

**HEARING TO EXAMINE THE USE OF
ENERGY AS A TOOL AND A WEAPON,
AND ENSURING ENERGY SECURITY FOR
THE UNITED STATES AND ITS ALLIES**

**HEARING
BEFORE THE
COMMITTEE ON
ENERGY AND NATURAL RESOURCES
UNITED STATES SENATE
ONE HUNDRED SEVENTEENTH CONGRESS
SECOND SESSION**

MARCH 10, 2022



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**HEARING TO EXAMINE THE USE OF
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THURSDAY, MARCH 10, 2022

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

The Committee met, pursuant to notice, at 10:05 a.m. in Room SD-366, Dirksen Senate Office Building, Hon. Joe Manchin III, Chairman of the Committee, presiding.

**OPENING STATEMENT OF HON. JOE MANCHIN III,
U.S. SENATOR FROM WEST VIRGINIA**

The CHAIRMAN. The Committee will come to order.

We are here today to talk about energy and how it can be used as a tool or a weapon. Vladimir Putin's unlawful invasion of Ukraine is the latest and most extreme example of his willingness to use European dependence on Russian energy exports as leverage to disrupt the peace, and in the process violate international humanitarian law. But what Putin did not expect was the extent to which his belligerence would unite the free world to take action. Despite the tragic circumstances of this situation, the U.S. and its allies have an opportunity to work in concert with a reconstituted resolve not seen since the outbreak of World War II. It is time for us to disarm Putin and other countries that have the ability to wield energy as a weapon. That includes the supply chains our energy systems rely on. I applaud the President's decision on Tuesday to use the authority he has to impose a ban on imports of Russian oil, petroleum products, LNG, and coal. There was broad support in Congress to take that step across various pieces of legislation, earning 44 Senate co-sponsors in all. That is unheard of.

The bill Senator Murkowski and I introduced had 37 co-sponsors. That was a necessary action to stop funding Putin's brutal war on the Ukrainian people, but now it is time for us to hone in on how we strategically use energy as a geopolitical tool and for our national security. We must use this moment to our advantage to rebuild our energy systems in a way that makes us less reliant on actors attempting to subvert democracy and who would undermine or threaten our allies and partners. This requires a three-pronged approach focused on domestic energy production, energy infrastructure, and supply chain security. This approach must include a near-term, mid-term, and long-term strategic focus; work in concert

with the European approach; and operate in reality, including the existential necessity of addressing climate change. The International Energy Agency (IEA) recently released a 10-point plan to cut EU dependence on Russian energy imports. This plan appears to be realistic and serious, not aspirational, and it happens to mesh well with my mantra of “innovation, not elimination.”

We, too, need a realistic and reasonable plan that is responsive in the immediate-term to our domestic needs and those of our allies while being forward-thinking in the short- and the long-term. The first immediate action item is to increase our domestic oil and gas production on both federal and non-federal lands. This is going to take both the Administration and industry to step up to the plate, stop pointing fingers, take action, and just get it done. The Administration has been pointing to 9,000 onshore drilling permits that have already been issued for federal leases that have not yet been drilled. What I am told is, that while this number is a little bit higher than normal, it is not extremely out of the ordinary, especially considering that 7,600 of the 9,000 permits have been extended past their initial two-year term by the Bureau of Land Management. A leaseholder has to apply for this drilling permit months—if not more—in advance due to the review process, and there is no guarantee that conditions will be right in the market or in the ground to drill with a given permit. With the oil prices going negative in April 2020 and the COVID pandemic, it is not surprising that companies asked for extensions and slowed down over the last few years. However, as I said with the leasing pause, it is well past time for the pause to end, and for well drillers and the Administration to move forward.

So yes, I am calling on industry and the shareholders to invest and put production before profits. We need you to ramp up on these existing leases and with those existing permits because that is the fastest thing that we can do. But industry also needs signals from the Administration that they will support oil and gas development and production. That includes taking concrete steps, like working on a new five-year plan for the Gulf of Mexico, since we know the current plan expires at the end of June. The Administration’s failure to act on the five-year plan, combined with the failure to appeal the vacated lease sale, means that we are almost certainly looking at no offshore lease sales until sometime next year, to say nothing about the failure to hold onshore sales. The fact of the matter is that Gulf oil is the heaviest we produce, and our refineries are well-calibrated for it. It makes no sense at all to me that the decision was made by Interior to not appeal a ruling throwing out the largest Gulf lease sale, particularly when that decision was made several days after Russia invaded Ukraine. We cannot take a short-sighted approach that pretends two years without lease sales will have no impact on our domestic oil and gas production. Just because the brunt of production impact from the lack of leasing hasn’t hit yet does not mean we can ignore them.

We also need to make sure that the infrastructure we need to get product to market is able to get built. This means pipelines and export terminals and supporting the corresponding infrastructure build-out in Europe and elsewhere. And I know some might bristle at investing in fossil-fuel infrastructure as a long-term asset, but

let me tell you, the Mountain Valley Pipeline could be completed in four to six months if it was finally given the green light, and I have legislation that would do just that—would do exactly what we just said. That would add two billion cubic feet per day into the market for domestic use, for export, and to have next winter when we will all need it the most. It would help get prices down, and it would help reduce emissions, allowing for utilities to continue to transition. And for long-term, it is a 42-inch pipe that can be sleeved and used for hydrogen in the future without building yet another pipeline. It is not locking us into a fossilized version of the past, it is infrastructure that is flexible. It is a total no-brainer to me. We just need to get out of our own way and get it done. We also need to be supporting our allies and partner nations who do not have the LNG hubs, pipelines, and terminals they need to get natural gas to end-users without relying on Russia. That is a real problem, as the European Union is heavily dependent on Russian energy, which accounts for 38 percent of its natural gas and 30 percent of its oil consumption.

We need to keep that back-of-mind as we look ahead to, and more importantly, start planning for next winter. But this problem is not limited to natural gas or oil. In fact, while we are properly focused on Russia, we also need to be thinking about our long game. We also rely on Russia for a significant portion of our nuclear fuels and some of our minerals, notably titanium and palladium, and our reliance on critical minerals and materials produced in China and other nations hampers broader energy security and climate goals. These minerals are subject to price volatility, just like oil and gas. Just a few days ago, nickel, which is used in many energy applications, including batteries, skyrocketed. If you can believe this, it skyrocketed to over \$100,000 per metric ton—\$100,000 per metric ton. And lithium prices are also up. In fact, right now, a nickel in your pocket is worth more than a dime based on the metals that are included in it. A nickel is worth more than a dime with the minerals that are in it. Don't start melting your nickels down—not yet. The mining and refining of these minerals is extremely geographically concentrated, much more than oil and gas.

I have heard calls for EVs as an answer for how we are going to pivot away from oil. I feel very strongly that it would be a major mistake to allow us to end up in the same situation where those minerals are weaponized against us, not just for our clean energy technologies, but also for our satellites, cellphones, and more. That is in part why I have been such a big advocate for hydrogen, which we can produce right here at home with CCUS, nuclear, or renewables. I want to see State and Department of Energy work together to establish bilateral and multilateral agreements in reliable countries that produce critical minerals. Additionally, the Department of the Interior needs to prioritize the USGS's critical minerals effort while making sure that the Department's role in permitting new mining helps facilitate that process rather than throwing up more roadblocks.

Now, let me close by making it clear that I am not saying to hell with our climate goals. These actions are not all mutually exclusive. I am a firm believer in an all-of-the-above energy mix and that we can and should be leading the world through innovation.

We need to get the robust funding out the door that we included in the Energy Act and Bipartisan Infrastructure bill for research, development, and commercialization in the areas of CCUS, advanced nuclear, hydrogen, transmission, renewables, storage, advanced materials, and other energy technologies to meet our emission goals. We must also increase the manufacturing of energy products, including wind turbines, batteries, solar panels, nuclear materials, technology, pipelines, and dual capability of natural gas and hydrogen, advanced materials, and anything else that will help us and our allies. That is a longer-term plan, and the one that Congress has clearly supported through these two historic pieces of legislation. And as the energy transition continues, we must be eyes-wide-open and responsive to solving the problems before us today while working toward the vision we have for our future and doing our best to solve these problems before they are used as weapons against us or our allies.

Finally, as we boost production here, which we must do, I want the United States to lead in deploying the technology that makes sure that our producers have the cleanest gas and barrels of oil possible. So I appreciate our witnesses for being here today to talk about these critically important issues, and I look forward to this discussion about an active, American energy strategy that enables us to better hone our energy as a tool. It is certainly going to take all of us—Congress, the Administration, and our industry partners—to respond today and to plan for our future.

With that, I am going to turn to Senator Barrasso for his opening remarks.

**OPENING STATEMENT OF HON. JOHN BARRASSO,
U.S. SENATOR FROM WYOMING**

Senator BARRASSO. Well, thank you so very much, Mr. Chairman. Thank you for your strong opening statement. Thank you for holding today's hearing, because last year President Biden inherited an energy-dominant America. He spent the last 13 months squandering it. Since day one, the President has sought to end American oil, natural gas, and coal production, and that is the source of nearly 80 percent of our energy. He has banned new federal leases for oil and gas. He has ground to a halt the permitting of natural gas pipelines and storage facilities, and he has made it much more difficult for energy producers to obtain financing. The results have been predictable: sky-high energy prices, the highest inflation in 40 years—new numbers out today—highest in 40 years. And of course, he has emboldened our adversaries. The price of a barrel of crude oil recently reached \$129. The last time oil prices broke \$100 was in 2014, and at the time, Joe Biden was Vice President of the United States.

The geopolitical importance of U.S. energy dominance cannot be overstated. In 2018, the United States was able to sanction Iranian oil over that country's ties to terrorism. Since we were energy dominant, those sanctions did not increase the price for Americans at the pump. Now, the President wants to cut a deal with Iran. Boy, how times have changed. We should not be bankrolling Iran's war machine, just as we should not have been bankrolling Russia's war machine. We have all heard about the atrocities that Putin's troops

are committing. Where do you think this barbarism has been paid for? It has been paid for by Russian energy. Energy is the single largest source of revenue to the Russian state.

In 2021, Russia was our third largest foreign supplier of oil after Canada and Mexico, and as Senator Murkowski has said in this hearing, that at a point Russia was providing more oil to the United States than was Alaska. Last year, we imported nearly 700,000 barrels of Russian oil each and every day. Russia is also among the largest suppliers of uranium to the United States, as the Chairman has mentioned in his opening remarks. Make no mistake, the money spent on Russian energy helps support Russia's invasion of Ukraine. A State Department official in a Foreign Relations Committee hearing even said that the sale of Russian energy was the cash cow that has paid for Putin's war machine.

Before the invasion, President Biden was begging OPEC and Russia to produce more oil to sell to the United States. He has now followed Congress's lead and banned imports of Russian oil, natural gas, and coal. He should also ban Russian imports of uranium.

Despite skyrocketing prices, the President is still hostile to American energy production. He wants to turn to Venezuela. He wants to turn to Iran. This is his pattern. The President was willing to plead with Russia and to let Russia build pipelines, like Nord Stream 2, but no, he will not let Americans build pipelines—not Keystone and not pipelines today for gathering lines and to allow us to produce and use American energy. The contrast is astonishing.

Russia's invasion of Ukraine shows just how shortsighted the President's energy policy has been, yet, the President said not a single word about increasing American energy production in his State of the Union speech. He said make this in America, make that in America, make the next thing in America, but not American energy—not a single word. The idea that America should be producing more energy does not appear to have crossed this President's mind.

Rising energy costs are punishing American families, especially those on low and fixed incomes. President Biden wants us to believe that his policies are not to blame. And his solution continues to be to stop using fossil fuels. He wants to force Americans to drive expensive electric cars and insulate their homes. This is a fantasy—a fantasy in his mind and in that of some of the members of his Administration. The reality is this world still largely runs on oil, natural gas, and coal, and that is not going to change in the foreseeable future, no matter how the work goes to reduce greenhouse gas emissions. Killing American oil, natural gas, and coal production is not going to change that, it will just enrich our adversaries and leave America weaker and more insecure.

The President announced that he is releasing another couple days' worth of oil from the Strategic Petroleum Reserve. Others want a gasoline tax holiday. We do not need gimmicks. We need more American energy.

No other major energy producing country shuts off its own reserves to production—not Russia, not Iran, not China, not Saudi Arabia. Why should we?

Mr. Chairman, I am glad you called attention to this talking line of the Administration about the 900 leases.

The CHAIRMAN. Nine thousand.

Senator BARRASSO. Oh, I'm sorry, 9,000 leases. As you know, the leasing is just the first area where you get permission from the government, and you pay for the lease. But then you have to apply for permission to drill. It is like you paid the rent for the apartment, but the government won't give you the key to get in the door because they haven't given you the permission yet to drill. And then, of course, once you are able to produce energy from there, they won't allow the production, they won't give you the permission to put together the pipeline to move the oil or the natural gas specifically from where it is coming out of the ground. Look, America is a world energy superpower. It is time, once again, that we start to act like it.

Thank you, Mr. Chairman, for this important hearing.

The CHAIRMAN. Thank you, Senator, I appreciate it.

I would like to turn to our panel of witnesses that we have. First, we have Jonathan Elkind, Senior Research Scholar and Adjunct Professor at the Columbia School of International Public Affairs.

We have Dr. Foss, Fellow in Energy at the Baker Institute for Public Policy at Rice University.

We have Colette Hirstius, Senior Vice President of Shell's USA Gulf of Mexico operations.

We have Melanie Kenderdine, Principal at the Energy Futures Initiative.

And we have, by web, Dr. Kenneth Medlock, Director of the Center for Energy Studies at the Baker Institute for Public Policy at Rice University.

Mr. Elkind, we are going to start with you.

STATEMENT OF JONATHAN ELKIND, SENIOR RESEARCH SCHOLAR, CENTER ON GLOBAL ENERGY POLICY, COLUMBIA UNIVERSITY

Mr. ELKIND. Thank you, Chairman Manchin, Ranking Member Barrasso, and members of the Committee.

Over the past two weeks, the world has watched tragic events unfolding in Ukraine. We see utter brutality—a war of choice that the Russian President, in Orwellian fashion, will not even acknowledge for what it is. Energy and many other foundations of everyday life are reverberating from this war. As the Chairman said, “Today’s Russian economy runs on energy.” The oil and gas industries represent roughly half of the country’s export earnings. Moreover, oil and gas are a tool that Russia has used on several occasions to place political pressure on its neighbors. For example, in 2006, 2009, and again in 2014, real or threatened cutoffs were used to destabilize Ukraine’s economy and politics. Ukraine was not the only country so treated. It is true that northwestern European companies purchased Russian gas for decades without major problems, but Russia’s treatment of less powerful central and eastern European customers revealed something important—Moscow’s willingness to use market power for political leverage. We should, therefore, assess our own and Europe’s energy security with care.

Though far from perfect, the energy security of the United States enjoys key strengths. For one, the U.S. oil and gas industry is strong. It leads the world in production, and growth is continuing. It would be a mistake, nonetheless, to view oil and gas as a silver bullet for energy security. East coast gasoline consumers faced huge uncertainties last May after the cyberattack on the Colonial Pipeline system. Just this week, we see news of a mid-February cyberattack on U.S. natural gas companies. We benefit from having diversified energy systems, and we should celebrate the dramatic growth of wind and solar power from the West Texas hills to the New York Bight, and from the plains of Iowa to mountaintops in Appalachia. These projects, however, do emphasize the need to modernize our electric transmission grids. Nuclear power, as has been noted, also enhances our energy security, but it is under stress. Many reactors will go offline unless we institute policies that value carbon-free electrons. And we need to focus now, as the Ranking Member has said, on the fuels for advanced reactors that can enter service later this decade. Let me also note that we need a comprehensive approach to innovation, commercialization, and deployment of everything from direct air capture to CO₂ pipelines, from hydrogen to long duration storage, to enhance our energy security and sustain American competitiveness.

Turning to Europe, in the past two decades, the EU created and strengthened integrated energy markets, but it grew steadily more reliant on Russian natural gas supplies. Today, as a consequence, Europe confronts real vulnerability. This week, EU leaders are debating both old and new ideas—mandatory gas storage requirements, new LNG import capacity, alternative fuels, accelerated renewables development, even coal reserves, and perhaps extended lifetimes for German nuclear power plants. Europe will hope to buy additional LNG from the United States, Qatar, and elsewhere but these purchases will only happen if European companies outbid other buyers. Europe and the United States face a number of common energy security threats, but in the interest of time, I will just mention two key issues in passing—cybersecurity and critical materials supply chains.

Let me close with one last observation. The full energy impacts of Russia's war in Ukraine are not yet clear. Some, therefore, argue that the United States and Europe must deemphasize climate protection and instead focus exclusively on security of energy supply. This is understandable, but shortsighted. Last week, the IPCC's impacts report found that as many as 3.6 billion people today live where they are highly vulnerable to the impacts of a changing climate. All across our country, we have witnessed devastating climate impacts—the loss of American lives, the destruction of American homes and businesses. We therefore need to respond to two kinds of risk simultaneously—the all-too-visible challenges to our energy security, and the already clear damage from human-caused climate change. We do not have the luxury of worrying first about one and then about the other.

Thank you.

[The prepared statement of Mr. Elkind follows:]

**Testimony of Jonathan H. Elkind
Senior Research Scholar, Center on Global Energy Policy, Columbia University**

**U.S. Senate Committee on Energy and Natural Resources
Hearing on the Use of Energy as a Tool and a Weapon**

March 10, 2022

Chairman Manchin, Ranking Member Barrasso, members of the Committee,

Over the past two weeks, the world has watched tragic events unfolding in Ukraine. We see a brutal attack on a sovereign neighbor, a *war of choice* that the Russian president, in Orwellian fashion, will not even acknowledge for what it is. Many factors underlie the violence that is being perpetrated on Ukraine. And many aspects of everyday life around the globe will feel reverberations from that violence. Energy implications are certainly an important element of this picture.

This hearing therefore provides an important opportunity to reflect on conditions and trends in energy security. In my testimony, I will summarize the energy security position of the United States and its friends and allies in Europe, and I will emphasize the importance of delivering both near-term energy security and on-time climate solutions.

Russia – a Raw Material Economy

Today's Russian economy runs on energy, and especially on oil and gas. The country [extracts](#) more than one-tenth of total global oil production and more than one-sixth of natural gas production. The oil and gas industries represent roughly half of the country's export earnings, depending on global market conditions (54% in 2019, as cited in Thane Gustafson, [Klimat](#), p. 15). Russia also plays a major role in coal and nuclear technology and fuel markets, representing one-sixth of coal [exports](#) and claiming a nuclear order book [valued](#) at \$133 billion.

Not only are Russian oil and gas supplies significant on the world market, and significant to Russia's overall economy, they also are a tool that has been used on several occasions to place political pressure on Russia's neighbors. In 2006 and 2009, after years of murky gas [dealings](#) between Russia and Ukraine, tensions boiled over. In an attempt to undercut Ukraine's role as transit country, on both occasions Russia partially cut natural gas supply to Europe at the peak of the winter heating season. In 2014, after Russia's first invasion of Crimea and other parts of eastern Ukraine, President Putin again tried to use gas transit to place pressure on Ukraine. He sent a [letter](#) to European heads of state and government in which he threatened renewed disruption to natural gas flows. Putin claimed that Ukraine had failed to abide by contractual terms, an assertion rejected by an arbitration [tribunal](#).

