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Written Testimony of
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Introduction

My name is David Hart. I am a professor at the Schar School of Policy and Government at George Mason University, the Commonwealth of Virginia's largest public university. I also lead the clean energy innovation policy program at the Information Technology and Innovation Foundation (ITIF), a non-profit, non-partisan think tank that focuses on accelerating innovation to spur growth, opportunity, and progress. I have published numerous works on energy innovation, including *Unlocking Energy Innovation* (MIT Press, 2012, co-authored with Richard K. Lester).[1]

Thank you for inviting me to share my views on energy innovation with you today. Your leadership on this topic is vital to our national interests.

Main Points

I will make six points in my testimony.

First, rapid innovation across a wide range of energy goods and services is vital to achieve our national goals in the coming decades, including but not limited to economic prosperity and environmental sustainability.

Second, the future economic prosperity of the United States will depend on innovation in energy supply, management, and use.

Third, energy innovation is vital to arrest global climate change and thereby avoid its worst consequences, which would include substantial damage to our economy.

Fourth, while failing to stop climate change will have enormous economic consequences, so too will succeeding, unlocking significant opportunities for growth.

Fifth, all states and regions of the United States have opportunities to participate in and benefit from energy innovation, and they should seize these opportunities.

Sixth, the federal government can and should do a better job of accelerating energy innovation, including supporting clean-energy-based economic development strategies at the state and regional levels.

1. Rapid innovation across a wide range of energy goods and services is vital to achieve our national goals in the coming decades, including but not limited to economic prosperity and environmental sustainability.

Clean, affordable, and reliable energy is essential to the prosperity of the U.S. and global economies. Making energy cleaner while enhancing affordability and reliability is essential to meet the environmental challenges of the nation and the world as well. I will elaborate on these two themes in the rest of this statement.

In addition to supporting our economic and environmental goals, cleaner, more affordable, more reliable energy can underpin improvements in Americans' health, enhance the life chances of the less-advantaged in our society, and strengthen our common defense. Many Americans, particularly children and seniors, suffer from chronic conditions caused or exacerbated by energy-related pollution. Energy innovation is an important tool to help alleviate these conditions. Energy insecurity afflicts a large segment of America's rural and urban populations, forcing households to choose between staying warm and paying medical bills or buying groceries. Lowering the cost of energy through innovation would aid Americans who have difficulty paying their energy bills. The U.S. military relies on energy for everything it does, and consumes much of that energy in combat settings, where it is extremely costly—in human lives as well as dollars—to obtain. Innovation that leads to more easily accessible, flexible, and durable energy resources will support the U.S. national security mission.[2]

2. The future economic prosperity of the United States will depend on innovation in energy supply, management, and use.

Energy is an enormous and vital economic sector in its own right, accounting for about 8-10 percent of U.S. gross domestic product. It is an important input to virtually every economic activity, and its cost and how efficiently it is used as an input will affect growth and competitiveness. As with any major product category and factor of production, innovation in energy goods and services has the potential to create new sources of advantage for American businesses, workers, and communities. Innovation is the core American strength in the global economy, and we must continue to build on that strength, in energy and in every other economic sector.[3]

Technological innovation is often divided into two categories: process innovation and product innovation. With respect to process innovation, perhaps the most important set of opportunities impacting energy arises from applying information technology and data analytics – in other words, making our energy system "smarter." Smart manufacturing systems can provide U.S. industries with a competitive advantage by radically improving energy productivity. Smart electricity grids can facilitate the integration of increasingly diverse and distributed energy resources. Smart infrastructure can help communities to improve their quality of life, for instance, by making mobility more convenient, affordable, and energy-efficient.[4]

Product innovations (and associated changes in business models) in major energy industries like electric power and transportation represent another set of enormous opportunities in the coming years. These innovations might include a new generation of nuclear power plants; carbon capture, utilization, and storage technologies; electric vehicles ranging from buses to cars to short-haul aircraft; energy storage devices at all scales, renewable power systems such as solar, wind, biofuel, and geothermal power; and many more. These innovations have often been motivated initially by environmental concerns, but they must make economic sense if they are to be adopted on a global scale.[5]

3. Energy innovation is vital to arrest global climate change and thereby avoid its worst consequences, which would include substantial damage to our economy.

