Subcommittee on Environment and Climate Change
Hearing on
"Building a 100 Percent Clean Economy: Opportunities for an Equitable, Low-Carbon Recovery"
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The Honorable John Shimkus (R-IL):

1. What are the biggest obstacles to reducing our reliance on critical mineral imports and increasing our domestic production?

RESPONSE:

Honorable Mr. Shimkus, this is an enormous question and there are a number of excellent resources for background.[1] It actually has two parts – one is direct replacement of imported raw materials. The other is whether we can substitute U.S. manufacturing (which would require appropriate supply chains) for goods that we import and that entail critical minerals inputs but are manufactured elsewhere because input costs are cheaper or more accessible (including labor availability and costs as well as associated raw materials supply chains to support manufacturing). When it comes to direct replacement of imported raw materials, the U.S. mining and minerals processing industries are affected by challenges that these businesses face worldwide. These include that gamut of environment, social, governance (ESG) risks that are being imposed across economic sectors (except, apparently, those that are perceived as "green" "clean" tech). In fact, the mining industry has demonstrated continuous improvement on the ESG front, as have other basic industries. The myriad safety, security, health and environment (SSHE) challenges in mining and minerals processing cannot be ignored. They can be addressed with proper controls that reflect realities of these businesses and allow some flexibility for operators. Mining and minerals processing operations consume water and energy, which must also be acknowledged but also can be managed. Labor is a huge consideration. Worldwide, the work force for these industries is ageing and for the U.S. and other developed countries, including China, demographics are not favorable for new recruitment and replacement. Trends worldwide in ore quality are worrisome for future

[1] A few are: https://www.mining.com/the-5-biggest-challenges-facing-the-mining-sector/, https://www.hatch.com/en/About-Us/Publications/Blogs/2018/08/Five-challenges-that-mining-needs-to-address-today, https://www.aggreko.com/en-fj/news/2018/auspac-news/07-july/five-common-challenges-facing-the-mining-industry, https://www.marsh.com/us/industries/mining-metals-minerals-insurance/solutions-to-mining-risk-challenges.html. The annual EY survey of top 10 business risks is excellent, https://www.ey.com/en_us/mining-metals/10-business-risks-facing-mining-and-metals. Also see https://www2.deloitte.com/xe/en/pages/energy-and-resources/articles/key-issues-facing-mining-sector.html.

demand and needs. In part, many of the resource opportunities in our country do not compare favorably with opportunities abroad. We could alter that equation by providing a more conducive business setting for our extractives industries. Volatile commodity prices and capital intensity of these industries are harsh realities. The more remote and difficult the target resource opportunities, the more costly the projects and value chains and the bigger the set of challenges and issues that must be managed including ESG and SSHE requirements and expectations. All of these realities should be reflected in analysis and opinions regarding policy recommendations, for instance those promoting aggressive investment and acceleration of materials intense applications, such as electric vehicles and alternative energy. They are not. Along with these and many other considerations, the U.S. has unique challenges associated with resource access, which mainly revolve around Federal lands and intense opposition to extractives industries in many locations. Our style of regulatory oversight across the SSHE landscape contributes to the cost structure of our mining and minerals processing industries, encumbering competitiveness. Finally, the most difficult obstacle is the most intangible – public and political will to face the music, so to speak, and engage in reasonable conversations about the importance of critical minerals to our modern lives and economies.

I would add that I now consider hydrocarbons to be potential candidates for critical minerals! Petroleum and natural gas are critical to advanced plastics and composites that permeate consumer products and that are essential to every alternative energy scheme. In fact they are the backbone – without these materials, everything from battery casings and packs to wind turbine blades and countless other applications are impossible. No viable substitutes exist. To the extent that we are taking oil and gas off the table, we are undermining our critical minerals security and preventing or, in the least, encumbering every single technology people want to pursue.

a. What are the workforce issues for Congress to consider?

RESPONSE:
To my point above about demographics – this has been an issue for all of the basic and manufacturing industries for decades. Recognizing these realities is the first step. Mining employment (excluding oil and gas but including coal) has dropped about 40 percent since 1990. (The decline in manufacturing employment over the same period is about the same, no surprise.)[2] Declines in employment and industry activity put pressure on technical and collegiate programs that historically prepared and produced these work forces. With the closure of the University of Alaska mining program we are host to only 12 collegiate programs. These typically handle student loads that are in the dozens. By comparison, the University of Botswana will handle student loads in the hundreds and even thousands.[3] Again, the SSHE realities in these businesses must be acknowledged

[2] All from U.S. Bureau of Labor Statistics, https://www.bls.gov/iag/.
[3] Information shared by colleagues at Missouri Science & Technology.

but they can be managed, in particular through emerging and expanding use of remote, digital, robotic and other enabling technologies that reduce the need for a human interface in the highest risk segments of these industries.[4] That means that training and education needs to evolve to reflect new approaches. All of this requires foresight and commitment, which we can achieve so long as the other enablers – public and political will – are firmly in place.

