Finance projected some \$70 billion in extra capital would be mobilized because of the ITC/PTC extension.”

“The federal tax credit for solar has been very instrumental in bridging the gap between where it would make sense to build a project or not,” Gregg Felton of **Altus Power** observed. “If you roll back the clock five years, you see many places where solar would not have been economic and the reason is because the all-in cost of installation was too high compared with the power price savings. We needed to create a system that provided a competitive alternative, given the existing utility business model.”

The ITC for solar here in the U.S. and comparable policies adopted in a number of other countries spurred considerable growth in solar deployments domestically and globally, which in turn led to sharply reduced costs of photovoltaic equipment, Felton said.

“There was a substantial increase in the volume of solar modules which led to a 90 percent global cost decline over the last five to seven years—a substantial decline in material cost and decline in the labor cost due to knowledge acquisition. The all-in price of construction came down substantially and ultimately made the product more competitive. There is no question that subsidies have worked.”

“People are savvy and they respond to those market signals. When the PTC lapsed, wind installations fell off dramatically, so industry clearly responds to these policy directives.” GABRIEL KRA, PRELUDE VENTURES

Gabriel Kra of **Prelude Ventures** said the ITC was central to the positive growth story of domestic utility-scale and residential solar over the past decade.

“If you invested in a solar company from 2008 to present you were taking advantage of the ITC. The ITC enabled solar to become cost competitive and possible,” he said. “If you want to sell solar, you have to do it on price and the ITC and accelerated depreciation made this possible. You knew your product would be more economically attractive.”

A **utility industry executive** articulated how the tax credits help make the economics work for his company and for their customers. “In the past it’s been a tradeoff, but with...the PTC and the transformation of wind and solar technology, we can bring wind in at below the avoided cost,” he said. “We save our customers money with every new megawatt of wind, especially with low natural gas. We’re getting wind in at below \$20 per megawatt hour, which is really remarkable. That’s equivalent to a fully depreciated coal plant with no emissions controls.”

Are tax credits the most efficient incentive?

One supporter of accelerated deployment of wind and solar energy questioned whether the renewable tax credits are the most efficient way to incentivize renewable projects. “The Production Tax Credit (for wind power) is a pretty crude instrument, with 75 percent of the benefit going to the projects and 20 to 25 percent leakage going to the lawyers and other inefficiencies with the tax credit scheme,” said Michael Skelly of **Clean Line Energy**.

Because not all wind developers generate enough profits (and thus tax exposure) to benefit from the PTC, the rules allow them to partner with investors who have tax liability and can make use of the tax credits. Even then, it can be challenging for wind developers and their investors to capitalize on the PTC or ITC as designed, and Tom Kiernan of the **American Wind Energy Association** would like to see Congress fine-tune to “make the PTC easier to monetize.”

“Even if a developer and sponsor can’t use the PTC they can often monetize the process in some other way,” he said. “We are working with Congress on the fundability and trade-ability of the PTC, in order to make the PTC more liquid and efficient and cost effective.”

This is not an optimal situation from the perspective of some. “This situation sets up a whole industry of bankers and middlemen to allow for tax equity-swaps and credit swaps, and to cream money off the top, making the deals more expensive,” said Bill Weil of **Tempest Advisors**.

David Miller of the **Clean Energy Venture Group** offered a comparable view: “I realize that the ITC and PTC are helpful for renewables to compete on a level playing field with fossil fuels that also have various other incentives. But the structuring required to deal with these provisions makes it more expensive to finance renewables because many renewable developers don’t have significant enough tax exposure.”

“A developer has to restructure the project to include tax equity,” he continued. “The tax equity market comes and goes. Changing this incentive into something that’s easier to finance would be hugely helpful.”

His colleague Daniel Goldman at the **Clean Energy Venture Group** expanded on the challenge. “The problem is you have to restructure a project to include tax equity, traditional project equity, and project finance, and it adds a whole level of complexity and increases the transaction costs. As for tax equity investors, some years there are a lot of investors and some years there aren’t.”

The on again, off-again authorization of the PTC and ITC by Congress has caused problems.

Over its history, the Congress allowed the PTC to lapse a number of times, which created periods of uncertainty among wind developers, utilities and investors that slowed development of wind power, sometimes sharply. From 1999, when the first lapse occurred, until December 2015, Congress reauthorized the tax credit for only one- or two-year stretches, with occasional lapses in between, which wind advocates say resulted in “boom-bust cycles of development.”⁷²

“People are savvy and they respond to those market signals.” Gabriel Kra of **Prelude Ventures** said. “When the PTC lapsed, wind installations fell off dramatically, so industry clearly responds to these policy directives. Developers know they’ll make more money on projects with the PTC than without.”

Congress allowed the PTC to expire on January 1, 2015 and did not reauthorize it until December of that year. A record amount of new installed wind capacity was logged in 2015, from projects begun before the 2015 lapse in authorization. The year-long lapse of the tax credit led to a precipitous drop of new projects in 2016, before its renewal catalyzed a new bow wave of projects in 2017.

This up and down performance was “tied to the uncertainty around the PTC/ITC,” said Marty Spitzer, Senior Director for Climate and Renewable Energy at the World Wildlife Fund who co-directs the **Renewable Energy Buyers Alliance**, an initiative that assists corporations in the direct purchase of renewable energy launched that is hosted by the **World Wildlife Fund, BSR, Rocky Mountain Institute** and **World Resources Institute**.

With the “on again and off again nature of the PTC,” Tom Kiernan of the **American Wind Energy Association** said, it has been “tough to keep costs down when you have that variability.”

The phase-out of the renewable tax credits is viewed as positive.

With the increasing deployment of new wind and solar energy facilities and the dropping cost of this clean energy, a number of economic leaders watching these developments said it was appropriate to phase out the renewable energy tax credits as Congress has dictated.

“This is now historical,” said Gabriel Kra at **Prelude Ventures**. “You don’t need these (tax credits) now to make solar competitive with natural gas or coal.... The value of the ITC and PTC were incredibly valuable, but now wind is so cheap that you don’t necessarily need the PTC.”

“A principle of sun-setting of subsidies or legislation is a good thing for industries,” Bill Weil of **Tempest Advisors** said. “Having a sun-setting frame creates a path rather than constantly intervening in the market. Let’s avoid the boom-and-bust development in solar and wind that we’ve seen by putting in a sun-setting path.”

⁷² See <https://www.awea.org/production-tax-credit>

A case for extending the PTC for nuclear energy.

In its 2005 Energy Policy Act, Congress adopted the advanced nuclear production tax credit, providing a 1.8 cent per kilowatt hour tax credit for electricity produced at new nuclear reactors that became operational by 2020. Congress set an annual cap of \$750 million in credits.

Given the long lead time to construct a nuclear reactor, the original 2021 deadline essentially assures that no reactors under construction or proposed are likely to be able to use the nuclear PTC. The tax reform bill approved by the U.S. House of Representatives in June 2017 changed the rules to allow for the reallocation of any unused portion of the allowed PTC credits and eliminated the 2020 deadline for reactor projects to qualify for the unused credits.⁷³

The **Nuclear Energy Institute's** John Kotek pointed to an amendment being discussed in the U.S. Senate that would match and extend the House version of the nuclear PTC, including eliminating the sunset date. "With the nuclear PTC, and cancellation of the South Carolina reactors⁷⁴, there is a fair amount of space here for small modular reactors, if Congress extends the deadline. We have been advocating with the administration on this," he said.

B) Expanding existing energy tax policies to be more inclusive would yield more carbon reduction.

Two existing federal tax programs—the Section 45Q tax credit for sequestration of carbon and Master Limited Partnerships—were frequently cited as examples of government tools that would have greater positive impact if they were expanded to embrace carbon reduction technologies.

Broad support for increasing and expanding the Section 45Q tax credit for carbon capture, utilization and storage (CCUS) development.

This idea garnered diverse support across the economic and political spectrum, as reflected in a letter sent in November 16, 2016 to the U.S. Senate Finance Committee leadership by a diverse coalition—including coal, oil and technology companies, labor unions, and environmental non-governmental organizations—requesting that the Section 45Q tax credit for CCUS projects be increased and expanded in the tax reform bill that was then under discussion.⁷⁵

As part of its Bipartisan Budget Act of 2018, signed into law by President Trump in February 2018, Congress responded by significantly increasing and expanding the Section 45Q tax credit for carbon capture, utilization and storage operations.

That action was "the culmination of a leadership deal on tax extenders spanning many months," said Colin Marshall of **Cloud Peak Energy**. The new law increases the tax credit from \$10 to \$35 per ton for CO₂ stored in an enhanced oil recovery operation or used in other products and from \$20 to \$50 per ton for CO₂ sequestered in geologic storage. "Lifting the program cap resulted in the program becoming subject to a commence construction deadline of January 1, 2024 for a project to be eligible to claim the credits and removes the uncertainty that was attributed to the original program."

73 EveryCRSReport.com. (2017). The advanced nuclear production tax credit. Retrieved from <https://www.everycrsreport.com/reports/IN10725.html>

74 Kotek is referring to the V.C. Summer 2 and 3 reactors in South Carolina that South Carolina Electric & Gas and Santee Cooper cancelled in July 2017. The reactors were 40 percent completed at the time of cancellation.

75 Hollub, V. A., Perciasepe, B., Anderson, B. D., Crabtree, B., Angielski, S., Slone, D., et al. (2016). Letter to Chairman Orrin Hatch and Ranking Member Ron Wyden of the U.S. Senate Committee on Finance. Retrieved from http://carboncapturecoalition.org/wp-content/uploads/2017/11/45Q_LettertoSenateFinance_11.16.16.pdf

Lee Anderson, Director of Government Affairs for the **Utility Workers Union of America**, described CCUS as “a technology that has been embraced and endorsed by both sides” and cited the Carbon Capture Coalition as “one of the most amazing political coalitions I’ve been a part of.” He said that “on one hand, there is the **Clean Air Task Force** and on the other hand we have **Peabody Coal, Arch Coal, and Occidental Petroleum**. There are also pipeline operators. It’s very focused on carbon capture technologies, legislation, and policy support.”

In addition to its support for expanding Section 45Q, the coalition is also advocating for ongoing public investment in CCUS technology and demonstration plants. “There is the Petra Nova plant in Texas, but we need more of that, particularly with the third and fourth generation technologies of CCUS.⁷⁶ We’re going to burn a lot of coal, at least globally, and those emissions can either go into the air or we can try to deal with them responsibly,” Anderson said.

“If a coal plant can make money by selling the CO₂ credits by burying it in the ground then that will help the economics of these plants.”

LEE ANDERSON, UTILITY WORKERS OF AMERICA

Utilities are shutting down coal plants “because they don’t make economic sense any longer,” he added. “If a coal plant can make money by selling the CO₂ credits by burying it in the ground then that will help the economics of these plants.”

ArcelorMittal supports expanding the 45Q tax credit to include carbon utilization beyond enhanced oil recovery, but with this twist: they advocated clarifying that qualifying carbon include “other carbon oxides” because steelmaking produces carbon monoxide. Finding alternative uses for carbon monoxide would “improve the economics of avoiding flaring,” Tom Dower said.

The steel producer is building a demonstration project at its Ghent, Belgium steel mill that would convert blast furnace off-gases to ethanol using another company’s bacteria-based process, which it believes will show that recycling carbon is a successful concept and can reduce CO₂ emissions. Dower said he would welcome the availability of Section 45Q tax credits for such “utilization usage” projects in the United States.

Calls for expanding Master Limited Partnerships to include renewable energy developers.

Master Limited Partnerships (MLPs) are publicly-traded limited partnerships established by federal tax law that provide tax benefits for the investing partners. As pass-through “partnerships,” they are allowed to avoid corporate tax rates. Current law allows the creation of MLPs for activity in certain sectors, such as oil, gas and petroleum products, coal, and timber, but not for renewable energy development, such as wind or geothermal energy.

Three existing categories of energy MLPs are allowed: upstream MLPs involved in exploration, recovery and development of crude oil and natural gas; midstream MLPs involved in gathering, storage and transportation of fuels; and downstream MLPs involved in the distribution of fuels to end users. Advocates for expanding the MLP accessibility to include renewable energy argue that wind, solar and other projects have development characteristics that are similar to pipelines, drilling rigs and other energy infrastructure, such as long-term contracts, significant hardware, cash flows and energy generation.

An array of respondents, from the **American Wind Energy Association** to **Prelude Ventures**, said MLP’s should be expanded to include any form of energy generation and development. Excluding renewable projects is unfair and extending this mechanism to renewable developers will help raise needed investment funds for projects, they said.

Gabriel Kra of **Prelude Ventures** said, “MLPs should include any form of energy generation and development. Why should it be particular to just fossil fuels? This is a simple argument; the MLPs are an incredibly attractive way to generate investment funds.”

⁷⁶ According to the U.S. Energy Information Administration, “The Petra Nova facility, a coal-fired power plant located near Houston, Texas, is one of only two operating power plants with carbon capture and storage (CCS) in the world, and it is the only such facility in the United States.” See <https://www.eia.gov/todayinenergy/detail.php?id=33552>

Even as there is strong support for taking this step, however, companies and investors say they have other tools in the toolbox to raise capital and make the finances of their renewable projects work. In **Altus Power's** case, the MLP tool has become less crucial as other sources of capital have become available to them. "Diverse pools of institutional capital have grown significantly in recent years and are focused on renewables as an attractive infrastructure asset," said Gregg Felton.

Similarly, Michael Skelly of **Clean Line** said that the Production Tax Credit for wind has an economic advantage over MLPs, as both are currently constructed. "Today the PTC is worth about \$20 over the life of the product. With MLPs it was in the \$7 to \$8 megawatt per hour range. It's not a substitute for PTC." In an additional consideration, the reduction in corporate tax rates included in the tax reform passed by Congress and signed into law in December 2017⁷⁷ may have made MLPs somewhat less attractive, Skelly said. "MLPs will also be less valuable in a world of a 20 percent corporate tax rate."

C) Ending or curbing subsidies for fossil fuels will level the playing field for renewables energy, some contend.

The importance of policies establishing or protecting a "level playing field" for the various actors in the energy economy was voiced by leaders across sectors, with a number pointing to what they described as ongoing subsidies for fossil fuels and related technologies that have been mature for decades.

"The tax landscape is incredibly skewed towards fossil industry," Gabriel Kra of **Prelude Ventures** said. "It's in the billions to oil, coal, and gas companies. It's nowhere near that for renewable energy and renewable developers." Kra said that he was comfortable with the renewable energy tax credits being phased out, but thinks that subsidies for fossil fuels should be eased out at the same time. "We need to thoughtfully consider how to increase low carbon technology, and look hard at where we subsidize coal and other fossils."

"The two major issues are the Master Limited Partnership (that allows investors to) avoid taxes on oil and gas exploration and accelerated tax depreciation on oil and gas drilling assets. These aren't available to other industries. When you have a specific industry tax break, that skews the scale," said Bill Weil of **Tempest Advisors**. "Typically, you want these subsidies to go to new or nascent industries, but this is a hundred-year-old industry that's still receiving subsidies. And we're not even talking about the externalities."

Weil said that in securing an agreement to end oil and gas subsidies, he would "happily trade a wind down on all subsidies to renewable energy for that."

"If utilities make investments in fossil fuel-based generation and infrastructure, which then lose their cost competitiveness in the coming years, that may force consumers to pay for stranded assets that no longer provide benefits to them."

DAVID MILLER, CLEAN ENERGY VENTURE GROUP

On the other hand, Kyle Isakower of the **American Petroleum Institute** questioned the characterization of cost recovery rules as a subsidy to his industry. "In terms of the subsidy question, we take exception to cost recovery provisions in tax law being labeled as 'tax subsidies,'" he said. "A subsidy is when the government is paying you to do something. Today, what are referred to as subsidies are just cost recovery provisions in the tax code. The cost recovery provisions in the tax code are similar to other industries. It's apples and oranges when comparing to subsidies and it's not accurate to say that our industry is currently receiving subsidies."

One argument was that as clean energy expands and pressure to reduce carbon in every corner of the economy only grows, policies that encourage continued use of fossil fuels could lead to consumers shouldering the cost of stranded assets when demand for oil, coal and even natural gas eventually evaporates.

⁷⁷ The Tax Cuts and Jobs Act of 2017.

“If we are talking about existing policies, it would behoove one to de-emphasize making significant new structural investments in fossil fuel,” said David Miller of the **Clean Energy Venture Group**, as there “will be a tremendous risk of stranded assets.”

“If utilities make investments in fossil fuel-based generation and infrastructure, which then lose their cost competitiveness in the coming years,” he explained, “that may force consumers to pay for stranded assets that no longer provide benefits to them.”

One example of that risk is recently constructed natural gas pipelines or new pipelines that may be on the drawing boards, said his colleague Dan Goldman. “In building new gas pipelines in recent years, that’s a no risk investment for the owners or for regulated utilities. But, at the end of the day, if after ten years we don’t need that gas because we have solar, wind or other more cost-effective options, we as consumers will still have to pay for the sunk cost of the pipeline. We need to be more forward thinking in our investment strategy and require developers to take the risk if they want the return and remove the burden from consumers.”

D) Investors prefer that companies and technologies not be reliant on public policy for financial success, but value government’s investments in discovery science to help young technologies take root.

Investors in clean and efficient energy consistently said they look for young companies or technologies that are not reliant on governmental policies, investment or subsidy to succeed commercially. This preference stems in great part from what they see as the unreliability of public policies, which can change at any time with the change of executive administrations or leadership in the legislative branch.

Even with that bias, these same investment leaders frequently place a high value on selected government policies and programs that help young technologies and companies make the often-precarious journey from a start-up enterprise to a revenue-positive operation with fully commercialized products and services.

The **Clean Energy Venture Group’s** Daniel Goldman articulated this view: “For a company to really have impact they have to be profitable. We look at companies to see whether or not they would survive without policy incentives. If there is a price on carbon or an ITC or PTC, that’s an upside, but the fact of the matter is that we want to see a company that will stand on its own two feet.”

“We ultimately want to see technologies less dependent on subsidies or particular policies at the national and sub-national levels. But the key to driving wide scale deployment of cleaner technologies has to be their ability to compete with incumbent technologies without any subsidies.” ANDREW SHAPIRO, BROADSCALE GROUP

Andrew Shapiro of the **Broadscale Group**, agreed. “We ultimately want to see technologies less dependent on subsidies or particular policies at the national and sub-national levels. I believe there is a role for tax credits, loan guarantees, grants from ARPA-E. But the key to driving wide scale deployment of cleaner technologies has to be their ability to compete with incumbent technologies without any subsidies. Then it’s free from being economic in one state and not another.”

“Broadly speaking, we focus on investing in companies that do not require a regulatory, policy or legal shift to be successful,” remarked Gabriel Kra of **Prelude Ventures**. “I don’t want to invest in a company that says ‘here’s what we’re doing and when this law gets passed, we’ll be vastly profitable.’ This is outside the level and type of risk we want to take. We’ll take market and technology risk, but I don’t want to take regulatory risks.”

However, Kra added, his firm does invest in some companies that “would be negatively impacted by regulatory risk” when the investment opportunity is otherwise attractive. “There are companies in our portfolio that rely on existing regulatory structure. If those regulatory structures come under attack, then our company is at risk.”

“Lots of investors prefer not to rely on government policy,” said Kyung-Ah Park of **Goldman Sachs**. Yet, she said, “policy, technology, and capital all have to work in concert. Policy was crucial in the early stages (of clean technology deployment).”

Volta Charging, committed to “accelerating the conversion to electric vehicles and therefore a low-carbon future,” is an example of a company whose business model is designed to flourish without government policies or subsidies. Its business model funds its electric vehicle charging equipment—stationed, for example, at most of the Whole Foods store parking lots in the Los Angeles area—by selling advertising on screens integrated into its recharging stations.

“The visual panels on the charger generates revenue to allow us to install the stations for free, paying for all maintenance, striping, trenching, boring and landscaping,” explained Ben Foss of **Volta Charging**. “We provide free charging to the public, covering all electricity cost, as much as they want with a Level 2 charger. We build the business with zero government dollars; we act largely independent of what happens with policy and as result we’ve been growing fast.”

E) Support for Obama-era federal vehicle fuel economy standards is strong; some seek changes.

During the Obama administration, the Environmental Protection Agency (EPA) and National Highway Traffic Safety Administration (NHTSA), working with the state of California and the major vehicle manufacturing companies, jointly promulgated two rounds of more stringent national greenhouse gas emissions and fuel economy standards for passenger cars and light trucks (i.e. pick-up trucks, SUVs and mini-vans).⁷⁸ The first round, announced by President Obama in May 2009, set new standards for model years 2012 to 2016, with a target of 35.5 miles per gallon by 2016 (up from 25 miles per gallon in 2009). The second round, announced by President Obama in January 2011⁷⁹, covered the model years 2017 to 2025 and set the 2025 average fuel economy of the American passenger vehicle fleet at the equivalent of 54.5 miles per gallon.⁸⁰ The President was joined at the 2011 announcement by the CEOs of 13 vehicle manufacturing companies, including **Ford, Motor Co., General Motors, Chrysler, Honda, and Toyota**, as well as leadership from the **United Auto Workers**.

“Vehicles are more efficient than they were a few years ago. Fuel economy standards position U.S. companies to sell (our efficient vehicles) into China and other countries. The real threat would be if we did not have U.S. standards.”