Ukraine was not the only country that had to manage Russia's efforts to use gas trade for political leverage. Gazprom stubbornly refused requests from independence-minded Lithuania, long an exclusive Gazprom consumer, to adjust prices to more fully reflect market realities. Only when Lithuania began liquefied natural gas (LNG) imports at [Klaipeda](#) did Gazprom abruptly find itself able to offer a 20% reduction in price. Gazprom had lost its leverage. Likewise, Poland has experienced protracted disputes with Gazprom over [pricing and terms](#). Poland ultimately opted to diversify away from Russian supplies and is instead focusing on LNG imports and new pipeline infrastructure. Such moves do not come cheap, but Polish officials have stressed that they are ready to invest to protect their independence.

Russian officials and some non-Russian commentators often claim that Russia is and has been a reliable energy supplier, even during the peak of the Cold War. The reality as we have seen is more complicated — a mix of commercial-economic and political motivations. Soviet, and later Russian, gas trade with customers in northwest Europe operated without major hiccups for years. But Russian treatment of less powerful European customers in central and eastern Europe betrayed Moscow's willingness to exploit its market power to exert political pressure.

Today, with Russian forces attacking Ukraine and Russia looking for ways to reply to pressure from Europe and the United States, we should look hard at our country's own energy security and that of our European allies and friends.

US Energy Security – Certain Strengths, More Needed

The energy security position of the United States is far from perfect, but it has a number of positive aspects. The first is the strength of US energy companies and the diversification of the US energy resource mix. Our oil and gas industry is strong, with a number of companies employing industry-leading techniques to extract needed resources while limiting the local and global environmental impacts of their operations. Domestic oil and gas production has a central role to play in our energy security today, especially given the risk that Russian oil deliveries may drop for any one of a variety of reasons. Outlooks for US oil production in 2022 foresee growth from [three-quarters](#) of a million barrels per day to perhaps as much as a [million and a quarter](#) barrels per day.

Despite this good news, it would be a mistake to view oil and gas production alone as a silver bullet for energy security. Consider the uncertainty that gasoline consumers faced last May when one of our major refined-product supply arteries, the Colonial Pipeline System, was taken off-line after a [cyberattack](#). Consider this week's unsettling [news](#) of a mid-February attack on nearly two dozen natural gas producers and exporters. Consider also the increasing physical vulnerability of large portions of the oil and gas industry that will need to invest significantly to adapt its own infrastructure to avoid catastrophic [impacts](#) from sea level rise, droughts, wildfires and other climate-driven events.

Some environmental advocates, when talking about the use of any fossil fuel, would prefer to see the United States "leave it in the ground." Such an approach would create significant

negative impacts on American households, companies, and workers. We clearly need to change our oil and gas usage patterns dramatically to avoid the worst outcomes of climate change. But to do this, we need to employ a combination of *policies* that reflect the true damage from greenhouse gas emissions and *technologies* that enable our economy to keep thriving and growing. We cannot deny the role of oil and gas in our energy economy today, and in fact doing so would only increase the challenge of accelerating real climate progress, as we absolutely must do.

Another positive aspect of our current energy security position is the fact that we have diversified energy systems. In this context, I want to focus on two particular trend lines. One is the dramatic [growth](#) of wind and solar power in countless locations across our country. From the West Texas hills to the New York Bight, from the plains of Iowa to mountaintops in Appalachia, wind and solar power capacity has lately dominated new generation investments. These projects offer opportunities for regional economic growth: creation of local supply chains, new job creation, and fiscal revenues. We should not miss the point, however, that the rapid growth of new renewable energy capacity increases significantly the importance of modernizing our electrical transmission and distribution grids. We have to find effective ways to speed up interconnections with regional transmission organizations as well as procedures for siting and permitting.

Nuclear power also plays an important role in a diversified American energy economy. Unfortunately, this reality is under threat. Nuclear power provides roughly one-fifth of our electricity nationwide, and roughly half of our zero-carbon electricity. Many US reactors are reaching the end of their operating licenses and some will go off-line unless we put in place policies that reflect the value of their carbon-free electrons. There is also the question of where the nuclear power industry is going. Exciting steps are occurring in the development of new, advanced reactors: small modular fission technologies, new fuels, new approaches to fusion, and more. In this context, we need to focus on our ability to produce the nuclear fuels required for both the current reactor fleet and the new technologies that will be entering commercial operation in a few years.

Let me offer one last comment on the significance of innovation and commercialization of new technologies for US energy security. The Biden administration, and particularly the Department of Energy, are focusing hard on how to support innovation, commercialization and deployment of a wide range of new energy technologies that can emerge into the marketplace and deliver both secure, American-made energy systems and the decarbonization we need. The range of technologies is wide — in fact as wide as the provisions of the Energy Act of 2020 that this Committee developed, moved through the Congress, and delivered to the president’s desk for signature: It is backbone pipelines to move carbon dioxide to sequestration sites, zero-emissions hydrogen, long-duration energy storage, vehicle electrification, energy efficiency for buildings, critical materials for the clean energy transition and much more. We need a comprehensive approach to innovation and commercialization to enhance our energy security, sustain the diversification of our energy economy, and create new industries for American competitiveness.

European Energy Security – Current Vulnerability Despite Progress

Having surveyed the US energy security landscape, I now turn to Europe. Here too, one can see certain areas of strength and many areas of improvement in the past decade, but also some important areas of vulnerability, especially in view of tensions arising from the war in Ukraine.

In the past two decades, Europe has grown steadily more [reliant](#) on Russian natural gas supplies as Europe's own production has waned in the Netherlands, the North Sea offshore, and Norway. Today, 40% of Europe's natural gas supply comes from Russia, as well as 35% of Europe's oil and 40% of its coal supplies. It is obvious that Europe's natural gas reliance today creates real challenges. Less well-recognized but important to acknowledge is the fact that the European Union has taken [significant steps](#) in the past decade to improve its natural gas security. In the wake of Russia's invasion of Ukraine in 2014, the EU evaluated its vulnerabilities to supply shutoffs through a series of stress tests, updated its security of supply directive, and created mandatory new obligations to have alternative supply lines. The EU brought an antitrust case against Gazprom for engaging in price manipulation and other anticompetitive practices. Brussels forced an end to so-called destination clauses (which limit a buyer's ability to trade gas to other parties), added new LNG receiving terminals, and enhanced interconnections between EU member states in electricity and natural gas transmission.

But as recent days have made only too plain, more improvements are needed to protect Europe's energy security. Across the continent, decision makers are looking at options that they resolutely rejected in the past. France is hosting on March 10 and 11 an informal EU summit to debate a new EU energy strategy. In Brussels and in a number of other EU capitals, possible structures are being [debated](#) to ensure that natural gas storages are at least 80% full by October – far exceeding recent years. The EU is also looking at a [variety](#) of approaches to reduce natural gas demand by accelerating renewable energy development, substituting in biogas from agricultural waste and/or zero-carbon hydrogen, and increasing the efficiency of the building stock. (It is hard to see how these options will yield appreciable impact in the near term, but directionally they may be positive.) Germany, with its new coalition government, is reviewing [ideas](#) that would have seemed unimaginable only two weeks ago: a coal reserve and perhaps even a delay in the decommissioning of Germany's final three nuclear power plants (now due to be retired at year's end under a decision that the Merkel government set in motion after the Fukushima nuclear accident in 2011). That said, Berlin indicated on March 7 that it does not support a voluntary [cessation](#) of energy purchases from Russia.

Europe surely will hope to procure additional supplies of LNG from the United States, Qatar and elsewhere if supplies from Russia are disrupted or appear that they could be. But these new purchases will only happen if European gas buyers outbid other off-takers, including those in East Asia. Historically, European LNG [prices](#) have not been sufficiently attractive to draw significant flows to European terminals, although this old truism changed dramatically at the end of last year, and up to three-quarters of US LNG cargoes flowed to Europe in January and February. Moreover, current European LNG facilities do not have sufficient capacity to meet all

of Europe's needs if pipeline connections were severed. And certain parts of the EU — such as the Iberian Peninsula — are essentially natural gas islands with minimal connection to the rest of Europe's gas grids.

US-European Collaborations

Europe and the United States face a number of common energy security threats, and closer collaboration in these areas is a natural priority that has already been [recognized](#) by EU officials and the Biden administration. For example, cyberthreats pose significant risks for American energy systems and are an important challenge for Europe as well. Cyberthreats become steadily more concerning as American and European power systems and natural gas systems each become more integrated. This development creates interdependencies between neighboring EU member states and between the power and gas systems. To highlight one specific European case of cross-border dependencies, Germany has struggled to build sufficient high-voltage transmission capacity to move electrons from its offshore wind installations in the north of the country to demand centers in the south (an echo of our own challenges with permitting and siting). As a result, Germany relies significantly on so-called [loop flows](#), which involve wheeling power onto the grids of Poland, Czech Republic and other neighbors and then wheeling the power back into Germany farther south. Germany, therefore, also relies on its neighbors' ability to defend their grids against cyberattacks. This is an area of high sensitivity, but close security collaboration among treaty allies may help facilitate productive engagement in the right channels.

Another important area for enhanced US-EU collaboration is integrated European-American supply chains for the energy sector. China's dominance of critical mineral resources and of supply chains for critical energy equipment creates a vulnerability that China has already [demonstrated](#) a willingness to exploit. Partner countries around the globe are now recognizing this situation as a problem that requires mitigation, so combining US and European efforts with partners such as Australia, Canada, Japan and Korea may be expedient, and institutions like the International Energy Agency can build on [existing work](#) to help to foster deeper analysis, policy options and possible collaborations.

Delivering Both Energy Security and Climate Security

The United States and our European allies thus face the imperative of strengthening our energy security. Russia's attack on Ukraine has dramatized the fact that unthinkable events — low-probability, high-impact events — do at times come to pass.

The full energy impacts of Russia's war in Ukraine are not yet clear. Do natural gas pipelines continue to operate in the middle of increasingly devastating attacks on civilian populations and infrastructure? Or do either malevolent or accidental acts knock them out of operation, thus cutting what is for many European countries a vital energy supply line? Do American and European partners allow continued (as of this writing) energy trade despite Russia's actions and

the responding sanctions? Or will sanctions expand to bring an end to oil and gas trade? Time will tell.

In the face of this uncertainty, some commentators argue that the United States and Europe must de-emphasize attention to climate protection and instead focus exclusively on security of energy supplies. Such an impulse is understandable but short sighted. Decision makers in Washington and European capitals will and should focus heavily on ameliorating the short-term risks arising from the current confrontation with Russia. Moscow's long-established willingness to employ energy as a weapon creates vulnerabilities for us, and decision makers will naturally wish to deprive Moscow of the ability to manipulate members of the Euro-Atlantic community.

But climate change is another long-established threat, and it too requires our attention. At the start of last week, the UN Intergovernmental Panel on Climate Change issued the [second installment](#) of its sixth assessment report. This new document focuses on the impacts of, adaptation to, and vulnerability to a changing climate. It underscores that climate change is not a faraway risk. Indeed, it finds that between 3.3 and 3.6 billion people around the globe are living in settings that are highly vulnerable to climate change. In recent months and years, all across the United States we have witnessed devastating scenes: loss of life, destruction of property as a result of floods along inland waterways, storm surges that deluged major metropolitan areas with unprecedented rainfall, out-of-season tornadoes in Kentucky and wildfires in the middle of the Colorado suburbs.

This bitter reality underscores the need to see and respond to two kinds of risks simultaneously: the very immediate challenges surrounding our energy security and also the already evident impacts of human-caused climate change. We do not have the luxury of worrying first about one and then later about the other. We need to improve our energy security as a priority matter; we also need to accelerate our efforts to find and implement effective, widespread climate solutions across our energy economy.

The CHAIRMAN. Thank you, sir.
Now we have Dr. Foss.

STATEMENT OF DR. MICHELLE MICHOT FOSS, FELLOW IN ENERGY, MINERALS AND MATERIALS, BAKER INSTITUTE FOR PUBLIC POLICY, RICE UNIVERSITY

Dr. FOSS. Thank you, Chairman and Ranking Member, for the invitation to be here today. As you all pointed out, there is a rush to try to find solutions around all of this, and many of them are very popular—very strong emotions around those—but we have to face the realities, and that is what I really want to point to in my testimony this morning.

The first one is that energy density matters. It really matters a lot. Human beings have gravitated toward higher energy dense materials, fuels, and technologies, for a very long time—for good reasons. When we move nuclear and fossil fuels out of the picture, it takes more to replace that. When you need more to replace the equivalent amount of energy that you are removing from the picture, that means more materials, more equipment, more infrastructure that has to get built, and more that has to be managed in terms of the energy supply chains—nor do you fully get away from using materials like hydrocarbons—oil and gas. We still need them for backup. We need them for balancing to ensure reliability on power grids, and also because from those molecules we get both energy and materials. And there is no other place where we have access to two things at once. Greater materials-intensity means a potentially large call on new materials that, in accelerated scenarios, will stress supply chains, put pressure on prices, and increase geopolitical tension. We sure got a lesson on that this week.

I was a peer reviewer for the International Energy Agency's report, "Mineral Requirements for Clean Energy Transitions." In my opinion, their estimate of a quadrupling of demand in minerals understates what we are looking at as we try to accelerate energy transitions, because we use these minerals for lots of things, and everyone forgets that. Base demand for non-fuel minerals has grown faster than petroleum and natural gas, almost as fast as electric power. Plastics and resins, which make up a lot of alternative energy technology equipment, have grown faster than some of the metals. Without plastics and resins, you wouldn't have wind turbine blades, you wouldn't have Plexiglass for solar PV, you wouldn't have upwards of 50 to 60 percent of the content of the electric vehicles that everybody wants to make. So this is a real issue. We have distinct opposition to mining and minerals processing in our country. Fitch and other credit rating agencies have taken note of this. Quality matters—not all minerals and metals are the same. When it comes to things like electric vehicle batteries, semiconductors, and other sensitive industries, purity is a really big deal, and that puts a lot of pressure on mineral supply chains and processing and sourcing.

China is all over the place in this business. We are spending an awful lot of time tracking Chinese dominance across the minerals supply chains in the countries where they are making investments. They represent about a quarter of the world's production on non-fuel minerals. Their outbound investments are all over the place—

Africa, South America, East Asia, and Russia. We are very, very concerned about their control of sensitive minerals, like rare earths—there has been a lot of conversation about that. The Chinese formed a monolithic, state-owned enterprise to control their own rare-earth resource, which the rest of the world depends on. They also control the bulk of electric vehicle battery manufacturing and the bulk of battery manufacturing in general, also capacity for wind turbine and solar PV equipment, and many other things that everybody needs to rely on to get all of this stuff done.

One of the really big concerns I have is how we think about the math around the oil and gas part of the picture. When the industry makes investments, upstream is funded by the sale of every molecule that gets produced. When you start locking out the sales of molecules, you impact the revenue that is available to the industry to do all the things that everybody would like it to do, including diversity and its capital investments, and that is a really important point. One of the issues is going to be how to reduce supply—if that is what we want to do—and maintain the amount of hydrocarbon-based materials that our lives depend on so dramatically.

Energy demand is increasing in a lot of interesting ways, which the Chairman pointed out. In all of this, thinking about how we should go forward and all the risks that we face scaling up these businesses, building the ecosystem for alternative energy technologies, and diversification—one recommendation from me would be to not push fossil fuels out of the mix at such a fast pace. We would do that at our peril. You would be exposing consumers and voters to risks that are unnecessary at this time. The industry needs access to locations. It needs capital for investment. It needs services to support those investments. We need creative thinking about managing emissions. We have ideas about that at Rice University that I hope my colleague Ken Medlock touches on related to hydrogen production and carbon sequestration. And we need to put materials first in your thinking. Please do that. Without putting materials first, every other thing that gets discussed becomes less stable, less promising, and less certain.

Thank you.

[The prepared statement of Dr. Foss follows:]

Written Testimony of Michelle Michot Foss, Ph.D.
Fellow – Energy, Minerals & Materials
Rice University's Baker Institute for Public Policy, Center for Energy Studies

Before the
Committee on Energy and Natural Resources
United States Senate
Hearing to Examine the Use of Energy as a Tool and a Weapon
March 10, 2022 at 10:00 am
366 Dirksen Senate Office Building

Chairman Manchin, Ranking Member Barrasso, and Members of the Committee, thank you for inviting me to participate on this panel.

The rush is on to promote “energy transition strategies” and green deals as panaceas for geopolitical tensions. Backers hope to ride herd on optimism that governments would aggressively embrace these concepts in pandemic recovery stimulus plans. So far, all that has happened is a reality check for investors as over-promising and under-delivery has eroded the pandemic run-up in “clean tech” valuations (Figure 1).

The underlying truths are much more complex. The notion of “ensuring energy security” here and abroad exists within a context of sometimes-harsh realities. Ignoring, avoiding or discounting these realities raises the specter of failures in strategies and tactics. A distinct threat in pushing on energy transition “strings” is that we simply transfer geopolitical risk and uncertainty from the devils we know to those we don’t.

- Energy density matters (Figure 2). The trade-offs between legacy fuels and systems and alternative energy technologies (wind, solar, electric vehicles, chemical battery energy storage in general) are harsh.
- Lower energy density implies greater materials intensity.
 - Energy density shortcomings show up most strongly in transport – only larger, heavier EV batteries can approach the performance of gasoline for range and towing, testing vehicle weight and adding to materials intensity.
 - In electric power, it simply takes more equipment, more infrastructure, more components to replace the intrinsic concentration of stored energy in fossil fuels and uranium (Figure 3). Roughly 78,000 wind turbines at more than 1,400 sites contribute about 8% of U.S. net generation while the more than 6,000 natural gas units at about 1,800 locations contribute almost 40%. The existing gas fleet could deliver more if operated at closer to base load. Meanwhile, it would take nearly 460,000 wind turbines to achieve 50% of current net generation.
 - Sophisticated grids and controls are needed to fully accommodate intermittent, diverse energy sources and device-grid interactions. Unless or until “V2X” (vehicles to anything) can be mastered, EVs represent a large new source of power consumption.
 - Nor does use of alternative energy eliminate the need for traditional resources. *Beyond the important functions of back up and balancing for reliability hydrocarbons, in particular, are*

essential feedstocks for materials that make “alt energy” technologies functional in the first place.ⁱ

- Greater materials intensity means a potentially large “call” on raw materials that, in accelerated scenarios, will stress supply chains, put pressure on prices and increase geopolitical tensions. I was a peer reviewer for the International Energy Agency’s report, *Mineral Requirements for Clean Energy Transitions*. If anything, their estimates of *quadrupling* demand for minerals in the strongest scenarios *understate* the impact of an energy transition push. This is because non-energy consumption of minerals and materials also is growing rapidly. Worldwide, total non-fuel minerals tonnage has grown nearly as fast as electric power supply and faster than petroleum and natural gas (Figure 4). Plastics and resins are the fastest growing major commodity group (Figure 5). From thermoset plastics for wind turbine blades, to Plexiglas for solar panels, to most of the content in EVs – hydrocarbon-based materials constitute essential ingredients in the energy transition landscape. This heightens the importance of understanding global oil and gas supply chain dynamics and economics, and preserving the integrity of this vital industry and its service providers.
 - Activism against mining, minerals processing and related businesses is strong. The roughly 2.5 billion tonnes of usable non-fuel minerals requires extraction of about 20 times more rock, on average. For some key minerals, waste volumes are upwards of 1,000-1,500 tonnes per tonne of recovered metal. The distribution of minerals throughout Earth’s crust is uneven. Ore grades for many key minerals already are low (Figure 6); low ore grades mean more waste, more energy for extraction and processing and more emissions. Going forward, the industry faces challenges in sustaining existing operations as properties mature and greater costs and uncertainties in pursuing new deposits of equivalent grades. Difficulties in gaining access and achieving new projects along with political risk and uncertainty in myriad countries (including the U.S.) is translating into longer cycle times for new critical minerals supplies and impacting corporate and sovereign credit ratings.
 - Quality of metals and materials is a vital concern for many industries, like batteries and semiconductors. Achieving levels of purity required for many applications is pushing the industry toward more expensive, energy intensive processing as operators compete to sell to these premium markets.
 - Diverse groups are directing more attention toward the large footprints of alt energy facilities, the impact of these facilities on everything from view sheds to ecosystems, their attributed emissions burdens and their life cycle waste streams. Overall, “sustainability” of the gamut of alt energy technologies and their supply chains, including decommissioning and capacity for recycling, reuse or ultimate disposal lags far behind promotion of these technologies. We line out these disparities in a new report.ⁱⁱ
- China’s dominance, influence over and outright control of sensitive materials and technologies and the alt energy landscape, in general, raise particularly acute tests for trade, defense and diplomacy.ⁱⁱⁱ Chinese interests control the bulk of existing, new and planned battery manufacturing, upwards of 80-90% in total. We are monitoring Chinese strategies over key minerals and will soon issue a detailed report on nickel.
 - China now has a monolithic state-owned entity (SOE) for rare earth elements (lanthanoids), the China Rare Earth Group Co. Ltd., [established December 23, 2021](#). The conglomerate was created by combining three out of the “Big 6” REE producers (Minmetals, CHALCO, Ganzhou Rare Earths). The SOE will account for [approx. 62% of China’s national medium/heavy rare earths](#) supplies (enhanced pricing over dysprosium and terbium); approximately [40% of all Chinese REE](#) (light, medium, and heavy); and will also hold 31% of

China's mining quota, and 29% of China's smelting quota. The State-owned Assets Supervision and Administration Commission (SASAC) holds largest stake at 31.21%.