2. Is there such a thing as "clean" energy? What are the environmental trade-offs of clean energy technologies such as batteries, wind, and solar?

RESPONSE:
All energy sources and technologies require industrialization (including industrial provision of technologies to be used at smaller scale and in decentralized, distributed systems). Our goal should be to pursue any/all of these as cleanly as possible. This means being honest about inherent properties and constraints, the physical and chemical characteristics that dictate much of the economics associated with each option. We should start by recognizing the powerful leveraging effects intrinsic to hydrocarbons – petroleum and natural gas. For every dollar invested in these, we obtain energy, energy storage (inherent in the commodities) and thus "reliability", and materials. With the liquid fuels, we also obtain "fungibility" with regard to options for how these are transported and stored. It has long been my view that we should delete certain words from the energy lexicon. "Renewable" would be one. We have natural assets that can be converted to useful energy – wind, solar, hydro (rivers), marine (waves and tidal), biofuels (from agricultural and other products). The popular notion, even if all of these sources are not popular (hydro), is that they are renewable. These natural assets will always exist, but we must capture them and they are uneven, subject to natural availability (variable and intermittent). In fact, we can think of "quality" of these assets in the same way that we consider quality for other things, like energy and non-fuel minerals resources. Lower energy densities associated with alternative energy technologies transmit to lower quality. The lower the quality, the more expensive the capture. Likewise, wind, solar, hydro, marine are not accessible to every load center (location of demand). In fact, with a few exceptions, they tend to be remote, located far from load centers. This means extending electric power systems, since ultimately these feed into grids, to accommodate capture of these resources. To reach scale appropriate for global populations and affordable energy access today and connect sources to markets, all of options require industrial equipment and inputs at levels akin to any other major industrial effort. This means nonrenewable raw materials like minerals, energy fuels and especially materials, water, land (biofuels including "green gas" are, so far, very large consumers of soil and water) and myriad other resources that are all non-renewable. End of life including disposal and recycling are only just now emerging. We believe that alternative energy components can be recycled, as are many components of

[4] See "The Future of Work in Mining", https://www2.deloitte.com/xe/en/insights/industry/mining-and-metals/future-of-mining-industry.html.

legacy energy systems, but recycling is only just now emerging. Very little is known about volumes, logistics, capacities, or even business economics (i.e., profitability of recycling for alternative energy components). As a result, overall ESG footprints for alternative energy technologies are quite large and not well documented in public debates and discussions. In sum, they incorporate the need to capture alternative energy sources; the need to build industrial scale; the need to manage extreme variations in quality and forge new and expensive connections to markets; emissions (air, greenhouse gases, effluents into waterways) and other consequences like direct ecosystems impacts that permeate development and use.

3. Do the market prices for clean energy technologies accurately reflect their true costs? What are the environment, social, and governance issues that should be considered?

RESPONSE:
Regarding whether market prices for alternative energy technologies reflect true costs – no, they do not. Market prices reflect only the capital cost associated with purchasing and installing equipment. They do not reflect any of the "system integration costs" that are incurred to add system capacity, balance variability including adding storage and/or to address other reliability issues. This is a distinct risk for both business and government. Businesses face pushback from consumers and customers as the full cost of developing and using alternative energy technologies becomes more transparent. Governments face pushback from consumers and voters as transparency improves, including transparency associated with the extent of government funding and support that must be committed in order for alternative energy technologies to be accessible and affordable. Regarding the ESG issues stemming from alternative energy technologies – these range from the environmental footprint considerations I mentioned above to societal impacts as communities react to increased transparency regarding footprints to international geopolitical and trade security concerns. Again, there are distinct business and government risks associated with alternative energy policies, including mandates, and strategies. Businesses already are grappling with how best to assess, represent and provide assurance on ESG risk and uncertainty given the extensive limitations to transparency. Governments will face pushback from nearly every stakeholder group as ESG risks and uncertainties become better known and understood.

The Honorable Markwayne Mullin (R-OK):

1. As you mentioned in your testimony, the United States has finally managed to become energy independent. Thanks to hydraulic fracturing and the shale revolution, we emerged as a major exporter, which gives us leverage over OPEC and Russia. U.S. businesses and consumers have benefited the most with stable access to the world's most reliable and affordable energy supplies.

a. What is the energy security trade-off of rapidly transitioning away from fossil energy?

RESPONSE:
Honorable Mr. Mullin, we face an assortment of energy security trade-offs of a rapid transition. I can present a quick laundry list – any/all of these require further consideration and will require mitigation.