JOSH NASSAR, UNITED AUTO WORKERS

EPA said that building on 2012–2016 standards and achieving the 2025 target will “reduce six billion metric tons of greenhouse gas emissions over the lifetimes of the vehicles sold in model years 2012–2025, save families more than \$1.7 trillion in fuel costs; and reduce America’s dependence on oil by more than 2 million barrels per day in 2025.”⁸¹ (The two federal agencies also promulgated the first-

78 White House. (2012). Obama administration finalizes historic 54.5 MPG fuel efficiency standards. Retrieved from <https://obamawhitehouse.archives.gov/the-press-office/2012/08/28/obama-administration-finalizes-historic-545-mpg-fuel-efficiency-standard>

79 White House. (2011). President Obama announces new fuel economy standards. Retrieved from <https://obamawhitehouse.archives.gov/blog/2011/07/29/president-obama-announces-new-fuel-economy-standards>

80 Analysis by the Center for Automotive Research in Ann Arbor, Michigan, calculated that after adjusting for “average real world fuel economy for new vehicles” and the flexibility that the standards give vehicle manufacturers, the model year 2025 “real world driving standard” will be closer to 40 miles per gallon. Source: McAlinden, S., Chen, Y., Schultz, M., & Andrea, D. J. (2016). The potential effects of the 2017–2025 EPA/NHTSA GHG/Fuel economy mandates on the U.S. economy. Center for Automotive Research. Retrieved from <http://www.cargroup.org/wp-content/uploads/2017/02/The-Potential-Effects-of-the-2017-2025-EPANHTSA-GHGFuel-Economy-Mandates-on-the-US-Economy.pdf>

81 United States Environmental Protection Agency. (2016). Regulations for greenhouse gas emissions from passenger cars and trucks. Retrieved March 30, 2018, from <https://www.epa.gov/regulations-emissions-vehicles-and-engines/regulations-greenhouse-gas-emissions-passenger-cars-and>

ever fuel efficiency and carbon emission standards for medium- and heavy-duty trucks in 2011 and issued more stringent follow-up standards in 2016.)⁸²

The federal regulators and the California Air Resources Board, at the time of finalizing the phase two rulemaking, committed to undertaking a “Midterm Evaluation” of the vehicle manufacturers’ ability to meet the longer-term standards for model years 2022–2025. According to the rule, EPA was required to determine by April 1, 2018 whether the 2022–2025 standards are achievable. In the same timing window, NHTSA is required to conduct a rulemaking process for the 2022–2025 standards.

EPA Administrator Gina McCarthy finalized her agency’s Midterm Evaluation Process, following an extensive, multi-year technology and economic analysis, by certifying in January 2017 that the 2017–2025 fuel efficiency standards are “appropriate.”⁸³ Following the 2016 Presidential election, CEOs from 18 vehicle manufacturing

companies wrote to President Trump in February 2017 asking for a “reset” of Administrator McCarthy’s Midterm certification and a “restoration of the process...without prejudicing the outcome.” Shortly thereafter, the Alliance of Auto Manufacturers⁸⁴ and the Global Automakers, each representing 12 automakers, wrote similar letters with the same request.

The Trump administration responded in March 2017 with a decision to reopen the EPA certification process. EPA and NHTSA opened a public comment period in August 2017 “on the reconsideration of the January 2017 Final Determination for greenhouse gas (GHG) emissions standards for cars and light trucks for model years (MY) 2022–2025”⁸⁵

On April 2, 2018, EPA Administrator Scott Pruitt announced the completion of the Midterm Evaluation for model years 2022–2025, with his final determination that, “in light of recent data, the current standards are not appropriate and should be revised.” He also announced the launch of a joint process with the National Highway Traffic Safety Administration “to develop a notice and comment rulemaking to set more appropriate GHG emissions standards and Corporate Average Fuel Economy (CAFE) standards.”⁸⁶

“The industry has made \$2.6 billion in investment commitment in the past five years. This company is betting on the continued expanded demand for lightweight materials like aluminum in the auto industry. The longer the (vehicle fuel-efficiency standards) are uncertain the longer these capital projects are held off and the more this capital is jeopardized.” HEIDI BROCK, ALUMINUM ASSOCIATION

82 From EPA’s website, where the full text of the Phase 2 rules can be found: The U.S. Environmental Protection Agency and the Department of Transportation’s National Highway Traffic Safety Administration jointly finalized standards for medium- and heavy-duty vehicles that would improve fuel efficiency and cut carbon pollution to reduce the impacts of climate change, while bolstering energy security and spurring manufacturing innovation. The final phase two program promotes a new generation of cleaner, more fuel-efficient trucks by encouraging the development and deployment of new and advanced cost-effective technologies. The product of four years of extensive testing and research, the vehicle and engine performance standards would cover model years 2018–2027 for certain trailers and model years 2021–2027 for semi-trucks, large pickup trucks, vans, and all types and sizes of buses and work trucks. The final standards are expected to lower CO₂ emissions by approximately 1.1 billion metric tons, save vehicle owners fuel costs of about \$170 billion, and reduce oil consumption by up to two billion barrels over the lifetime of the vehicles sold under the program. Source: United States Environmental Protection Agency. (2017). Final rule for greenhouse gas emissions and fuel efficiency standards for medium- and heavy-duty engines and vehicles - phase 2. Retrieved March 30, 2018, from <https://www.epa.gov/regulations-emissions-vehicles-and-engines/final-rule-greenhouse-gas-emissions-and-fuel-efficiency#rule-history>

83 Formally known as the “Final Determination on the Appropriateness of the Model Year 2022–2025 Light-Duty Vehicle Greenhouse Gas Emissions Standards under the Midterm Evaluation (Final Determination) which was announced on January 13, 2017.”

84 Bainwol, M. (2017). Alliance letter to EPA administrator Scott Pruitt regarding midterm evaluation of MY 2022–2025 GHG standards. Retrieved from <https://autoalliance.org/2017/02/22/alliance-letter-epa-regarding-midterm-evaluation-2022-2025-ghg-standards/>

85 United States Environmental Protection Agency. (2017). EPA, DOT open comment period on reconsideration of GHG standards for cars and light trucks. Retrieved from <https://www.epa.gov/newsreleases/epa-dot-open-comment-period-reconsideration-ghg-standards-cars-and-light-trucks>

86 United States Environmental Protection Agency. (2018). EPA administrator Pruitt: GHG emissions standards for cars and light trucks should be revised. Retrieved from <https://www.epa.gov/newsreleases/epa-administrator-pruitt-ghg-emissions-standards-cars-and-light-trucks-should-be>

Current vehicle fuel economy standards enjoy strong business and labor support; views differ on how to handle the Midterm Evaluation.

A common perspective on the existing federal vehicle fuel efficiency standards is that while they are ambitious, the advanced technology exists to meet them and they position U.S.-based auto manufacturers to be able to compete in car-buying markets around the world that increasingly want vehicles that are extremely efficient and have low- or zero-carbon emissions. However, there was disagreement among our respondents about how the scope of the mid-term review might impact long-term emissions reductions on the one hand and the global competitiveness of the U.S. auto industry on the other. Some interviewees were strongly opposed to EPA and NHTSA making significant changes or weakening the standards during the Midterm Evaluation, while others saw it as an important opportunity to provide manufacturers some sought-after changes.

“The way we do CAFE⁸⁷, with benchmarks and flexibility and phase-ins and technology choice, these policies work,” said Josh Nassar of the **United Auto Workers**. “Vehicles are more efficient than they were a few years ago. Fuel economy standards position U.S. companies to sell (our efficient vehicles) into China and other countries. The real threat would be if we did not have U.S. standards.”

Motor vehicle manufacturers have turned to light-weighting with high-strength materials as a key strategy to improve the fuel efficiency of their heaviest vehicles, and aluminum has emerged as an attractive material to incorporate into their designs. That has led much of the aluminum industry to support the efficiency standards.

“We’ve been active in letting (EPA and NHTSA) know about the benefits (of the 2021 fuel-efficiency standards) to the aluminum industry,” Heidi Brock of the **Aluminum Association** said. “We support regulatory certainty as a part of the reopened Mid-Term Review process. We support one national policy to include EPA, NHTSA, and California regulations. We support maintaining the 2021 fuel economy standard, and we’d like to see directional guidance on fuel economy standards for 2026-2030.”

The standards have also created what some believe is a healthy competition for the best materials that is driving innovation. An executive of an **industry trade group** said, “Policies like CAFE standards are helpful. They are driving innovation in steel.” He said that steel is lower cost than aluminum but said more research is needed to lighten its weight as a material for vehicles without reducing its strength.

“We think light weighting will continue regardless of what happens with the vehicle fuel-efficiency standard,” said John Donnan of **Kaiser Aluminum**. “As a country, it seems like an increasingly large part of the population generally likes the idea of fuel efficiency for some combination of both environmental reasons and reducing what we spend on gasoline.”

Consistency and certainty is as important to this policy as it is to many others, leaders said. We’ve been involved for ten years in helping the government establish robust emissions standards,” Brian Mormino of **Cummins** said. “If there is certainty about these targets and who needs to achieve what, then we’ll invest. We’ll put our engineers on it, and we’ll deliver.”

Meanwhile, one respondent said the standards are fueling manufacturing investments that the uncertainty of the mid-term review could jeopardize. “I recently attended a ribbon cutting for an expanded Aleris Co. automotive aluminum body sheet rolling facility in Kentucky,” reflected Heidi Brock of the **Aluminum Association**. “This is a world class facility that one doesn’t see built very often. The industry has made \$2.6 billion in investment commitment in the past five years. This company is betting on the continued expanded demand for lightweight materials like aluminum in the auto industry. The longer the (vehicle fuel-efficiency standards) are uncertain the longer these capital projects are held off and the more this capital is jeopardized.”

Outside the auto industry and its suppliers, other businesses expressed concern about the uncertainty caused by the Midterm Evaluation and its growing scope. One company that relies on trucking to distribute its products held up the fuel efficiency standards as a well-designed and helpful regulation.

87 CAFE is the acronym for Corporate Average Fuel Economy, referring to the vehicle fuel efficiency standards set by EPA and NHTSA.

“The standards are clear and let automakers go innovate on that clarity,” **an executive with that major corporation** said. “The in-again, out-again approach doesn’t allow industry to invest with the clarity that it needs to innovate. They level the playing field by providing clear, long-term guidance that everyone can operate from.”

The standards are helpful to the company in setting expectations down through their supply chain. “With our transportation suppliers, as they invest new capital, they know what they’re going to have to hit in regard to fuel efficiency standards,” the executive said. “We can make assumptions that we can build into contracts. We bake those CAFE rules in to the contractual relationship with our transportation suppliers.”

Others cautioned against major surgery on the standards. Daniel Goldman of the **Clean Energy Venture Group** expressed concern that the “car companies are pushing back” on the 2025 standards and are “being welcomed in D.C. with open arms.”

This is problematic because China is gearing up to sell a massive number of EVs over the next few years, he said. “They are really going to dominate this market down the road. I think we are just sending ourselves on another wild goose chase because the leaders of these American companies are saying all the right things but behind their backs their lobbyists are proposing to reverse the standards. I think we really need to see how Wall Street is going to respond to that because they should really view this as an existential threat to their long-term survival with both European and Chinese companies now producing an ever-increasing number of EVs at scale and they will end up selling these vehicles in the U.S. at lower cost than US companies can achieve.”⁸⁸

David Miller, also of the **Clean Energy Venture Group**, agreed: “Fuel economy standards are key. California leading the way on ambitious fuel economy standards makes our industry competitive with the rest of the world. If we don’t keep up with China, among other countries, then we will fall behind and lose all sorts of jobs.”

Some look to the Midterm Evaluation for desired changes to the 2025 standards.

The Midterm Review is a chance to update the standards to reflect more than just the miles per gallon metric, some from the automotive industry and its suppliers said.

Ford Motor Co. is one of the auto manufacturers that must respond to those rules. Curt Magleby said that government’s role is to “provide a cohesive impetus to move industry forward.” That means that “government needs to create a flexible framework for progress so that innovation can be at the forefront. Excessive regulation does have cost implications and impacts the consumer.”

The **American Iron & Steel Institute**, which was strongly opposed to the Obama administration’s certification of the 2022–2025 standards before it left office, called for regulators to consider the entire life-cycle of the vehicle and the “use phase and the end-of-life phase,” according to Tom Gibson. “We think we should not just be looking at the tail-pipe emissions, so that we’re not favoring one material over another. Steel is more recyclable than aluminum. Steel can be recycled and used again at its highest use. Steel is much less carbon intensive to produce. So, let’s look at the whole life-cycle.”

An auto industry executive who worked with EPA and NHTSA to shape the efficiency standards, said, “The Obama administration was a collaborative partner with us on mid-term review until three weeks after the election. We had good discussions with them, but we saw (EPA’s certification of the 2022–2025 standards) as a move to turn the process into a political football. That’s why the industry asked the Trump administration to get back to a data driven approach. Let’s look at the real technologies in play. What are the costs, the affordability, to achieve this?”

Some see the Midterm Evaluation and subsequent rulemakings as a chance to encourage broader technological innovations and more creative approaches to meeting ambitious targets. Observing that the fuel

⁸⁸ In other international developments, India and Norway have announced that they will only allow the sales of electric and hybrid vehicles by 2030, and France and Great Britain declared their intention to ban gasoline and diesel vehicles by 2040. China has signaled a similar intent but has not yet set a date.

economy standards for light duty vehicles began as a policy to reduce imported oil from OPEC⁸⁹ nations and that it “has been morphing into a greenhouse gas policy,” Tom Dower of **ArcelorMittal** said that the focus of the rules on tail pipe emissions “puts blinders on.”

“If you’re only looking at tailpipe emissions, the end of the line, that can create perverse incentives,” Dower said. “It is always efficiency that is promoted, but as you go to higher efficiency it is important to look at emissions in the production phase. When they shift from steel to other products (for light-weighting) they do this from a tailpipe perspective but ignore the upstream emissions. When an automotive manufacturer switches from steel to another product they only do that for the tailpipe emissions savings. They do not have to account for the overall resulting emissions.”

An **auto industry executive** echoed the point that fuel economy as a metric was defined in the 1970s, and “technologies are moving fast and this metric does not capture many of them.” He offered this case in point: “Start-stop technologies are not defined in the drive cycle, so we worked with the Obama administration to get those benefits recognized. An air dam is not seen in the drive cycle⁹⁰. We have to create flexibility for off-cycle credits. More and more electrification also makes the miles per gallon metric less and less relevant.”

“As we look to the future, the hardware is just one element. The driver use pattern is critical, as is the fuel. So, whether its electric, hybrid, or alternative fuel, we’re trying to measure something with a single measure and it’s not accounting for things beyond the hardware,” the executive said.

The **United Auto Workers** is looking for more information from the manufacturers during the Midterm Evaluation process. “We want a consensus process,” Josh Nassar said. “A lot of lawsuits or bad bills on (Capitol) Hill is not good. We want a predictable course of action over a long period. What kind of honest broker will this EPA be? The basic model of the program should remain but there may be some small details to review.”

He said that the EPA process under the Obama administration was a good one. “There was a willingness to listen to industry. Anyone who says otherwise is just not telling the truth. As far as the results, the standards are stiff and will be hard to reach. I thought it was ambitious.”

F) State renewable portfolio standards are seen as economic development policy and have a strong record of catalyzing new markets.

Twenty-nine states plus the District of Columbia and three U.S. territories have adopted renewable portfolio standards (RPS)⁹¹, which require utilities in those jurisdictions to generate or purchase a percentage or specified amount of their electricity sales from wind, solar, biomass and other forms of renewable energy. Another eight states have voluntary renewable portfolio targets.

First-mover Iowa was followed by Nevada and Massachusetts adopting renewable portfolio standards in 1997, Wisconsin and Connecticut in 1998, and Texas, Maine and New Jersey in 1999. Hawaii has the most ambitious renewables mandate: 40 percent by 2030 and 100 percent by 2045. California and New York are among the next-most aggressive at 50 percent by 2030.⁹²

Many states have met or exceeded their RPS targets and a number have increased the stringency of their targets over time. For example, since 2016 alone, Maryland, Michigan, New York, Rhode Island, Oregon and the District of Columbia have increased their RPS targets.⁹³ Arizona, Michigan and Nevada are expected to

89 Organization of Petroleum Exporting Countries.

90 President Obama’s vehicle efficiency rules gave automakers an off-cycle credit for air dams.

91 Also known as renewable electricity standards.

92 Durkay, J. (2017). State renewable portfolio standards and goals. National Conference of State Legislatures. Retrieved from <http://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx>

93 Barbose, G. L. (2017). U.S. renewables portfolio standards: 2017 annual status report. (LBNL-2001031). Lawrence Berkeley National Laboratory. Retrieved from <https://emp.lbl.gov/publications/us-renewables-portfolio-standards-0>

have ballot referenda in 2018 that would increase their renewable targets.⁹⁴ A number of governors and state legislatures have attempted to cancel or weaken their state's RPS, but none have done so successfully.⁹⁵

The closest that Congress has come to establishing a federal renewable energy standard was in 2009, when the Senate Committee on Energy and Natural Resources, under the leadership of then-Chair Jeff Bingaman of New Mexico, reported out a national mandate of three percent renewable energy by 2013. The full Senate did not take up and pass that provision. In his 2011 State of the Union address, President Barack Obama called for a similar national standard with a target of 80 percent clean energy by 2035, but Congress did not act on that proposal.⁹⁶

While offsetting electricity produced from polluting sources is often the inspiration for renewable standards, in many states utilities, renewable developers, investors, grid managers, and host communities have discovered over the last two decades that this policy approach is yielding impressive economic benefits as well. Those include downward price competition with more traditional energy sources, investment and jobs that accompany construction, assembly, maintenance and repair of wind and solar installations, and expanded tax revenue for communities.

“Renewable electricity standards are about economic development,” said Peter Rothstein of the **Northeast Clean Energy Council**. “You can only understand states’ policies if you understand that they are primarily interested in economic development; they are not simply ‘into’ renewable energy for itself.”

“Renewable electricity standards are about economic development. You can only understand states’ policies if you understand that they are primarily interested in economic development.”

PETER ROTHSTEIN, NORTHEAST CLEAN ENERGY COUNCIL

An economic motivation is ultimately necessary for widespread adoption of clean energy, he said, and the reduction of greenhouse gas emissions is among the benefits even if it's not the primary plus for some investors. “(T)he end result is good for the climate even if the motivation boils down to economic motivation— attracting investment and avoiding the costs and risks of not reducing carbon. Everyone needs to be able to feed their families and have a job.”

Government signals “from the top like the RPS have been incredibly helpful,” said Danny Kennedy of the **California Clean Energy Fund**. “The RPS phenomenon has been fantastic.” He described the experience with California’s renewable portfolio standard from its 2002 beginnings through today as one in which “policy works in setting the stretch goals and the market delivers.”

“We (originally) got ten percent renewable energy no problem, then (set the goal at) 25 percent and beat it easy, along with screaming from incumbents,” he related. “Thirty-three percent, same story, 50 percent on track to beat it easy. There’s a bill in the state legislature for 100 percent renewable energy, and to bring forward the 50 percent goal to 2025.

With the cost of wind and solar dropping sharply over the past decade and a growing number of corporations buying renewable energy directly, some are asking whether renewable portfolio standards have completed

94 In a companion policy approach that has also been successful, 26 states have established energy efficiency standards (EES) that set binding energy savings targets. Approaches have varied state-by-state, and include “passing legislation to enact formal energy efficiency resource standards, setting long-term energy savings targets through utility commissions tailored to each utility, or incorporating energy efficiency as an eligible resource in renewable portfolio standards (RPS),” according to the American Council for an Energy-Efficient Economy (ACEEE). Under these laws, utilities or third-party administrators are required to meet those targets by providing energy efficiency programs to customers. After Texas wrote the first energy efficiency standard, it was quickly followed by Vermont in 2000 and California, Hawaii and Pennsylvania in 2004. Source: American Council for an Energy-Efficient Economy. (2017). State energy efficiency resource standard standards (EERS). (Policy Brief). Retrieved from <http://aceee.org/policy-brief/state-energy-efficiency-resource-standard-activity>

95 The only state to roll back an energy efficiency standard is Indiana, when the state legislature passed a bill to do so and then-Governor Mike Pence allowed it to become law by taking no action in the prescribed period of time.

96 President Obama’s clean energy definition, for the purposes of the 80 percent target, included wind, solar, nuclear, clean coal and natural gas.

their job of jump-starting the industry and have outlived their usefulness. Several leaders said Renewable Portfolio Standards continue to have an important role even as the industry matures.

“The RPS still acts as a pull factor which drives the market,” said Kyung-Ah Park of **Goldman Sachs**. “With the costs (of wind and solar energy) coming down we’re seeing scale. Corporates are now stepping up and doing power purchase agreements due to low cost of renewables and their long-term price certainty. The combination of these leads our analysts to be bullish on the U.S. renewable energy sector even in the absence of direct federal policy support.”

Tom Kiernan of the **American Wind Energy Association** said renewable portfolio were “historically really important and we still think they’re an important strategy going forward.” Nevertheless, “many states have blown past their RPS targets (and they) are no longer the driver of demand, but they got things going,” he continued. “A number of states are upping their standards. California, for example, has a target of 100 percent for renewables. That has been conceptually politically important and has in some cases forced utilities to buy renewables.”

One **clean energy executive** said that in the energy domain, “nothing has been more consequential in the past ten years than state Renewable Portfolio Standards.” However, he added, “they are nowhere near sufficient and they haven’t (had) the stringency we need.” To address that, he said, “If I could wave a magic wand and fast forward post-2018, in states where they have a current RPS that could be made more stringent through the legislature and...where they would thus outpace the ITC and PTC as a lever, that would be a good, near-term thing. These RPS’s should be ratcheted up.