Climate change is real, accelerating, and caused primarily by unabated combustion of fossil fuels. The current trajectory puts many of our major cities and industries, including agriculture, at risk. According to the 2018 National Climate Assessment, "Climate change has the potential to adversely impact agricultural productivity at local, regional, and continental scales through alterations in rainfall patterns, more frequent occurrences of climate extremes (including high temperatures or drought), and altered patterns of pest pressure." The report also states that "rural communities, where livelihoods are more tightly interconnected with agriculture, are particularly vulnerable to the agricultural volatility related to climate."[6]

The world will need to adopt a diverse array of energy innovations on a massive scale to bend the greenhouse gas emissions curve sharply downward. Energy-related emissions account for the vast majority of all emissions globally and in the United States. The International Energy Agency has identified 45 critical energy technologies that must progress rapidly if the average rise in global temperature is to be kept below two degrees Celsius. Only seven of these technologies are assessed to be on track to meet that goal today.[7]

4. While failing to stop climate change will have enormous economic consequences, so too will succeeding, unlocking significant opportunities for growth.

The innovations required to avert climate change will transform major sectors of the global economy. If the United States does not lead these transformations, it risks missing out on growth opportunities. The auto industry is a good example. It has now begun to shift inexorably toward electric propulsion. Massive investments in new battery and electric vehicle factories are being made in China, Europe, and elsewhere, while the United States lags.

Further in the future, industries that produce metals, chemicals, and other bulk materials, which produce about a quarter of the world's carbon emissions, will also be ripe for energy innovation. The race is on now to find solutions for these industries, which might involve carbon capture, biomass or hydrogen combustion, and nuclear power as well as process redesign. The producers that make breakthroughs will have a head start to gain customers in huge and growing global markets.[8]

5. All states and regions of the United States have opportunities to participate in and benefit from energy innovation, and they should seize these opportunities.

A big part of energy innovation in the 21st century involves developing and managing distributed energy resources, which are growing exponentially. The grid of the future will not be a one-way system through which large power plants sell their output, but a dynamic, multi-directional, interactive platform for exchange. Everyone connected to the grid – and that means just about everyone in the United States – can join in the innovation process.[9]

In addition, many regions, including many rural areas, are blessed with unique energy resources. In many cases, these resources have the potential to support good new jobs. According to Bloomberg New Energy Finance, which uses a relatively narrow definition, more than $300 billion in investment has flowed into clean energy globally in each of the past five years.[10] It is not surprising, then, that clean energy has emerged as a focus for state and regional economic development strategies. These strategies include offering incentives to manufacturers and other investors to site or retain facilities, nurturing technology-based start-up companies, deepening existing clusters of related industries, substituting indigenous for imported energy resources, and

stimulating market demand for clean-energy products and services. These strategies are not mutually exclusive and are often used in combination with one another.[11]

The best of these strategies take a long-term, asset-building perspective that leverages the region's existing strengths. They include investments that fill the gaps in the innovation chain between federally-funded research and privately-funded commercialization, particularly through targeted R&D and technology transfer programs. Large-scale energy technology demonstration projects which may involve a variety of public and private participants may also contribute to regional growth and lay the foundation for further development. New York's energy storage manufacturing initiative and North Carolina's effort to create a smart grid cluster are two examples of promising state and regional strategies.[12]

6. The federal government can and should do a better job of accelerating energy innovation, including supporting clean-energy-based economic development strategies at the state and regional levels.

ITIF has offered many recommendations for federal energy innovation policy. Some of the key ideas include:

- Providing financial and technical support to clean-energy-focused state and regional economic development strategies,[13]
- Encouraging national laboratories, military bases, and other federal institutions to contribute to these strategies,[14]
- Expanding investment in use-inspired R&D and cluster-deepening programs, such as ARPA-E and Manufacturing USA, [15]
- Aiding communities and workers who are at risk as the energy economy evolves,[16]
- Expanding federal energy research and development investment across a wide range of opportunities and challenges,[17]
- Co-investing with private, state, and other partners in a new generation of energy technology demonstration projects,[18]
- Reforming how federal research, development, and demonstration (RD&D) programs and institutions are managed, so that we get more value from federal RD&D investments,[19]
- Sharing the risks taken by early adopters of new energy technologies to drive innovation through time-limited tax incentives,[20]
- Providing clear, predictable, and increasingly stringent pollution control regulations and emissions taxes to drive industrial innovation,[21] and
- Taking a leadership role to accelerate clean energy innovation globally.[22]

Conclusion

Innovation is intrinsically uncertain, and energy innovation at this moment is particularly so. No one knows precisely what the energy landscape will look like in 2050. We need to build a robust portfolio of options not only to address the diversity of challenges across the global energy system, but also so that we are ready to cope with the inevitable surprises and failures that come with innovation.

Thank you again for your leadership in this vital policy area and for offering me the chance to share these ideas with you.

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