- China controls two-thirds of global REE production. China likely is not afraid to use REE as leverage; in 2010, China [protested Japan's nationalization of the Senkaku Islands](#) by stalling REE exports from their stockpiles.
- When it comes to oil and gas, the “net zero” math is especially fraught (Figure 7). For all of its ups and downs, global oil and gas industry upstream capital spending to discover and prove up new resources averaged well over \$600 billion per year 2010-2021. That spending enabled current production of more than 100 million barrels per day of oil equivalent. Producers must monetize all molecules in order to generate sufficient revenue to cover costs and return a profit. Sales of energy (petroleum fuels and natural gas) provide the bulk of monetization. The assumption in extreme scenarios is that the industry can reduce oil supply to about *one-third of current output* while *eliminating* fuels sales from its revenue streams and *doubling* non-fuel (chemicals for vital materials) production. Implicit in these assumptions are that nearly every well drilled is successful and that resulting production slates are fully predictable (for those who prefer that the industry only produce natural gas and natural gas liquids for petrochemicals). I maintain that these assumptions are untenable.
- In all of this, we are leaning the hard way that citizens and voters have quite diverse views, opinions and preferences. Beyond the narrow focus on emissions and climate people care about many things and public reactions are unpredictable. Energy use is growing in ways that are not fully reflected in outlooks and scenarios. From video streaming and smartphones to cryptocurrency mining, new energy demands also represents new consumption of materials. Alt energy technology is presented as “cheap” when that is far from the truth – the full cost of utilizing intermittent and materials intense sources is hidden in rate making and subsidies.^{iv} Carbon pricing and taxing transfer to the cost of energy and goods for customers and consumers exacerbating dissatisfaction and inflation stress. The promise of green jobs in the future does not compensate for high paying jobs lost today, affecting many communities.
- With these and many other harsh realities in mind, we have defined the potential for an “energy transition valley of death” (Figure 8)^v as societies and their governments stumble to push alt energy technologies deeper into the global mix. In many respects, the easy, low hanging fruit has been captured. Since the 1880s, inventions and commercialization of internal combustion engine vehicles and central generation of electric power mainly using coal and water (hydro) dominated the energy landscape. Only in recent years have incursions been made. While sales of EVs of various types have captured imaginations, EVs now comprise about 1% of the global light duty passenger fleet of around 1.4 billion. Utility scale wind and solar are estimated to comprise about 9% of global electric power generation. Lofty goals are to move these market shares to much more aggressive levels, even to 100% in some instances, at least for developed countries.
- The tenuous nature of energy transition viewpoints creates a bottom line – we force fossil fuels out of the energy mix at our peril.^{vi} This means several things from a policy/regulatory standpoint.
 - Attention to the integrity of industry investment – especially for oil and gas, operators from the largest to smallest need to continue to invest, frameworks that facilitate risk taking and reward, access to potential locations for production replenishment. Better understanding of the full oil and gas value chain is essential.

- In the U.S. and beyond, oil and gas producers need access to diverse markets and customers need access to affordable, competitive supplies, meaning the ability to locate and build new pipelines, expand existing conduits and improve shipping lanes and capacity.^{vii}
- The good ideas and actions over the years for improving and maintaining transparency around oil and gas operations and operators and use of these important resources need to be encouraged and continued – including the phase out of subsidies that provide politically expedient support for demand but that also serve to discourage much needed investment downstream.
- Creative thinking for cost effective emissions reductions with logical deployment of recovered materials needs to continue. We have our own ideas to offer in the form of carbon capture and redeployment as black carbon, BCarbon soil amendments including how we can couple BCarbon with hydrogen.^{viii}
- Finally, key to the future is for decision makers to pursue a “materials first” approach to policy and strategy for energy and other dynamic industries like semiconductors and electronics.^{ix} Unless high integrity materials supply chains can be built, enlarged, sustained, maintained all bets are off.

Figure 1

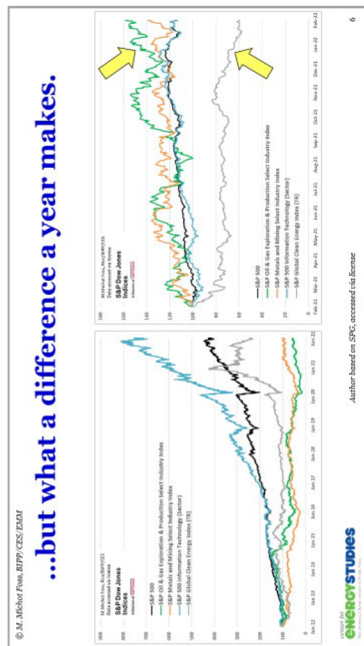


Figure 3

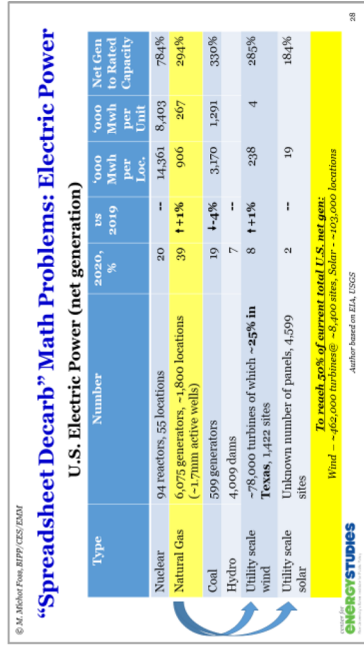


Figure 2

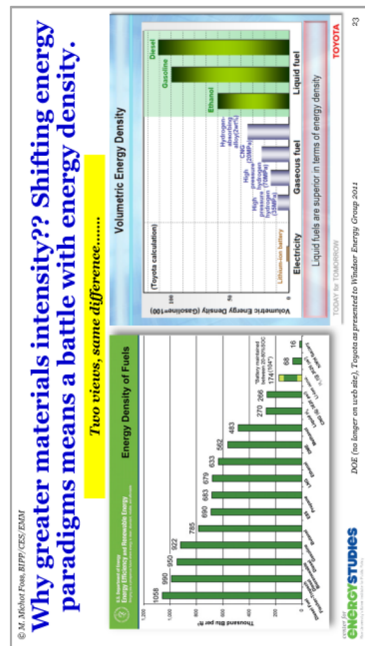


Figure 4

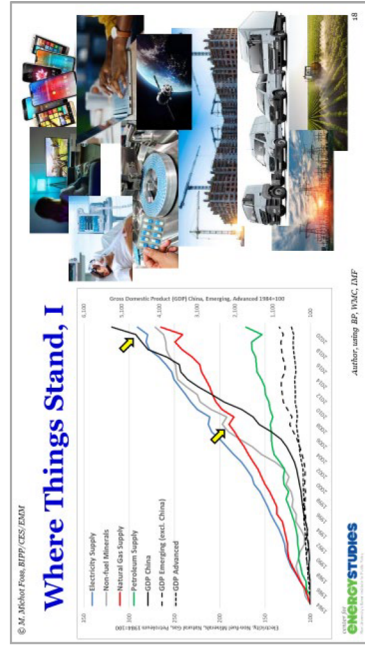


Figure 5

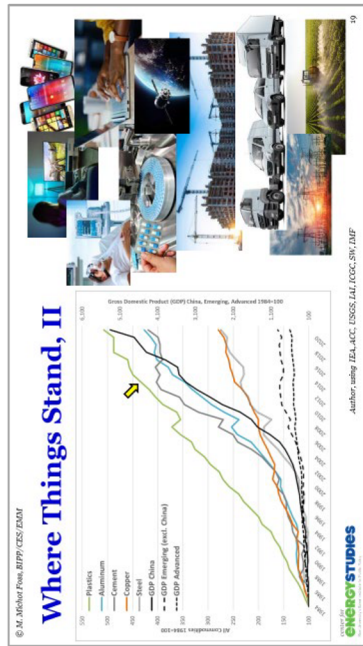


Figure 7



Figure 6

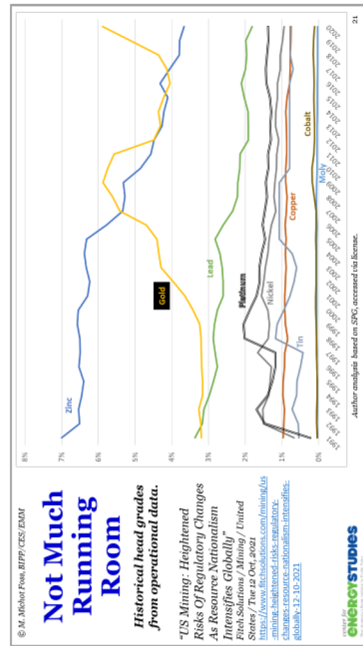


Figure 8

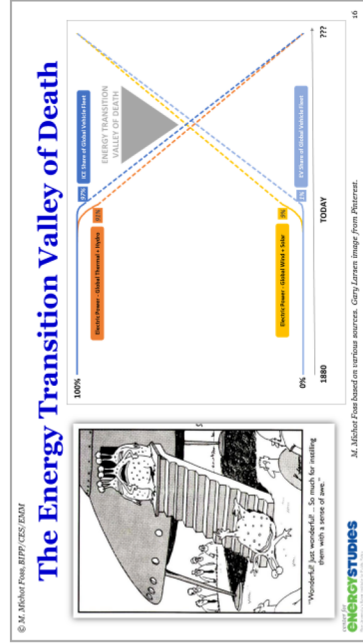
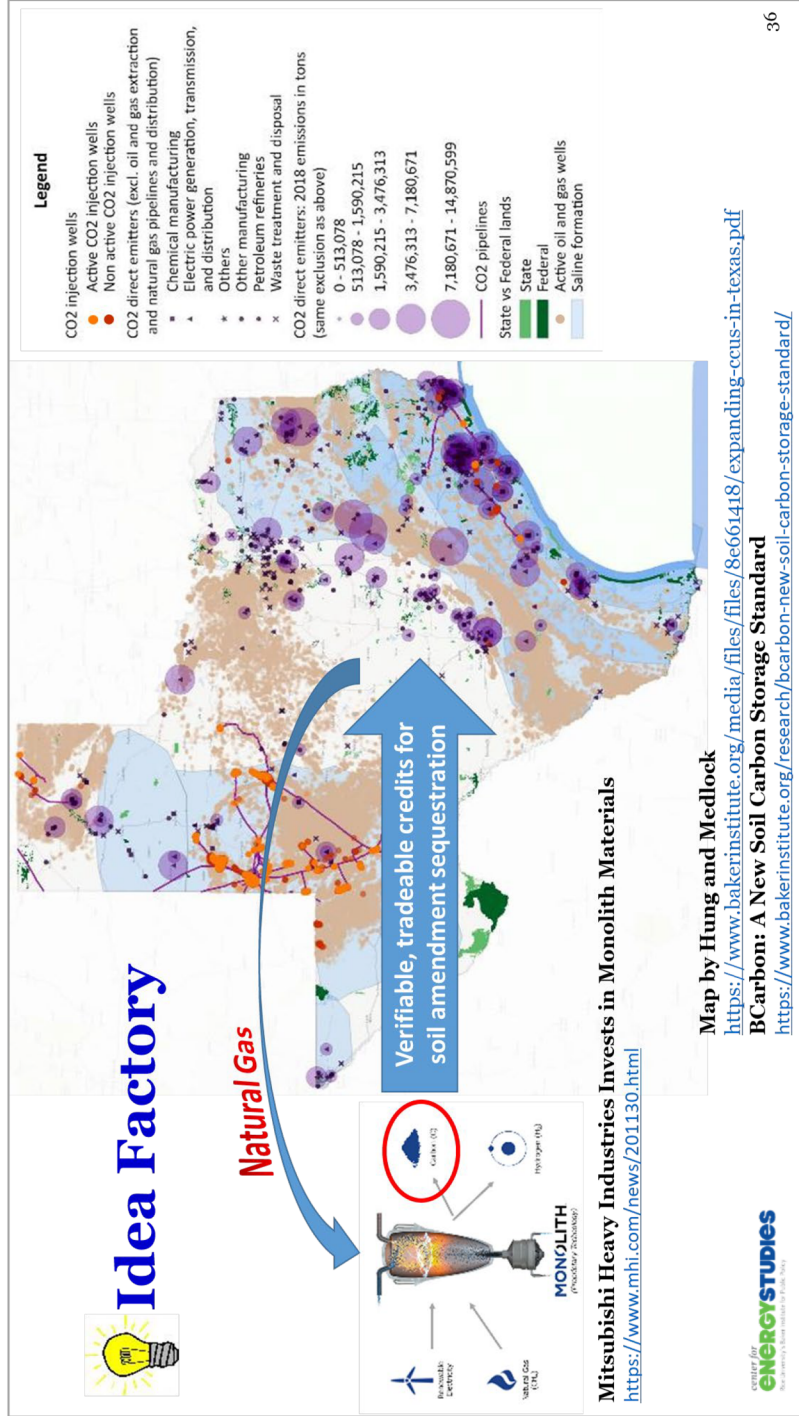


Figure 9



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The CHAIRMAN. Thank you.
Ms. Hirstius.

**STATEMENT OF COLETTE HIRSTIUS, SENIOR VICE
PRESIDENT, GULF OF MEXICO, SHELL USA, INC.**

Ms. HIRSTIUS. Chairman Manchin, Ranking Member Barrasso, and members of the Committee, thank you for the opportunity to testify today. My work as Senior Vice President for Shell's Gulf of Mexico operations fits within a global marketplace affected by the invasion of Ukraine. We are disturbed, and I am personally heartbroken by this unprovoked attack, which threatens global security and stability. In response, Shell has announced its exit from Russian joint ventures and withdrawal from all Russian hydrocarbons. Although right, it is not easy. It carries serious consequences. Europe relies on exports from Russia to heat homes, drive cars, and aid the defense of Ukraine. This crisis powerfully highlights the need to move away from fossil fuels. Shell is committed to provide more and cleaner energy solutions, and to help the world transition to a net-zero system by 2050.

Our dilemma now is how to restore the energy security while making the transition. We can and must do both. Today's hearing is about how quickly we can resolve supply constraints, bring more natural gas to Europe, and produce enough energy to ease prices at home. Gulf of Mexico production has amongst the lowest greenhouse gas intensity in the world. For years, Shell has been working as fast as we can to bring that production online. For example, a new field will begin producing in the next few weeks. It is worth noting that Shell's carbon environmental footprint continues to shrink as we use existing infrastructure and innovation to produce energy more efficiently. Regarding this dilemma of energy security and transition, we offer three thoughts: number one—diversify energy supply with lower carbon sources. Two—immediate government action to bring supply online sooner. And three—a comprehensive medium- to long-term energy policy.

First, diversifying energy supply and increasing lower carbon sources is essential. Shell is making substantial investments in American renewables, like our recent \$380 million investment for New York wind leases. We have made new investments in solar, renewable natural gas, hydrogen, and CCUS projects.

Second, both federal and state governments can take specific actions to address the ongoing crisis, including release of Strategic Petroleum Reserves along with international partners to provide some near-term relief; address a backlog of LNG export permits so the United States can supply allies, especially those in Europe; and move forward with permitting oil and gas infrastructure and projects that could come online within weeks or months. From my perspective, these permits are needed to bring additional volumes online in the Gulf of Mexico, which remains key to our shared objectives of stabilizing supply and accelerating the transition to net zero.

Third, America needs a comprehensive, long-term energy policy that includes the thoughtful production of lower carbon intensity oil and gas as a responsible element of the transition. The Interior Department should address the fact that no federal oil and gas

leases have been issued in over a year, and urgently work to restart federal leasing.

Shell's position is clear. Climate change is real. Energy security is fragile. World demand continues to rise. We must find a way to meet the urgent supply needs while reducing the carbon intensity of our energy system. This is an inflection point. How we balance security of supply and transition in this crisis will determine our nation's energy future. Let us rise to this moment and use the unparalleled resources of our hardworking American people and their American ingenuity, not simply to meet the current supply crisis, but to build a more diverse, lower carbon energy system while we do so.

Thank you for the opportunity to be here today.

[The prepared statement of Ms. Hirstius follows:]

Statement of
Colette Hirstius
Senior Vice President, Shell Gulf of Mexico.

before the

Committee on Energy and Natural Resources
United States Senate
March 10, 2022

Chairman Manchin, Ranking Member Barrasso, and Members of the Committee, thank you for the opportunity to testify today regarding energy security for the United States and our allies. I am Colette Hirstius, Senior Vice President of Shell Gulf of Mexico for Shell Energy Resources Company, a subsidiary of Shell USA, Inc., which is the U.S. Subsidiary of Shell, plc, headquartered in London. I was born and raised in Louisiana and am raising my own three teenage children to understand and respect its natural environment and its rich, diverse culture, from Grand Isle to our neighborhood in New Orleans. This role is a homecoming for me, as I previously worked internationally for the better part of a decade to support Shell's Group Strategy team as well as our lines of business – from Integrated Gas to Exploration; from Trinidad and Tobago to the Middle East and Africa.

My current role does not directly involve business outside of the United States, and I am best prepared to discuss those domestic energy issues about which this Committee has timely held this hearing, of course in the context of current and very troubling global events. However, my work very much sits within a global oil marketplace, and I will have some things to share about how that fits together. My business also sits within Shell's larger U.S. portfolio, every part of which is working as hard as I am both to decarbonize and accelerate the energy transition while supplying Americans with reliable energy. I can share thoughts about that larger U.S. portfolio. And finally, Shell USA, Inc., while clearly a separate legal entity with its own leadership, is part of the larger family of companies owned by Shell, plc. Although I don't speak for those other entities, I can share what I know, what is being communicated, and how I understand our U.S. operations and strategies to fit.