“If I could wave a magic wand and fast forward post-2018, in states where they have a current RPS that could be made more stringent through the legislature and...where they would thus outpace the ITC and PTC as a lever, that would be a good, near-term thing.” CLEAN ENERGY EXECUTIVE

How utilities decide to meet a state’s RPS targets can depend on what the best renewable resources are in that state and, as importantly, what’s the best buy for ratepayers’ money. “The Michigan renewable electricity standard goal just increased from ten percent to 15 percent with a longer-term goal of 30 percent,” Skiles Boyd of **DTE Energy** explained. “We’re deploying mostly wind now, but the cost effectiveness of solar will improve by 2025, and things will start flipping and we’ll be doing a lot of solar in Michigan due to falling photovoltaic costs.”

Public policy is a key ingredient, said Gregg Felton of **Altus Power**, but the economics and business climate must work as well. He held up Massachusetts as an example of a state that “either through a direct financial incentive or through some administrative flexibility, creates a framework that encourages a business model like ours.” Elaborating, he said “the state is creating the right framework for all the various stakeholders. There is an important policy initiative, but the various people saying yes to these projects are saying yes due to the economics.”

G) Renewable energy developers seek to streamline permitting and environmental review at the federal and state levels.

Companies that mine coal and drill for oil and natural gas have long advocated for faster and simpler processes for applying for and securing permits at the federal level, when the proposed activity is on public lands, and the state level, where regulation of drilling and mining on private lands typically takes place. As more renewable energy projects are proposed on public land or involve crossing multiple state boundaries to transmit its electricity from the wind and solar fields to urban areas—thus requiring approvals from federal agencies such as the Department of Interior, Department of Energy and Federal Energy Regulatory Agency (FERC) as well as state agencies—the renewable energy sectors’ advocates find themselves making comparable arguments for a more efficient and timely permitting process.

“It’s the permitting and siting that is holding these (wind and solar) projects up,” said Donnie Colston of the **International Brotherhood of Electrical Workers**. “An easier path through permitting and siting would allow investor-owned utilities to invest more and create a number of jobs for our sector.” Tom Kiernan of the **American Wind Energy Association** said that the “one potential positive of President Trump’s energy policies is his initiative on regulatory reform—to the extent that it encourages the Interior Department to streamline the permitting process for wind projects.”

Transmission infrastructure is a key and often complicating element of any renewable project because it is linear and typically passes through different land ownerships and, sometimes, sensitive areas with environmental considerations such as habitat for rare flora and fauna. But lengthy environmental and jurisdictional reviews can add so much time to a project timeline that even if ultimately successful, investors will move onto their next project, some said.

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DONNIE COLSTON, INTERNATIONAL BROTHERHOOD OF ELECTRICAL WORKERS

“So many of our construction projects are dependent on moving generation to the load. The grid is the key and there is a lot of instability before an investor knows if a project will be viable,” Donnie Colston of the

International Brotherhood of Electrical Workers said. “The time to build a transmission project is five to eight years, which is way too long for private capital.”

Colston pointed to the “tremendous job growth opportunities for us with these new transmission projects. A University of Massachusetts Amherst study found that 18,000 jobs are created for every \$1 billion in infrastructure investment. Yet, “no one is prepared to spend the huge amount of money on training for projects that won’t come online,” he said. One example of a transmission project that “took eight years before it was finally approved (by the federal government)” is the Northern Pass project that the utility **Eversource** is proposing to transmit electricity from **HydroQuebec** to homes and businesses in New Hampshire and Massachusetts, Colston said.⁹⁷

Planning and siting new transmission lines across multiple state borders is essential for wind energy but also extremely challenging, Tom Kiernan of the **American Wind Energy Association** said. That leads him to propose that responsibility for reviewing and permitting transmission lines be moved to a federal agency that has longstanding experience with permitting new natural gas pipelines.

“It’s cumbersome to site new transmission lines. It’s a whole lot easier to site new natural gas pipelines. FERC does it every day of the week. We think one of the potential solutions is delegation of transmission siting authority from DOE to FERC,” Kiernan said. Referring to the Fixing America’s Surface Transportation (FAST) Act passed by Congress and signed into law by President Obama in December 2015, Kiernan said “I know the FAST Act and the White House are responsible for increasing the rate of siting wind transmission

97 The Northern Pass project is a 192-mile transmission line with a capacity of 1,090 megawatts that would start in Pittsburg, N.H. at the Canadian border and run through the White Mountains to a converter terminal in Deerfield, N.H. before continuing on to Massachusetts. The initial application for a Presidential Permit for Northern Pass was submitted to the U.S. Department of Energy (DOE) by Eversource and Hydro-Quebec in October 2010. DOE issued the Presidential Permit in November 2017. A selection panel appointed by the Commonwealth of Massachusetts conditionally selected the Northern Pass project from among 46 transmission proposals on January 25, 2018, but a week later, on February 1, the New Hampshire Site Evaluation Committee unanimously rejected the Northern Pass project and subsequently issued its final written decision on March 31, 2018. On March 28, 2018, the Massachusetts selection panel terminated its conditional selection of the Northern Pass proposal. See <http://www.northernpass.us/project-overview.htm>

lines. We have to figure out a way to speed up the federal permitting process for wildlife and transmission purposes. We need more transmission lines faster.”⁹⁸

A related idea is to encourage the Federal Regulatory Energy Commission (FERC) and the states to work more closely together on national transmission needs, since “FERC acts quicker than states” and projects tend to get held up in the states, said Austin Keyser, Director of Political and Legislative Affairs at the **International Brotherhood of Electrical Workers**. “How do we get FERC and states to work together, and get FERC to lead national planning?”

“It’s hard to go to private markets when regulation is so different from state to state or regional grid operator to regional grid operator. The DOE has limited ability help cross state transmission issues—it has only used its S1222 authority once,” Keyser said. “FERC coordination with regional organizations on transmission lines and having them plan together rather than developing individual plans, would help reduce cost.”

Wind and utility-scale solar developers often must work with the U.S. Fish & Wildlife Service to navigate the Endangered Species Act if there’s a possibility of at-risk plant and animal species that could be adversely affected. Tom Kiernan of the **American Wind Energy Association** said that “working with the U.S. Fish and Wildlife Service can be, at times, a challenge and we would say that the bureaucracy can be a significant hindrance to wind deployment.”

Kiernan continued: “The U.S. Fish and Wildlife Service permitting can be very helpful and very burdensome. It’s all about how quickly permits can be obtained with whatever mitigation or minimization happens. From our view, the requirements of mitigation are not as important as the speed of securing a permit. Companies are willing to invest and change the design of their wind farm as long as they can move forward and build it into their plans.”

A positive step forward would be if the Regional Transmission Operators took on a more robust and far-sighted role in assessing multi-state transmissions needs and planning regional transmission infrastructure, Keyser said. “A big piece is getting regional grid operators to coordinate on their planning. No one wants to tell them that they have to do it. They’re encouraged to do it, but no one says they have to do it. We’re going to have to move generation to load centers at different points of the day. This is different from just building power plants near load centers. A more viable alternative is to force regional grid operators to coordinate on transmission.”

⁹⁸ The [Fixing America’s Surface Transportation \(FAST\) Act](https://www.fhwa.dot.gov/fastact/legislation.cfm) (Pub. L. No. 114-94, see <https://www.fhwa.dot.gov/fastact/legislation.cfm>) provided long-term funding for surface transportation infrastructure planning and investment, authorizing \$305 billion over fiscal years 2016 through 2020 for highway, highway and motor vehicle safety, public transportation, motor carrier safety, hazardous materials safety, rail, and research, technology, and statistics programs. The law includes provisions to continue “efforts to streamline project delivery.” See <https://www.fhwa.dot.gov/fastact/>



Policy Finding 8: Corporate policies and strategies are moving the clean energy economy forward, often dramatically.

The degree to which private sector policies and strategies have become an important driver of advancing climate solutions emerged from the interviews as a key finding. Businesses are now seen as a major force alongside governmental policies for catalyzing action. For instance, the decision by a growing number of large companies to purchase renewable electricity directly for their large data centers and other needs has heightened demand while expanding economic development at the state level.

A) Direct purchase of renewables by large companies is a new pathway to meet corporate electricity needs and clean energy goals.

Price stability and growing commitment to sustainability merge.

Companies across the economy, initially led by large internet and technology companies, are purchasing renewables outside the regulated utility sector, through power purchase agreements negotiated directly with wind and solar energy developers or through investing directly in those projects, or both. In many instances, the companies are setting ambitious goals to purchase zero-carbon energy, with an increasing number setting the goal of 100 percent renewable energy by a particular date.

Many of these companies are working with initiatives such as the **Renewable Energy Buyers Alliance** (REBA) and the **Advanced Energy Buyers Group** (AEBG). Those initiatives' memberships show the breadth of this movement to directly secure clean energy outside the traditional utility model.

The Renewable Energy Buyers Alliance, which set a goal to help corporations purchase 60 gigawatts of additional renewable energy in the U.S. by 2025, counts among the 73 companies that have signed their Renewable Energy Buyers' Principles **Kaiser Permanente, MacDonald's, AT&T, Yahoo, Unilever, EBay, Target, 3M, Ikea, Volvo, Genentech, and Hewlett Packard. The Advanced Energy Buyers Group**, which was established by **Advanced Energy Economy**, is a coalition of "advanced energy purchasers who have come together to engage on the energy policy issues that will help them achieve their ambitious clean energy targets."⁹⁹ Its corporate participations include **Google, Microsoft, Apple, Facebook and Amazon.**¹⁰⁰

"The irony is that these companies are now buying renewable energy at a scale that they would have never predicted," said Marty Spitzer at **World Wildlife Fund**. "These companies can cut their energy costs significantly. Renewables used to be the side show. Now they're the main event. And, they are helping to scale company ambition to set science based goals, something that wouldn't have happened just two years ago. Everybody is doing renewables now, It becomes so normal for corporates to look at renewables first, that you can't reject this trend."

Spitzer said that the corporate members of **REBA** "want to be responsible for bringing additional renewables onto the grid, in collaboration with utilities. The companies expect the benefits to be more resiliency, better pricing, price stability. This is about meeting their stakeholders' needs and the economics."

"Eighty-four multi-nationals have committed to 100 percent renewable energy by 2050," Kevin Self of **Schneider Electric** said. "These companies aren't only in the U.S., they're answering to the entire world and they're not waiting around for policy in the U.S. to align with their goals and objectives. All the conversations among these companies are around how we're moving to deep decarbonization."

⁹⁹ See <https://www.aee.net/contact/ae-buyers>

¹⁰⁰ A number of corporations belong to both REBA and AEBG, such as Google, Facebook, Amazon, Microsoft, Target and Walmart.

The companies engaging in direct purchase of renewables cite the fact that wind and solar energy are now cost-competitive with traditional sources and that locking in contracts for large amounts of renewable energy provide welcome price stability.

Mars Hanna of **Google** said that his company is the largest corporate purchaser of renewables around the world, with total procurement of nearly three gigawatts to date. “We’ve done 22 deals across three continents. This includes wind in the U.S. and northern Europe, as well as solar in the U.S. southeast and Chile.”

“We’ve seen the cost of wind and solar come down significantly in the last decade. Between 2010 and 2017 the cost of wind came down 66 percent and the cost of solar came down 86 percent. In a growing number of markets, the levelized cost of renewable energy is on par with or lower than the average wholesale price of electricity on the grid,” Hanna said.

As a company with large power data centers that consume high amounts of electricity, **Google** believes it has found a solution that makes good business sense while reducing adverse environmental impacts created by that energy demand. “The financial case for purchasing renewable energy resources is strong,” Hanna said. “Because energy resources like wind and solar have no fuel inputs, once they are constructed it’s easy to set a fixed price for the energy they produce. If we can pay that fixed price on our retail bill at our data center, that gives us important certainty in our electricity expenses.”

Julia Hamm of the **Smart Electric Power Alliance** observed that corporate direct purchase of renewables has been picking up its pace in recent months and is “a great non-policy driver to get renewables moving at a faster pace.” She flagged several factors that are motivating this trend, but with the attractive economics at

the top of the list. “Part of it is purely...a financial driver in terms of being able to secure power at a known price, eliminating volatility. And then because solar and wind have come down so much in price it’s become very price competitive. Now we are also seeing very high-level sustainability commitments.”

Graham Richard, formerly of **Advanced Energy Economy**, agreed that companies are directly purchasing renewable capacity because they expect to be more resilient, save money, and ensure price stability.

This direct purchasing of power is disrupting the traditional utility model and capturing the attention of state officials, who traditionally have the lead on regulating electricity generation and distribution within their borders. Large energy buyers are moving the needle on renewable

energy policy at the state level, Richard said, in great part because **REBA’s** 60-gigawatt goal by 2025 would bring on as much renewable energy as the Clean Power Plan, “but more quickly.”

That is creating competition among the states for these large corporate investments. However, not every state has the capacity—or current plans to produce the capacity—to meet many of the companies’ ambitious renewable goals. “(I)f you’re a large company and have a 100 percent renewable energy goal and you have a 2025 timeline, and the local utilities are moving too slowly, then you can’t get to your aggressive 100 percent goal. So, companies realize that in order to get to their goals they have to go and purchase the renewables themselves,” Richard said. “Those companies like **Amazon** who pledge to buy 100 percent renewable energy need a state that meets their criteria,” he said. “The Governor of Indiana is now scratching his head and saying he’d like to court the new Amazon headquarters, but he has 74 percent coal on the Indiana grid.”

As **Google** has pursued its own goals to develop and secure access to renewable energy, it has simultaneously focused on designing approaches that other companies can also use, said Mars Hanna. “Since the early days of corporate renewable energy deals that began around 2010, corporate purchasing has become a category of its own. Google has tried to be a leader not only in forging new purchasing pathways that meet our own supply needs, but that also create structures and models that work for many companies. You shouldn’t have to be a Fortune 100 (company) to get renewable energy.”

“The financial case for purchasing renewable energy resources is strong. Because energy resources like wind and solar have no fuel inputs, once they are constructed it’s easy to set a fixed price for the energy they produce.”

MARS HANNA, GOOGLE

“Our understanding is that all of these large corporate buyers don’t just want to buy RECs¹⁰¹, they want to buy things that result in putting projects in the ground,” said Julia Hamm of the **Smart Electric Power Alliance**. “In many cases that requires (state energy) commissions to think about things a little differently.”

Tom Kiernan at the **American Wind Energy Association** welcomes the corporate direct purchases of wind energy, noting that in the third quarter of 2017, 62 percent of Power Purchase Agreements were by corporations. But then, he cited a concern: “Corporates have long term goals. They can buy clean renewables now or they can wait for a year and buy then. They can be patient and buy when the price is right. That just adds less urgency to the deployment of wind, which is important for us.”

B) Companies that set ambitious GHG-reduction targets improve their company environmental performance, often irrespective of government policy.

As more companies of all sizes recognize the potential harm of the emerging impacts of climate change on their business models and are pressed to respond to government policy and stakeholder concerns, they are formulating internal policies and targets to reduce greenhouse gas emissions. Those private-sector policies and practices, leaders across the economy said, are leading to strikingly positive results in company environmental and financial performance. While these company policies may assist any given company in meeting government regulatory requirements, they are also taking on an independent life of their own and, nearly universally, are proceeding independent of changes in federal or state governmental policy.

Concrete corporate vision and goals lead to concrete results.

“When we think about policy we recognize that policy can also be made by very large actors in the private sector. We’re talking about the role of **Google, Apple, Facebook, Walmart, General Electric** and others,” said Andrew Shapiro of **Broadscale Group**. “The standards they set, the procurement policies they embrace, the programs they try to get their suppliers in on, all have a dramatic effect on the economy. Don’t overlook the critical role that these actors play. When **Walmart** started talking about driving sustainability through the supply chain, this had a bigger impact than the Environmental Protection Agency trying to drive some new standard.”

The essential elements of corporate climate change and clean energy policy is clarity, specificity and ownership by the CEO and the C-Suite.

NRG’s current generation profile is about “50 percent gas, 30 percent coal, the remainder is renewables, some interests in nuclear in Texas,” Bruna Sarda said. Recognizing the need to change the makeup of its generation capacity to dramatically reduce its carbon emissions, Sarda said his company has set the far-reaching, science-based greenhouse gas reduction targets of 90 percent reduction (in CO₂ equivalent emissions) by 2050, with step reductions between now and then. “We

will achieve this in a number of ways in our conventional fleet, while also increasing the number of low-carbon businesses we have such as energy solutions and services.”

DTE Energy has comparably ambitious carbon reduction plans announced in 2017: 30 percent reduction from 2005 by 2020; 40 percent by 2030; 70 percent by 2040; and more than 80 percent reduction by 2050. “To do this we are planning on having about 20 percent of generation from nuclear, 40 percent from natural gas, and 40 percent from renewables by 2040,” Skiles Boyd of **DTE Energy** said. “Currently, our mix is 20 percent nuclear, ten to 15 percent renewables, and the remaining coal.”

“We’ve taken the position that the future is increasingly renewable. We’ve divested our oil and natural gas assets and we’re phasing out our coal use by 2023. This is where we see the world going.” THOMAS BROSTRØM, ØRSTED NORTH AMERICA

¹⁰¹ Renewable energy certificates.

Noting that implementing this plan will be a major undertaking by DTE, Boyd said the utility believes it is achievable and will be financially positive. “We see this as a good plan where we can be profitable. We’re a regulated company and we can only do what our Public Service Commission approves, but we believe that this plan is the most economic and the best one for our customers.”

One of the energy companies that has undergone a dramatic transformation in recent years is **Ørsted**. “As a company, we have a very bold vision and we’re at the forefront of the energy transition,” Thomas Brostrøm of **Ørsted North America** said. “We’ve taken the position that the future is increasingly renewable. We’ve divested our oil and natural gas assets and we’re phasing out our coal use by 2023. This is where we see the world going.”

An **executive with an industrial corporation** said his company has moved ahead of government requirements to publicly pledge to reduce emissions and increase energy efficiency because it appreciates the power that internal goals can provide. “We certainly see an opportunity to take a leadership role on climate change,” he said, adding that “we see more benefit in setting the kinds of volunteer goals and having companies reach those versus a federal mandate.”

C) Energy-intensive industries have a natural incentive to reduce energy use.

Leaders from heavy industry pointed out that because energy is typically such a large percentage of the core costs of running their furnaces, kilns, processing and manufacturing equipment, and power plants, managers have a constant and powerful incentive to find ways to reduce those costs.

“Energy intensive industries have powerful incentives built in to reduce energy use,” an **executive with an industrial corporation** said. “Energy efficiency is a proprietary advantage that every company seeks. Each facility is different, but our team tries to squeeze every ounce of efficiency out of our operations. We are very globally competitive, and so every decision to reduce our costs even by a dollar makes a difference. So regardless of what the federal government does here, we need to stay ahead of the competition.”

“To be an effective manufacturer, you have to be lean and this means eliminating waste, improving efficiency, and upgrading equipment. Through this process we lean out our operations, reduce our costs, and reduce our emissions.” JOHN DONNAN, KAISER ALUMINUM

Government policy, such as federal energy efficiency rules for industrial equipment, furnaces, fans, chillers and lighting, can be of significant help, he said, but his company is always looking for every marginal efficiency advantage. “If you can squeeze a little more productivity out of a machine, that’s helpful,” he said. “We see the federal energy efficiency rules as a baseline: what is the incremental advantage we can gain on top of that baseline? How can we do even better? Annually we have a set amount of capex to spend on energy efficiency and so must think about the best way to apply those dollars.”

John Donnan at **Kaiser Aluminum** noted a tension between government mandates and the practical needs of his company’s industrial operations. “Sometimes it feels like government policies are efforts to make headlines, rather than well thought out, pragmatic approaches to achieving a policy objective,” he said. “To be an effective manufacturer, you have to be lean and this means (constantly) eliminating more waste, improving efficiency, upgrading equipment. Through this process we lean our operations, reduce our cost, and reduce our emissions.”

Donnan said that **Kaiser** reduced the carbon footprint of its facility in Spokane, Washington by 17 percent per ton over the last seven years “without a government mandate” because it is “the right thing to do for our business.”

D) Climate-related financial disclosure, assessment of climate risk and data tracking are helping change company cultures; goal-setting produces results.

Tracking and disclosing climate risk helps Boards of Directors and other company leadership take responsibility—with positive economic results.

In recent years, a number of initiatives have been created to assist companies in tracking, accounting for and publicly disclosing their baseline greenhouse gas emissions. Champions of this approach say that when a company benchmarks its emissions and then tracks those emissions quarter-to-quarter or year-to-year, it becomes a powerful and effective tool that guides and incentivizes internal actions to reduce those emissions.

“We operate on the premise that if information about climate related risks and the corporate governance put in place to manage for them is easy to access in a standard fashion, business and financial behavior will change as a result,” said Lance Pierce of **CDP North America**, which works with 6,000 companies that are voluntarily self-disclosing GHG emissions. “We’ve seen this borne out via our work.”

The data that **CDP** collects through its engagement with companies is incorporated by **CDP** into a number of low carbon indices and financial products. Pierce pointed to one successful example when **STOXX**, a globally-integrated index provider, licensed **CDP** data to build a low carbon index that subsequently outperformed its underlying benchmark by the “significant margin” of six percent over five years.

