Hearing on the Case for Climate Optimism:

Realistic Pathways to Achieving Net-Zero Emissions

Testimony to the Energy and Mineral Resources Subcommittee,

House Natural Resources Committee

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October 17, 2019

* The views expressed here are my own and do not represent the position of the American Action Forum. I thank my colleague Dan Bosch for his assistance.

Chairman Lowenthal, Ranking Member Gosar and Members of the Subcommittee, thank you for the opportunity to testify today regarding realistic pathways to achieving net-zero emissions. I hope to make three main points:

- From an economic perspective, achieving net-zero emissions in the short term is unrealistic, and the available research literature bears this out;

- Emissions goals should involve the participation of emerging economies, since the United States cannot solve this conundrum on its own, particularly with the price tag attached to short term net-zero emissions plans; and

- A long-term strategy of market incentives for energy innovation would make the most efficient progress toward a lower emissions goal.

Contrary to the title of today's hearing, I do not share optimism that the pathways to net-zero emissions are realistic, and certainly not within 10 years. In short, the proposals to get the United States to net-zero carbon emissions in a decade are impossibly expensive and would likely have a devastating effect on our economy.

COST ESTIMATE OF NEEDED CAPACITY

The American Action Forum published research[1] in January on how much it would cost to get to 100 percent renewable energy over the next 10 years. That study found that merely installing the required renewable capacity — in the form of solar, wind, hydroelectric, and storage — would cost $5.7 trillion.

The assumptions under which these costs were calculated were very optimistic. They are: the United States could entirely use solar power during the day, and wind power during the night; for the hours in the day where neither solar nor wind produce their stated capacity (due to capacity factors of electricity sources), it is assumed that a mixture of hydroelectricity and storage is used; the United States builds the entirety of all potential hydroelectricity resources; storage costs associated with batteries is their average operation and maintenance cost, rather than the (significantly higher) costs of batteries that can discharge a lot of electricity quickly and repeatedly throughout the day; electricity demand is roughly flat (rather than demand spiking during afternoon hours); and there is no increase in the price of wind, solar, hydroelectric, or storage.

The average annual expenditure under this scenario would be about $423.9 billion each year. For perspective, total revenue raised in the United States from electricity sales in 2017 was $390 billion[2]. Even under the optimistic conditions of the above assessment, which assume very low electricity storage and discharge costs, and no increased transmission costs, merely building and operating the required number of renewable electric power plants would cost more than what Americans pay for electricity today.

The above estimates show that a 100 percent renewable target would require an extraordinary amount of investment but determining exactly how much a typical consumer would be affected is not easy, since electricity costs encompass more than merely the capital and operating costs. An analysis from Jesse Jenkins[3] produced for the Massachusetts Institute of Technology, however, estimated that a decarbonized 100 percent renewable electricity system would result in an average electricity cost of $150–$300 per megawatt hour (2017's average electricity cost is $104.8[4] per megawatt hour). Simply, a 100 percent renewable electricity grid would require Americans to pay between 43 and 286 percent more on their electric bills. In 2017, the average monthly electric bill was $111[5], so a 43-286 percent increase would translate to an average of between $576 and $3,882 more spent on electricity per year, per residence.

OTHER ESTIMATES SHOW SIMILAR EXPENSE

This estimated annual cost figure is roughly in line with other estimates. For example, a Risky Business study[6], which estimated the costs of transitioning to a clean energy economy, concluded that an average annual investment of $320 billion would be required through 2050, and the model for this estimate assumed more resources than just renewables available. A National Bureau of Economic Research study estimated the net cost of reducing total greenhouse gas emissions by 80 percent would be $1.3–$4.0 trillion[7] (with $3.3–$6.0 trillion of required investment). Although this $5.7 trillion estimate should not be taken as an accurate assessment due to the optimistic assumptions, it does provide a ballpark figure that is consistent with what more thorough research on the topic has produced.

MORE OPTIMISTIC STUDIES ARE FLAWED

Despite the apparent popularity of a "100 percent renewable electricity" goal, there is surprisingly little academic research on what it would cost. This dearth is because renewable electricity is not the same as clean or low-carbon electricity. As explained by Jenkins in the MIT study, restricting low-carbon electricity objectives to renewable electricity creates much higher policy costs — 10 to 62 percent higher[8]. This expense results from a phenomenon known as the "duck curve[9]," which is that the more non-dispatchable (i.e. renewable) resources you have supplying electricity, the greater the demands are upon your dispatchable (i.e. fossil) resources.

There are two commonly cited analyses, though, which are used to claim that a 100 percent renewable electricity target is affordable. The first, and most notable, is by Dr. Mark Jacobson of Stanford University. In his 2015 analysis[10], Jacobson et al. assert that it is net beneficial to switch to 100 percent renewable electricity, and that the reason it has not happened yet is because people are "unaware" of the benefits or ease of transition. This study has since been widely debunked[11], as it assumes far more hydroelectric usage than is even remotely technically achievable in the United States.

Another major assessment comes from the Lappeenranta University of Technology and Energy Watch Group. The research[12] notes that widespread adoption of storage technology, particularly lithium-ion batteries, coupled with declining costs of renewable electricity make transitioning to 100 percent renewable electricity a low-cost endeavor. This study is flawed in that it assumes a massive, nearly 90 percent, decrease in lithium-ion battery cost by 2050. This assumption is contrary to the expectation of market analysts, which is that a global shortage of cobalt will make lithium-ion batteries *more* expensive.