All of us at Shell reacted with horror at the unprovoked attack on Ukraine, where Shell colleagues live and work. We are shocked by the senseless loss of life and military aggression, which threaten European security and global stability. In response, Shell announced its exit from Russian oil and gas – including LNG and oil projects as well as the Nord Stream II pipeline and joint ventures with Gazprom and related entities. As stated plainly by our CEO last week, "Exiting these joint ventures is the right thing to do, and a decision we take with conviction, regardless of any financial implications that come with it. We cannot – and we will not – stand by." We are furthermore in action now to untangle our operations from the dominant supply position Russia has held in the market. You will all have seen that this is not easy and not without serious tradeoffs. The same barrels we are working to stop are the very ones which our

allies overwhelmingly rely on to fuel trucks, run factories, deliver medicine, and even to aid in the defense of Ukraine. This global energy disruption has also highlighted the importance of moving toward a future in which global economies are not as dependent as they are today on fossil fuels. Shell remains committed to our Powering Progress strategy, where we are working with our customers and across sectors to accelerate our own progress to provide more and cleaner energy solutions, and to support the transition to net-zero emissions in the United States and globally, in step with society, by 2050. Addressing these twin imperatives – ensuring energy security and promoting the global energy transition to lower carbon – is arguably the critical challenge of our time.

Shell and the United States

Energy security for the United States and its allies has been brought into stark focus over recent days. It seems more apparent than ever that the current stability and sustainability of global supply has, in certain ways, deteriorated – requiring realistic and resilient solutions for the immediate, medium, and long term. At Shell, we remain fully committed to a transition toward a lower-carbon energy system. This transition is well underway, but it is and will continue to be volatile. The energy needs of the world have to be met as we go, including the need for oil and gas. As the Senior Vice President of Shell Gulf of Mexico, and as an American, I have a strong preference that we work to meet these global energy needs with energy from places with stable, allied governments and strong environmental regulations.

Working together, industry, governments, policymakers, and consumers must move toward a world that meets a growing global energy demand and stabilizes supply against highly disruptive scenarios like the one we are currently facing, while at the same time accelerating the transition to net-zero carbon emissions. The events unfolding in Ukraine and the global response that is required have made meeting those dual challenges all the harder. As a proud participant in the American energy industry, I firmly believe we can rise to the challenges we face. Policymakers must balance the need for economic stability and recovery from a pandemic with the imperative to stand against unprovoked aggression and needless violence in the strongest possible way – all while continuing to reduce emissions aggressively. As Americans, we are at our best when we come together to tackle just this sort of challenge. We have done it before, and we can do it now. As an energy company with more than a 100-year history in the United States, Shell USA will play our part.

These are challenges for all of society across the world. I am very proud that Shell is leading, investing, and innovating to find solutions for the world's biggest energy challenges, like those we are discussing at this hearing.

In the United States, Shell's assets span all 50 states, leading the sector in energy, petrochemicals, and refined products. Today, we provide millions of Americans with the energy needed to heat and cool their homes and power the economy. We provide much of this energy through our platforms in the Gulf of Mexico. Additionally, for more than 90 years we have been in the business of providing fuel and jobs at our Louisiana refining and manufacturing facilities. Furthermore, our chemical complex at Deer Park, Texas makes the building blocks of everything from fertilizer to medical supplies to the masks we are all so grateful have become less prevalent. And our soon-to-open Chemicals complex in Monaca, Pennsylvania will use ethane from the

Marcellus region to produce 1.6 million tons of polyethylene each year, which will be used in everyday products, from food packaging and containers to light-weight automotive components essential to enable the energy transition. Shell has been honored to be part of the engine fueling the American economy for a century. We reach our customers through a number of platforms, but most notably through 13,000 branded retail stations. We also offer the leading brand of motor oil in the United States, Pennzoil, with our premium product Pennzoil Platinum made from natural gas. We are excited to play a key role in the move to net-zero carbon emissions while providing the oil and gas needed by society for many decades to come. And this discussion centers in on how to fit that need into a world in transition.

Addressing Demand

Energy is essential for survival, mobility, health, cooking, heating and cooling, lighting, travel, and many other aspects of modern life. Every product or service that we use to improve our lives comes from a business or organization that needs energy. For the last century, that energy has overwhelmingly come from fossil fuels. To make meaningful progress in reducing greenhouse gas emissions, society has begun to address the way it uses hydrocarbons. Likewise, if energy is either prohibitively expensive or simply cut off from consumers, the consequences can be drastic in terms of both human suffering and the environment. Access to energy paves the road out of deep poverty. Currently, it is estimated that perhaps one billion people, or roughly 13% of the global population, do not have access to electricity. Much of the increase in energy demand that is anticipated over the coming decades is related to population growth and a decrease in energy poverty. Shell's Powering Progress strategy is intended to support this outcome and drives many of our actions. Today's discussion centers on security of supply for the United States and its allies, especially given the geopolitical constraints that have already placed a major risk premium in global commodity markets and, when combined with necessary economic sanctions and actual supply risk, are visiting serious consequences on many sectors of society. While we must not lose sight of our climate goals, we must be honest with ourselves that there are no easy or standalone answers to avoiding or resolving a crisis like this one. It will take all sectors and all governments being realistic, thoughtful, flexible, and bold to position ourselves for the future.

The energy system is complex, and knock-on effects of world events are not easy to predict. A few weeks ago, not many would have predicted how the recent developments would impact the energy system. European gas was last week trading at about 200 Euros per kWh (equivalent to about \$60 per million btu, over ten times the cost of Henry Hub natural gas in the United States); commodity prices like this are crippling to energy-intensive industries and create serious follow-on effects. For instance, this will mean less available fertilizer, with impacts on the continent's food security and exports. This reality sits on top of the fact that 30% of the world's seaborne grain comes from the Caspian Region. Also, within the past week, factors including risk premium on natural gas cargoes helped cause Newcastle grade coal from Australia to command \$450 per ton, more than twice the previous highest price ever. By contrast, Powder River Basin coal brought \$21.65 per ton in the same period.

Meeting the demand for reliable energy – while simultaneously addressing climate change – is a huge undertaking and one of the defining challenges of our time. For example, hospitals, laboratories, and manufacturing plants, as well as universities, businesses, sewage

plants, and power stations, continue to require today's fuels to meet their energy needs. Fuel is needed to power trucks, airplanes, and ships that move people and commerce around the globe. Petrochemicals are needed for everything from clothing to cell phones, from hand sanitizer to the syringes, vials and solutions which make up COVID-19 vaccines. In short, today's energy sources are deeply integrated into every part of our lives.

These practical realities may be the reason that virtually every credible study – whether from governments, academic institutions, financial houses, or independent analytics firms – project that oil and gas will remain in the global energy mix in the future, even as society transitions to net-zero emissions. Therefore, it is important to improve energy efficiency and minimize the emissions from both their use and associated upstream energy production. For instance, our oil production in the Gulf of Mexico is among the lowest greenhouse gas intensity in the world. Still, we are working to further reduce the carbon intensity and improve the energy efficiency of those production activities. We are working with sectors and customers which use large amounts of energy to identify and enable custom decarbonization pathways. To that end, we have a role to play in helping to supply the market as best we can, given the supply and pricing constraints now so apparent in the system.

Responding to the Crisis of Today While Positioning for Strength in the Future

Today it is expected that there will be many questions about how quickly we can resolve energy supply constraints, how quickly we can bring more natural gas to Europe, and how quickly we can produce volumes of oil sufficient to put downward pressure on gasoline prices in our own communities. Certainly, Shell USA, Inc. would hope to play a role in helping. LNG could play an important role, as identified in the IEA's recent 10-point plan to reduce the EU's reliance on Russian natural gas.¹ The United States is now the world's largest LNG exporter with around 100 million tons per year of liquefaction capacity, and has the potential to grow given the country's natural gas resource base is estimated by the Potential Gas Committee to be over 3,000 trillion cubic feet, or roughly a century's worth of production at current levels.² Furthermore, before any of the events in Ukraine and even before we began to see the commodity markets grow so intensely volatile, Shell has been taking serious steps to accelerate bringing its energy projects online as fast as possible to keep pace with growing demand. Shell's Gulf of Mexico business unit expects to bring online the Powernap project in the next several weeks. More significantly, Shell has announced that it will bring online a new production platform, the Vito project, by the end of this year. I am also asking our Gulf of Mexico team to do everything they safely can to accelerate this project.

The Gulf of Mexico is a strong example of a strategic national asset that can play a key role in the federal government's objectives of stabilizing supply against highly disruptive scenarios like the one we are currently facing, and accelerating the transition to net-zero carbon emissions. Policies should take into account that global demand for oil has not necessarily peaked; that production from many wells, certainly those in the Gulf of Mexico, declines rapidly; that development of a deepwater project, while accelerated from historically longer time cycles, still takes a period of years from lease sale to first production. So, future lease sales through a consistent and predictable leasing program are necessary to keep production at current

¹ <https://iea.blob.core.windows.net/assets/1a170a5f-9059-47b4-a2dd-1b479918f3cb/A10-PointPlanToReduceTheEuropeanUnionsRelianceonRussianNaturalGas.pdf>

² <http://potentialgas.org/>

levels. In this sense, stopping or delaying all federal projects and leasing is counterproductive to our shared goals of meeting current demand in the lowest-carbon ways possible – and, pertinently, in ways that improve global relations and the security of our country and our allies.

We can and must talk about immediate and near-term solutions. If we do not take serious steps toward the combination of secure, clean, diverse, affordable, and accessible energy sources – which I know both sides of the aisle in this Committee have been committed to pursuing – the world risks being back in this situation again, at some point in the future. At worst, we would never fully emerge or recover from it.

We offer three thoughts regarding the challenges posed in today’s hearing. Simply put, meeting the complex energy demands we presently face requires acceleration and growth across virtually every aspect of the U.S. energy system – requiring a full recognition of this great nation’s capacity, fortune, and responsibility to lead. To reiterate, no single response is sufficient; each is incremental; and without a unified effort our nation risks falling short of this moment. Acceleration and cooperation will be urgently needed on these and many more solutions.

First, I cannot emphasize enough that we need not and cannot, in this critical moment, lose our foothold on the pathway toward diversification of energy supply and lower-carbon sources – in part so that no one nation and no one source can dominate or unduly control the supply to other reliant nations or even continents. For Shell, this means diversifying our own portfolio into a wide array of new energy sources, which we expect to remain growth areas for the foreseeable future – including several key recent developments:

- Shell’s recent acquisition of solar and energy storage provider Savion.
- Substantial wind power investments and partnerships in Texas and offshore Massachusetts and New Jersey, to name a few; including our recent winning bids for the New York Bight totaling \$380 million in just one lease sale; all adding up to more than 4 gigawatts of wind projects in our portfolio and in development.
- Renewable natural gas ventures in Oregon, Idaho, and Kansas.

These investments and many others like them will grow to help diversify and thereby secure energy supply, and will go great lengths towards meeting our net-zero ambitions – simply reflecting that we can address the clear need for more security of supply from all sources without abandoning the need and commitment to combat climate change through emissions reduction. Shell is also holding our executives, including me, accountable for these reductions. The compensation for more than 16,500 senior employees is tied to performance against Shell’s energy transition strategy.

Second, in this same moment, there are levers we can and should pull now to address the ongoing crisis. We should deploy our strategic petroleum reserves in the United States in concert with our international partners. We should advance the approval of backlogged LNG export permits in the United States to supply our allies, especially those in Europe. And, critically, we should move forward with permitting of otherwise ready oil and gas projects which could come online within weeks or months. One specific example involves California, which is presently slated to import between 10 and 15 million barrels of oil from Russia this year. If the current

moratorium on oil and gas permits in California were lifted, it is estimated (although not guaranteed) that up to 50,000 barrels per day would come online in a matter of months, if not weeks, and this would have the capacity to replace the state's incoming Russian cargoes.

Finally, medium- to long-term solutions should also be considered with an eye towards improving the efficiency and lowering the carbon footprint of those hydrocarbons which the world will continue to use. The current situation in Ukraine is an unfortunate reminder that it is in the United States' national interest (and that of our allies) to implement an energy policy that includes the responsible production of oil from federal lands and waters, while accelerating a transition to net-zero emissions. The solution would expressly involve the Interior Department ending its pause on federal oil and gas leasing and instead directing urgent attention to accelerating and completing its legal and administrative work necessary to restart federal lease sales – and it should do so with appropriate environmental safeguards and fiscal terms in place. Failure to take these steps immediately will result in a weakening of our energy security in the near future. But taking these steps will bring a wide spectrum of positive impacts: national and energy security, domestic investment and jobs, revenue generation, reducing carbon emissions, responsible and sustainable development of energy resources, and protection of the environment. Even as the world transitions from fossil fuels, there are appreciable benefits to this key element of the U.S. energy supply. Again, deepwater Gulf of Mexico production is among the lowest greenhouse gas intensive in the world, and the carbon and environmental footprint continues to improve as operators like Shell use existing infrastructure to produce hydrocarbons in increasingly efficient ways.

This effort should also include the support for and deployment of CCUS technology, including an acceleration of clear policies and regulatory regimes which enable operators, both onshore and offshore, to move forward with plans as soon as possible; the continuing and intensifying improvement of energy efficiency of the upstream and downstream production processes; and the use of nature-based solutions for offsetting emissions in a way which empowers communities and protects the natural environment.

Another (and closely related) element of mid-to-long-term solutions should also be to ensure, as is the general practice both under the U.S. federal onshore and offshore revenue sharing regimes, that a substantial portion of the revenues from production go directly to the benefit of communities where the operations take place. The Gulf of Mexico Energy Security Act's support for large-scale coastal protection and climate resilience work is a fine example which Shell has supported since its inception and should be expanded upon. This should in turn help support, if regulation and permitting allows for it, investments in infrastructure like ports, roads, waterways, pipelines, and coastal protection systems at the heart of our current energy production which provide the foundation upon which we venture further into offshore wind, renewables and other new energy businesses. But it is clear that a combination of regulatory barriers and legal challenge are creating risk and delay for a variety of infrastructure projects, which in turn has somewhat constrained our ability as a nation to optimize flows of all forms of energy from one location to another. I am told that this Committee is examining infrastructure constraints and hope that reasonable and appropriate action to debottleneck and enable faster buildout.

The thoughts above do not purport to represent “all the answers,” but rather a series of meaningful actions which we can see as likely to help and where this Committee has a degree of influence. To reiterate, acceleration and growth are required across virtually all of Shell’s U.S. lines of business.

* * *

We are committed to a leadership role in both the energy transition and continuing to provide the life-sustaining and life-enabling products Americans need. Shell is proud of its history providing energy to consumers in the United States and around the world, and we look forward to enabling a future where we all move to net-zero emissions as well as ensure stability of supply and, we insist, a more peaceful world because of that stability. I hope we, as Americans, are driven by an eagerness to participate in a new age for energy – to build a new future through the sheer force of our ingenuity. This progress is already well underway and the prize before us is not only a lower carbon future, but renewed global leadership for the United States in technology and energy innovation, and a more secure economic future for us and our allies.

In the immediate, medium, and long term, a more stable and resilient energy system requires a more stable and resilient energy policy – it is necessary but not sufficient to react effectively to the problems of today if we will only be facing them again in a few years or, at worst, never fully recover. We can succeed in a way that empowers and enriches our communities and society as a whole if we react wisely now to provide needed energy for our current and foreseeable demand and ensure we are able to provide even more and cleaner energy, stably and sustainably, in the future.

Thank you for the opportunity to be here today. I would be happy to answer your questions.

The CHAIRMAN. Thank you.
Ms. Kenderdine.

**STATEMENT OF MELANIE KENDERDINE,
PRINCIPAL, ENERGY FUTURES INITIATIVE**

Ms. KENDERDINE. Thank you. Mr. Chairman, Ranking Member Barrasso, members of the Committee, thank you for this opportunity to testify.

First, let me extend my support for the Ukrainian people. Their strength and resolve in the face of Russia's brutality is inspirational. This crisis and the global response crystalizes critical energy security imperatives. The immediate focus on the need for gas and oil supplies underscores their current importance for the health, safety, security, and economies of the U.S. and its allies. At the same time, we cannot lose focus on the need for deep decarbonization by mid-century. The crisis and the world's response underscore the need for a thoughtful, informed, and sequenced strategy for the transition from fossil fuels to a deeply decarbonized future. In 2014, we received an early warning signal about the current Russian designs on Ukraine when in February of that year, it invaded then annexed Crimea. The response of the U.S. allies was swift. The G8 became the G7. We kicked Russia out. DOE put together a set of modernized energy security principles—not oil-centric, as it had been to that point. Those were adopted by the G7 leaders. The principles focused, in part, on flexible gas markets and emissions reductions, not surprisingly. The leaders also recommended an immediate focus on promoting low-carbon technologies, renewables, nuclear, and CCS, and promoting a more integrated liquefied natural gas market around the world.

My remarks are focused on two of these—global LNG trade and metals and minerals needed for low-carbon technologies. Replacing Russian gas in Europe via supply source diversification will be difficult in the near- to mid-term. Many countries in Europe are 93 to 100 percent dependent on Russian gas. Fortunately, the U.S. is in a strong position to provide major assistance in the LNG space. The U.S. is now the number one natural gas producer in the world and the world's largest exporter of LNG. Clearly, we need to do all we can to supply our allies in Europe, but we also have allies in Asia. Our largest consumers of U.S. LNG are Japan and South Korea. So satisfy the Europeans now—we have other allies we need to worry about as well. It is also clear that in the near- to mid-term, more supply and additional export capacity is needed. Existing global LNG import regasification facilities—including those under construction—totaled 1,102 million tons per year. Sixty-four percent of that demand is in Asia. On the flip side, our LNG export capacity, existing and under construction, is 576 million tons per year. The difference between demand and supply is 525 million tons per year. So importantly, we do not want Russia to fill that gap, and it is surely looking for other markets for its natural gas right now. Fortunately, we have planned supply in the U.S. and the world of another 571 million tons per year. Forty-eight percent of that is in the United States. We need to expedite decisions on that planned capacity and fill that gap and make sure that the Russians don't.

We also cannot lose sight of the fact that the LNG production and consumption will increase greenhouse gas emissions, depending on what it is replacing. The industry needs to dramatically reduce its methane emissions. Just do it. We have the technologies. Do it. Others have mentioned carbon capture and hydrogen, and so I will leave it at that—they are important.

Now, a few words on energy security issues raised by the growing need for metals and minerals for the clean energy transition. In 2017, the UN's environment program concluded that low-carbon technologies will need over 600 million metric tons more metal resources in a 2° scenario compared to a 6° scenario. USGS has categorized 50 metals and minerals as critical. The U.S. is 50 percent import-dependent on 27 of those, and 100 percent import-dependent on 13 of them. And we get a lot of them from China. So we need to be very careful. We need to engage our allies and trading partners through all available forms to protect those supply chains. They are new supply chains, and we need recycling. IEA says that we can get nine percent of the materials we need for batteries by 2040 via recycling.

Let me just say, in closing, raise a couple of suggestions. We have a LEED standard for buildings. I think we need a LEED standard for mines. I would call it "Leadership in Equitable and Environmentally Responsible Mining (LEERM)." Such a certification could provide a carrot, not a stick, and provide a key differentiator for mining businesses. And so I think that that is something we should do. This raises an important issue about the energy transition as well—creating additional and critical jobs that focus on rural America. Auto repair is currently a major—if not the major—center of commerce in many small towns in rural America. EVs will diminish that commercial activity. Creating recycling centers for batteries and other key materials in rural areas could help replace that commerce. And finally, we tend to think of energy security in terms of fuels. Beyond the cost of commodities such as copper, the metals and minerals used for clean energy technologies are capital costs, not fuel costs. The lifespan of all of these clean energy technologies defines the draw on the metals and minerals that we are talking about. So the lifespan of those technologies is a measure of our energy security. Manufacturing warranties aside, we need to assess and understand and get honest assessments of the lifespan of those technologies.

So thank you very much.