“It’s not enough to say we can’t measure climate risk. We know enough about climate risk; we don’t have all the information, but I find it a bad excuse when people say ‘we don’t know what to disclose.’” MINDY LUBBER, CERES

Mindy Lubber of **Ceres** said that the proliferation of disclosure initiatives—such as **CDP**, the **Global Reporting Initiative**¹⁰² and the **Carbon Disclosure Standards Board**¹⁰³—along with the fact that 14 stock exchanges around the world are committed to requiring reporting of climate risk, means that no company has an excuse not to measure and track their carbon footprint.

“It’s not enough to say we can’t measure climate risk. We know enough about climate risk; we don’t have all the information, but I find it a bad excuse when people say ‘we don’t know what to disclose,’” she said. “We need to integrate sustainability into capital markets, from the board room to the supply chain and integrate climate risk and opportunity into capital markets and everything they do.” Lubber put the responsibility squarely on corporate boards of directors: “The number one job of a board is to address risks and potential risks that companies are facing. Companies should be disclosing their risk.”

Aron Cramer of **BSR** said that securities statutes and rules can dis-incentivize action on climate change. “The rules in capital markets are in many cases deeply flawed and they create a brake on action such as steps on climate change.” He blames “the primacy of shareholder interest, narrowly-defined,” along with accounting rules and securities laws that “are not fit for this purpose because they currently fail to reward companies that take a long-term view and act on climate.”

102 See <https://www.globalreporting.org/Pages/default.aspx>

103 See <https://www.cdsb.net/our-story>

The Securities and Exchange Commission's climate risk disclosure rules should be consistently enforced.

One institution that has established disclosure rules that “require a company to disclose the impact that business or legal developments related to climate change may have on its business” is the Securities and Exchange Commission (SEC), but a number of respondents said the SEC rarely enforces its rules.¹⁰⁴

Back in January 2010, the SEC issued “interpretive guidance” on existing SEC disclosure requirements as they apply to business or legal developments relating to the issue of climate change. The guidance highlighted several examples of where climate change may trigger disclosure requirements, including when international climate change accords and treaties may create material business risks; legal, technological, political and scientific developments regarding climate change may create new opportunities or risks for companies; and actual or potential physical impacts from climate change on their business.¹⁰⁵

“If the SEC were to enforce the existing (climate risk disclosure) rule, then it would go a long way towards creating visibility around corporate climate risk management.” LANCE PIERCE, CDP

“At the SEC, even during the prior administration, they didn’t do a good job enforcing disclosure filings,” Mindy Lubber of **Ceres** said. “All of their enforcement people were focused on Dodd-Frank. Now that we have Trump, it’s not a priority. They told us that ‘no, it’s not on the agenda.’” Lance Pierce of **CDP North America** agreed that the SEC rules have only been enforced selectively, including during the Obama administration. “If the SEC were to enforce the existing rule, then it would go a long way towards creating visibility around corporate climate risk management,” he said.

Lubber said that a growing number of companies are meeting their responsibility to report climate risk, such as the 7,000 companies that do so under the **Global Reporting Initiative**, “a lot of them are doing much more detailed climate disclosure reports.”

Task Force on Climate-Related Financial Disclosure is a welcomed initiative.

One positive disclosure highlight that several leaders working in this domain flagged is the work of the **Task Force on Climate-Related Financial Disclosure** (TCFD),¹⁰⁶ a 32-member ad-hoc group established by the **Financial Stability Board** (FSB).¹⁰⁷ Co-chaired by businessman and former New York City Mayor Michael Bloomberg and Mark Carnegie, Chairman of the Bank of England, the Task Force issued recommendations in June 2017 regarding “voluntary, consistent climate-related financial risk disclosures for use by companies in providing information to investors, lenders, insurers, and other stakeholders.”¹⁰⁸

“The Task Force on Climate-Related Financial Disclosure...is important because it’s a financial sector-led effort calling for more transparency and data from companies, asking that they disclose the risks they face due to climate change,” Lance Pierce of **CDP North America** said. “Why? Because TCFD’s starting premise is that climate change is a systemic risk to the world economy, and as a result, investors and the public need to understand the ways that risk shows up in the governance, management, and balance sheets of the companies they own.” Pierce said that **CDP**, while a voluntary disclosure platform, believes that ultimately carbon disclosure should be mandatory.

104 United States Securities and Exchange Commission. (2010). SEC issues interpretive guidance on disclosure related to business or legal developments regarding climate change. (Press Release). Retrieved from <https://www.sec.gov/news/press/2010/2010-15.htm>

105 Ibid.

106 See <https://www.fsb-tcfd.org>

107 The FSB is an international body that monitors and makes recommendations about the global financial system. See <http://www.fsb.org>

108 Task Force on Climate-related Financial Disclosures. (2017). Recommendations of the task force on climate-related financial disclosures. Michael R. Bloomberg. Retrieved from <https://www.fsb-tcfd.org/wp-content/uploads/2017/06/FINAL-TCFD-Report-062817.pdf>

E) Corporate and investor stakeholders want action on climate change, resulting in changes in how corporations look at sustainability.

Companies and investment firms across sectors are experiencing an intensifying press for action on climate change from their customers, shareholders, institutional investors, and employees, in addition to environmental advocates. This being noticed in board rooms and C-suites, and is inspiring updated and broader perspectives on sustainability and climate responsibility internally.

“(A)s more and more consumers choose products or services that stand for something, more and more entrepreneurs are responding by creating mission-oriented companies. Since some of that consumer demand is for clean energy and energy efficiency, we’re seeing more clean energy and energy efficiency companies.”

FORMER MASSACHUSETTS GOVERNOR DEVAL PATRICK, BAIN CAPITAL

Governor Deval Patrick of **Bain Capital** has observed a change in sensibility in recent years. “One of the reasons that impact investing is a ‘thing’ is because as more and more consumers choose products or services that stand for something, more and more entrepreneurs are responding by creating mission-oriented companies. Since some of that consumer demand is for clean energy and energy efficiency, we’re seeing more clean energy and energy efficiency companies.”

At **Google**, reducing its energy usage is a natural business pursuit because it is a large infrastructure company with 14 data centers around the world that it owns and operates. “Any time you are watching **YouTube** or sending an email through your Gmail or doing a Google search, all that is happening

inside a Google data center,” Mars Hanna said. “Data centers are large, manufacturing scale facilities. In aggregate, in 2016 we used over 6.2 terawatts of electricity, which is larger than the city of San Francisco.”

Electricity usage from those data centers make up the majority of Google’s carbon footprint as a company (which has been carbon neutral since 2007), which means that the company cares “about electricity the same way that other large consumers do, in that we spend a significant amount of money on it,” Hanna said. That said, Google also cares about reducing its energy use from an environmental and sustainability perspective, he said, and they know many of their stakeholders do as well. “Our users and shareholders want to know that using Google products and services won’t contribute to global climate change.”



Policy Finding 9: Nuclear energy, natural gas, and carbon capture, utilization and storage (CCUS) are essential pieces of the carbon reduction puzzle.

A) Nuclear energy and CCUS are needed for deep decarbonization.

A number of leaders spoke to the importance of maintaining a diversity of technologies and fuels as critical to climate solutions globally and domestically. Even with dramatic growth of renewables such as wind, solar and biomass and aggressive demand-side management of energy consumption, these leaders say that an ongoing and expanded role of nuclear energy and carbon capture, utilization and storage (CCUS)¹⁰⁹ technology will be crucial—in both the near- and long-terms—for successful deep decarbonization of the economy.

That translates, in their view, to the need to keep the current fleet of operating nuclear reactors from closing, to push the development of advanced nuclear reactor technology, including small modular reactors (SMRs), and to continue the technical advancement and deployment of CCUS technologies for power plants and the industrial sector. Consequently, public policies that support nuclear energy and CCUS were cited as top priorities by several leaders.

“It’s going to be very easy for us to hit our 2030 carbon reduction targets... with natural gas and renewables, if gas stays cheap. But if we’re going to hit deep decarbonization by 2050, then...we’re going to need a significant amount of new nuclear and some amount of carbon capture and storage. We might even have to do biomass with CCS.” UTILITY EXECUTIVE

“It’s going to be very easy for us to hit our 2030 carbon reduction targets... with natural gas and renewables, if gas stays cheap. But if we’re going to hit deep decarbonization by 2050, then...we can’t do that with just gas and renewables,” a **utility executive** said. “We’re going to need a significant amount of new nuclear and some amount of carbon capture and storage. We might even have to do biomass with CCS.” That executive added, “Advanced nuclear is absolutely necessary. Small modular reactors may work. We need to drop the cost of these technologies.”

Colin Marshall of **Cloud Peak Energy** pointed to an International Energy Agency conclusion “that a lot of fossil fuels will be used around the world (for some time) and if we really care about climate change then we need nuclear and CCS, not just for coal, but also for natural gas and industrial processes.” Subsidies for wind and solar initially intended to bring down the cost of that technology “are now subsidizing large scale generation for power

that is not required,” he said. “Climate policies are leading to the closure of nuclear power plants, which is crazy. It’s a carbon-neutral baseload source of power that is fully paid for.”

Austin Keyser of the **International Brotherhood of Electrical Workers** said, “We’ll need to invest in our nuclear fleet and CCS if we want to keep emissions low. Keeping these nuclear plants online is key. We need a policy to keep older reactors online, at least in the near term.”

B) Concern exists that accelerating closure of existing nuclear reactors adds to the carbon-reduction challenge.

The U.S. generates approximately 20 percent of its electricity from its existing nuclear fleet of 99 reactors—providing the largest source of carbon free generation in the economy. However, the relatively low cost of natural gas and, in some markets, the rapid expansion of wind and solar capacity have unsettled the economics of nuclear plants which, by their nature, have no variability when operating and form a considerable portion of many grid operators’ baseload power. These factors have resulted in or contributed to the premature closing of several nuclear plants in the last decade.

¹⁰⁹ Also referred to by some in this report as carbon capture and storage, or CCS. The term utilization refers to the oil extraction industry’s long-established practice, commonly known as enhanced oil recovery, of capturing carbon dioxide and injecting it into active oil wells to help retrieve trace amounts of oil.

A number of interviewees spoke to the dilemma of losing additional nuclear plants and the complication that created for low carbon transition strategies.

Nick Stavropoulos of **PG&E** articulated the dilemma: “We are seeing across the country decisions to close nuclear plants that from an environmental standpoint provide great benefits. But from a risk point of view, it’s better to go build a combined cycle natural gas plant or solar and wind. Of course, there are advocates who say nuclear is not safe and we should shut it all down etc., but we haven’t talked about the impact of closing nuclear reactors on our efforts to decarbonize the electric sector. Nationally it needs to be part of the debate.”¹¹⁰

“We are seeing across the country decisions to close nuclear plants that from an environmental standpoint provide great benefits. Nationally it needs to be part of the debate.”

NICK STAVROPOULOS, PG&E

With most existing nuclear reactors in the U.S. producing between 800 to 1,500 megawatts of electricity, each time one of those reactors are retired—as five have been in the last five years, with utilities announcing another seven reactors at five plants will be closed in coming years—that creates a sizable hole to be replaced by renewables, natural gas or reduced demand.

Stavropoulos said his utility’s decision to close the Diablo Canyon power plant was “really difficult,” in part because of the loss of a large amount of carbon-free electricity. Noting that the output capacity of Diablo Canyon’s two reactors is 2,200 megawatts, he said “that capacity is hard to replace with wind, solar and energy conservation. We are seeing a lot of those (reactor closures) across the country.”

“We know that a lot of utilities are struggling with nuclear, but we don’t think it’s good to shut these down,” said Skiles Boyd of **DTE Energy**. Referring to DTE’s 1,130-megawatt reactor in Michigan, the Enrico Fermi Nuclear Generating Station, also known as Fermi 2, Boyd said “Our reactor is running well and the PSC¹¹¹ believes it’s an important part of the energy mix.” He added that DTE has a license from the Nuclear Regulatory Commission to build a second reactor at the Fermi site, and that his utility sees that option “as a hedge on carbon pricing.” However, “right now, it is not economical to consider.”

Making progress on near- and long-term storage of spent fuel rods is essential.

Several leaders pointed to the ongoing lack of centralized and secure storage facilities for spent fuel rods from commercial reactors, away from active and retired reactor sites where they are housed now, as a problem that must be resolved if nuclear energy is going to continue to play a significant role in our energy mix in the future.

“A national nuclear waste site would be helpful to get some of that cost of the individual sites down,” said Austin Keyser of the **International Brotherhood of Electrical Workers**. “How can we move a long term nuclear waste site further down the line? Lots of Department of Energy investment in this field has gone to the wayside.”

John Kotek of the **Nuclear Energy Institute (NEI)** flagged this need as well and said **NEI** is advocating for consent-based interim storage and a long-term repository. “Private companies are moving forward with the support of host communities,” he said, to explore options for hosting an interim storage facility. “This administration is trying to push forward with what their waste program looks like but despite the best efforts of some members, Congress is not being helpful in moving forward a national nuclear waste program.”

¹¹⁰ For more information, see a report on California PSC’s approval of PG&E’s application to close Diablo Canyon’s two reactors at the end of their license periods: World Nuclear News. (2018). California commission approves Diablo Canyon closure. Retrieved from <http://www.world-nuclear-news.org/C-California-commission-approves-Diablo-Canyon-closure-1201187.html>

¹¹¹ Public Service Commission.

C) Nuclear energy should be properly valued as a zero-carbon source.

Advocates for the nuclear power sector believe that the nuclear fleet's zero emissions' generation should be valued and counted in a carbon-constrained environment—citing efforts in both Illinois and New York¹¹² to pass legislation and introduce regulations that did just that. New Jersey followed with comparable legislation to support nuclear energy in its state on April 12, 2018.¹¹³

“Most policymakers support renewable energy, but nuclear isn't getting valued nearly as much as it should be as a zero-carbon source,” said Ralph LaRossa of **PSEG Power**. “Nuclear, today, would be profitable in the \$30 to \$40 megawatt-hour range. Offshore wind shows great promise as an energy resource, but there are still questions of affordability. If the goal is to reduce carbon, then we should value nuclear in the same way we value renewables.” LaRossa said he thought the regional transmission organizations, such as ISO, was the forum to “set up a competitive process that makes (that valuation) work.”

“Any U.S. policies focused on carbon reductions can help us get to a thriving U.S. nuclear industry. There are lots of policies that promote other low carbon technologies, but don't promote nuclear. We'd like to see that rectified.”

JOHN KOTEK, NUCLEAR ENERGY INSTITUTE

“We need policy that subsidizes more than just solar and wind—that allows for the monetization of zero and low carbon emissions,” Austin Keyser of the **International Brotherhood of Electrical Workers** said. “I think emissions will go up if we just rely on solar and wind.”

John Kotek of the **Nuclear Energy Institute** said, “Any U.S. policies focused on carbon reductions can help us get to a thriving U.S. nuclear industry,” especially if they value nuclear energy. “There are lots of policies that promote other low carbon technologies, but don't promote nuclear. We'd like to see that rectified. We'd also like to see other attributes like resiliency and supply security issues properly valued.”

One step would be if governments and companies began including nuclear energy in their definition of clean energy. “You'll recall that the North American Clean Energy Agreement, signed by President Obama between Canada and Mexico, said that they wanted to get to 50 percent of clean energy by some date—nuclear energy was included in the definition of clean energy,” Kotek said. “This is the exception, not the rule. Usually when you see a company sign a clean energy purchase it is usually with wind and solar. You don't see them talking about nuclear. How do we get companies to include nuclear in their green energy targets? That would be a game changer.”

“Getting a price on carbon would be very helpful to nuclear,” he continued, and “a zero-emission credit is certainly an important step along the way to supporting nuclear at the state-level.” He said **NEI** has supported efforts to restore funding for all clean energy technologies. “With nuclear, the costs associated with new nuclear technologies can be daunting—higher than \$1 billion for a new reactor design, for example. Getting to a point where government is matching the private sector investments going into new nuclear technologies would be helpful.”

Because the scope of needed reductions in greenhouse gas emissions worldwide is so enormous, Kotek argued that it should get a second look as a major part of the global decarbonized energy mix. As more countries are building additional nuclear reactors, he said that exporting American-designed advanced reactor technologies will help countries meet those environmental goals. “More and more countries will start looking at nuclear to meet commitments under the Paris Agreements. Are we going to have the technology and ability to export our technology to those countries that need it?”

112 For more information on the Illinois legislation, see <https://www.elp.com/articles/2016/12/illinois-pass-subsidy-bill-to-save-state-s-nuclear-power-plants.html>; for information on the New York legislation, see <https://www.nytimes.com/2016/08/02/nyregion/new-york-state-aiding-nuclear-plants-with-millions-in-subsidies.html>.

113 For more information on the New Jersey legislation, see <https://www.nytimes.com/2018/04/12/nyregion/new-jersey-renewable-energy.html>

D) Natural gas remains a critical part of the transitional puzzle.

A range of economic leaders see natural gas retaining a significant role in the U.S. energy mix for some period to come even if we move aggressively to shift to zero- or low-carbon energy sources.

“The grid will be dominated by renewables, controllable demand, storage, and fast ramping natural gas to balance out the renewables,” said Bruno Sarda of **NRG**. “This is the generation portfolio of the future, of ten, 20 years from now.”

“There’s a growing appreciation for the role of natural gas in carbon reduction,” said Kyle Isakower at the **American Petroleum Institute**. “As the rest of the world looks to how they’re going to comply with their (greenhouse gas reduction) commitments, natural gas will be the answer, more often than not. Even renewable-based systems will need natural gas peakers to back up those renewables.”

Giving credit to natural gas for much of the greenhouse gas reductions the U.S. has achieved in recent years—because relatively low prices for natural gas have led to investment in new natural gas generation plants, and those often displace older coal-fired power plants—Isakower cautioned that “any regulatory scheme that reduces the economics of natural gas will hurt our ability to drive down emissions.”

“There’s a growing appreciation for the role of natural gas in carbon reduction. As the rest of the world looks to how they’re going to comply with their (greenhouse gas reduction) commitments, natural gas will be the answer, more often than not.”

KYLE ISAKOWER, AMERICAN PETROLEUM INSTITUTE

“My instinct is that (natural) gas has to have a role in this transition, particularly in the near-term,” said Kyung-Ah Park of **Goldman Sachs**. “In the recent cold snap in the Northeast, natural gas prices went through the roof. We don’t have sufficient gas pipelines in the Northeast so there was greater burning of coal and oil to meet heating energy needs. Do we really want to do this if we can burn relatively cleaner gas?”

This view is especially held by some in energy-intensive industries, such as **Kaiser Aluminum**, along with a sense that policymakers don’t recognize that industries heavily reliant on fossil energy to make their products may require a different strategy to reduce their carbon footprint. “There is a lack of understanding of what it takes to make our product,” said John Donnan of **Kaiser**. “Some people think wind and solar will allow us to make the products we want. That’s simply not the case. You need carbon for aluminum. Aluminum is going to require natural gas.”



Policy Finding 10: Public investment in early-stage clean-energy technology innovation and energy infrastructure is crucial to private-sector progress across all economic sectors.

A) Government investment in energy research, development and demonstration has delivered huge benefits in the past and deserves strong support going forward.

The interview responses included many comments about the distinct roles of government and the private sector in early stage technology development. Among the respondents who addressed this point, all identified the need for public investment in basic science and technology research and development, as well as in the later stages of demonstration and initial deployment of the technologies that make it out of the lab and to the point of patenting and licensing at commercial scale.

These views held that companies often cannot or will not take the risk of investing sufficient funding at those early stages outside of a company's narrow mission-oriented needs, and even strong investment by some individual companies is no substitute for key federal agencies and national labs that are able to take a landscape perspective to identify overarching needs and opportunities and consider the public interest.

Government has a strong track record of helping companies successfully make the leap from breakthrough to commercialization.

"The policy to invest in research and development, which is a staple at the state and federal level, is powerful and important to acknowledge," said Danny Kennedy of the **California Clean Energy Fund**. "So many good ideas and companies are the product of deep federal R&D spending—at the Department of Defense, Department of Energy, Department of Commerce, state funds, national labs, colleges. These new technologies are coming out of the labs, out of the colleges. R&D investments work, they pay dividends."

"Steve Jobs didn't invent the iPhone, the Department of Defense did, all the components were the product of federal R&D," Kennedy continued. "Having that policy of being willing to invest in the future, from the very beginning of ideas to test stage is important. This isn't a policy that enough politicians are willing to get behind."

Helping companies move from initial deployment to scale is one of the challenges with new technologies, said Christina DeConcini, Director of Government Affairs at the **World Resources Institute**, who also assists her organization's **Corporate Consultative Group**. "R&D funding is needed to advance that. There are a number of examples of project developed from publicly-funded national labs that translate into private sector advancing technologies that become commercially viable and profitable."

"One of the things to keep in mind is that there has been research that shows that we can meet our emissions goals with current technology, but the speed and cost at which we're able to do this will depend upon increased market signals to speed deployment and increase cost competitiveness," she said.

A number of economic leaders called for major increases in spending on clean technology RD&D.

"We, as a country, just don't invest enough in energy R&D," Brian Mormino of **Cummins** said. "Public investment in energy R&D is absolutely critical. We need to increase the rate and pace of clean energy technology system-wide." The growing interest in electrifying the economy is an example of the need for more research, he said, as it "requires significant grid modernization and significant renewal on our power generation sector and those have to go together. Some of this can be done today, but there has to be a lot of innovation and private-public partnerships to move this forward systematically and at the pace needed."

“A good research and development program with the right type of controls is something that a lot of people should get behind, and something we should invest in more than in other areas,” he said.