MORE REALISTIC APPROACHES EMBRACE MARKETS AND INNOVATION

The vast majority of proposed policies to address climate change are focused on the United States and domestic efforts to reduce emissions. Embedded in ideas such as the "Green New Deal" is the assumption that the United States is such an important global actor in climate change, and such a large contributor to it, that American action alone can dramatically change the outlook for carbon emissions around the world. Unfortunately, the data tell a different story: The biggest challenge in climate change is growing energy consumption (and thus emissions) abroad, and particularly in nations that are on average significantly poorer than the United States.

A pragmatic strategy for climate change must account for this reality. Currently favored policies in the United States, and the West more generally, are expensive, and poorer countries are highly unlikely to adopt policies that would substantially hurt their economies. As a result, to have large impacts on future emissions, climate change policies need to be centrally focused on bringing down the costs of clean energy. In a word, the focus should be innovation.

The United States, however, does not invest heavily in energy innovation, nor does it have a climate-focused innovation mission. The current model of U.S. energy innovation is, first, to invest a modest amount of federal dollars in energy research conducted by National Laboratories, and those dollars are not invested broadly but rather narrowly in specific technology areas (renewables, energy efficiency, nuclear, etc.). Inventions that emerge from the National Labs, or privately developed inventions, receive essentially no support that would allow the introduction of unproven technologies in the commercial sector. Instead of supporting the development of breakthroughs, already-proven technologies such as wind or solar power get the most government support in the form of subsidies (both federal and local) and regulations that explicitly require consumers to purchase their products through renewable portfolio standards. In short, current policy invests relatively little in advancement while investing much in propping up current technologies.

That said, there are bright spots when it comes to effective allocation of renewable technology research and development investments within the government. In fact, compared to other agencies, the Department of Energy (DOE) is relatively efficient with its R&D spending, given its objective-driven approach, originally borne out of the nuclear weapons development of the first half of the 20th century. DOE has also demonstrated a commitment to improve public-private partnerships, having implemented several programs with an emphasis on commercialization such as the Labs-Corps program. The Federal Agreements for Commercializing Technology (FedACT), first announced in 2017, allows private companies to partner with the National Labs without covering all of the development costs as they were previously required to do. Another example of a public-private mission on the part of DOE is the Advanced Research Projects Agency–Energy (ARPA-E) program, designed to fund high-risk, high-reward projects that the private sector would not likely undertake on its own. Its stated goal is to reduce energy imports, increase energy efficiency, and reduce energy-related emissions.

At least two major energy innovation bills were signed into law last year, including the Department of Energy Research and Innovation Act and the Nuclear Energy Innovation and Capabilities Act. Both promote the accessibility of publicly funded research to the private sector, and facilitating commercialization by making it easier for universities and private entities to collaborate with the National Labs on research and development goals.

Of course, much more can be done to get the most out of these R&D resources with the ultimate goal of pursuing emissions reductions through innovative and market-friendly approaches. One relatively minor, but important step could be for the DOE to update its Technology Transfer Execution Plan, so that programs such as the Technology Commercialization Fund, Labs-Corps, FedACT, and Technology-to-Market requirements under ARPA-E could be fairly evaluated[13].

Regardless of these specific efforts, a cogent innovation strategy should instead be agnostic as to what technologies are supported, and governmental support should be primarily focused on earlier-stage research and development. Federal subsidies, if any are offered at all, should be for newer technologies that struggle to attract investment. Fundamentally, a U.S. innovation strategy should be about transitioning from the existing system, where government policy heavily favors a select few technologies that have little hope of replacing fossil fuel consumption abroad, to a system that ensures new and revolutionary ideas can compete with all the advantages of incumbent technologies. Without an innovation strategy, technologies that may be game changers and more marketable abroad may never get opportunities to demonstrate their commercial value or viability.

The substantive policy changes needed for a more pro-innovation energy policy are relatively simple. Reforming the roughly $110 billion of energy subsidies[14] that take the form of tax breaks over the next 10 years could be done in a way that is technology neutral, and also revenue neutral. Such a reform would reduce political bias and encourage more responsible use of federal tax dollars. The Loan Programs Office, which provides guarantees to loans for new technologies, could be reformed to be more transparent and competitive to better attract high quality applicants. The National Labs' innovation programs should have more flexibility to partner with outside organizations and maximize the utilization of their resources and technical expertise. These policy proposals are also relatively uncontroversial, as over the past two years several significant pro-innovation energy bills have been signed into law, aiming at easing regulations for clean energy and encouraging private-public partnerships with the National Labs.

Better climate policy must employ the advantages of dispersed choice and markets. Cleaner energy is more readily adopted when it has a market advantage over incumbents and consumers have an option for choice. Such a situation can only arise in a market that allows for choice, and broad regulatory mandates or subsidies typically reduce choice and market competition. A serious look at U.S. climate policy should not simply be seeking opportunities for regulations or subsidies, but rather consider what are the market conditions under which advanced nuclear, carbon capture and sequestration, and energy storage become competitive with incumbent energy sources.

CONCLUSION

If setting a lower emissions target is a key policy goal for the United States, it is critical to attempt these reductions in a way that acknowledges market forces, the inefficiency of top-down regulation as a mechanism, and the crucial importance of innovation as the key driver of advancement. Unfortunately, policies that set a net-zero emissions target in the very short term will be remarkably costly and unlikely to achieve their stated goals.

Notes

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[4] U.S. Energy Information Administration. Electric Power Annual 2017. October 2018. Available at: https://www.eia.gov/electricity/annual/pdf/epa.pdf.
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