[The prepared statement of Ms. Kenderdine follows:]

Testimony of Melanie Kenderdine, Principal, Energy Futures Initiative
Before the
Senate Committee on Energy and Natural Resources
March 10, 2022

Mr. Chairman, Ranking Member Barrasso, members of the committee, thank you for the opportunity to testify this morning on a topic that is critical for navigating in today's very difficult times – the uses of energy both as an instrument of collective strength and as a weapon of aggression.

To more fully inform these important issues, some historical perspective is instructive. In 2014, we received an early warning signal about Russia's current designs on Ukraine when in February, it invaded, then annexed Crimea a month later. The response of the US and our allies was swift. In March of that year, the G8 became the G7 after its leaders expelled Russia from its ranks. At that time, the G-7 leaders also issued this statement: "International law prohibits the acquisition of part or all of another state's territory through coercion or force. To do so violates the principles upon which the international system is built. We condemn the illegal referendum held in Crimea in violation of Ukraine's constitution. We also strongly condemn Russia's illegal attempt to annex Crimea in contravention of international law and specific international obligations."

As it is now, energy was at the forefront of serious concerns in 2014, when Russia started moving in on Ukraine. I was working as the Energy Counselor to then US Secretary of Energy Moniz and was alarmed by the implications these events had for global energy security. I was concerned that our focus on energy security at that time was largely about oil supplies when there were many other pressing energy issues, including natural gas supplies and climate change, that were impacting or could impact the energy security of both the US and its allies.

I took those concerns to Secretary Moniz who, in response to the range of energy issues raised by Russia's actions, decided to advance the idea that the definition of energy security used by the US and its allies was antiquated – a relic of the oil embargoes of the 1970s – and that it needed updating. Although oil supplies remained a concern, it was just one of many – and a more modernized understanding of energy security was needed to inform collective and individual actions to protect and promote overall energy security and stability. We then drafted a proposed set of modernized energy security principles and developed a final set after negotiations with our G7 energy minister counterparts in Rome in May 2014. Later that year, these new modernized energy security principles were adopted by G7, EU and European Commission leaders in Brussels. Excerpted text from the Brussels' declaration offers some valuable guidance about a collective responsibility for energy security and how we should view and respond to Russia's most recent invasion of Ukraine:

"The use of energy supplies as a means of political coercion or as a threat to security is unacceptable. The crisis in Ukraine makes plain that energy security must be at the center of our collective agenda and requires a step change to our approach to diversifying energy supplies and modernizing our energy infrastructure...Under the Rome G7 Energy Initiative, we will identify and implement concrete domestic policies by each of our governments separately and together, to build a more competitive, diversified, resilient and low-carbon energy system. This work will be based on the core principles agreed by our Ministers of Energy ... in Rome:

- Development of flexible, transparent, and competitive energy markets, including gas markets
- Diversification of energy fuels, sources and routes, and encouragement of indigenous sources of energy supply
- Reducing our greenhouse gas emissions and accelerating the transition to a low carbon economy as a key contribution to sustainable energy security
- Enhancing energy efficiency in demand and supply, and demand response management

- Promoting deployment of clean and sustainable energy technologies and continued investment in research and innovation
- Improving energy systems resilience by promoting infrastructure modernization and supply and demand policies that help withstand systemic shocks
- Putting in place emergency response systems, including reserves and fuel substitution for importing countries, in case of major energy disruptions

Based on these principles we will take the following immediate actions:

- Promote the use of low carbon technologies (renewable energies, nuclear in the countries which opt to use it, and carbon capture and storage) including those which work as a base load energy source; and
- Promote a more integrated Liquefied Natural Gas (LNG) market, including through new supplies, the development of transport infrastructures, storage capabilities, and LNG terminals, and further promotion of flexible gas markets, including relaxation of destination clauses and producer-consumer dialogue.

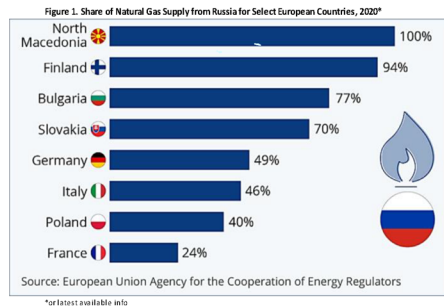
The recommendations for these “immediate actions” at that time addressed both climate needs and fossil fuels (LNG). This approach is also needed today as the US and its allies are working hard to address Europe’s near term need for natural gas as well as the ongoing need to mitigate climate change. This requires carefully sequenced actions and policies to address both critical imperatives.

As noted, key to these modernized energy security principles was collective action between the US and its allies, to “...identify and implement concrete domestic policies by each of our governments separately and together”. In the current crisis we have already seen a collective response on energy security issues when the Ministers of International Energy Agency (IEA) countries agreed to release 60 million barrels of oil from their emergency reserves “to send a unified and strong message to global oil markets that there would be no shortfall in supplies as a result of Russia’s invasion of Ukraine.” This action also underscored the importance of one of the key principles of modern energy security adopted by the G-7 in 2014: putting in place emergency response systems, including reserves and fuel substitution for importing countries, in case of major energy disruptions.

In addition to the G7 principles, the IEA – an energy security, treaty-based organization in Paris established by the US and its allies after the Arab oil embargoes of the 1970s -- recently put together a set of near-term recommendations for how Europe could address its overall vulnerabilities to Russian actions and diminish the ability of Russia to use energy as a weapon in the current conflict. In describing this 10-point plan, Fatih Birol, executive director of the IEA noted, “Nobody is under any illusions anymore. Russia’s use of its natural gas resources as an economic and political weapon show Europe needs to act quickly to be ready to face considerable uncertainty over Russian gas supplies next winter... The IEA’s 10-Point Plan provides practical steps to cut Europe’s reliance on Russian gas imports by over a third within a year while supporting the shift to clean energy in a secure and affordable way. Europe needs to rapidly reduce the dominant role of Russia in its energy markets and ramp up the alternatives as quickly as possible.” The IEA recommendations are:

- Do not sign any new gas supply contracts with Russia.
- Replace Russian supplies with gas from alternative sources.
- Introduce minimum gas storage obligations to enhance resilience of the gas system by next winter
- Accelerate the deployment of new wind and solar projects.
- Maximize power generation from bioenergy and nuclear to reduce gas use
- Enact short-term tax measures on windfall profits to shelter vulnerable electricity consumers from high prices
- Speed up the replacement of gas boilers with heat pumps
- Accelerate energy efficiency improvements in buildings and industry
- Encourage a temporary thermostat reduction of 1 °C by consumers
- Step up efforts to diversify and decarbonize sources of power system flexibility

As seen in this plan, an immediate concern raised by the Russian invasion is ensuring that our allies in Europe have adequate supplies of natural gas, reflected in the first three IEA recommendations: sign no more gas supply contracts with Russia; replace Russian supplies with gas from alternative sources; and introduce minimum gas storage obligations to enhance resilience of the gas system by next winter. These critical energy security concerns are reinforced by two G7 energy security principles: supporting the development of flexible, transparent, and competitive energy markets, including gas markets; and diversifying energy fuels, sources, and routes.

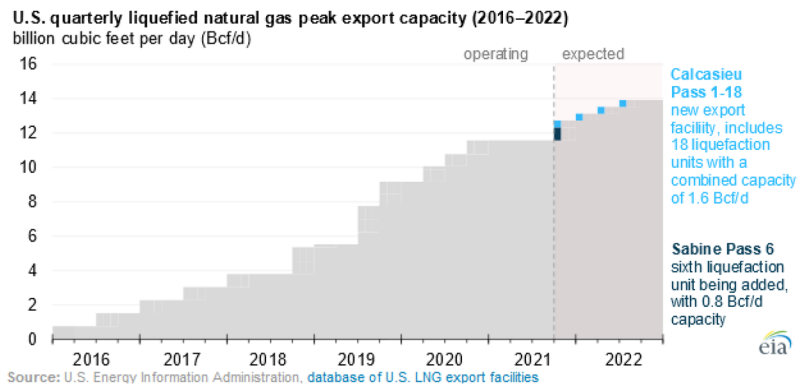


Replacing Russian gas in Europe via supply source diversification, will however be difficult in the near to mid-term. Figure 1 shows the extent of Russian gas use by several European countries and underscores both the need for – and the difficulty of – reducing Europe’s reliance on Russian gas. In that same time-period, Bosnia-Herzegovina, Moldova, and Latvia were also 100% dependent on Russian gas and Latvia was 93% dependent.

Fortunately, the US is in a strong position to provide major assistance in this area. The US is now the number one natural gas producer in the world and has a robust natural gas export infrastructure. In fact, the Energy Information

Administration (EIA) forecasts that in 2022, the US will be the largest LNG exporter in the world (Figure 2), a position that is supported by abundant domestic natural gas supplies.

Figure 2. US Liquefied Natural Gas Export Capacity Largest in the World in 2022

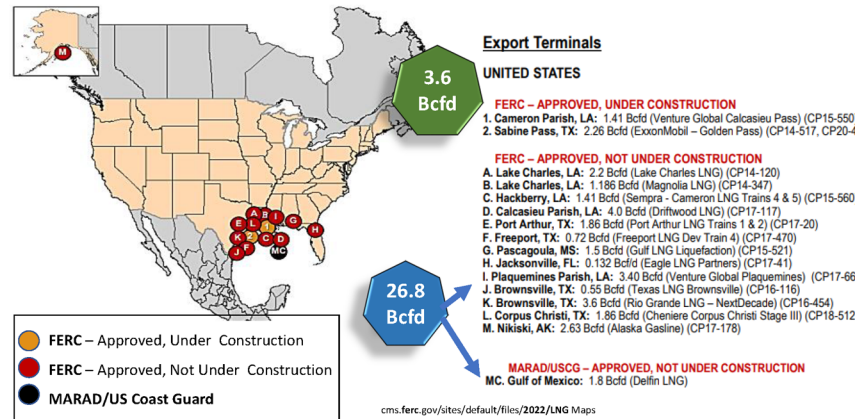


In its analysis of this new prominence, EIA noted that “...by the end of 2022, U.S. nominal capacity is expected to increase to 11.4 Bcf/d, and peak capacity will increase to 13.9 Bcf/d, exceeding capacities of the two largest LNG exporters, Australia (which has an estimated peak LNG production capacity of 11.4 Bcf/d) and Qatar (peak capacity of 10.4 Bcf/d). In 2024, when construction on Golden Pass LNG—the eighth U.S. LNG export facility—is completed and the facility begins operations, U.S. LNG peak export capacity will further increase to an estimated 16.3 Bcf/d.”

I would note that as recently as 2003, Alan Greenspan testified before Congress that the “...a major expansion of U.S. import capability appears to be under way. These movements bode well for widespread natural gas availability in North America in the years ahead.” In 2007, Exxon CEO Lee Raymond said “...gas production has peaked in North America”. Innovations in unconventional natural gas development (one of the first actions DOE took after it was formed in the late 1970s was to characterize US shale basins), including new drilling and production technologies were key to this transformation of the US energy profile, enabling it, again, to become the largest natural gas (and oil) producer in the world, the largest LNG exporter by the end of this year, and to provide assistance to its allies in Europe during this crisis. While the development of shale gas and oil has generated significant controversy and raises environmental concerns that must be addressed, it has totally changed the US energy profile and provides us with a powerful tool for helping our allies in this time of crisis.

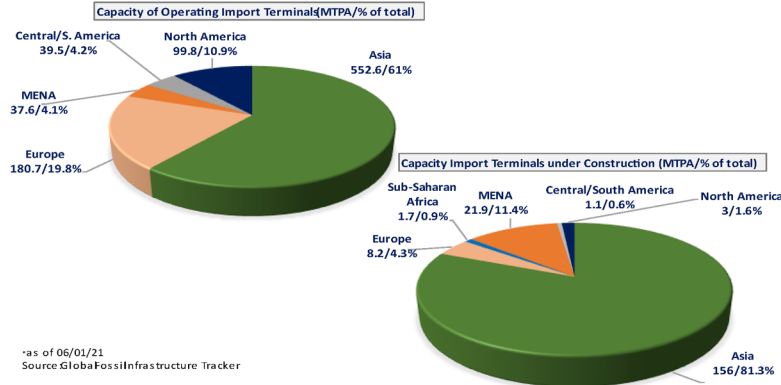
Figure 3 shows FERC/MARAD approved LNG export projects and approved projects under construction and associated volumes as of last month. Many of these projects are however, fully subscribed so ensuring surplus capacity is an essential need for addressing the current crisis in Europe and enabling it to, as recommended by Director Birol, to “...not sign any new gas supply contracts with Russia”. Approvals and construction need to be expedited.

Figure 3. Approved US LNG Export Terminals as of 2/16/2022



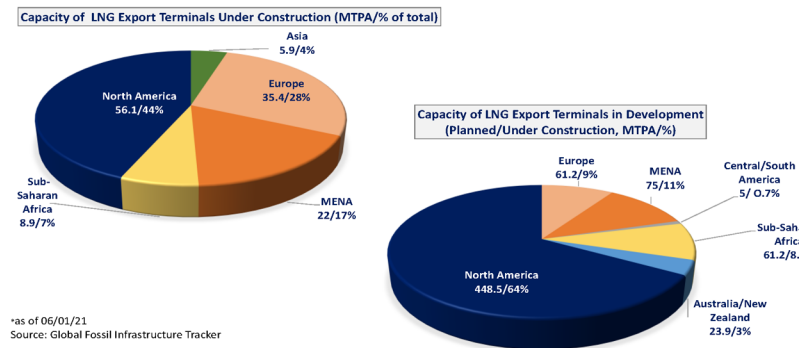
While providing Europe with natural gas is an immediate and critical need, it is not without implications for other US allies around the world, who also rely on natural gas exports from the US. Figure 4 shows the current import capacity by volume by country and import capacity under construction by region of the world (note that numbers in Figure 4 are in million tons per year; Figure 3 units are in billion cubic feet per day. One bcf equals roughly 7.4 MTPA). The existing import terminals and terminals under construction in Asia are notable, representing 61% of current import capacity and over 81% of capacity under construction.

Figure 4. Capacity of Operating LNG Import Terminals and Import Terminals Under Construction*



Going forward, the US will have to carefully balance the need to address the current crisis with the needs of our trading partner and allies around the world. Clearly, the interests of our allies in Asia – Japan and South Korea are our two largest customers – will be affected by our efforts to replace Russian gas in Europe and need to be factored into our calculus as we and our allies manage responses to Russian aggression. It is important to note that the lack of destination clauses in US LNG export contracts provides greater flexibility for addressing the crisis. We have already talked to the Japanese about help in diverting supplies to Europe – they offered assistance as long as their domestic needs were met. It is also clear that for the near- to mid-term, more supply and additional export capacity, including additional LNG tankers, are needed.

Figure 5. LNG Export Terminals Under Construction or in Development*



On this front, as seen in Figure 5, US export capacity under construction as of 06/01/21 was 44% of the global total and capacity under development was 64% of total. From an energy security perspective, it

is also important to note that *all* of Europe's export terminals under construction and in development are in Russia.

Importantly, we cannot lose sight of the fact that producing, transporting, and shipping natural gas has the potential to increase greenhouse gas emissions in both the US and Europe. Another key energy security principle we advanced for G-7 adoption was, as noted, "Reducing our greenhouse gas emissions and accelerating the transition to a low carbon economy as a key contribution to sustainable energy security" -- addressing this principle is critical.

To do so, the Biden Administration has committed to a target for the United States to achieve a "50-52 percent reduction from 2005 levels in economy-wide net greenhouse gas pollution in 2030", rejoined the Paris agreement, and has set goals of "creating a carbon pollution-free power sector by 2035 and net zero emissions economy by no later than 2050." Also, in September, 2021, President Biden and the European Commission President Ursula von der Leyen announced the Global Methane Pledge as "...an initiative to reduce global methane emissions to be launched at the UN Climate Change Conference (COP 26) in November in Glasgow [that]...aims to catalyze global action and strengthen support for existing international methane emission reduction initiatives to advance technical and policy work that will serve to underpin Participants' domestic actions. The Pledge also recognizes the essential roles that private sector, development banks, financial institutions and philanthropy play to support implementation of the Pledge and welcomes their efforts and engagement."

These goals create a natural tension between current demands for natural gas and net zero targets by mid-century. In Europe, near term options for addressing this tension include delaying planned retirements of nuclear power plants, efficiency (another G-7 principle) and energy conservation policies and practices such as demand response. Deploying more wind and solar, while a longer-term option, is also desirable.

On the US side of the Atlantic, these tensions can be managed in several ways. Importantly, the industry needs to dramatically reduce its methane emissions from the production, transport, and processing of natural gas systems. The technologies exist for doing so and many gas producers are actively engaged in mitigating emissions. While the adequacy of EPA's data on methane emissions is in question and may need to be revised to more accurately reflect sources and amounts of methane emissions, existing data suggest that between 1990 and 2018, methane emissions associated with natural gas (and oil systems) has declined by 23%. Also, according to both EPA and EIA data, average methane intensity declined by more than 70 percent between 2011 and 2020 in five major US production regions.

At the same time, carbon capture and storage could dramatically reduce emissions from power generation and industrial uses of natural gas. In 2014, the value and need for CCS were highlighted by the G-7 ministers in Brussels when they adopted the modernized energy security principles. At that time, as noted, the ministers urged immediate action on, among other things, promoting "...the use of low carbon technologies", including "carbon capture and storage". In a similar vein, in 2020, IEA analysis concluded that "Reaching net zero will be virtually impossible without CCUS." In addition, analysis conducted by the Energy Futures Initiative and Stanford University concluded that there were local air quality benefits to capturing carbon from industrial facilities. This happens because some industrial facilities with high CO₂ emissions also emit high levels of criteria air pollutants such as sulfur dioxide (SO₂), nitrous dioxide (NO₂), and particulates. Post-combustion carbon capture requires reduction of these other pollutants resulting in improved local air quality.

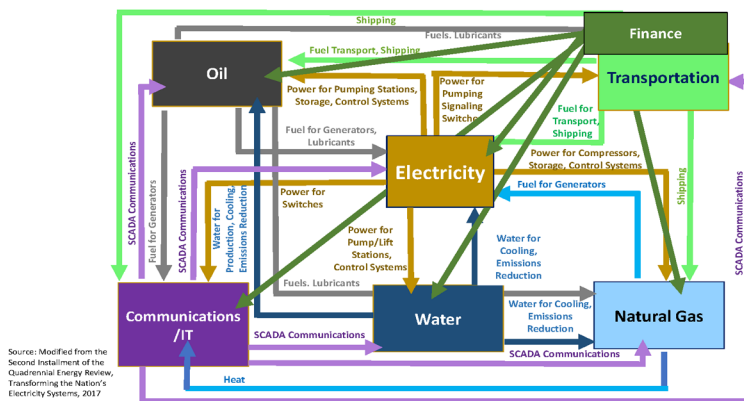
There could be an additional benefit to CCS and the pipeline infrastructure needed to move it from capture to storage sites. These pipelines take CO₂ away from emitting sites but could also transport clean hydrogen to facilities that could use it as a fuel for a range of needs for which electricity is inadequate, such as generating high quality process heat. Because hydrogen embrittles pipelines, special treatment of CO₂ pipelines upfront could enable this valuable infrastructure to re-purposed for

transporting hydrogen in the future. A tax credit for the additional expense of this initial treatment could support early emissions reductions via a *vis* CCS, while supporting the buildout of infrastructure needed in the longer term to provide clean fuel for a clean energy future.

While the G7 principles were an important step forward for defining and guiding individual and collective actions to ensure energy security of the US and its allies, two additional issues have been identified that suggest these principles need to be updated on an ongoing basis. First, is the need to address cyber security threats to energy systems. This energy security concern was illustrated by another Russian attack on Ukraine. In 2015, a Russian cyber-attack on Ukraine's grid shut down power for 230,000 Ukrainians for 1-6 hours.