“The idea of private public R&D programs that feed into stronger regulatory policy has been really positive for Cummins and for society, overall.” BRIAN MORMINO, CUMMINS

Peter Rothstein of the **Northeast Clean Energy Council** lamented that while “public sector investment in early stage R&D is critical in energy just as it is in life sciences, information technology and other sectors,” investment in the life sciences have “quadrupled over recent decades while government support to energy research has been flat.” He called for increases in government R&D funding to support “programs like ARPA-E which fund to a stage where the risk-return of private capital can begin to play a larger part.” He noted a particular need to fund energy innovation at the demonstration-project level, and that utilities in particular should be provided a budget by regulators for “RD&D, with the emphasis on that second D, ‘demonstrate’.”

The stakes are very high if we fail to step up to this need, said Eric Toone of **Breakthrough Energy Ventures**. “If you actually read the (United Nations) Intergovernmental Panel on Climate Change¹¹⁴ assessment reports and look at what’s required for us to stay under 2 degrees centigrade, you realize that there is an enormous amount of fundamental science that needs to be developed and translation of that science into technology at unprecedented scales. (The year) 2050 sounds like a long way away, but it’s not in terms of energy technology deployment.”

“If we’re going to have meaningful deployment of technology in the energy space that will have a material impact, then there is going to have be an enormous additional increase in R&D from the public and private sector,” he said. “Mission Innovation is an important step in that direction.”

As with other aspects of energy policy, some leaders look for an even-handed approach to investing in technologies to reduce greenhouse gas emissions.

Dave McCurdy of the **American Gas Association**, who believes in “R&D and American innovation and think it is probably one of the better roles for government,” advocates for more public investment in natural gas-carbon capture and storage technology, noting that his industry already works closely with the U.S. Department of Energy and the Gas Technology Institute. “We’d like to see more money for natural gas research.”

“Funding for R&D is the biggest aspect for us for how do we move to a cleaner grid, overall,” said Donnie Colston of the **International Brotherhood of Electrical Workers**. “Coal isn’t coming offline anytime soon, so how do we make it cleaner and more efficient? Through CCS and other technologies. We need research on the more resilient aspects of renewables, as even during intermittency, how can we take advantage of the renewable resource? If DOE is going to punt on R&D and leave it to the private sector, we won’t get very far.”

Companies can be reluctant to take risks investing in early-stage research and development and thus welcome government as a partner.

“Companies won’t invest in something if they don’t think it will pay off and be financially beneficial to them and their shareholders,” said Christina DeConcini of the **World Resources Institute**. “R&D is crucial to this. Government, historically, has played an important role in advancing technologies that have had big pay-offs for the private sector,” including investments that led to the “development of computers, the internet, solar power as well as fossil fuel technologies, including natural gas and oil.”

¹¹⁴ See <http://www.ipcc.ch/organization/organization.shtml>

The private sector is not stepping up its own investment sufficiently, according to Peter Rothstein of the **Northeast Clean Energy Council**. “It’s been clearly demonstrated that private corporations and investors fund even smaller amounts of early stage R&D.” Because “underinvestment in R&D is a market failure and companies underinvest in R&D,” Stephen Harper of **Intel** agreed there is a need for government to invest in fundamental science and breakthrough research.

“Companies won’t invest in something if they don’t think it will pay off and be financially beneficial to them and their shareholders. R&D is crucial to this. Government, historically, has played an important role in advancing technologies that have had big pay-offs for the private sector.” CHRISTINA DECONCINI, WORLD RESOURCES INSTITUTE

As a strong supporter of public investment in research and development, Brian Mormino of **Cummins** offered the example of a successful partnership with a federal agency that inspired his company to invest in advanced technology development that he said would not have happened without the catalyst of the government program, called SuperTruck.

SuperTruck was begun by the U.S. Department of Energy (DOE) program in 2010 with the goal of improving heavy-duty truck freight efficiency by 50 percent. DOE notes that big rigs known as 18-wheelers “haul 80 percent of goods in the United States and use about 28 billion gallons of fuel per year, accounting for around 22 percent of total transportation

energy usage.” In the initiative’s first round, known as SuperTruck I, four companies were selected to receive funding, which they matched, and all four developed technological approaches that exceeded the 50 percent increased efficiency goal.¹¹⁵

Cummins was one of those companies and, teaming with **Peterbilt Motors Co.**, demonstrated more than 50 percent brake thermal efficiency. Their “demonstration tractor-trailer averaged a 76 percent increase in drive cycle FTE and a 43 percent reduction in GHG emissions versus a 2009 baseline truck.”¹¹⁶ Building on that success, DOE launched SuperTruck II in August 2016 and again selected the Cummins-Peterbilt team, this time to develop and demonstrate cost-effective technologies that would double yet again the freight efficiency of these Class 8 trucks.¹¹⁷ **Cummins** noted at that time that “as evidence of the favorable market impact that DOE partnered research and development continues to have, many of the engine and drivetrain efficiency improvements and vehicle power demand reductions pioneered in SuperTruck I are headed for production with the latest model year 2017 product offerings by **Cummins** (and) **Peterbilt** and its key product delivery partners.”¹¹⁸

“We’re bringing this technology now to the marketplace,” Mormino said. “This program got us working on stuff that we frankly would not have been working on at that time without this type of partnership. The DOE program worked in concert with EPA on PM¹¹⁹ and NO_x regulations and new CO₂ requirements. The idea of private public R&D programs that feed into stronger regulatory policy has been really positive for **Cummins** and for society, overall.”

When vehicle manufacturers looked to the light-weighting of materials as one strategy for improving fuel efficiency, they could draw from the experience of the U.S. armed forces, said Heidi Brock of the **Aluminum Association**. “Aluminum is a material that has been used in the U.S. military for many years. It’s great to see those alloys repurposed in things like the Ford F-150.”

115 United States Department of Energy. (2016). Energy department announces \$137 million investment in commercial and passenger vehicle efficiency. Retrieved from <https://www.energy.gov/articles/energy-department-announces-137-million-investment-commercial-and-passenger-vehicle>

116 Cummins Inc. (2016). Cummins and Peterbilt to team up on SuperTruck II. Retrieved from <http://investor.cummins.com/phoenix.zhtml?c=112916&p=irol-newsArticle&ID=2198980>

117 United States Department of Energy. (2016). <https://www.energy.gov/articles/energy-department-announces-137-million-investment-commercial-and-passenger-vehicle>

118 Cummins Inc. (2016). <http://investor.cummins.com/phoenix.zhtml?c=112916&p=irol-newsArticle&ID=2198980>

119 Particulate matter.

B) Government programs that assist U.S. companies in advancing innovation and opening new markets have many fans in the private sector.

A number of companies and investors said they appreciate government programs designed to assist them in advancing innovation, bringing technologies from the lab to commercialization, and opening new markets. Respondents singled out the U.S. Department of Energy’s ARPA-E program, national laboratories, Advanced Manufacturing Office and Better Plants initiative, along with EPA’s Energy Star program, as examples of effective programs of importance to the private sector.

ARPA-E in particular was repeatedly cited as a highly effective and needed program. Its creation, which was modelled on the Pentagon’s Defense Advanced Research Projects Agency, was recommended by the authors of the 2007 **National Academy of Sciences** report, *Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future* to help advance U.S. leadership in science and technology at a time when the authors feared it was eroding. In 2007, Congress included in the America COMPETES Act an authorization to establish ARPA-E and President George W. Bush signed it into law. As part of the American Recovery and Reinvestment Act, Congress in 2009 provided ARPA-E with its initial funds of \$400 million.

ARPA-E’s mission is to advance “high-potential, high-impact energy technologies that are too early for private-sector investment.” ARPA-E provides grants to companies and consortia that are “developing entirely new ways to generate, store and use energy,” and have “the potential to radically improve U.S. economic prosperity, national security and environmental well-being.” The agency’s program directors, often from the technology sector, serve for single three-year terms to “ensure a constant infusion of fresh thinking and new perspectives.”¹²⁰

Support for ARPA-E was broad and deep among the respondents. “We do believe that there is role in government R&D—ARPA-E for example,” Kyle Isakower of the **American Petroleum Institute** said. Dave McCurdy of the **American Gas Association**, citing deep reductions in basic science and technology research funds proposed by the Trump administration in its Fiscal Year 2018 and 2019 budgets, said, “We don’t think (the Trump administration) should kill the investment budget or ARPA-E. We’d like balance in that budget.”¹²¹

“The process of (the ARPA-E team) forcing people to sit down and say that ‘if I’m going to take a product to market then I need to know what the next big milestones and markers are’. The kind of rigor, discipline, and hard thinking about what it takes to advance a technology to market is tremendously impactful.”

ERIC TOONE, BREAKTHROUGH ENERGY VENTURES

Programs like ARPA-E are especially crucial, Kyung-Ah Park of **Goldman Sachs** said, because energy research and development investments by the private sector are relatively limited when compared to the information technology and pharmaceutical industry. “The public sector’s role in early stage R&D and technology investment is incredibly important in the energy sector, as it’s a place the private sector may not be well positioned to step up to fill the gap.”

“The real value of ARPA-E is the discipline and habits of mind that come from working on a project,” said Eric Toone of **Breakthrough Energy Ventures**. “This is not something in the university lexicon. Universities don’t think like businesses. That is not the way university research works. The process of

(the ARPA-E team) forcing people to sit down and say that ‘if I’m going to take a product to market then I need to know what the next big milestones and markers are’. That exercise, on the academic side of things, has a tremendous impact. The kind of rigor, discipline, and hard thinking about what it takes to advance a technology to market is tremendously impactful.”

¹²⁰ Source: <https://arpa-e.energy.gov/?q=arpa-e-site-page/about>

¹²¹ The Trump administration’s Fiscal Year 2018 budget request proposed eliminating funding for ARPA-E (along with deep cuts in science and technology research and development programs), but Congress, in adopting its Fiscal Year 2018 omnibus appropriations legislation in March 2018, instead provided a 16 percent funding increase for ARPA-E over the Fiscal Year 2017 enacted budget.

A **utility executive** expressed strong support for ARPA-E because it “offers the prospect of lowering the economic risk of future policy and potentially very much so.”

“ARPA-E is fantastic, Gabriel Kra of **Prelude Ventures** said, “but it’s doing what government has always done, fund basic and applied research. As we continue to shift research from government sponsored institutions such as universities and national labs, ARPA-E is a good example of reversing the trend. ARPA-E’s budget of couple hundred million dollars is nowhere near enough.”

The limited private investment in early stage technology development is because companies often do not wish to make risky investments in technologies with uncertain futures, Daniel Goldman of the **Clean Energy Venture Group** said, and taking on that risk is an important role of government. “Certainly, things like ARPA-E and early technology development in national labs is critically important because that’s an area where you want to keep the pipeline full,” he said. “You want as much good technology being funded by government because there are very few places where you can take that kind of risk.”

Danny Kennedy at the **California Clean Energy Fund** said that ARPA-E is a strong and necessary program, but it is not in itself sufficient. He pointed to a tool that is increasingly being utilized by key players in the technology development space: a Cooperative Research and Development Agreement, or CRADA.¹²² “We have a relationship, a CRADA, which allows our member companies to access the labs: Lawrence Berkeley, Stanford Linear Accelerator (SLAC) and Lawrence Livermore. It helps jump companies ahead,” Kennedy said. “We’ve recently invested in an optical switching mechanism company where the technology comes out of the Livermore Lab. This saves energy and cost and could be a game changer for grids and the transmission system.”

The Department of Energy’s Advanced Manufacturing Office (AMO) was cited as a welcome partner to assist the U.S. manufacturing sector in strengthening its ability to flourish in the global competition for advanced manufacturing processes and technologies. That office “supports R&D projects, R&D consortia, and early-stage technical partnerships with national laboratories, companies (for-profit and not-for profit), state and local governments, and universities through competitive, merit reviewed funding opportunities designed to investigate new manufacturing technologies.”¹²³

Tom Gibson of the **American Iron & Steel** Institute said that his organization has had a good working relationship with AMO, and another executive with an **industry trade group** said that “the Department of Energy’s Advanced Manufacturing Office is one of the few places in the U.S. where we have industrial policy.” This is important, he said, because “we’re playing in the minor leagues when it comes to many of our competitors.”

Also cited as especially helpful was the Department of Energy’s Better Plants program and EPA’s Energy Star program. The Better Plants program partners with manufacturers and water utilities to “improve energy efficiency and competitiveness in the industrial sector” through voluntary goals to, for example, “reduce energy intensity by 25 percent over a ten-year period across all their U.S. operations.”¹²⁴ Energy Star is the program that features the now widely-recognized symbol that provides “simple, credible, and unbiased information that consumers and businesses rely on to make well-informed decisions” about the energy consumption and efficiency of appliances of all kinds.¹²⁵

122 From the Sandia National Lab website: A Cooperative Research and Development Agreement (CRADA) is a legal document that permits the transfer of National Lab technologies, processes, research and development capabilities, and technical know-how to the private sector. Such technology transfer is authorized by the Stevenson-Wydler Technology Innovation Act of 1980. National Labs and the Department of Energy (DOE) benefit from collaborative research supporting DOE missions and program objectives. The Participant benefits from access to the Labs unique technologies, capabilities and expertise. What distinguishes a CRADA from other partnership mechanisms is the collaborative nature of the work. Source: http://www.sandia.gov/working_with_sandia/agreements/crada/index.html

123 Source: <https://www.energy.gov/eere/amo/advanced-manufacturing-office>

124 Source: <https://betterbuildingssolutioncenter.energy.gov/better-plants>

125 Source: <https://www.energystar.gov/about>

“We do participate in DOE’s Better Plants¹²⁶ program and the EPA Energy Star¹²⁷ program. Those are helpful with getting together with other industries and with government experts to work through new technologies,” Tom Dower of **ArcelorMittal** said.

Direct public investment from the American Recovery and Reinvestment Act of 2009 was also helpful to his company, Dower said. “We won one of the awards for a combined heat and power project at one of our

Indiana plants—a \$62 million 50/50 cost share. This project wouldn’t have happened had there not been federal money on the table. Despite the fact there is a good payback on this investment, it would not have been funded. Without government assistance, we don’t have sufficient capital laying around to do huge investments in energy efficiency.”

The U.S. Department of Energy national labs that focus on energy are a valued partner for many companies.

“Through EPIC, our electric R&D program, we partnered with the national labs here and that gave us a lot of credibility,” said Nick Stavropoulos of **PG&E**.¹²⁸ Tom Dower of **ArcelorMittal**, which makes steel for mining, drilling, pipelines, drilling platforms, wind towers, and transmission poles, said his company works with the national labs through a R&D collaboration sponsored

by the **American Iron and Steel Institute**. That institute’s Tom Gibson said he has appreciated that the Department of Energy’s national labs have reached out to his industry to offer to help it solve problems. “We need to use our ability to leverage our national labs,” Gibson said, and the labs “are anxious to work with us.”

“The public sector’s role in early stage R&D and technology investment is incredibly important in the energy sector, as it’s a place the private sector may not be well positioned to step up to fill the gap.”

KYUNG-AH PARK, GOLDMAN SACHS

Company-funded R&D is important.

Kyle Isakower of the **American Petroleum Institute** cited a 2015 report by **T2 & Associates**, *Key Investments in Greenhouse Gas Mitigation Technologies from 2000 to 2014 by Oil and Gas Firms, Other Industry and the Federal Government*, which found that during the same timespan that the federal government invested \$110 billion in clean energy R&D, the oil and gas industry invested \$90 billion and auto manufacturers invested \$38 billion.

He gives significant credit to that private sector investment—especially in hydraulic fracturing technology—for the reductions in carbon pollution that the U.S. has achieved in recent years. “We’ve seen greenhouse gas emissions dropping over the last 12 years not because of government policies but because of market forces. Hydraulic fracking of natural gas is the number one reason why power plant emissions are now at their lowest levels in 30 years.” Isakower continued: “Yes, the Department of Energy’s R&D helped with fracking research, but we feel most of the R&D was through private sector investment. Fracking is a technology that was invented 60 years ago.”

Innovation investments lead to dropping technology costs, and that’s rapidly expanding markets.

Many economic leaders attribute the impressive reductions in costs for renewable energy, efficient lighting and battery storage that have occurred in recent years to focused investment in innovative clean energy technologies and the breakthroughs and subsequent commercialization that often result.

126 From the Department of Energy’s website: “Better Plants is partnering with leading manufacturers and water utilities to improve energy efficiency and competitiveness in the industrial sector, saving money in the process. Through Better Plants, partners voluntarily set a specific goal, typically to reduce energy intensity by 25% over a ten-year period across all their U.S. operations. See <https://betterbuildingssolutioncenter.energy.gov/better-plants>

127 See <https://www.energystar.gov>

128 From the California Energy Commission website: “The Electric Program Investment Charge provides funding for applied R&D, technology demonstration and deployment and market facilitation for clean energy technology and approaches for the benefit of ratepayers of Pacific Gas & Electric Co., San Diego Gas & Electric Co. and Southern California Edison Co. Source: <http://www.energy.ca.gov/research/epic/faq.html>

“The price of batteries is dropping dramatically,” said Ben Foss of **Volta Charging**. “In 2018, the price of battery storage will cross the \$100 per kilowatt hour threshold. That is down from \$800 per kilowatt hour in 2011. This lower price means a 250-mile range EV car costs less than a combustion vehicle today. This is mainly due to manufacturing improvements.”

C) Investing in energy infrastructure (such as transmission for renewable energy) should be a priority.

Private sector interest in expanding investment in clean energy infrastructure to reduce emissions and support economic growth is high.

While the traditional focus of debate about the need to invest in public infrastructure is on roads and bridges and often ports and airports, several leaders urged that the focus be expanded to include rebuilding the electricity grid to accommodate renewable energy, smart grid technologies, and electric vehicle recharging equipment, as well as natural gas and water pipe distribution networks. Notably, offshore wind was raised as a rare opportunity to add to the renewable energy infrastructure while creating a new domestic industry, with all the elements of a job-producing supply chain of indigenous companies and jobs.

Kevin Self of **Schneider Electric** called for a greater focus on infrastructure—“the electric utility infrastructure in particular.”

Leo Gerard of the **United Steelworkers** set out a long-term vision: “Let’s have a green rebuilding of America’s infrastructure...a 20-year program to do a green retrofit of America’s public infrastructure. We need to rebuild our electric infrastructure. The largest emitters are buildings. Fifty percent of our schools are more than 60 years old. Seventy-five percent of our public buildings are more than 50 years old. We have to modernize our transmission and switching lines.”

Aging water pipelines and transmission lines are costing consumers and businesses money in wasted energy, he said. “We lose seven to eight million gallons of water on a daily basis (from leaking pipes). That water has already been through water treatment so keeping it from leaking will save energy. We lose five to 25 percent of our generated electricity (on our older transmission lines). If we modernize the energy grid we’ll save lots of energy and emissions because we’ll be using and losing less energy.”

Michael Langford of the **Utility Workers Union of America** agreed that a comprehensive approach to modernizing the energy infrastructure is essential—driven in part by its vulnerability to intensifying climate impacts. “We can’t continue to rebuild things when they get destroyed. (Hurricane) Sandy opened our eyes. That storm ripped down thousands of wood poles. To continue to rebuild the same old way is insane. Gas, electric and water. The whole electric grid infrastructure has to be rebuilt.”

“There is \$160 billion in pent up transmission needs in the U.S.—for example, the need for transmission projects that move wind energy from Iowa to Chicago.” AUSTIN KEYSER,
INTERNATIONAL BROTHERHOOD OF ELECTRICAL WORKERS

The **International Brotherhood of Electrical Workers** wants to see major investments in the electricity grid from both the private and public treasuries. “There is \$160 billion in pent up transmission needs in the U.S.—for example, the need for transmission projects that move wind energy from Iowa to Chicago,” said Austin Keyser. “We want to see the government more engaged in getting these investments out there via public private partnerships or private money. It would take minimal government money but requires rules from the government.”

The **International Brotherhood of Electrical Workers** naturally advocates for union labor to be hired to rebuild the nation's electricity grid, and a clear, long-term program would improve the ability to recruit, train and hire the required workforce. "There would have to be a dramatic increase in power linemen in the U.S., but we need stability and predictability in the markets," Donnie Colston said.

Offshore wind represents a rare opportunity to create and build a new domestic industry.

The first offshore wind installation in the U.S., the Block Island Wind Farm built by **Deepwater Wind** off the coast of Rhode Island, began commercial operation in December 2016. Governor Charlie Baker of Massachusetts signed an energy law in August 2016 that requires Bay State utilities to procure at least 1,600 megawatts of off shore wind energy by 2027. Governor Andrew Cuomo of New York subsequently announced, on January 29, 2018, a goal of 2,400 megawatts of offshore electricity by 2030 off his state's coast and New Jersey Governor Phil Murphy two days later announced a goal of 3,500 megawatts of offshore energy off his coast. Other states actively considering offshore wind development include Virginia, Maryland, North Carolina and Delaware.

Several respondents said that offshore wind represents a rare opportunity to create and build a new industry in the U.S. that would feature not only the jobs and investment that goes with constructing and operating large turbines miles offshore, but also the possibility, over time, of spurring the growth of domestic companies and jobs related to manufacture of turbines, towers, blades, transmission cables and converter stations. Also on the table is the possibility of creating domestic jobs in a new U.S.-based wind energy supply chain, including those engaged in the testing, transportation, staging and assembly of those components, along with ongoing repair, maintenance and upgrades. Because the existing experience with building offshore wind capacity is in Europe—with the United Kingdom (5000 MW), Germany (5000 MW), the Netherlands (1000 MW) and Belgium (700 MW) leading the way—most of the companies vying to build the U.S. offshore wind industry are from across the Atlantic Ocean.