- Taking the most obvious first, our national defense rests on legacy fuels systems. Our equipment operates on petroleum fuels. Our bases and other facilities in the U.S. and worldwide are powered by legacy energy systems that operate in ways that ensure the reliabilities we need (100 percent all of the time for readiness). The U.S. Department of Defense and the service branches have all investigated various options for introducing alternative energy sources and technologies into our defense systems. This is accomplished most easily for fixed onshore facilities. DOD generally relies upon open markets for procurement of critical energy supplies. The U.S. has become one of the larger suppliers of fuels procured in open markets. DOD procurements are cheaper when the market for the fuels is larger – that is, energy costs for DOD, worldwide, will be lower, more cost effective, the broader the customer base. Our national defense benefits, hugely, from the very large customer base for petroleum and natural gas. Clearly, altering that picture in a fundamental way will make national defense both more expensive and less secure. All of the options for replacing oil and natural gas and other legacy energy fuels and systems for national defense have very long lead times and ramps. Serious thinking is needed to ensure functionality of national defense in the meantime.
- Outside of direct, national defense considerations, the biggest question is whether a rapid transition can work and, if not, what the implications could be. We could construct any number of scenarios in which a bumpy, costly transition that cannot provide sufficient competency fast enough puts at risk entire suites of energy and economic securities. These would range from system failures and disruptions to geopolitical and trade tensions. They would include pressures on fragile states providing most of the raw materials, fiscal pressures on all governments attempting to escalate a transition with public funding, inflation and monetary risks derived from commodity price pressures (for instance, for battery metals and biofuels crops) and government budget balances, damage to ecosystems if insufficient attention is paid to risks and mitigation. It is for these reasons that pre-pandemic energy security attainment for the U.S. was not a small thing, and why any scenario for transition needs to incorporate details on how to best manage the process and a frank assessment of risks and uncertainties.

b. Is China the biggest winner if we suddenly ban hydraulic fracturing and bet it all on wind, solar, and batteries?

RESPONSE:
Given that China is the largest and dominant producer of wind, solar and battery components, and the largest and dominant presence in all of the associated supply chains, and clearly has imperatives to remain in those positions, the answer, unfortunately, is yes. We – all societies that are net importers of Chinese goods – have transferred enormous wealth to China, to the betterment of the Chinese people, for the most part. The cost has been deterioration in our own capacity and a fair economic analysis needs to account for both sides. We would be transferring additional enormous wealth to China in a rapid and disorderly transition. As I mentioned during the hearing, but we did not have time to pursue, analysis of economic impacts of options needs to be thorough. In the least, we must account for the leakages of wealth and jobs if we depend on imports of alternative energy goods, and the costs that would be incurred domestically to replace imports unless we can figure out how to substitute with a cost structure as cheap as China's.

c. What are the renewable technology companies doing to secure and diversify their supply chains? Do you think they are taking this seriously?

RESPONSE:
Mr. Mullin, in all honesty, I don't know. From all of my interactions, I can see that pressure is growing on alternative energy companies to "own" their supply chain risks and deal with ESG realities. In July, incidents at Chinese polysilicon facilities gained attention within and outside of the solar industry.[5] Other similar incidents are starting to raise the bar. Alternative energy still is a very small share of world energy mix and so these realities have not penetrated the public domain as extensively as industrial accidents in other, much larger industries would. That said, we need to add to the risk and uncertainty column the possibilities of disruptions and outages in supply chains as businesses strive to accelerate capacity expansions in order to meet government targets and mandates.

d. What about the environmental and human rights issues? Are electric vehicles really "clean" if you account for the full life cycle impacts?

RESPONSE:
As stated before, we can be build, operate and use all energy fuels and technologies safely and cleanly. However, we don't satisfy environmental and human rights or achieve "cleanliness" simply by choosing fuels and technologies that are new or popular or perceived to be cleaner than legacy fuels and systems. They must really meet those standards and expectations, in real terms. Every

[5] See, for example, https://www.bernreuter.com/newsroom/polysilicon-news/article/lessons-from-the-polysilicon-plant-accidents-at-daqo-and-gcl/ which raises questions about workforce competency and https://www.ft.com/content/b3e3f134-2295-46a6-98df-3ef5994539e1 for impacts on polysilicon prices.

single option that we have for fuels and technologies requires industrialization, and all must entail standards and practices to satisfy ESG and SSHE requirements and expectations. Established energy businesses have much more experience on this front. The electric vehicle industry including all suppliers and vendors as well as customers has a huge amount of ground to cover when it comes to identifying, assessing, managing, mitigating environmental and societal risks. So far, from what we can see, the broader industry understands these realities. In fact, I suggest that the industry, at least the leading companies, understands it better than governments and non-governmental organizations who are pushing for rapid transitions.