The broad impact of cyber-attacks is underscored by the fact that all lifeline networks in the US rely on electricity to operate. Figure 6, from the second installment of the government-wide Quadrennial Energy Review released by the Obama Administration in January 2017 (my DOE office did the analysis and writing of this government-wide review), shows that electricity, finance, and communications networks are connected to all other lifeline networks; the financial and communications networks, however, rely on electricity to operate, making it both central and essential to our economy, energy security and well-being.

Figure 6. Electricity and Lifeline Network Interdependencies



This figure illustrates the critical importance of our electric grid and the potential for great damage from cyber-attacks. I am not, however, a cyber expert and the essential pathways for managing cyber-security threats (again, the Russians used cyber-attacks on Ukraine in 2015, shortly after we developed the G7 Energy Security Principles); this is a topic for another day and a different witness. I would, however, suggest that the G7 principles be updated to reflect this vulnerability and to also address another issue that has surfaced, post 2014: the growing demand for metals and minerals for clean energy technologies.

I first started paying attention to the issue in 2017, shortly after we left the Department of Energy and launched the Energy Futures Initiative. Around that time, the UN's Environment Program concluded that, "...low carbon technologies will need over 600 million metric tonnes more metal resources in a 2° C scenario compared to a 6° C scenario where fossil fuel use continues on its current path." Around the same time, a World Bank Study noted that "Simply put, a green technology future is materially intensive

and, if not properly managed, could bely the efforts and policies of supplying countries to meet their objectives of meeting climate and related Sustainable Development Goals.” I would note that the UNEP conclusion was based on a 2-degree scenario, not on a 1.5 degree or net zero scenarios and that since that time, 130 countries around the world have either implemented in policy or law net zero targets or are strongly considering net zero targets. This will further increase the demand for key metals and minerals needed to support a clean energy future. Over the five or so years since these analyses were released, the US Geological Survey (USGS) has been reporting on critical metals and minerals, their sources, production, and reserves around the world including in the US, and the degree to which the US relies on imports of these key metals and minerals. It should be noted that the Energy Act of 2020 defined critical minerals as those that:

- are essential to the economic or national security of the United States;
- the supply chain of which is vulnerable to disruption (including restrictions associated with foreign political risk, abrupt demand growth, military conflict, violent unrest, anti-competitive or protectionist behaviors, and other risks through-out the supply chain); and
- serve an essential function in the manufacturing of a product (including energy technology-, defense-, currency-, agriculture, consumer electronics-, and healthcare- related applications), the absence of which would have significant consequences for the economic or national security of the United States

Figure 7 illustrates three different but related issues: the percentage of imports of a range metals and minerals the US imports; what those metals and minerals are used for; and which minerals the USGS identified as “critical” earlier this year.

Figure 7. Metals/Minerals, 2020 % US Import Dependence, Key Uses

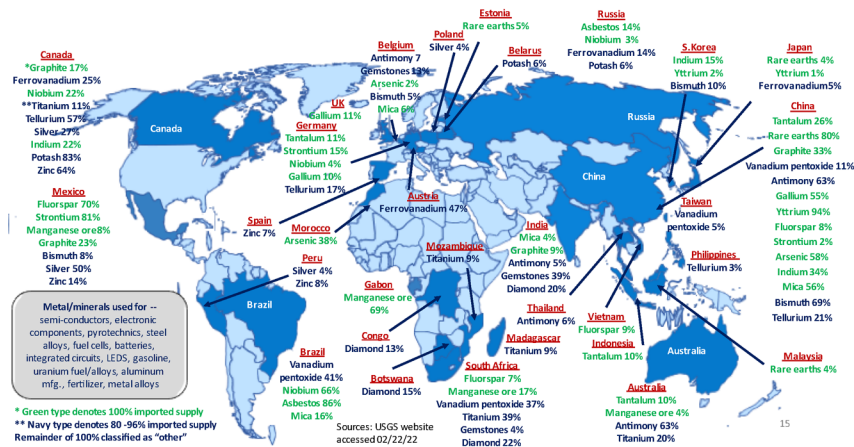
100% Import Dependent		96 - >50% Import Dependent	
Arsenic	Lumber preservatives, pesticides, lead acid batteries, solar cells	Vanadium	96% Metal, steel, uranium alloys
Tantalum	Electronic components, gas turbine alloys	Tellurium	>95% Cooling, energy production, solar cells, cast iron production
Strontium	Pyrotechnics, ceramic magnets, drilling fluids	Bismuth	94% Used in medical/ atomic research
Scandium	Alloys, fuel cells, electronics	Potash	90% Fertilizer, chemical, & industrial apps
Rubidium	Electronics, glass	Titanium*	>88% White pigment, metal alloys
Rare Earths	Catalysts, ceramics, glass, alloys, metallurgy	Diamond	84% Computer chips, O&G drilling, transportation
Niobium	Steel alloys	Zinc	83% Metal galvanizing
Manganese	Steel production	Antimony	81% Flame retardants, metal products, ceramics, glass
Indium	LCD screens, electrical components	Silver	80% Electricity, electricity conductivity, batteries, plastics
Graphite	Lubricants, batteries, fuel cells	Platinum	79% Catalytic agents
Gallium	steel making	Rhenium	76% Lead-free gasoline, super alloys
Fluorspar	Integrated circuits, optical devices (LEDs)	Cobalt	76% Rechargeable batteries, superalloys
Cesium	Aluminum manufacturing, gasoline, uranium fuel, refrigerants	Barite	>75% Oil/gas drilling
Yttrium	Oil/gas well drilling, fuel cells	Bauxite	>75% Cement, petroleum industries
Asbestos	Catalysts, ceramics, metallurgy, jet engines	Iron Oxide	>75% Concrete, construction materials
Mica (sheet)	Oil industry, rubber sheet, vehicle friction products	Tin	75% Coatings & alloys for steel
	Oil drilling, roofing, rubber products	Chromium	75% Stainless steel other alloys
		Gold	>52% Electrical/electronics
		Tungsten	>50% Wear resistant metals
		Germanium	>50% Fiber optics, solar cells
		Lithium	>50% Batteries, EVs
		Nickel	>50% Steel alloys

Note: Navy type indicates on USGS Critical List 2022
Red type highlights some key energy uses

Sources: USGS; Methodological Note to the Inventory of Export Restrictions on Industrial Raw Materials
*Titanium mineral concentrates

Also important to the level of import dependence is the source of those imports. Figure 8 shows metals and minerals for key industry/energy applications on which the US is 80-100% import reliant and the source of those imports by percentage. Note that green type indicates 100% import dependence, blue type 80-96% import dependence.

Figure 8. US Metals, Minerals on Which the US 80 to 100% Import Dependent, Country Suppliers of US Market/% Total Imports from Country



Of special concern in these critical times are imports from China, which abstained from a UN vote on the Russian invasion and has denounced sanctions against Russia. Also of concern are imports from Russia and Belarus; while not substantial, they supply, for example, 12% of US potash imports and 14% of our ferrovandium supplies, important for fertilizers, metal, steel, and certain industrial applications.

These imports raise critical supply chain issues. These global supply chains are relatively new, growing in importance and raise a new set of energy security issues. Clean energy technologies must accommodate potential material and process limitations, and the geopolitical risks that could, without policy support, delay, or hinder U.S. and global decarbonization efforts. Figures 9 and 10 are instructive in this regard. Figure 9 shows which countries and the metals and minerals they supply to the US that are currently supplied to the US by Russia and China, as well. The figure also shows which of those countries have net zero targets, important because this could raise their own domestic demand for those metals and minerals, thereby potentially diminishing the supplies available for export to the US. The figure also shows the top 15 recipients of US exports and which international forums – the G-7, G-20, OECD, the United States-Mexico-Canada Agreement, the participants in the Obama Administration's Trans-Pacific Partnership Agreement, from which the Trump Administration withdrew, and participants in its successor organization (absent the US), the Comprehensive and Progressive Agreement for the Trans-Pacific Partnership formed in 2018 – forums where critical metals and mineral supply chain agreements and protections could be discussed and developed.

Figure 9. Potential Forums for Dialogue with Key Suppliers of US Imported Metals/Minerals (80-100% imports dependent, non -Russia/China/Belarus suppliers)

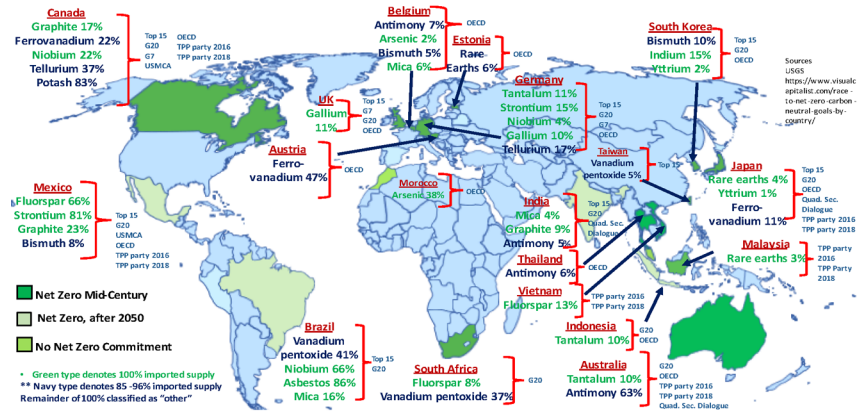


Figure 10 offers a look at *potential* suppliers of US imports of key metals and minerals is a set of countries with resources on which the US is 80-100% import dependent but that are not current suppliers of these metals and minerals to the US.

Figure 10. Countries w/ Large Reserves of Metals/Minerals on Which US is 80-100% Import Dependent, Not Current US Suppliers



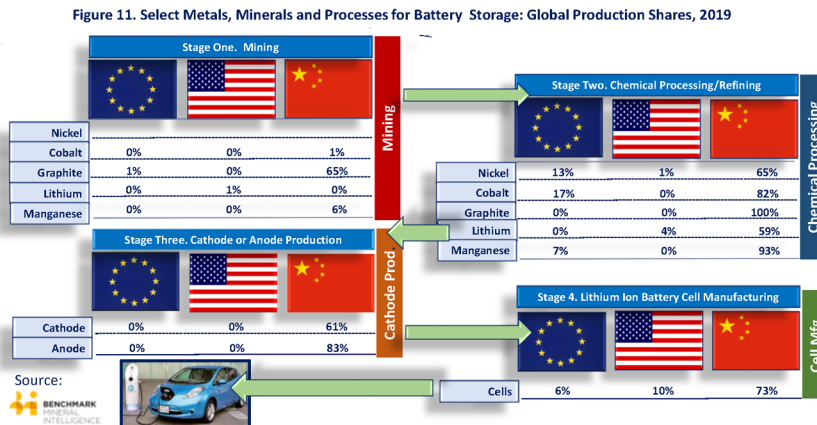
It should be noted that the starred countries in Figure 10 – Bolivia, Chile, Mozambique, Tanzania, Madagascar, Laos, Iran, Ukraine, Kazakhstan, Kyrgyzstan, Mongolia, and Senegal – are members of none of the forums outlined in Figure 9. Chile has a pending application to become a member of the CPTPP.

Also of interest are the four countries in Africa that have graphite and titanium resources. Increased bilateral relationships and work with entities such as Africa50, which has a large investment fund for 26 countries in Africa, could help diversify sources of supplies of metals and minerals on which the US is highly import dependent.

Supply chain issues were highlighted in President Biden's Executive Order 14017, *America's Supply Chains*, which noted that "More resilient supply chains are secure and diverse—facilitating greater domestic production, a range of supply, built-in redundancies, adequate stockpiles, safe and secure digital networks, and a world-class American manufacturing base and workforce. Moreover, close cooperation on resilient supply chains with allies and partners who share our values will foster collective economic and national security and strengthen the capacity to respond to international disasters and emergencies." DOE's response to Executive Order 14017, *"America's Strategy to Secure the Supply Chain for a Robust Clean Energy Transition"* released on February 24th of this year, highlights these issues, and identifies several supply chain strategies to:

- Promote adoption and implementation of traceability standards to improve global supply chain mapping capabilities, instill integrity of product custody, promote social responsibility, and support carbon foot-printing of energy supply chains;
- Invest in and support the formation of diverse and reliable foreign supply chains to meet global climate ambitions;
- Establish and fund an initiative for expanding clean technology manufacturing capacity globally to achieve the dramatic scale-up in manufacturing of key climate and clean energy equipment associated with meeting net-zero commitments;
- Support studies that assess and quantify the economic, environmental, social, and human rights impacts of different aspects of the energy supply chain for all clean technologies; and
- Create and maintain a manufacturing and energy supply chain office as well as a database and analytical modeling capabilities.

On the topic of manufacturing, it is important to note that the US is not only dependent on imported metals and minerals for clean energy technologies but is also highly dependent on their processing and manufacturing by other countries, especially China. Figure 11 compares mining, processing, production, and manufacturing percentages for lithium-ion battery storage in the EU, US, and China.



As Figure 11 shows, the US has very low percentages in all categories (zero percent in most), underscoring that the energy security issues associated with metals and minerals for clean energy technologies extend far beyond raw materials. In this regard, DOE's strategy for securing robust supply chains for a clean energy future includes a focus on expanding domestic manufacturing capabilities.

This is important from an emissions perspective as well. Many raw materials from the US are often shipped to China for processing then shipped back. Global shipping emissions, around three percent of total greenhouse gas emissions, are not counted in any country's nationally determined contribution. While three percent sounds relatively small, it's significant when trying to meet net zero targets. Developing domestic processing and manufacturing capabilities will both create jobs and reduce emissions from shipping.

This figure also highlights another critical strategy for meeting the energy security challenges posed by metals and minerals supply chains; increasing domestic mining, albeit mining that employs environmentally sustainable practices. The mining industry has a long history of creating environmental problems and needs to demonstrate responsible mining practices. Acknowledging both the need for domestic mining and the history of environmental problems associated with mining, the Biden Administration recently announced its, "*Fundamental Principles for Domestic Mining Reform*." These principles recommend that the US:

- Establish strong responsible mining standards
- Secure a sustainable domestic supply of critical minerals
- Prioritize recycling, reuse, and efficient use of critical minerals
- Adopt fair royalties so taxpayers benefit
- Establish a fully funded hardrock mine reclamation program
- Conduct comprehensive planning
- Provide permitting certainty
- Protect special places
- Submit community input and conduct tribal consultation
- Utilize the best available science and data
- Build civil service expertise in mining

This is an extensive list of principles. I would, however, suggest yet another action for consideration by the Congress and the Administration to encourage, enable and achieve responsible mining to help meet clean energy, net zero and energy security objectives. According to the *Responsible Mining Index*, "Responsible mine management requires that companies understand the important environmental values and take steps to avoid impacting threatened ecosystems and resources that are of high significance to the social and economic wellbeing of communities. Where impacts are not preventable, a 'mitigation hierarchy approach' can be followed, which requires that unavoidable impacts be avoided and minimized to the greatest extent possible, damaged landscapes and ecosystems are restored, and companies compensate for remaining impacts.

This index (see Responsible Mining Index, Framework 2020), in addition to providing criteria for managing ESG issues associated with mining, offers a list of criteria/indices for environmentally responsible mining. These include indicators such as:

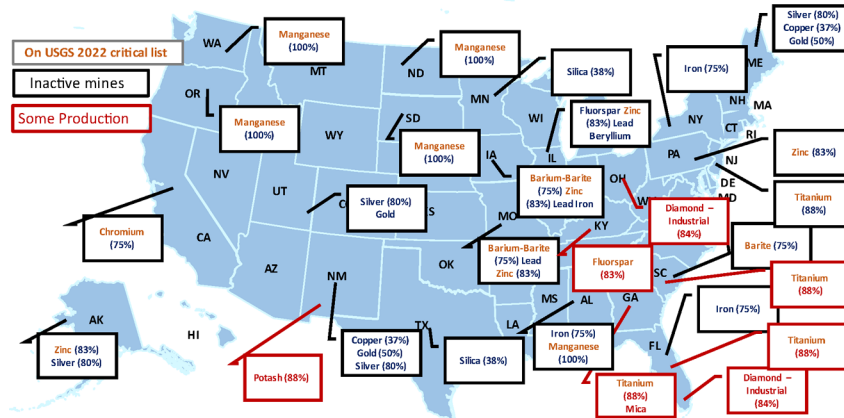
- The company has systems in place to ensure its operations conduct and disclose regular assessments of its environmental impacts through an integrated approach that considers the linkages between socioeconomic and environmental impacts
- The company commits to not use riverine, lake or marine disposal of tailings

- Where applicable, the company tracks, reviews and acts to improve its performance on addressing potential risks related to its tailings facilities, including seepage and tailings dam failure
- The company has systems in place to ensure its operations design and implement water stewardship strategies and plans, based on a catchment-level approach, to address water security in the affected area for current and future water users and the environment
- The company tracks, reviews and acts to improve its performance on reducing its water consumption and its adverse impacts on water quality
- The company has systems in place to ensure its operations limit the impacts of noise and vibration on affected communities, structures, properties, and wildlife
- The company commits to not explore or mine in World Heritage Sites and to respect other terrestrial and marine protected areas that are designated to conserve cultural or natural heritage.
- The company has systems in place to identify and report on the potential implications of climate change on its current and future operations' impacts on communities, workers, and the environment, and to design and implement appropriate adaptation and transition strategies.

Most people are familiar with the LEEDs standard for buildings that offers a means to “objectively measure how sustainable a building is”. I would propose that, using the indicators listed above as a starting point, we consider using LEEDS as an example for developing a “*Leadership in Equitable and Environmentally Responsible Mining (LEERM)*” standard to certify mines. Such a certification would have to be re-issued on a regular basis – mining, unlike a building, is not static -- but it could provide the necessary impetus for increased domestic mining of metals and minerals needed for clean energy, offering a “carrot and not a stick” approach where companies would be incentivized to use sustainable mining practices as a key differentiator for their businesses.

Figure 12 shows state locations of inactive mines for key metals and minerals, locations where there is some mining of these key metals and minerals, the percentage of import dependence, and metals and minerals in these locations that the USGS has deemed “critical” in 2022. This figure highlights how domestic mining of key metals and minerals could enhance energy security – a “LEERM” certification could help ensure that this is achieved in an environmentally responsible way.

Figure 12. States with Inactive US Mines or Limited Production of Select Metals and Minerals, % Import Dependence



On a related issue, the recycling of metals and minerals could create additional jobs at the same time it enhances energy security by extending the supplies of critical materials. Analysis in the IEA's sustainable development scenario suggests that between 2030 and 2040, recycling/reuse of batteries could meet up to nine percent of the copper, nickel, lithium, and cobalt needed to meet demand. This raises another issue important for the energy transition -- creating additional and critical jobs with a focus on rural America. Auto repair is currently a major center of commerce in small rural towns and could be affected by vehicle electrification. Creating recycling centers for batteries and other key materials could provide new commercial opportunities in small rural towns. Recycling of lithium-ion batteries, which can be dangerous and will require training programs to enhance safety of recycling, while creating jobs, and aiding rural America as we transition to clean energy.

I would like to raise a final energy security issue in the metals and minerals space. We tend to think of energy security in terms of "fuels". Beyond the costs of commodities such as copper, the metals and minerals needed for clean energy technologies represent capital, not fuel costs. The lifespan of clean energy technologies will determine the draw on many critical metals and minerals. Accurate assessments of clean energy technology lifespans will become indicators of energy security; analysis, standards, and updated methods and metrics for may be necessary for ensuring energy security as technologies evolve.