"We are keen to see continued lease auctions by the Bureau of Ocean Energy Management because you need volume to attract the supply chain. If you want the big suppliers to locate domestically, you need large market potential. The states that develop the first and largest offshore wind markets will benefit from having the supply chain established in their states."

THOMAS BROSTRØM, ØRSTED NORTH AMERICA

"Offshore wind is now a big market," an **executive of an industry trade group** said. Noting that offshore wind is poised to take off in the U.S., but that the early companies competing for the manufacturing and construction contracts are European, he said, "I think this is a huge missed opportunity if we don't find a way to incentivize off-shore wind. Clean energy development is going to be indigenous. We need public policies to incent the U.S. industry. China is doing this. Germany is doing it with solar. Germany shouldn't be a world leader in solar production (because of its relative lack of sunshine)—it's policy-based."

"From the construction standpoint we've been involved with a lot of the developers who want to develop offshore wind energy," said Austin Keyser of the **International Brotherhood of Electrical Workers**. "We certainly see this as a big growth opportunity. There's lots of environmental push back and tourism concerns. There will be lots of wrestling with state regulation, but overall, it's a huge growth opportunity."

Indeed, European wind developers are attracted to the opportunity to build offshore wind in the U.S. because the economics are so positive. "The U.S. is extremely attractive (for offshore wind development)," said Thomas Brostrøm of **Ørsted North America**. "There are so many good (wind) resources here. We also feel that the energy and electricity infrastructure is very under-invested. The U.S. is becoming a core market for us."

Ørsted is one of the European companies with deep experience building offshore wind farms back home that is bringing that experience to the nascent American market. A "belief in the technology" and decreasing costs resulting from their successful experience in Europe inspired **Ørsted** to look to the United States to help build an offshore wind capacity. "One of the major benefits of offshore wind is its ability to locate generation close to the load centers," Brostrøm said. "In the U.S. there's a perspective that offshore wind is very expensive, but over the last 25 years the turbines have grown from less than one gigawatt each to eight

gigawatts, which means fewer foundations, cables and components and generating more power. This helps lower costs and over the last three to four years the cost has been reduced by 60 to 70 percent. In Europe, wind is now one of the most competitive energy sources.”

Brostrøm talked about the linkage between the volume of leases of offshore acreage to wind developers by the U.S. Interior Department’s Bureau of Ocean Energy Management and the ability of states to compete to be at the vanguard of building economic activity that supports the emerging offshore wind industry. “We are keen to see continued lease auctions by the Bureau of Ocean Energy Management because you need volume to attract the supply chain. If you want the big suppliers to locate domestically, you need large market potential,” he said. “The states that develop the first and largest offshore wind markets will benefit from having the supply chain established in their states.”

He went on to emphasize the essential role of host states in supporting this new economic development in targeted ways. “States play a critical role in development. Investment in infrastructure is important, workforce training is important, available land is important, and tax incentives for the supply chain are important,” Brostrøm said. “The state also needs to be involved in managing different stakeholders to ensure that all interests can co-exist.”

D) Interest in electrifying the economy is significant among some utilities, motor vehicle manufacturers and investors, but attention needs to be paid to the economics.

The most ambitious concepts of electrifying the economy envision decarbonizing the electric utility sector by replacing fuels that emit greenhouse gas emissions with zero-carbon energy, and then converting the transportation sector (cars, trucks, buses, rail and ships) and building infrastructure (home heating and cooling) to be powered by electricity instead of fossil fuels. A number of leaders made the case for some variation of this shift, while a few cautioned that the economics of replacing natural gas with electrification to heat and cool our homes and heat our water would be enormously expensive and drive up consumer costs.

Enthusiasm for electrifying vehicles, rail, heating/cooling etc. is passionate.

Part of the growing movement to electrify the economy arises from an understanding of how deeply the country and the world need to reduce greenhouse gas emissions to have a fighting chance to slow climate change. “When you think about Paris-like (emission reduction) figures, you need the utility sector at close to 100 percent zero- emissions and that is very hard,” said a **utility executive**. “We need to see significant change over in the vehicle fleet and basically need to electrify everything with zero-carbon energy.”

Because the contribution of electric vehicles to reducing greenhouse gas emissions is linked to the effective decarbonization of the electricity generation sector over time, the concept of electrifying the economy includes at its core both the transportation and electricity sectors.

“Our vision for prospering in a carbon constrained future is basically to transition to a 100 percent renewable energy-supplied electricity and transportation sector. We believe in the electrification of everything as the strategy,” said Danny Kennedy of the **California Clean Energy Fund**. This is an extraordinary opportunity to increase the accessibility, affordability and decentralization of more affordable clean energy—to essentially dramatically change the energy economic model, he said.

“On top our technological vision, there is a desire that this will be a different kind of economy—a shift to 100 percent electrification towards a decentralized energy architecture. Place the generating asset at the point of use to reduce the cost of distribution and loss of energy,” Kennedy said. “This distributed architecture also lends itself to decentralized ownership, less centralized capital formation, and a democratized control—similar to the co-ops in Germany and Community Choice Aggregations in California. This is what we call 3D energy future: distributed technology, decentralized ownership and democratized control.”

Kennedy said this approach envisions offering energy and mobility services for almost free. “Energy goes from a scarcity commodity to an abundance commodity like Wi-Fi, which has been adopted worldwide and is very-low cost.”

“We’re in favor of electrifying everything—that means jobs to us,” said Donnie Colston of the **International Brotherhood of Electrical Workers**, including highways and the rail system. “From the utility perspective, we have a lot of interest in EV infrastructure, and states that allow utilities to invest in recharging infrastructure. If you’re going to rely on private investors, not very much will be put in place. Where you allow utilities investing, you see utilities moving quickly,” Colston said. Also, “major projects are being proposed to expand rail, which will be a more effective carbon reduction transportation strategy.”

Many see electric vehicles as the vanguard in the shift to electrification.

As one **clean energy executive** said, “Pretty much every major OEM¹²⁹ has announced plans to electrify either significantly or fully sometime in the next five to ten years. And, that’s not even mentioning the fact that in China there are 600 companies that are interested in electrifying vehicles. So, the competition is coming.”

Volta Charging’s Ben Foss concurred that “most major OEMs are converting their offerings to EVs.” He pointed to **Ford Motor Co.’s** announcement at the 2018 Detroit Auto Show “that they will invest \$11 billion and have 40 hybrid and fully electric vehicles in the company’s model lineup by 2022.”

Utilities are looking at the anticipated growth of electric vehicles sales an emerging market for electricity to counter the recent experience of flat or declining demand.

“We’re in the motor city so we’re thinking about EVs,” said Skiles Boyd of **DTE Energy**, the Detroit utility. “A lot of our largest customers are a part of the auto industry. They have made a lot of announcements (about making electric vehicles). Senior leaders see that we can’t achieve climate reduction goals without electrification. But our electricity demand is basically flat, declining in some places, and if we want to achieve deep decarbonization, then more electrification of the transportation sector will be necessary. We see it as a big opportunity.”

“I’d love to see policy that requires installing charging (connections) with new building.... That would save a lot of money on the back end if you were to require that the charging infrastructure was required for all new home builds.” BEN FOSS, VOLTA CHARGING

Nick Stavropoulos of **PG&E** said, “I think that’s the place we have to go as a society if we are going to make meaningful GHG reductions—in particular in those parts of the country that (the electricity) generation mix is favorable, like the Pacific Northwest and here in California, that give you a good environmental bang for buck when you displace the internal combustion engine with electric vehicles.”

“New Jersey could be a poster child for electric vehicles due to the state’s density and average commute,” said Ralph LaRossa of **PSEG Power**. “Most of our air pollution issues are from transportation.” A number of considerations need to be thought through, he said. “(W)e have to think about which generation supply (will meet the demand for EV recharging): nuclear or renewable energy? It matters when consumers charge versus not, in terms of time-of-use rates. And ‘last mile’ issues: We need more engineering analysis. I’m not sure that everyone understands the effect full EV charging will have on the grid that we have today.”

Not least is the need to build out the electric vehicle recharging infrastructure. “If cities can expedite the installation of EV charging, in a way that California has done with AB 1236, that would be really helpful,” said **Volta Charging’s** Ben Foss. Among the ideas for ensuring sufficient recharging capacity as the number of electric vehicles on the street and in parking garages grows is what is often called “make ready legislation,” he said. “I’d love to see policy that requires installing charging with new building.... That would save a lot of money on the back end if you were to require that the charging infrastructure was required for all new home builds.”

129 Original equipment manufacturer.

Designing and building High Occupancy Lanes (HOV) for electric vehicles is another desirable component of the needed infrastructure, Foss said. “One change would be HOV in all cities for EVs. That would move the EV needle substantially. EVs plus HOV lanes would make a significant dent (in greenhouse gas reductions). This would be huge for major cities with traffic congestion and really affect behavior. This could be more important than subsidies.”

Some argue that natural gas can heat and cool houses less expensively than electricity.

“This approach to electrify the country is a policy choice that could have really detrimental consequences for the country,” said Kathryn Clay of the **American Gas Association**.¹³⁰ Noting that the Canadian Province of Ontario is requiring the complete electrification of all heating, she said “people are wading into this unknowingly.”

“What’s wrong with this vision, in our estimation, is that people are not really grappling with how much energy it requires to electrify heating,” Clay said. “The electricity needed to heat a home is far greater than an entire home’s total energy use—60 percent (of a home’s total energy need) is space and water heating, while 40 percent is from electricity use like lighting and plug-load. Coming up with that on the electric side is a monumental undertaking.” The infrastructure implications are enormous, she said. Electrifying the economy would “require the buildout of three or four more grids. This won’t save you carbon—it will cost you carbon. The implications for consumer costs are enormous.”

Nick Stavropoulos of **PG&E** has a similar perspective as his utility’s home state of California “is really moving into an electrification effort.”

“So here on my networks on an equivalent energy basis, whatever metric you want to use, the gas network delivers about 140 percent of the amount of energy that the electric network does in my territory. But it does it at about half the cost,” he said. “If you do that simple math it’s saying that the natural gas network is an amazingly efficient way to distribute large amounts energy. So, if you’re going to electrify, on any network, it’s going to be a lot more expensive to provide electricity to society than deliver it through the existing gas network.” Electrifying the entire gas network would lead to “a massive increase in energy costs for customers,” Stavropoulos said.

¹³⁰ At the time of the interview with Kathryn Clay (and Dave McCurdy), Clay was the Vice President for Policy at the American Gas Association. In March 2018, she became the President of the International Liquid Terminals Association.

Conclusion

The 53 interviews conducted with corporate, labor and investor leaders yielded a number of striking areas of consensus concerning the nexus of clean energy policy and opportunities to expand markets for zero- or low-carbon products and services. The ten policy findings detailed in this report reflect those areas of broad agreement, while also noting when there were multiple or divergent views.

The core findings in this report shed light on how the United States might amend or add to our clean energy and climate change policy infrastructure. Policy changes are needed in Washington and in all 50 states to strengthen the ability to of companies and investors to thrive in an accelerated transition to a decarbonized economy.

Our analysis of the interviews, reflected in this report, offers a timely perspective from a range of economic leaders that contributes to our understanding of the underlying energy- and climate-related challenges facing the private sector. This report shares their thinking about how to improve or add to the policies, programs and investments at the state, regional, national and international levels. The report also identifies those policies that are most useful in helping the private sector achieve economic success in the years and decades ahead, while simultaneously sharply reducing greenhouse gas emissions from their products, operations and activities.

The resulting narrative is both a vivid snapshot of a robust debate at this dynamic moment in time and a virtual, free-ranging conversation from which anyone interested in solutions to a rapidly-changing

energy economy and intensifying climate change can find guidance, ideas and wisdom from those with the responsibility of leadership within the private sector.

The core findings in this report shed light on how the United States might amend or add to our clean energy and climate change policy infrastructure. Policy changes are needed in Washington and in all 50 states to strengthen the ability to of companies and investors to thrive in an accelerated transition to a decarbonized economy.

The start of those discussions should be the overarching points of consensus highlighted in this report:

- 1) that efforts to address climate change represent a clear economic opportunity for many companies and investors and
- 2) that comprehensive, stable and coherent federal policies would provide welcome long-term certainty and help U.S. companies capture first-mover advantage in the growing markets for low-carbon energy.

Close behind those points was the broad advocacy we found for an economy-wide price on carbon to provide a universal incentive for sustained scale-up of business investment in clean energy and energy efficiency. The insightful comments on that point revealed varied and creative views on the optimal design of a carbon price policy. Those ideas were consistently based on a strong desire that the cost of greenhouse gas emissions be properly priced to ensure economic decisions are based on more complete information. A number of representatives of energy-intensive manufacturers and their associated unions said that any carbon pricing policy might need to include a carbon border adjustment to ensure that domestic manufacturers that comply with carbon-reduction requirements do not lose competitive advantage to less efficient foreign companies.

Most of the corporate and labor leaders we interviewed took a global perspective when considering markets, business decisions and government policies, even when headquartered in the United States. The investors we talked to increasingly look through an international lens as well. We learned that these leaders see climate change as an issue of global economic competitiveness for U.S. companies because international markets are progressively demanding more low-carbon technologies and services. Also, nearly everyone we interviewed who discussed the Paris Climate Agreement felt that a prospective U.S. withdrawal from that accord puts American businesses at a global competitive disadvantage vis-à-vis their competitor companies in other nations.

The dramatic and quickening change in the electricity sector was a topic that attracted much discussion in the interviews, with leaders of traditional utilities talking of juggling the often competing demands of reliability, safety, security, resilience and affordability along with greenhouse gas reductions; an increasing number of corporations committing to decarbonizing their energy use and purchasing renewable energy

directly from wind and solar developers in competitive markets; and expressed desires for Regional Transmission Operators and state Public Service Commissions to step up to address fragmented energy policy across their regions and provide clearer rules of the road to assist with the transition to clean electricity. These insights are useful contributions to the many discussions occurring around the country about how best to design electricity generation and delivery in the future.

Among the most robust debates reflected in this report was the extensive but nuanced support for government policies and programs that aid private sector development and deployment of clean and efficient technologies. Legislators and others who think about optimal policy design will want to look closely at the calls from multiple quarters for time-limited, targeted incentives for emerging technologies and ensuring that low-carbon policies are inclusive and technology-neutral. Also noteworthy is the wish of some wind energy developers for more efficient permitting processes. Among the most timely deliberations in this report concerns the status of the 2022–2025 federal vehicle fuel efficiency standards, as the Trump administration has launched an effort to weaken the Obama-era agreement between the federal government, state regulators and the auto industry. Our interviews revealed strong support for the existing stringent standards while some in the motor vehicle manufacturing industry and supply chain provided details about their requests for changes in the requirements.

We concluded that corporate policies and strategies that are increasingly improving company performance should also be considered as part of the policy infrastructure. These policies include setting and enforcing ambitious internal greenhouse gas reduction goals, tracking and disclosing climate-related emissions and

financial risk, and listening more closely to shareholders, investors, and other corporate stakeholders. Those commitments are contributing toward public climate change goals and modeling effective approaches for other companies, and should be recognized as an important element of the nation's overall decarbonization strategy. The contention that nuclear energy, natural gas, and carbon capture and storage technology remain necessary to achieve deep decarbonization on the needed time-scale will undoubtedly invite critique by some, but the interviewees provide useful perspective about why they feel these technologies and fuels are necessary.

Finally, a large number of economic leaders said they highly valued government investment in clean energy technology innovation and clean energy infrastructure—repeatedly citing robust investment in basic science and technology RD&D in our national labs and programs such as

the U.S. Department of Energy's ARPA-E that assist companies with emerging technologies to move toward commercialization. The U.S. Congress, in its recent writing of its Fiscal Year 2018 omnibus appropriations legislation that was signed by the President, appeared to agree that those investments provide high value to the American taxpayer and the economy.

Crafting effective statutes, regulations and practices that make serious inroads toward solving challenges such as building a reliable national energy system or addressing intensifying climate change is never an easy undertaking. Just as economists seek but rarely secure complete information in designing economic policy, this report was not intended to be exhaustive or comprehensive. However, in empirically soliciting contemporary insights directly from leaders representing major sectors of the economy, we believe we have compiled essential information that can help shape energy and climate policy development in the months and years ahead.

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Appendix One: Project approach, process, and protocol

PROJECT APPROACH AND PROCESS

The research phase of this project began with a review of the literature to identify actions already underway by key companies. We initially compiled an extensive list of potential companies, firms and organizations from which we might request interviews of their leadership, with the goal of interviewing at least 50 leaders. In assembling the list, we sought to achieve a balance of companies' core business pursuits within each sector and across the economy.

The list included companies across the major sectors that produce energy and/or use energy intensively: electric utilities, auto manufacturers, renewable energy developers and producers, transmission developers, energy management providers and fossil fuel, heavy industry, and information technology companies. We added a range of industry trade groups to secure sector-wide perspectives, as well as corporate alliances that focus on clean energy and climate change policies and practices—typically non-profit organizations that partner with corporations to advance environmental and energy responsibility. We also included a number of labor unions representing heavy industry and the utility sector and a group of investment firms focused on companies that produce energy technologies and services.

We interviewed all that accepted our invitation. A few declined to participate and others were unresponsive. A full list (with descriptions) of the companies, unions, and organizations who participated in on-the-record interviews is in Appendix Two. In total, we completed 53 interviews, conducted between October 2017 and January 2018, with the following breakdown (each sector includes the relevant corporations, industry trade groups and labor unions):

- Electricity generation and distribution (10)
- Heavy industry (8)
- Information technology and consumer products (3)
- Motor vehicle manufacturing (4)
- Oil, gas and coal production (3)
- Renewable energy development and production (4)
- Transmission development and energy management services (5)
- Labor federation (1)
- Investment firms (8)
- Corporate alliances (7)

By the nature of our approach—with the semi-structured interview format, the self-selection of those who agreed to participate and the lack of participation by others we invited—this research is not designed to be exhaustive or comprehensive. Its strength is in empirically capturing perspectives directly from the leaders we interviewed. Despite our best efforts, it is somewhat unevenly spread across the sectors on which we chose to focus.

In securing the robust participation by a wide range of CEOs, Vice Presidents and other senior leaders throughout the economy, the research team benefited from the interviewees' extensive knowledge of their sectors and fields, along with candid and seasoned insights about how policies might be improved or expanded, the impacts of those policies on economic prosperity, consumers and the environment, and the interplay between the private and public sectors. Those interviews were rich in data and detail, historical understanding of the energy economy and public policy, and creative thinking about how companies and investors can prosper in an increasingly carbon constrained world.

After completing the interviews, the research team analyzed what we learned and assembled an initial outline of the primary policy findings. We then convened an ad-hoc working group of knowledgeable experts in the public, private and non-governmental organization spheres, who reviewed and discussed our findings in a working session and in exchanges of comments and proposed edits.¹³¹ The working group helped the research team sharpen and prioritize the findings, and reviewed drafts of this report for accuracy and clarity.

The heart of the report is the list of ten primary policy findings, each followed by a narrative that allows the economic leaders we interviewed to share their views in their own words. The narrative text that the Research Team added is intended to crisply summarize the topics raised by the interviewees and provide factual background to give the reader context for the quotes. We also highlighted both common points of agreement and differences of perspective as they arose within each discussion. Distilling was necessary. We focused on those statements that best provided the reader with the key information and most succinctly and sharply made the points under discussion.

The leaders we interviewed alluded to a broad array of complex policies and situations in the energy and climate change domains, and the scope of this project makes it impossible for us to discuss them in lengthy detail or to provide extensive analysis on any single topic. For that reason, we also include in the appendices a bibliography and recommended readings of relevant reports, books and articles for further reading. For the most part, these references were cited by the interviewees or came to the research team's attention as we worked to understand the issues brought up in the interviews.

PROJECT PROTOCOL

The research protocol for this project was reviewed and approved by the Tufts University Social, Behavioral & Educational Research Institutional Review Board (SBER IRB).

From initial conversations we understood that some corporate and investment leaders might have concerns about candidly sharing what could be commercially- or politically-sensitive strategies or information. Consequently, we offered all participants the option of doing the interview “on-the-record” or “off-the-record.” For those who elected to be on-the-record, we invited them to review the quotes from their interview that we intended to use in this report and to edit them for accuracy and clarity if they wished. Many provided such edits.

For those who elected off-the-record treatment of their interview content, we committed that we would ensure the confidentiality of their name, title and company or organization in the final project report and any public treatment of the study's results. In those instances, we agreed that we would only draw on the interview to identify major themes, policy ideas or points of agreement or disagreement within a sector. Our preference was to secure the chance to understand the perspective of each leader, rather than lose that chance through non-participation. A number of the participants who elected to participate off-the-record invited the Research Team to subsequently return with specific quotes that we felt would add value to the report, for their review and possible approval.

Thirty-one of the participants agreed to be interviewed on-the-record and 22 elected to participate off-the-record.¹³² In the end, all but six of the off-the-record interviewees subsequently reviewed and approved a number of quotes that we could attribute to them in this report. Of those six, four approved our using their quotes in an anonymous fashion, without identifying them or their employer. When using those quotes in this report, we identify the source as an anonymous senior leader in a particular sector, such as an “industry executive” or similar identification.

¹³¹ Biographies of the Research Team and Working Group members are in Appendix Three.

¹³² Pursuant to the IRB-approved protocol, we are storing all interview transcripts and recordings in a secure document storage service maintained by Tufts University. For those participants requesting confidentiality, we are storing identifying information separately from the interview transcripts and recordings, using only general code titles (“Utility Sector Leader”). Access to that material is restricted to the immediate research project investigators and research assistants, and will be destroyed after SBER IRB's mandatory holding period of three years.

In each case we requested permission to record the interview to ensure accuracy, and all but one participant agreed to that request. In all instances, detailed notes were taken.

We shared in advance the following core questions that were asked of all participants:

1. What is your company/firm's vision for prospering in a carbon-constrained future? What has driven this vision to date, and is the company unified around the vision? How do you communicate and implement your vision?
2. Given the sectors with which your company/firm operates, what has been the general perspective on the government's overall approach to energy and environmental policy? Which of the existing government policies, programs, financial tools, public-private partnerships and innovation (R&D) investments in the energy/climate domain do you see as beneficial to maintaining or expanding markets for your company or firm? Which are viewed as specific impediments to company/firm performance and bottom lines?
3. How would you adjust any of the above policies and programs to maximize financial return while keeping true to the objective of reducing climate change and environmental impact?
4. What additional policies, incentives and programs would you like to see in the future in the energy/climate domain, and why?
5. How are you viewing the proposed policy shifts on energy and climate change at the federal level? Do you see them as having an impact—positive or negative—on your image, business plans, shareholder value, investor returns, and profits?
6. Have you found that business activities that reduce greenhouse gas emissions and energy use have been beneficial in terms of profits, jobs and economic growth? If yes, do these positive financial results resonate with your internal leadership, shareholders, customers, investors, regulators and other stakeholders?
7. How are you viewing the distinctions—and opportunities/challenges—between domestic versus foreign markets in the clean and efficient energy domain?
8. What do you see as the biggest challenges and needs that must be overcome in the current political and policy climate for the clean energy/tech/efficiency sector to expand?
9. As is the nature of such an exchange, we often asked additional questions that came to mind during the interview or reflected an area of inquiry suggested by the interviewee.

Appendix Two: Descriptions of participating companies, unions and organizations

Following are descriptions of all the companies, investment firms, labor unions, industry trade organizations and corporate alliances whose leadership granted interviews for this research project and approved inclusion of quotes from those interviews in this report. The list is organized by industries, followed by the AFL-CIO, listed separately as a Labor Federation, and the corporate alliances group. Industry trade groups and labor unions are listed with their principal economic sector.

ELECTRIC UTILITY INDUSTRY

DTE Energy www.dteenergy.com

DTE Energy is a Detroit-based diversified energy company with more than 10,000 employees involved in the development and management of energy-related businesses and services nationwide. Its operating units include an electric utility serving 2.2 million customers in southeastern Michigan and a natural gas utility serving 1.3 million customers in Michigan. The DTE Energy portfolio includes non-utility energy businesses focused on power and industrial projects, natural gas pipelines, gathering and storage, and energy marketing and trading.

Duke Energy www.duke-energy.com

Headquartered in Charlotte, North Carolina, Duke Energy delivers electricity to approximately 7.4 million customers. One of the largest electric power holding companies in the United States, Duke Energy has approximately 52,700 megawatts of electric generating capacity in the Carolinas, the Midwest and Florida, and natural gas distribution services serving more than 1.5 million customers in Ohio, Kentucky, Tennessee and the Carolinas. Their commercial business owns and operates diverse power generation assets in North America, including a portfolio of renewable energy assets.

International Brotherhood of Electrical Workers www.ibew.org

The International Brotherhood of Electrical Workers (IBEW), formed in 1891, is one of North America's oldest and largest trade unions, representing approximately 775,000 members and retirees across the U.S. and Canada. Members work in all sectors of the energy industry, including utilities, construction, telecommunications, broadcasting, manufacturing, railroad and government. The IBEW is headquartered in Washington, D.C.

Nuclear Energy Institute www.nei.org

The mission of the Nuclear Energy Institute (NEI) is to build awareness of the value of nuclear energy; advocate for policies that recognize that value before Congress, the White House and executive branch agencies, federal regulators, and state policy forums; proactively communicate accurate and timely information; and provide a unified industry voice on the global importance of nuclear energy and nuclear technology. Headquartered in Washington, D.C., NEI's members include companies that own or operate nuclear power plants, reactor designers and advanced technology companies, architect and engineering firms, fuel suppliers and service companies, consulting services and manufacturing companies, companies involved in nuclear medicine and nuclear industrial applications, radionuclide and radiopharmaceutical companies, universities and research laboratories, law firms, labor unions and international electric utilities.

Pacific Gas and Electric <http://www.pge.com>

Pacific Gas and Electric Company (PG&E) transmits and delivers energy to approximately 16 million people throughout a 70,000-square-mile service area in northern and central California. Based in San Francisco, California, PG&E owns nearly 7,700 MW of generation that includes hydro, nuclear, natural gas, solar, and fuel cells. Nearly 80 percent of its electricity comes from resources that produce no greenhouse gases.

PSEG Power www.pseg.com/family/power/index.jsp

PSEG Power is a major power producer in the U.S. with four main subsidiaries: PSEG Fossil, PSEG Nuclear, PSEG Energy Resources & Trade and PSEG Power Ventures. A member of the PSEG (Public Service Enterprise Group) family of companies that is headquartered in Newark, New Jersey, PSEG Power owns

and operates a diverse fleet of power plants with approximately 10,600 megawatts of generating capacity located primarily in the Mid-Atlantic and Northeast regions and has solar energy facilities throughout the United States. The largest subsidiary of the parent PSEG, Public Service Electric and Gas (PSE&G), is New Jersey's largest provider of electric and gas service, serving 2.2 million electric customers and 1.8 million gas customers.

Smart Electric Power Alliance sepapower.org

The Smart Electric Power Alliance (SEPA) is a non-profit organization dedicated to working with electric power stakeholders through the most pressing issues affecting the growth and utilization of smart energy. Located in Washington, D.C., SEPA serves as a platform for research, standards, and collaboration. Its membership encompasses utilities, independent system operators (ISOs); regional transmission operators (RTOs), governments, nonprofits and corporations specializing in solar, demand response, energy storage and other enabling technologies.

Utility Workers Union of America uwua.net

The Utility Workers Union of America (UWUA) represents more than 50,000 members working in eight utility sectors: electric, gas, water, nuclear, call center, professional/technical, public sector, and renewable energy. The UWUA operates in five regions and 29 states, and is headquartered in Washington, D.C. The UWUA advocates for rebuilding industry, training and retraining workforce, maximizing existing technologies to reduce carbon emissions and developing promising technologies such as renewables.

We interviewed two additional utility leaders, who asked that their interviews be treated as confidential and any quotes from those interviews used in this report be attributed to an anonymous "utility executive."

HEAVY INDUSTRY

Alliance for American Manufacturing www.americanmanufacturing.org

The Alliance for American Manufacturing (AAM) is a non-profit, non-partisan partnership formed in 2007 by some of America's leading manufacturers and the United Steelworkers. Based in Washington D.C., its mission is to strengthen American manufacturing and create new private-sector jobs through smart public policies. AAM achieves its mission through research, public education, advocacy, strategic communications, and coalition building around the issues that matter most to America's manufacturers and workers.

Aluminum Association www.aluminum.org

Located in Arlington, Virginia, the Aluminum Association promotes the production and use of aluminum in products as a sustainable material choice. The organization represents companies in the United States, where the aluminum industry creates \$186 billion in economic activity, and foreign-based companies and their suppliers throughout the value chain, from primary production to value added products to recycling. The Association provides global standards, business intelligence, sustainability research and industry expertise to member companies, policymakers and the general public.

American Iron and Steel Institute www.steel.org

The American Iron and Steel Institute (AISI) represents more than 75 percent of U.S. and North American steel capacity. AISI, located in Washington, D.C., advocates on behalf of its member companies for public policies that support a globally competitive North American steel industry. AISI's mission is to influence public policy and to educate and shape public opinion in support of a strong, sustainable North American steel industry committed to manufacturing products that meet society's needs.

ArcelorMittal www.arcelormittal.com

ArcelorMittal is the world's largest steel and mining company, selling its products in 160 countries. Incorporated in 2001 and headquartered in Luxembourg with U.S. operations in Ohio and Indiana, ArcelorMittal is guided by a philosophy to produce safe, sustainable steel. The company supplies steel for a number of major markets, including automotive, construction, household appliances and packaging. It is among the largest producers of iron ore with a geographically diversified portfolio of iron ore and coal assets.

Kaiser Aluminum www.kaiseraluminum.com

A manufacturer of semi-fabricated specialty aluminum mill products, Kaiser has 12 production facilities and has headquarters in Lake Forest, CA, and Spokane Valley, Washington. The company offers its products for various end market applications, such as aerospace, automotive, general engineering and other industrial products. Its fabricated aluminum mill products include flat-rolled (plate and sheet), extruded (rod, bar, hollows and shapes), drawn (rod, bar, pipe and tube) and cast aluminum products.

United Steelworkers www.usw.org

The United Steelworkers is North America's largest industrial union, with 1.2 million members encompassing a broad sector of industries, including primary and fabricated metals, chemicals, glass, paper and forestry, rubber, manufacturing, energy, utilities, transportation, pharmaceuticals and health care. Headquartered in Pittsburgh, Pennsylvania, the United Steelworkers represents workers in the United States, Canada and the Caribbean.

We interviewed an executive with an additional industrial corporation who asked that his interview be treated as confidential and any quotes from his interview used in this report be attributed to an anonymous "executive with an industrial corporation." An executive with a second industrial corporation who we interviewed ultimately asked that he or his company not be identified and his quotes not be used.

INFORMATION TECHNOLOGY AND CONSUMER CORPORATIONS**General Mills** www.generalmills.com

General Mills, Inc. manufactures and markets branded consumer foods sold through retail stores in more than 100 countries. Headquartered in Minneapolis, Minnesota, the company's many brands include Betty Crocker, Cheerios, Gold Medal, Nature Valley, Old El Paso, Pillsbury, Progresso, and Yoplait. The company has made a commitment to sustainably source its top ten priority ingredients and to improve resource efficiency so that farmers will grow more with less, and is committed to promote environmentally and social responsible practices across its value chain.

Google www.abc.xyz

Google's mission is to organize the world's information and make it universally accessible and useful. Through products and platforms like Search, Maps, Gmail, Android, Google Play, Chrome and YouTube, Google has become one of the most widely-known companies in the world. Headquartered in Mountain View, California, Google is the world's largest corporate buyer of renewable power, with commitments reaching 2.6 gigawatts (2,600 megawatts) of wind and solar energy. Google is a subsidiary of Alphabet Inc.

Intel www.intel.com

Headquartered in Santa Clara, California, Intel operates at the boundary of technology in silicon innovation, microprocessor manufacturing, and advances programmable solutions. One of the world's largest semiconductor chip makers, Intel invented the x86 series of microprocessors that are found today in most personal computers (PCs) and supplies processors for computer system manufacturers such as Apple, Lenovo, HP, and Dell. Other products and equipment manufactured by Intel include network interface controllers and integrated circuits, motherboard chipsets, graphics and flash memory. Intel has advanced its strategy of purchasing renewable energy certificates for energy generated from wind, solar, geothermal, low impact hydro and biomass sources to successfully offset 100 percent of its energy usage with green energy.

MOTOR VEHICLE MANUFACTURING INDUSTRY**Cummins** www.cummins.com

Cummins, Inc. designs, manufactures, sells and services diesel and alternative fuel energy, and diesel and alternative electrical generation. Headquartered in Columbus, Indiana with operations across six continents, Cummins consists of four principle lines of business: engines, distribution, components, and power systems. Cummins adopted its first comprehensive environmental sustainability plan in 2014, focusing on the areas of water, waste, energy and greenhouse gases, with a special focus on fuel efficiency, energy reduction, reducing direct water use, increasing recycling rate, and reducing CO₂ emissions from transportation.

Ford Motor Company www.ford.com

Ford Motor Company is a global automotive and mobility company with operations in 100 countries. The company's business includes designing, manufacturing, marketing, and servicing a line of Ford cars, trucks, and sport utility vehicles (SUVs), as well as Lincoln luxury vehicles. The Company operates in four segments: Automotive, Financial Services, Ford Smart Mobility LLC, and Central Treasury Operations. The company, headquartered in Dearborn, Michigan, also seeks to focus on a wide range of social, economic and environmental challenges with a commitment to review global and best practice and a recognition of a changing world and growing cities.

United Auto Workers uaw.org

The United Auto Workers (UAW), whose full name is International Union, United Automobile, Aerospace and Agricultural Implement Workers of America, is one of the largest and most diverse unions in North America, with 400,000 active members in virtually every sector of the economy. UAW-represented workplaces range from auto manufacturing factories, multinational corporations, small manufacturers and state and local governments to colleges and universities, hospitals and private non-profit organizations. The UAW, headquartered in Detroit, Michigan, recognizes the urgency of climate disruption and a major overlap between economic, environmental and racial injustice.

We interviewed two additional executives with a vehicle manufacturing company, who asked that their interview be treated as confidential and any quotes from that interview used in this report be attributed to an anonymous "auto industry executive."

OIL, GAS, AND COAL INDUSTRIES**American Gas Association** www.aga.org

Located in Washington, D.C., the American Gas Association (AGA) is the trade organization representing the nation's natural gas supply companies and other companies with a significant stake in the natural gas production, manufacturing and transportation sectors. The AGA also works with lawmakers, regulatory bodies, environmental and consumer affairs organizations, and the public at large, informing them of the natural gas utility industry in the United States. Almost every major natural gas supplier, user, and utility, is represented by the AGA, with member companies delivering natural gas to more than 177 million U.S. consumers.

American Petroleum Institute www.api.org

The American Petroleum Institute (API) is the only national trade association representing all facets of the oil and natural gas industry. With more than 625 members, including large integrated companies, as well as exploration and production, refining, marketing, pipeline, and marine businesses, and service and supply firms, its purpose is to promote safety across the industry globally and to influence public policy in support of a strong, viable U.S. oil and natural gas industry. API is based in Washington, D.C.

Cloud Peak Energy cloudpeakenergy.com

Cloud Peak Energy is headquartered in Wyoming and is one of the largest U.S. coal producers and the only pure-play Powder River Basin coal company. Headquartered in Gillette, Wyoming, Cloud Peak mines low sulfur, subbituminous coal and provides logistics supply services. The Company owns and operates three surface coal mines in the Powder River Basin. The Antelope and Cordero Rojo mines are located in Wyoming and the Spring Creek Mine is located in Montana. In 2017, Cloud Peak Energy shipped approximately 58 million tons from its three mines to customers located throughout the U.S., Asia and elsewhere.

RENEWABLE ENERGY DEVELOPERS AND PRODUCERS

Altus Power America www.altuspower.com

The Greenwich, Connecticut-based Altus Power America builds, owns and services solar photovoltaic arrays for commercial buildings and properties, schools and municipalities across the United States. The company uses its experience in asset-based finance and risk management and construction to provide capital solutions for the solar industry. Altus Power America also invests in, trades, and structures portfolios of renewable energy certificates and other renewable attributes. The company has more than 50 operational solar projects in the U.S.

American Wind Energy Association www.awea.org

The American Wind Energy Association (AWEA) is the national trade association for the U.S. wind industry and promotes wind energy as a clean source of electricity for American consumers. AWEA's more than 1,000 national and international members include utilities, financial firms involved in wind energy development, wind energy developers, independent power producers, non-profits and academic institutions. Based in Washington, D.C., AWEA focuses on both federal and state-level policy. AWEA's main policy priorities include protecting and strengthening renewable portfolio standards at the state level, predictable tax credits, favorable transmission policies, and prudent siting standards.

NRG www.nrg.com

NRG Energy (NRG) is an integrated power company engaged in producing, selling and delivering electricity and related products and services in various markets in the United States. Dual headquartered in West Windsor Township, New Jersey and Houston, Texas, the company owns and operates approximately 47,000 megawatts (MW) of generation and engages in the trading of wholesale energy, capacity and related products; transacts in and trades fuel and transportation services, and directly sells energy, services, and products and services to retail customers.

Ørsted www.orsted.com

Ørsted, headquartered in Frederica, Denmark, has three main areas of business: wind power, bioenergy and thermal power. These business lines contribute to the vision of a planet entirely run on green energy where green is replacing black energy. As part of its vision, the company will fully transition out of its coal business by 2023. Ørsted's U.S. headquarters in Boston, Massachusetts is focused on offshore wind development in multiple markets along the east coast. Formerly DONG Energy, whose acronym stood for Danish Oil and Natural Gas, the company changed its name to Ørsted in November 2017, after Danish scientist Hans Christian Ørsted.

TRANSMISSION DEVELOPERS AND ENERGY MANAGEMENT PROVIDERS

Anbaric Development Partners www.anbaric.com

Anbaric Development Partners specializes in early stage development of electric transmission systems and microgrid projects. Together, the Ontario Teachers' Pension Plan (OTTP) and Anbaric are developing innovative projects that fall outside the traditional scope of investor-owned utilities. Headquartered in Wakefield, Massachusetts, Anbaric developed the Neptune Regional Transmission System, a 65-mile high voltage direct current transmission line that extends under water and underground from Sayreville, New Jersey to Nassau County on Long Island and provides up to 660 MW of power to Long Island, and the Hudson Terminal Transmission Project, a 660 MW electric transmission link between New York City and a PJM interconnection in Ridgefield, N.J. Anbaric has several other large transmission projects in the development stage.

Clean Line Energy www.cleanlineenergy.com

Clean Line Energy Partners is developing new infrastructure projects that will connect renewable energy resources in North America to communities and cities that lack access to new, low-cost renewable power. These projects deliver renewables through transmission lines from the windiest areas of the U.S. to communities that seek clean energy. It's Plains & Eastern Clean Line transmission project will connect 4,000 megawatts of clean energy generation from western Oklahoma, southwest Kansas, and the Texas Panhandle with utilities and customers in Tennessee, Arkansas, and other markets in the Mid-South and Southeast. The Grain Belt Express Clean Line is an approximately 780-mile direct current transmission line that will

connect the wind resources of Kansas to Missouri, Illinois, Indiana and markets farther east. Clean Line Energy is headquartered in Houston, Texas.

Opower/Oracle www.oracle.com

Opower, a subsidiary of Oracle, provides customer engagement and energy cloud services to utilities. Opower's solutions enable more than 100 global utilities to provide a modern digital platform for 50 million households in nine countries. Opower's big data platform stores and analyzes over 600 billion meter reads from 60 million utility end use customers, enabling utilities to proactively meet regulatory requirements, decrease the cost to serve, and improve customer satisfaction. Opower was acquired by Oracle, a global provider of enterprise cloud computing, in 2016. Oracle is headquartered in Redwood City, California.

Volta Charging www.voltcharging.com

Founded in San Francisco in 2010, Volta Charging is a nationwide network of Level 2 electric vehicle charging stations that partners with brands to sponsor free charging for all electric vehicle drivers. Volta creates new ways for brands to reach highly coveted audiences in high traffic locations and for real estate owners, including shopping malls, grocery store and local retailers, to attract new customers who stay longer. The company is teaming up with partners like eMotorWorks to ensure a clean energy mix and avoid peak load charging.

Schneider Electric www.schneider-electric.com

Schneider Electric provides energy management and automation solutions in 100 countries, connecting technologies and solutions to manage energy and process in ways that are safe, reliable, efficient and sustainable. The company, headquartered in Rueil-Malmaison, France, also invests in research and development in order to sustain innovation and differentiation, with a strong commitment to sustainable development.

LABOR FEDERATION

AFL-CIO www.aflcio.org

The American Federation of Labor and Congress of Industrial Organizations (AFL-CIO) is a federation of 55 national and international labor unions that represents more than 12 million working women and men. As the umbrella organization to 64 unions, the union strives to ensure all working people are treated fairly, with decent paychecks and benefits, safe jobs, dignity, and equal opportunities, and helps people acquire valuable skills and job-readiness for the 21st century economy. The organization, headquartered in Washington, D.C., was created in 1955 by the merger of the American Federation of Labor and the Congress of Industrial Organizations.

INVESTMENT FIRMS

Bain Capital www.baincapital.com

Bain Capital is a private multi-asset alternative investment firm based in Boston, Massachusetts, with approximately \$95 billion in assets. Founded in 1984, Bain pioneered a consulting-based approach to private equity investing, partnering closely with management teams to offer the insights that challenge conventional thinking, build businesses and improve operations. Today, Bain strives to create value through private equity, public equity, fixed income and credit and venture capital investments across multiple sectors, industries, and geographies. Bain serves a diverse group of investors including pensions, endowments, foundations and individuals.

Breakthrough Energy Ventures www.b-t.energy/ventures

Breakthrough Energy Ventures, an investor-led fund with more than \$1 billion in committed capital to build cutting edge companies that will help stop climate change, was created by Breakthrough Energy Coalition in December 2016. The fund specializes in early stage, startups, and growth stage investments. The fund seeks to invest in companies developing clean energy technologies that have the potential to significantly reduce greenhouse gas emissions with a focus on renewables, nuclear fusion, "next-generation" nuclear fission, storage, building efficiency and insulation, and carbon dioxide capture. Breakthrough has brought together a group of private investors with patient capital and risk tolerance that can finance large projects with enormous global wealth.

Broadscale Group www.broadscale.com

The Broadscale Group, based in New York City, is a new model of investment firm working with leading corporations (ENGIE, General Electric, Johnson Controls, National Grid, Panasonic and Statoil) and other strategic partners to invest in and commercialize the most promising market-ready innovations. This network is comprised some of the world's most prominent energy and industrial companies who gain preferred access to new technologies in a clearinghouse arrangement.