This discussion has highlighted some of the evolving energy security issues that have been brought into clear focus by the crisis in Ukraine. It has underscored the value of a set of modernized energy security principles adopted by the G-7 in 2014 that can help guide and enhance our energy security at a time when energy is being used as a weapon by Russia.

In the near term, US natural gas production to support exports of LNG to Europe can help reduce Europe's dependence on Russian gas. At the same time, we must meet the demand for natural gas of other key US allies and trading partners. This will require increased production and additional export infrastructure, and is consistent with the G7 principle, "diversification of energy fuels, sources and routes, and encouragement of indigenous sources of energy supply". We also need to support the innovation, technologies and infrastructure needed to reduce the emissions associated with these activities, develop a suite of technologies and policies to minimize the tensions inherent in these two pathways, and provide a supportable pathway for deep decarbonization of energy systems by mid-century.

In the longer term, as we transition to clean energy technologies, protecting global supplies and supply chains for critical metals and minerals, and reducing our reliance on China and Russia as suppliers of some of these materials will help enhance our energy security. This will involve finding new trading partners, increasing environmentally responsible domestic mining, investing in processing and manufacturing capabilities and capacities, developing alternatives, and recycling, re-using, and re-purposing key metals and minerals. The synergy between energy security and climate change mitigation offers many opportunities for addressing energy transition challenges in a coherent, sequenced manner.

Thank you for this opportunity and I look forward to your questions and comments.

The CHAIRMAN. Thank you.
Now, Dr. Medlock, via web.

STATEMENT OF DR. KENNETH B. MEDLOCK III, JAMES A. BAKER III AND SUSAN G. BAKER FELLOW IN ENERGY AND RESOURCE ECONOMICS AND SENIOR DIRECTOR, CENTER FOR ENERGY STUDIES, BAKER INSTITUTE FOR PUBLIC POLICY; DIRECTOR, MASTER OF ENERGY ECONOMICS, ECONOMICS DEPARTMENT, RICE UNIVERSITY

Dr. MEDLOCK. Thank you, Chairman Manchin, Ranking Member Barrasso, and the rest of the Committee. I am glad to be here virtually. I wish I could be there in person, but scheduling didn't permit.

The topic of this hearing is very interesting and it is an issue that tends to rise up and bite us every so often. The issue around Russian natural gas, in particular, has been something that has been explored ad nauseam over the last two decades and there have been many recommendations made by various parties with regard to Europe's dependence on Russian gas and what it could actually bring forth, yet, they have largely been ignored. In fact, if you think about dependence on Russian natural gas—and I think Jonathan referred to this earlier—but in 2012, it was roughly 26 percent of market share in Europe. Today, it is about 38 percent. So despite the obvious warning signs, dependence has actually grown, not declined.

And that raises a really interesting point about the concept of energy security that I want to refer to. It is important, first, to recognize that the definition of energy security has changed over the last three decades. It has broadened substantially to incorporate environmental concerns, social concerns, et cetera, and all of those definitely matter. As an economist, what I tend to focus on and what the economics literature generally tends to focus on in talking about energy security are the macroeconomic implications of unexpected shocks to supply or increases in price. And typically what we see historically is a massive amount of macroeconomic malaise that ensues as a result of these unexpected outages or unexpected price shocks, and then we tend to think about what sorts of hedging tools we can deploy to minimize those shocks in the future. There have been tremendous strides taken by policymakers, if we go back over 50 years now, in this dimension. The Strategic Petroleum Reserve is a great example of something that was created in an effort to mitigate the negative impacts associated with unexpected outages. And certainly, that is one that should be on the table in the short-term right now, given what is transpiring in global energy markets and how it is impacting U.S. consumers at the pump currently.

But one thing that is really important to recognize is that energy security, in particular, has shifted dramatically since 2000—just over the last 20 years, and that is largely the result of the “shale revolution” as it is often referred to. The shale revolution is one of the single largest drivers of transitions in global energy systems that we have seen in a long time, and it has dramatically shifted geopolitical discourse. It has changed lines of trade. It has changed investment patterns.

Of course, demand growth in Asia over the last 20 years has been equally dramatic in terms of its implications for the global energy system. But without a doubt, shale has transitioned the U.S. from a position of becoming more energy import-dependent to becoming less. In fact, back in the 2011–2012 time frame, the U.S. State Department had, on the Bureau of Energy Resources website, declared the U.S. to be an energy superpower. And I can tell you, we see that as well. We actually hosted, pre-COVID—and it is starting to pick up again now, thankfully—an average of 23 different delegations from different countries around the world every year. And in every case, when those individuals walked through the door, they wanted to talk about U.S. energy—understand what was happening in the shale patch, understand how policy was influencing the ability to access those resources through trade. So a lot of interest. The world watches what we do, without a doubt.

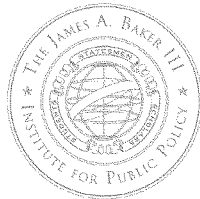
Now, I want to point something out about shale because this is really important and I think it rings with a lot of remarks that have been made so far today. What drove shale? It was a combination of legal structures, of regulatory architecture, of property rights. But at the core of it, it is innovation. And if we want to think about how the world of energy is going to transform over the next 30 years, innovation is going to be critical. So as we think about the future and we think about the geopolitical prowess that shale has brought to the front of the stage, in particular, it is a blunt-force tool that we can use to hedge against Russian hegemonic intent. I have some colleagues that have written about this with regard to the situation in Lithuania, where once that terminal was actually under construction, the Russians renegotiated gas price terms with Lithuania because they realized that the potential to bring in LNG, largely from the U.S., was a credible threat to their ability to use gas as a weapon.

Things like that are incredibly important to internalize, but at the core of it is innovation, and I said to this Committee, I think, three years ago, that we need to have a long view when we talk about innovation because the next great innovation is in the mind of a four-year-old somewhere playing with Legos. We don't know what it is, but we have to create platforms that encourage it so that it can actually begin to make meaningful transitions that are commercially viable and don't really require tremendous government support to move forward because, quite frankly, when those innovations materialize, they are game-changing and they actually have tremendous implications for our ability in the United States to impact outcomes everywhere. So it is a tremendous foreign policy tool.

Thank you very much.

[The prepared statement of Dr. Medlock follows:]

Kenneth B. Medlock III
Hearing on Energy Security



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Testimony of

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“Hearing to Examine the Use of Energy as a Tool and a Weapon”

The purpose of the hearing is to examine the use of energy as a tool and a weapon, and ensuring energy security for the United States and its allies.

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At a macroeconomic level, energy security refers to the concept that unexpected energy price increases and unanticipated disruptions in energy supply create dislocations that compromise welfare and economic activity. As such, energy security is often interwoven with national security, particularly when the threat of energy-derived economic dislocations come from a foreign actor. Unfortunately, history is all too familiar with malign intent and the use of energy as a weapon to influence geopolitical outcomes.

The link between energy availability, price and macroeconomic performance has been a subject of intense study for decades and it is one that was taken up the T20 in its communique to the G20 in 2020.¹ Energy security is an international concern, as evidenced by the fact that every G20 “Leaders Declaration” since St. Petersburg (2013) has included a reference to energy security, with a focus on market transparency, improved data collection and all energy sources and technologies.

Despite the attention given to the topic of energy security, it still has no single, universally accepted definition. Nonetheless, avoiding the macroeconomic malaise associated with an unanticipated shock to price or availability of supply of energy is one salient definition,² that has many variants, including the IEA’s own definition of energy security as the uninterrupted availability of energy sources at an affordable price. More generally, the literature on energy security encompasses a broad range of topics from security of supply to security of demand to health to environment to efficiency.³

As the portfolio of energy choices expands with the development and deployment of new energy technologies, attention must shift to supply chains for all forms of energy. Supply chain function is a classic coordination problem, and the scale of future global energy requirements alongside the need for energy sources with lower environmental impact will have enormous implications for future supply chain development. Hence, energy security concerns are not disappearing as establishing low vulnerability energy systems remains paramount.⁴ Indeed, energy security is already penetrating discussions about electricity sector resilience and reliability as the electric power sector expands and transitions toward new technologies and energy sources.

All this stated, policy directed at promoting energy security should have a clear definition of what it aims to achieve. In general, history reveals a continued focus on attempts to decrease vulnerability to energy price/supply shocks, as can be seen by aspirations of “energy

¹ Morgan Bazilian, Mark Finley, Steve Griffiths and Kenneth Medlock (2020), Refreshing Global Energy and Infrastructure for the Energy Transition,” Policy Brief for T20 Task Force 10: Sustainable Energy, Water and Food Systems, available at <https://t20saudiArabia.org.sa/en/forces/pages/Sustainable-Energy-Water-and-Food-Systems.aspx>.

² See Douglas Bohi and Michael Toman (1996), “The Economics of Energy Security”, Springer Publications.

³ See Abdelrahman Azzuni and Christian Breyer (2017), “Definitions and dimensions of energy security: a literature review,” Wiley Interdisciplinary Reviews: Energy and Environment, 7(1).

⁴ See, for example, Jonathon Elkind (2010), “Energy Security: Call for a Broader Agenda,” in *Energy Security: Economics, Politics, Strategies, and Implications*, ed Carlos Pascual and Jonathan Elkind, Brookings Institution Press, or Mark Finley (2019), “Energy Security and the Energy Transition: A Classic Framework for a New Challenge,” Baker Institute Report no. 11.25.19. Rice University’s Baker Institute for Public Policy.

independence” and freedom from “foreign oil.” The motivation for such aspirations become self-evident upon a brief review of recent US economic history, which reveals a correlation between high oil (energy) price and recession (see Figure 1).

Figure 1. Real oil price and US Recessions



Key	Short explanation
*	Mild recession. Interest rate increased due to 60s inflation (over 5% in 1969). Ended when interest rates were lowered.
I	The Oil Embargo. In response to inflation pressures, price and wage freezes across major US industries were instituted, which triggered layoffs and "stagflation." Fed tried to accommodate by lowering interest rates, which led to very high inflation in the late 1970s.
IIa	Iranian revolution and Iran-Iraq war drove increases in oil price. Inflation climbed to 13.5%, which drove Fed to increase interest rates.
IIb	"Double dip" recession. Oil prices remained high. Fed increase interest rates to 21.5%, which quelled inflation but also shrunk GDP by 3.6% and raised unemployment to over 10%. Fiscal policy – tax cuts and defense spending – ultimately reversed the course.
III	S&L crisis and Gulf War. Mortgage lending collapsed and construction followed suit. Iraq invasion of Kuwait spikes oil price and compounds woes.
**	"Dot-com" crash and 9/11. Mild recession in which Nasdaq lost 75% of its value and S&P500 lost 43% of its value. Housing boom helped end the recession.
IV	The Great Recession and the Global Financial Crisis. Perfect storm of events that included rising energy prices, and high risk moves in mortgage-backed securities by large financial institutions. S&P500 and DJIA lost half of their values. Massive fiscal support followed by quantitative easing pulled the economy out of the recession.
***	COVID. Pandemic-driven economic shutdown in attempt to slow spread of virus.

Sources:

WTI and CPI used to construct Real Oil Price are from the US Federal Reserve Database (<https://fred.stlouisfed.org>); Recession begin and end dates are from NBER US Business Cycle Expansions and Contractions (<https://www.nber.org/research/data/us-business-cycle-expansions-and-contractions>); Synopsis of causes of recession and recovery are from History.com "How the US Got Out of 12 Economic Recessions Since World War II" (<https://www.history.com/news/us-economic-recessions-timeline>).

Figure 1 indicates the real (inflation-adjusted) price of oil from January 1968 through December 2021 and NBER reported periods of economic contraction. Not every recession is caused by high energy prices, but periods in which energy prices rise are highly correlated with periods of economic contraction. There are number of reasons that have been posited for this correlation – ranging from monetary policy response to a reduction of real consumer disposable income to increased uncertainty that slows investment – and all possible channels of transmission from oil price to economic activity have bearing. Regardless of the drivers, recognizing the simple fact that high energy prices coincide with slowing economic activity naturally leads to an exploration of what drives energy prices higher, especially if energy-related economic contractions are to be avoided.

Of course, we also see economic dislocations at a more micro and regional scale when energy prices rise or energy supplies are disrupted. One needs to look no further than winter freeze Uri, which struck the central US in February 2021, and the resulting power outages that ensued driving loss of life and billions in economic damages. The causes of the electricity outages have been explored and policy has been reactive in attempt to abate similar crises in the future.⁵ That stated, there is still much more to do to ensure electricity supply remains reliable.

While the events that unfolded in February 2021 are relatively localized, it is important to note that the primary driver of the calamity that ensued was a record freeze, or a “tail event” in the distribution of possible events. In turn, this highlights that energy systems must be able to withstand low probability events in order to avoid widespread economic losses, or worse. As such, energy systems must have redundancy and resilience if they are to remain secure.

In the energy-related episodes indicated in Figure 1 (I, IIa, IIb, III, and IV), the drivers of higher energy prices were embargo, conflict, and unexpected and rapid demand growth in developing countries. None of these issues are within the direct control of the US, and thus require diplomatic intervention and/or the development of tools to hedge against the risks these issue present. Indeed, we have seen interventions such as the development of strategic stocks and the adoption of greater efficiency standards bear some benefit. Notably, each is aimed at providing a hedge against the risk of disruption – stocks can be drawn upon for emergency supplies in the near term and efficiency reduces the need for energy input for basic services.

This brings us to a central point with regard to how energy can be used as a tool to affect other dimensions of global and regional interaction – be they geopolitical, territorial, economic, or all of the above. The US has seen dramatic increases in energy production, oil and gas in particular, over the last 17 years. According to the US Energy Information Administration, marketed natural gas production increased from 18.9 trillion cubic feet (tcf) in 2005 to 37.0 tcf in 2021. This has resulted in a shift in the US market from one of becoming more dependent on imported natural gas – via pipeline from Canada and LNG from the Middle East and Asia-Pacific – to one where

⁵ See Peter Hartley, Kenneth Medlock and Elsie Hung (2022), “ERCOT Froze in February 2021. What Happened? Why Did It Happen? Can It Happen Again?” available at <https://www.bakerinstitute.org/electricity-in-texas/>.

the US now exports large volumes of natural gas by pipeline to Mexico and as LNG to 39 different countries in 2021. Similarly, US oil production has increased over the same time frame (2005-2021) from 5.2 million barrels per day (mmb/d) to 11.2 mmb/d in 2021. Notably, oil production was at its highest level ever recorded in late 2019, reaching almost 13 mmb/d before declining as the pandemic hit.

The dramatic shift in the domestic energy fortunes of the US was the result of innovations in the upstream that unlocked domestic shale resources, as well as a unique regulatory and legal architecture.⁶ The outcome was one of the two single largest drivers of transition in the global energy system over the last two decades – the “shale revolution” – with the other being demand growth in Asia. In no small way, the growth in US oil and gas production altered global discourse on energy security in profound ways, leading to proclamations that the US “is the world’s energy superpower” almost a decade ago.⁷

As discussed more than 7 years ago⁸ and noted in a recent report⁹ outlining the options available to Europe should Russian supplies of natural gas be severed, “the US has a valuable counterpunch to Russian actions that impact Europe’s gas supplies: LNG.” A fundamental lesson of the Cold War is that détente is born of a credible threat. Therefore, if US foreign policy is to be successful in swaying Russian (or any foreign actor with hegemonic intent) behavior – current and future – then such a lever must be presented.

The current situation in Europe is abhorrent. It extends well beyond energy, impacting lives and ways of life in irreversible ways as well as having ramifications for commodities in agriculture, energy and metals. Here, we focus on energy because that is the point of this exercise, but none of these issues can, or should, be taken in isolation when considering appropriate policy action.

Natural gas is the patrimony of the Russian economy and a major source of its political, economic, and diplomatic leverage over the Ukraine, the European Union, and its other former Soviet neighbors. Indeed, threats to Gazprom’s market share in Europe are taken very, very seriously. This has been demonstrated in recent years by a concerted effort by Gazprom to defend its market, as seen in physical infrastructure investments (for example, Nord Stream 1 pipeline system, completed in two phases in 2011 and 2012) and a willingness to alter pricing terms in the face of competitive threats (such as a renegotiation of terms for gas sales to

⁶ See Kenneth Medlock (2014), “The Land of Opportunity? Policy, Constraints, and Energy Security in North America,” available at <https://www.bakerinstitute.org/research/land-opportunity-policy-constraints-and-energy-security-north-america/>.

⁷ See US State Department website archives at <https://2009-2017.state.gov/e/enr/index.htm>.

⁸ See Kenneth Medlock (2014), “A ‘Credible Threat’ Approach to Long Run Deterrence of Russian-European Hegemony,” available at <https://www.bakerinstitute.org/research/us-lng-exports-weapon-against-russia/>.

⁹ See Gabriel Collins, Kenneth Medlock, Anna Mikulska and Steven Miles (2022), “Strategic Options if Russia Cuts Gas to Europe,” available at <https://www.bakerinstitute.org/research/strategic-response-options-if-russia-cuts-gas-supplies-europe/>.

Lithuania when the LNG import terminal there was built).¹⁰ Each of these commercial actions has been undertaken to secure direct access to central and western European markets by avoiding transit country risk (in Belarus and Ukraine) and to maintain long term contractual relationships with customers in Europe.

Unseating the depth of European dependence on Russian natural gas (and energy more generally) will only come through concerted action by the EU and its member governments to develop sufficient infrastructure to import alternative sources of gas (LNG infrastructure and pipelines), enable more efficient utilization of existing gas infrastructure (regulation of storage, pipelines and LNG terminals), and develop redundancy through alternative and exiting sources of energy (hydrogen, nuclear, renewables, etc.). In almost every case, the solutions are long-term and of varying time horizons because they depend on investment and time-to-build. As such, the abundance of US energy resources will play a critical role in blunting the impacts of Russia's use of the energy weapon in Europe in the short term, and will likely remain critical for the long term as well, even as energy systems continue their inexorable transition to a lower carbon future.

¹⁰ See Nathalie Hinchey (2018), "The Impact of Securing Alternative Energy Sources on Russian-European Natural Gas Pricing," *The Energy Journal*, International Association for Energy Economics.

The CHAIRMAN. Let me say thank you to all of you. It was extremely important for us to hear the expertise you all have and also your opinions on this. We are at a critical time right now and we are going to start with our questions. I will start and then we will go around.

We are at a critical junction, I believe, as far as in the world and our country, what role we play in the world. We are looked to as a leader. I think there are some of my friends and colleagues that believe that we are going to throw caution to the wind and just double down on fossil and forget about the cleaner environment that we are responsible for and how we do it with technology. That is the furthest thing from the truth. I think we can do both. We can walk and chew gum at the same time, and we have to. We are at a critical stance right now—how quickly can we get back into production and get up to where we cannot only defend ourselves and keep ourselves independent, but how can we support our allies, who are going to need energy. We have no idea how this thing might end. No one ever thought that we would be in the situation we are in now and Ukraine would be faced with the unbelievable war going on now. Atrocities are happening to innocent people. I do not think the world will stand for that, but it could go further than this without further provocation.

So what I would ask all of you—the only thing I know that we can get back in and quick—we talked about leasing not being done, pipelines not being built, this and that—can you give me your opinion on the Defense Production Act? Is this a time for us to consider the Defense Production Act to get things done so we remain energy independent and also can support our allies so they do not have to go back—even though they don't want to—to being reliant on Russia or areas of the world where we have very little influence and it is to our detriment for them to supply the energy?

I mean, we are hearing all the criticism—talking to Iran, talking to Venezuela. The Saudis are sitting on the sidelines doing nothing right now because of the strained relationships we have with them. But the only way that we can do something is to get back into the game. So I will just go down quickly. If you can give me your opinions on that, and Dr. Foss, I will start with you because it looks like you are ready.