California Clean Energy Fund www.calcef.org

The California Clean Energy Fund (CALCEF) is a private equity and venture capital firm specializing in direct and fund of fund investments. The San Francisco-headquartered firm invests in early stage and seed/startup companies and in private clean energy and transformational clean technology companies focused on low carbon transportation, green building, cleaner fossil fuel, solar, energy efficiency, lighting sector, energy storage, products and services. Included in its investment portfolios are software, renewable generation, power and communication transmission lines, electric power distribution, and demand-side management.

Clean Energy Venture Group www.cevg.com

Clean Energy Venture Group is a venture capital firm specializing in seed and early stage investments that have a potential to mitigate climate change and to generate attractive financial returns. The firm seeks to invest in clean energy companies, including their technology, products, and services, to substantially reduce the environmental damage from the production or use of energy. This seed investment firm, based in Cambridge, Massachusetts, usually invests in the first institutional investment round for its portfolio companies.

Goldman Sachs Group www.goldmansachs.com

A global banking investment firm headquartered in New York City, the Goldman Sachs Group, Inc. provides a wide range of financial services to a substantial and diversified client base that includes corporations, financial institutions, governments and individuals. Its business units include investment banking, institutional client services, investment and lending, and investment management. The Alternative Energy Investment Group at Goldman deploys capital by financing a broad range of solutions from conventional renewable energy to storage solutions and other alternative technologies.

Prelude Ventures www.preludeventures.com

Prelude Ventures is a venture capital firm focused on innovations that will have a positive impact on climate change. The San Francisco-based firm supports entrepreneurs driven to technical innovations that have the means to reduce global CO₂ through scale and velocity. The company is a long-term investor willing to take informed risk by developing more efficient products and systems powered by non-hydrocarbon resources.

Tempest Advisors

Tempest Advisors provides economic and financial advisory services to foundations and other charitable funders and develops and implements finance and market-based strategies to help address climate change in the United States and internationally. Based in San Francisco, the firm provides economic analysis and studies, merger and acquisition, divesture, joint venture, recapitalization, spin-off, and corporate restructuring advisory services.

CORPORATE ALLIANCES**Advanced Energy Economy** www.aee.net

Advanced Energy Economy (AEE) is a national association of business leaders who are working to make the global energy system more secure, clean, and affordable. With offices in San Francisco, Washington, D.C., and Boston, AEE uses policy advocacy, analysis and education to open markets across multiple technologies and services, including energy efficiency, demand response, energy storage, natural gas electric generation, solar, wind, hydro, nuclear, electric vehicles, biofuels and smart grid.

BSR www.bsr.org

BSR is a nonprofit with a network of some 275 members across more than ten industries that works to build a just and sustainable world. Located in San Francisco but focused globally, its products include consulting,

research and cross-sector collaboration. Formerly Business for Social Responsibility, BSR provides business strategy and consulting services across stakeholders to member companies, thought leaders and stakeholders who are focused in created sustainable solutions.

CDP www.cdp.net

With offices and partners in 50 countries, CDP is a not-for-profit that runs the global disclosure system for investors, companies, cities, states and regions to manage their environmental impacts through a self-reported environmental data in the world in order to make better informed decisions. Formerly known as the Carbon Disclosure Project, its focus is on climate, water, and forests and engages investors and supply chains. CDP is headquartered in London, England, and CDP North America is based in New York City.

Ceres www.ceres.org

Ceres is a nonprofit organization working with influential investors and companies to build leadership and drive solutions throughout the economy. Headquartered in Boston, Ceres seeks to tackle the world's biggest sustainability challenges, including climate change, water scarcity and pollution. Its approach is to engage influential investors and companies to integrate environmental, social and governance practices into its business strategies and mobilize leadership in this area.

Northeast Clean Energy Council www.necec.org

The Northeast Clean Energy Council (NECEC) focuses on clean tech entrepreneurs and connects them to the innovation ecosystem and its robust resources as clean energy companies start and scale. and succeed with our unique business, innovation and policy leadership. From its Boston, Massachusetts headquarters, NECEC brings together business leaders and key stakeholders to engage in influential policy discussions and business initiatives while building connections that propel the clean energy industry forward.

Renewable Energy Buyers' Alliance rebuyers.org

A coalition of four non-governmental organizations, the Renewable Energy Buyers Alliance (REBA) is helping grow large buyer demand for renewable power and helping utilities and others meet it. The host organizations are BSR, Rocky Mountain Institute, World Resources Institute, and the World Wildlife Fund. Together, they work with corporations, cities, and public institutions that want to power their operations with clean energy but need assistance in navigating the path to renewables. REBA exists to make the transition easier by helping companies understand the benefits of moving to renewables, connecting large buyer demand to renewable energy supply, and helping utilities better understand and serve the needs of all energy buyers.

World Resources Institute Corporate Consultative Group

www.wri.org/business/join-corporate-consultative-group-ccg

The World Resources Institute's (WRI) Corporate Consultative Group brings together nearly 40 Fortune 500 companies and expertise in sustainability to advance business practices that mitigate risks and support sustainable growth. WRI is a global research organization headquartered in Washington, D.C. that turns ideas into action at the nexus of environment, economic opportunity and human well-being.

Appendix Three: Biographies of the Research Team and Working Group members

RESEARCH TEAM MEMBERS

This research project was led by co-investigators Senior Fellow Kevin Knobloch and Professor of Practice Barbara Kates-Garnick as an initiative of the Climate Policy Lab in the Center for International Environment and Resource Policy (CIERP), which is led by Professor Kelly Sims Gallagher. Dr. Gallagher served as our faculty adviser. David Foster, former special advisor for economic development at the U.S. Department of Energy, served as a consultant throughout the project.

Stefan Koester and Coralie Harmache, second-year Masters' students at The Fletcher School of Law and Diplomacy, were the project research assistants. CIERP Associate Director Penny Storey provided budget, funder, and administrative support. Program Coordinator Jillian DeMair provided editing, organizational and logistical support.

The team's biographies follow:

Kevin T. Knobloch (Project Co-investigator)

Kevin Knobloch was a Senior Research Fellow at the Center for International Environment and Resource Policy at the Fletcher School of Law and Diplomacy in Medford, MA, from February 2017 to April 2018, during which time he designed and co-led this research project. He has an ongoing relationship with CIERP as a Research Affiliate. Knobloch joined Anbaric Development Partners, an independent clean energy transmission developer based in Wakefield, MA, in April 2018 in a senior role.

In January 2017, he completed a 3.5-year Obama administration appointment as Chief of Staff of the U.S. Department of Energy (DOE), a large, complex agency with an annual budget of \$30 billion and more than 110,000 employees. As the senior manager for Secretary of Energy Ernest Moniz, Knobloch helped raise the profile and impact of DOE at home and abroad and ensured that the DOE team delivered on its multiple critical missions: national energy security and infrastructure; clean energy technology research and development; international leadership on climate change, clean energy and nuclear security; nuclear weapons management and nonproliferation; scientific discovery; and nuclear waste remediation.

Knobloch led the agency's efforts to successfully implement President Obama's Climate Action Plan, including finalizing some 50 economy-wide energy efficiency rules for appliances, electronics, heating-cooling systems and lighting; taking steps to modernize the electricity grid; advancing bio-energy; implementing the clean energy Loan Program, and deploying advanced vehicle technology. He also coordinated the agency's efforts to design and launch Mission Innovation.

At the Secretary's direction, Knobloch headed up successful negotiations with state regulators in Nevada and New Mexico to address conflicts around nuclear waste issues at the Nevada National Security Site, Waste Isolation Pilot Project in New Mexico and Los Alamos National Laboratory—saving taxpayers more than \$100 million in avoided state fines and project costs and restarting critical missions at those sites.

Prior to DOE, Knobloch was President of the Union of Concerned Scientists (UCS) for ten years. During his tenure, he led the quadrupling of UCS's capacity, resources and effectiveness along with successful efforts to advance public policies on vehicle fuel efficiency, renewable energy, tropical forest protection, U.S. Senate ratification of the New START nuclear arms treaty with Russia, and scientific integrity protections for federal scientists.

Earlier in his career, he served as Director of Conservation Programs at the Appalachian Mountain Club, Legislative Director for U.S. Senator Timothy Wirth (D-CO) and Legislative Assistant for U.S. Representative

Ted Weiss (D-NY). He began his career as a newspaper journalist for several publications in Massachusetts, including *The Berkshire Eagle* in Pittsfield.

Knobloch holds a Master in Public Administration degree from the John F. Kennedy School of Government at Harvard University, with a focus on natural resource economics, and a Bachelor of Arts degree from the University of Massachusetts Amherst.

Barbara Kates-Garnick (Project Co-investigator)

Barbara Kates-Garnick Ph.D. is currently a professor of practice at the Fletcher School of Tufts University and senior research fellow at the school's Center for International Environment and Resources Policy (CIERP), where she teaches a course on energy policy, energy finance and innovation.

Dr. Kates-Garnick recently served as Undersecretary of Energy for the Commonwealth of Massachusetts and her prior public service positions included Commissioner of Public Utilities and Assistant Secretary of Consumer Affairs. She also held the position of Vice President of Corporate Affairs at KeySpan, a gas utility in the Northeast. She conceived of and developed the initial proposal that created the New York City Accelerator for Clean and Renewable Energy (NYC ACRE) at NYU.

She serves on the board of PowerOptions, a pioneer in energy aggregation for the nonprofit community in Massachusetts and on the Board on Energy and Environmental Systems (BEES) of the National Academies of Science, Engineering and Medicine. She has also advised the American Academy of Arts and Sciences on a clean power study. Dr. Kates-Garnick serves as an ambassador to DOE's 3CE, a global initiative that promotes women in clean energy through the creation of role models and champions to enhance their visibility and success in energy careers.

Dr. Kates-Garnick has a Ph.D. in international political economy from the Fletcher School of Tufts University, an A.B., *cum laude*, in political science from Bryn Mawr College and was a pre-doctoral fellow at the Center for Science and International Affairs at the Kennedy School of Government, Harvard University, where her focus was on energy security.

Kelly Sims Gallagher (Faculty Adviser)

Kelly Sims Gallagher is Professor of Energy and Environmental Policy at The Fletcher School, Tufts University. She directs the Center for International Environment and Resource Policy and the Climate Policy Lab at the University's Fletcher School.

From June 2014–September 2015 she served in the Obama administration as a Senior Policy Advisor in the White House Office of Science and Technology Policy, and as Senior China Advisor in the Special Envoy for Climate Change office at the U.S. State Department. Dr. Gallagher is a member of the board of the Belfer Center for Science and International Affairs at Harvard University, where she previously directed the Energy Technology Innovation Policy (ETIP) research group. She is also a faculty affiliate with the Harvard University Center for Environment.

Broadly, Dr. Gallagher focuses on energy and climate policy in both the United States and China. She specializes in the role of policy in spurring the development and deployment of cleaner and more efficient energy technologies, domestically and internationally. A Truman Scholar, she has a MALD and PhD in international affairs from The Fletcher School, and an AB from Occidental College. She speaks Spanish and basic Mandarin Chinese, and is a member of the Council on Foreign Relations. She is the author of *China Shifts Gears: Automakers, Oil, Pollution, and Development* (The MIT Press 2006), editor of *Acting in Time on Energy Policy* (Brookings Institution Press 2009), *The Global Diffusion of Clean Energy Technologies: Lessons from China* (MIT Press 2014), and numerous academic articles and policy reports.

Stefan Koester (Research Assistant)

Stefan Koester is a second-year dual-degree master's student at the Fletcher School and the Urban and Environmental Policy and Planning program at Tufts University. His research is focused on national and international climate and energy policy, particularly carbon pricing programs and policies to promote increased renewable energy deployment. Prior to graduate school he worked for an environmental consulting company based in Washington, D.C. focused on increasing corporate engagement in state and federal energy and climate policy. He has an undergraduate degree in economics and philosophy from the College of Charleston in South Carolina. He is originally from the D.C.-area.

Coralie Harmache (Research Assistant)

Coralie Harmache is a dual degree candidate with the Fletcher School and the HEC MBA program in Paris, France where she studies energy policy and finance. Her interests lie in the deployment of renewable energy sources and energy access.

Over the summer of 2017 Ms. Harmache worked as a Project Development Analyst for the Eco Banking department of XacBank in Ulanbaator, Mongolia to develop a consumer loan program that would encourage the adoption of energy efficient home appliances. She currently lives outside of Paris on the HEC Campus and will finish her dual degree in December of 2018.

David Foster (Project Consultant)

David Foster served as Senior Advisor to U.S. Secretary of Energy Ernest Moniz from 2014-2017 on energy, environmental, climate, economic development, workforce development and labor relations issues. During that period, he designed and implemented the creation of the Department of Energy's Jobs Strategy Council, an initiative that linked the department's technical and financial resources to a wide group of external stakeholders including state and local governments, private sector energy and manufacturing businesses, non-profits, academic institutions, and labor unions.

He also designed and oversaw the annual production of the U.S. Energy and Employment Report, a survey driven study of labor markets in four key energy-related sectors of the U.S. economy. In addition, he led the interagency effort to create the Energy and Advanced Manufacturing Workforce Initiative, which formally linked the Department of Energy with the Departments of Labor, Education, Commerce, Defense, and the National Science Foundation on workforce development issues. He also spurred the formation of the Utility Industry Workforce Initiative that joined six utility trade associations with four government agencies and two national labor unions to promote veterans hiring in the utility industry.

Prior to working at the Department of Energy, Mr. Foster served as the founding Executive Director of the BlueGreen Alliance (BGA), a strategic partnership of 14 of America's most important unions and environmental organizations with a combined membership of 14.5 million. The BlueGreen Alliance is the country's foremost labor/environmental advocacy group on climate change policy solutions with a special emphasis on energy intensive industries, job creation, and the interchange between global warming and trade policy.

From 1990–2006, he was the Director of United Steelworkers (USW), District #11, a 13-state region based in Minneapolis, MN. His responsibilities included serving on the union's International Executive Board and negotiating labor agreements with many of the country's largest steel, iron ore and aluminum companies.

In 2004, he was awarded the Jane Lehman Bagley Award from the Tides Foundation for his work building labor/environmental coalitions in the United States and in 2009 in he received the first Peter A. Berle Award for Environmental Integrity along with Dr. James Hansen of the Goddard Space Institute.

Since 2009, Mr. Foster has served on the Board of Directors of Kaiser Aluminum Corporation and, since 2006 the Board of Directors of Oregon Steel Mills and its successor, Evraz, North America. Mr. Foster has a BA from Reed College in Portland, OR. He lives in Minneapolis, MN.

Jillian DeMair (Editing and Project Support)

Jillian DeMair is Program Coordinator at the Center for International Environment and Resource Policy (CIERP) of The Fletcher School, Tufts University. She supports the administration and implementation of CIERP's objectives: policy-relevant research and teaching to promote sustainable prosperity in light of the global impacts of climate change. Prior to her current role, she shared her expertise in German language and culture as a faculty member at the University of Central Arkansas, Harvard, MIT, and Lesley University. Her publications include articles on the role of the environment in German literature, a book chapter on the podcast Serial, and translations of studies on cultural and political thought. She holds a Ph.D. from Harvard University in Germanic Languages and Literatures.

WORKING GROUP MEMBERS

The Working Group consisted of the Research Team members above as well as Susan Tierney, Rick Duke and Nora Mead Brownell. Their additional biographies are below.

Dr. Susan Tierney

Dr. Tierney is an expert on energy policy and economics, specializing in the electric and gas industries. She has consulted to companies, governments, non-profits, and other organizations on energy markets, economic and environmental regulation and strategy, energy and renewables policy, and energy facility projects.

A former Assistant Secretary for Policy at the U.S. Department of Energy, she is chairman of the board of the Energy Foundation and previously co-chair of the National Commission on Energy Policy. She has published widely and frequently speaks at industry conferences.

In Massachusetts, Dr. Tierney was previously Secretary of Environmental Affairs, Chair of the Board of the Massachusetts Water Resources Agency, Commissioner of the Massachusetts Department of Public Utilities, and executive director of the Massachusetts Energy Facilities Siting Council. Dr. Tierney has a Ph.D. in Regional Planning from Cornell. Her dissertation: Congressional policy making on energy policy issues.

Richard Duke

Rick Duke is Founder and President of Gigaton Strategies, LLC. Previously, he served as Special Assistant to President Obama, helping to craft the 2013 Climate Action Plan and driving its domestic and international implementation through the end of the second term. His domestic priorities spanned the EPA's Clean Power Plan, the 2015 budget deal to achieve long-term extensions to renewable energy tax credits, DOE's appliance standards program, regulations on non-CO₂ gases, and measures to bolster lands sector carbon sinks and cut agricultural emissions.

His international work in support of the Paris Agreement included defining the United States' 2025 emissions reduction target for the November 2014 leader-level joint announcement with China that jumpstarted the Paris negotiations process; bilateral engagement with Mexico and other major economies on their respective Paris Agreement emission reduction targets; and two successive U.S. Biennial Reports to the UNFCCC. He also served as the White House lead to negotiate the landmark Kigali Amendment to the Montreal Protocol to phase down HFCs as well as a global market-based measure to offset growth in international aviation emissions from 2020 under the International Civil Aviation Organization (ICAO). Finally, he led the team that authored the U.S. Mid-Century Strategy to achieve deep decarbonization by 2050.

During the first term, he served as Deputy Assistant Secretary for Climate Policy at the U.S. Department of Energy, including helping to launch the Clean Energy Ministerial and contributing to first-term policies such as the social cost of carbon, the mercury and air toxics standard, and the clean energy standard legislative proposal.

Previously, he launched the Center for Market Innovation at NRDC. As an engagement manager at McKinsey & Company, his projects included managing development of the firm's first global greenhouse gas abatement curve.

He holds a Ph.D. from Princeton University, where his doctoral work focused on the economics of public investment in clean energy.

Nora Mead Brownell

Nora Mead Brownell is the co-founder of Espy Energy Solutions, LLC, an energy consulting firm. Commissioner Brownell was nominated by President George W. Bush to the Federal Energy Regulatory Commission (FERC) on April 30, 2001. She was confirmed by the United States Senate on May 25, 2001, for a term that expired June 30, 2006.

Commissioner Brownell's tenure at the FERC reflects her longstanding and unwavering commitment to fostering competitive markets to serve the public interest. She championed the development of independent transmission organizations for wholesale power, which now represent the electricity market structure serving two-thirds of the U.S. \$10 trillion economy. As a leading advocate of responsive and effective independent board governance at RTOs and corporations, Ms. Brownell is a strong proponent of FERC policies that promote investment in national energy infrastructure development.

Prior to FERC, Ms. Brownell served as a member of the Pennsylvania Public Utility Commission (PUC) from 1997 to 2001. During her time at the PUC, Ms. Brownell took an active role in the rollout of electric choice in Pennsylvania. In addition to her work in establishing the framework for one of the most successful retail electric markets in the country, she actively supported Pennsylvania's pursuit of competition in the local markets for telecommunications, deployment of advanced services, enhancement of services to rural areas, protection of consumers, and advancement of special services. Ms. Brownell has helped craft unique solutions to a number of these industry issues.

Prior to her appointment to the Pennsylvania Commission, she was Executive Director of the Regional Performing Arts Center in Philadelphia, a \$200 million arts and economic development initiative. Additionally, she previously served as the Senior Vice President for Meridian Bancorp, Inc.'s Corporate Affairs Unit. Prior to joining Meridian in 1987, Commissioner Brownell was Deputy Executive Assistant to former Pennsylvania Governor Richard Thornburgh. Commissioner Brownell is the former President of the National Association of Regulatory Utility Commissioners (NARUC).

Ms. Brownell serves on the boards of National Grid, PLC, Spectra Energy Partners, Tangent, and the Terviva Advisory Board. Previously, Ms. Brownell served on the Boards of Comverge, ONCOR, Starwood Energy Fund, Times Publishing Company, New World Capital Advisory Board, Leaf Clean Energy Company, GridWise Architecture Council, Millennium Bank, Foundation of Architecture, Philadelphia Free Library, and the Philadelphia Regional Performing Arts Center. In addition, Ms. Brownell has lectured at the Vermont Law School's Center for Energy and the Environment, the Michigan State University Institute of Public Utilities, and at the University of Idaho, Wharton Energy Club, among others. Commissioner Brownell is a native of Erie, Pennsylvania and attended Syracuse University.

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THE FLETCHER SCHOOL

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The Fletcher School at Tufts University was established in 1933 as the first graduate school of international affairs in the United States. The primary aim of The Fletcher School is to offer a broad program of professional education in international relations to a select group of graduate students committed to maintaining the stability and prosperity of a complex, challenging, and increasingly global society.

The Center for International Environment and Resource Policy (CIERP) was established in 1992 to support the growing demand for international environmental leaders. The Center provides an interdisciplinary approach to educate graduate students at The Fletcher School. The program integrates emerging science, engineering, and business concepts with more traditional subjects such as economics, international law and policy, negotiation, diplomacy, resource management, and governance systems.

The Climate Policy Lab (CPL) convenes teams of scholars and practitioners to evaluate existing climate policies empirically and works with governments contemplating new climate policies. The main questions the Lab seeks to answer are: Which climate policies work in practice? Which don't work? Why? Under what conditions would they work elsewhere? The scope of the Lab is global while remaining highly attuned to state, national, and bi-lateral policy processes. It has a particular emphasis on international comparative policy analysis.