Dr. FOSS. I am not a DPA lawyer—

The CHAIRMAN. Give me your opinion.

Dr. FOSS. I would like to consult one on your question.

The CHAIRMAN. What is the quickest way to get back in, and how—do you think it is important? Do all of you think it is important for us to move quickly?

Dr. FOSS. What I was going to say is that one of the interesting DPA procurements is the minerals procurement in partnership with Australia.

The CHAIRMAN. Okay.

Dr. FOSS. To the extent that we need to rely on international sources, we do have friends out there and if DPA can be used with procurement to help move things along—it is not going to solve the problem tomorrow, but it gets things in the works that will make a difference 10 years down the road in an important way. So you could think about that.

The CHAIRMAN. Thank you. I appreciate that very much.

Mr. Elkind.

Mr. ELKIND. Thank you, Chairman. I, too, am not a DPA expert, so I can't comment—

The CHAIRMAN. I think what I am really asking is about the urgency. That is the only thing I know that we can use to have the urgency, that we need the products.

Mr. ELKIND. The even more urgent feature—

The CHAIRMAN. Okay.

Mr. ELKIND [continuing]. That you need to really be aware of is the cyber threat to the energy systems. We are seeing it all the time in the press in the United States. Europe, likewise, has to be in the crosshairs of those that would like to complicate their energy security and their ongoing economic operations. This is a hard area because of the sensitivity and the intelligence that is underlying most of the actions, but intensifying collaborations there, it seems to me, would be an important and really near-term step.

The CHAIRMAN. Ms. Hirstius.

Ms. HIRSTIUS. Yes, Chairman, I think the answer is yes. There is clear urgency and we need to move quickly on many fronts. I think there are tools that are in our hands today. We can increase production. We can increase infrastructure, which will really help with the flexibility that we need.

The CHAIRMAN. Under normal conditions right now—you are in the private sector—what would it take you to get up and running right now? Just as things have happened in the past—the permitting process, getting things ramped up and everything. We are in unusual times right now.

Ms. HIRSTIUS. Indeed. So in my sector, in the Gulf of Mexico, seismic permits is something that we need to get after to make sure that we can continue to drill wells, and also in the longer term we need to make sure that we have the stock of leases that are coming in so we can continue to sustain the supply.

The CHAIRMAN. Thank you.

Ms. Kenderdine.

Ms. KENDERDINE. As I mentioned, there are a lot of LNG projects in development. Whatever we can do to expedite those projects and get them done—I have checked into the availability of LNG tankers. There are tankers available. I am going to be the third person who said I am not an expert on the Defense Production Act, but I have a little bit of concern about declaring emergencies. I know we had to do that to use the Strategic Petroleum Reserve. We are drawing that down. We could do an SPR exchange right now without declaring an emergency, and I think the market is pretty backwardated, I have been looking into that as well. So get oil onto the market—

The CHAIRMAN. Right.

Ms. KENDERDINE [continuing]. In addition to getting gas onto the market. I think there are a lot of things that we could do, but expediting those projects that are under development, and the ones that are under construction, expediting those projects—

The CHAIRMAN. Thank you.

Dr. Medlock, do you have a thought on that?

Dr. MEDLOCK. Yes, I think urgency is critical and I think it is critical that we work hand-in-hand with our allies in Europe. And something that hasn't been mentioned yet, but the use of floating storage and regasification units—offshore units for LNG—should be on the table. You can actually view those as short-term fixes to advance more supply of natural gas into Europe, which needs it dramatically right now. Longer-term though, yes, anything that can be done to accelerate or expedite permitting and production would pay massive benefits.

The CHAIRMAN. The only reason I am saying that is because, sitting in different committees, hearing different proposals, with what is going on, this is a critical time for us. We do not know where it is going, but we have a full-fledged war going on in Ukraine with Russia with no end in sight. Where do they stop? What is the endgame? We do not know.

The bottom line—what we do know is that Russia has weaponized energy and they have used it as a geopolitical weapon, and the only thing I know about an adversary or a bully is that if they have a weapon, you better have one that will match or will be better than theirs, and we do. We just haven't used it. How quickly we get it in production is going to determine whether we are able to thwart this or not, and that is the concern I have.

With that, I am going to turn to Senator Barrasso for his questions.

Senator BARRASSO. Well, thanks, thanks so much, Mr. Chairman. I think you are absolutely right when you talk about Russia. Ms. Hirstius, over the years, Shell, an international company, has made significant investments in Russian oil and natural gas production. The company is also part of a joint venture which built Nord Stream 2. Last Friday, Shell purchased 100,000 metric tons of Russian crude oil at a massive discount. Shell has since apologized for the purchase and has announced that it will stop buying Russian oil. This is the right decision. I understand Shell now also intends to exit its joint ventures with Gazprom, including Nord Stream 2. Could you just give us an update in terms of the status and progress of Shell's efforts to divest these assets?

Ms. HIRSTIUS. Yes, thank you, Senator Barrasso. And indeed, we did purchase a tanker of Russian crude, and since then announcements have been made. Our CEO has made it very clear that we apologize for that and are taking all steps to withdraw from our joint ventures. That includes upstream, it also includes our lubricants business in-country, it includes our downstream gas stations, and also extends to all purchases outside of country of any hydrocarbon products.

Senator BARRASSO. And when should we expect the divestments to be complete?

Ms. HIRSTIUS. As far as a date, I am happy to provide an update to you or to the Committee. You know, you can imagine it is a pretty detailed process that needs to be executed to make sure that we can do that safely and the withdrawal is clear and it will be expedited.

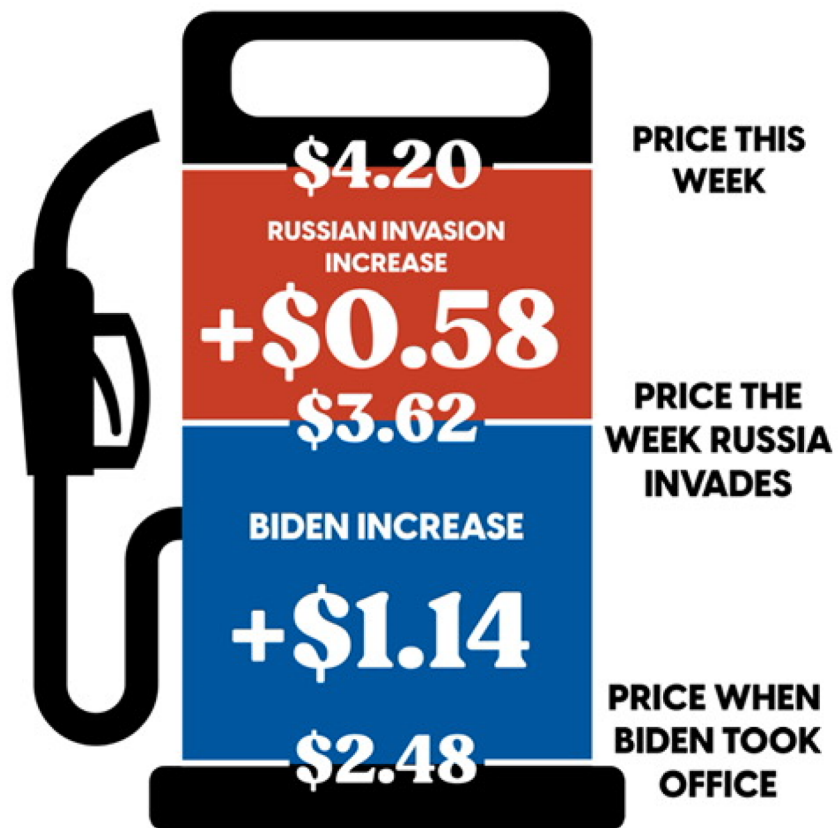
Senator BARRASSO. Thank you.

Dr. Foss, the Administration is claiming that rising gas prices are all the fault of Putin's invasion of Ukraine. But gasoline prices

had been rising well before that invasion. The President does not want to take any responsibility. Instead, he claims it is simply not true that Administration policies are holding back domestic energy production.

There is a chart here. I want to get that into the shot, with the camera, if we could. I just want to make sure that the witnesses can see it as well.

[The chart referred to follows:]



(EIA, Weekly U.S. All Grades Retail Gasoline Prices)

Senator BARRASSO. So looking at the average weekly prices from the point of Biden's inauguration, which was here—at the time, talk about \$2.48 a gallon. Biden's inflation accounts for about \$1.14 of that. Putin's invasion of Ukraine adds 58 cents to that. So has the Biden Administration's energy policy affected current and future oil and gas production here in the United States?

Dr. FOSS. We have already talked about leasing. Colette did a really wonderful job on that. Let's talk about how perception is reality. This is my really, really, really, big concern. And when you are deep in the oil and gas patch, this is what you hear about the most. You do not take a lease, you cannot execute on the lease unless you have capital available to you. There are threats against capital for the industry that are just simply not constructive. It is not necessary. It is really silly in many respects. The idea is to starve the industry of capital to keep it from operating to force us off of oil and gas before we can viably move forward with other things. Investors see that. Financial markets see that. Regulators see that. A lot of this is coming from nominees who are being proposed for key regulatory positions in financial markets. That gets out there. It creates uncertainty. Companies can deal with risk. You can quantify risk. Uncertainty is open-ended. It is very tough to deal with—whether your government is with you or against you. That is a big amount of uncertainty that affects decisions—what am I going to invest in? What kind of project and when? Over what time frame?—and other things.

So those are my biggest concerns. It is the things that are in the background that are contributing to gasoline prices today because this has gone on for a while. For over a year, we have been seeing these pressures build in financial markets. We have been hearing this discussion. It has been coming at the industry from all directions. And that takes its toll eventually, and you have to add that into the mix.

Senator BARRASSO. Can I get to one other thing that you talked about in your testimony? So there are 260 million cars and light-duty trucks in the United States today. If you wanted to move to all electric vehicles in America tomorrow, do we produce enough critical minerals? You know, where are we going to get the minerals from? Can we do it without relying on minerals from Russia, China, Chinese-controlled mines? I mean, the Secretary of Transportation the other day said, "well, put everybody in electric vehicles." Can you kind of run down the possibility of doing that, what it would take? How many years and what it is going to cost to get those minerals?

Dr. FOSS. We couldn't do it ourselves. There is no way we can do it ourselves. The U.S. is currently about 12 percent of total nonfuel minerals tonnage, and a lot of that is aggregate for construction. We do not produce enough to support what companies are trying to build out now in terms of battery manufacturing capacity, or for that matter, semiconductor fabs and manufacturing to support all of the other things that are needed.

I mentioned Chinese dominance. I have talked about this in House Energy and Commerce testimony and other hearings. The mining industry is as much under pressure as other basic industries are to make investments and to be able to find opportunities

to execute on to be able to bring those into the market. And it does not help when you have an uncertain political context in your own market. So this is really an issue.

There are best practices for the mining industry out there, by the way. The mining industry responds to what comes out of the World Bank, to the ICM, which provides crosscutting standards for companies, for ESG and best practices in mining operations. So it's not like the industry is not responsible or not looking at how to be responsible going into the future. But it is the same problem. You have to have access to the minerals. You have to have the capital to develop the minerals. You have to have the supply chains to support them.

One last point about this—everything that we are planning in the United States—the announcements, the joint ventures—invariably include partners that have supply chains that they can bring into our country. That means international sourcing. So we are going to continue to rely on metals and materials that are produced outside of the United States because it is the fastest way for the industry to try to accelerate given all the time frames that are under discussion.

The CHAIRMAN. Thank you.

Senator Cortez Masto.

Senator CORTEZ MASTO. Thank you, Mr. Chair.

Let's talk facts, because what I hear coming from some of my colleagues are more of the politics than the true facts. Crude oil and natural gas prices are primarily determined by global markets and international events, which is why American families are hurting right now in Nevada and across the country under these high energy prices. I am hearing this conversation about threats against capital in the industry, but here is a fact—oil and gas companies certainly are not hurting. The six largest publicly traded oil and gas companies, including Shell, reported combined profits of \$90 billion for 2021. And on top of that, the oil and gas industry already receives an estimated \$3.1 billion in taxpayer subsidies each year. In recent days, major oil companies in the United States have said that they would rather use their earnings from higher prices to boost payouts to shareholders and expand their operations slowly rather than rush to drill new or develop existing wells.

So Ms. Hirstius, my question to you is, can you explain, at a time like this, why your company would be prioritizing payouts to shareholders rather than working to increase our oil supply?

Ms. HIRSTIUS. Yes, thank you, Senator, thanks for the question. At this time, I think it is important that we continue to proceed to increase all of the energy sources that we have, and that includes looking at what are the levers that we have to make sure that we can add additional electrons into the system, because when we add electrons, we—

Senator CORTEZ MASTO. Thank you. I only have so much time. But my question is this, directly—why are you prioritizing your payouts to your shareholders instead of working to increase the oil supply? Let me ask you this: would your company be willing to forgo paying out dividends to pass along that relief to consumers who are seeing high prices in my state and across the country?

Ms. HIRSTIUS. Yes, so the prices are something that we do not control. I think that you said that yourself. The way in which we prioritize—

Senator CORTEZ MASTO. So you would not be willing to pass off your dividends actually to consumers, who are hurting right now?

Ms. HIRSTIUS. We are committed to continue to invest and make sure that our production does not decline.

Senator CORTEZ MASTO. All right. I only have so much time, so let me move on here because I did not get an answer to my question. Let me just say this—it is false to lay blame on the Biden Administration's energy policies for the cost and the cause for the high gas prices that are currently facing Americans right now. And I see some heads nodding here. That is absolutely right.

In fact, the data that I have—and please tell me if this is incorrect—the BLM, under the Biden Administration, approved more permits to drill last year than it did in the first three years of the Trump Administration, and oil production on federal public lands is higher now than at any point since at least 2003. We have heard this statistic—the oil and gas industry has more than 9,100 approved permits to drill that have not yet been put into use, and 14 million acres of leased public lands that have not been put into production, and I keep hearing that we have to increase production, but there is the opportunity to already do that.

Mr. ELKIND, can you explain to me why oil and gas permits are going unused if they could help lower costs? And then, could you also distinguish between federal and public lands? My understanding is that 90 percent of oil production in the U.S. takes place on private and state-owned land, and we are only talking about 10 percent on federal land. So can you answer those questions for me? If that is true? And if it is not, please clarify for me.

Mr. ELKIND. Senator, I do not have a different understanding of the current ratio of federal to non-federal lands, but I think it is really important that we take a look at two things here. One is that the financial discipline, you know, has come from Wall Street, from investors that are putting capital into these companies. John Hess, the Chairman of Hess petroleum, was quoted as saying earlier this week that “Investors have been telling oil companies not to invest so much. Well, this is a crisis. We should be investing more as an industry. We have had five years of underinvestment and we are paying for it now.”

I do stress the five years—

Senator CORTEZ MASTO. And explain that. Five years of underinvestment in what? In new drills? In new sites, right?

Mr. ELKIND. In new upstream drilling, yes.

Senator CORTEZ MASTO. That's right.

So the oil companies—

Mr. ELKIND. But the part that I'm—

Senator CORTEZ MASTO [continuing]. Have been listening to Wall Street, right? And not actually investing in new drilling sites.

Mr. ELKIND. The investors keep them alive, so from that perspective, that is understandable. I also think it is important to note that the price increases that one has seen in the last year also reflect the massive upswing in economic activity as we recover after

COVID. So this is a really important thing to keep in mind as a backdrop to retail prices.

Senator CORTEZ MASTO. So let me ask you, and this is my final question, because this is why—this is just driving—I think it is just a false narrative that somehow this Administration is responsible though. You just said that for the last five years they have been underinvesting, and so is it true, investment in new wells has dropped more than 60 percent? That's nearly 25 percent just as the COVID virus hit. And so now they are trying to play catch up. Is that correct, based on the demand?

Mr. ELKIND. Look, it is only natural that oil companies reduced their production when demand cratered, and demand did crater. So I think as an economic matter, that only makes sense. It is pretty tough for American consumers now to be looking at the prices that we are seeing today. That is really hard stuff, but the fact that the production went down when it did in 2020 should not surprise us.

Senator CORTEZ MASTO. Right. And that was prior to this current Administration, correct?

Mr. ELKIND. Yes, Ma'am.

Senator CORTEZ MASTO. Thank you.

The CHAIRMAN. Senator Lee.

Senator LEE. Thank you, Mr. Chairman.

Ms. HIRSTIUS, do you believe the Biden Administration has been withholding lease sales specifically to raise costs for consumers? And before you answer that, I want to explain a little further what I am getting at.

In the Cook Inlet sale, the Administration, in issuing its draft EIS in October of last year, stated that by withholding leases—this is on pages 46 and 47 of the draft EIS, as I recall—that if they were to proceed with not doing this, that the result would be a decrease in demand, resulting in lower emissions, because as the price of oil and oil-related products, including gasoline increased, people would diminish consumption. Now, I also want to add here that prices of gasoline are up considerably, and so too is consumption up. So a twofold question—do you think the Biden Administration has been withholding lease sales in order to raise energy costs, perhaps with an environmental objective in mind? And do you believe that doing that produces environmental benefits?

Ms. HIRSTIUS. With regard to lease sales and has it raised the cost to consumers—I do not think that not having lease sales has raised the cost to consumers. I think that Mr. Elkind describes it very well—some of the elements that have heavily contributed to the prices that we see today.

Senator LEE. And do you think that part is deliberate in order to discourage and diminish consumption and therefore, emissions?

Ms. HIRSTIUS. I mean, I think the leases that we need to retain and bring into the system—there is a bit of a misconception about it. These leases—this idea of an idle lease does not really exist. There is an evaluation period that is required after we bid on the lease. And there really is no benefit to holding onto a lease. So once we bring it into our portfolio—so given in Shell's portfolio—we begin an evaluation process. We submit permits that will allow us to conduct activities on those leases, and then if we like what we see—and really about 10 percent of the remaining leases in the

Gulf of Mexico we estimate to have oil and gas—so in many cases, we acquire a lease, we do technical work, and then we determine that we do not want to drill on those leases. In some cases, we decide we do want to drill on those leases, and when we do, we are either successful or unsuccessful. And if we are unsuccessful, we relinquish that lease and put it back into circulation. If we are successful, then it takes additional time, and while no activity is going on physically on the lease, there is a large amount of evaluation and interpretation that is required to determine how best to develop those natural resources.

Senator LEE. So not every lease results in a drilled well. Not every drilled well ends up being a smashing success.

Ms. HIRSTIUS. That is correct.

Senator LEE. And so as a result of that, there is a connection. You have to have a flow of approved leases in order to keep it moving, is that right?

Ms. HIRSTIUS. That is correct.

Senator LEE. Without that, you shut it down.

Now, it appears to me that this is a feature, not a bug, for the Biden Administration. They want to keep supply low so they can bring costs higher. This business of saying, “oh, we’re surprised, we’re upset that the prices are this high.” That is a feature, not a bug, based on what they are saying, and that is deeply concerning to me because that harms the American people. And it harms them in a way that does not improve the environment. There is still demand for that. That demand goes somewhere. It goes to other people producing oil and gas in a way that is less environmentally responsible than it is here, resulting in even more emissions as they move it across oceans or otherwise in order to get it here. And I think that is unfortunate.

Now, the Biden Administration recently announced a ban on Russian energy imports. We have to keep in mind that Russian oil, while a small percentage of our overall oil consumption, does include a fair amount of heavy crude, and heavy crude is an important feedstock for many U.S. refineries. I am worried about this because I wonder how this ban will interact. I mean, I think it was probably the right thing to do to not buy heavy crude from them—not buy products from them—especially at this moment, but we do have to know where we are going to get heavy crude from. And so I worry about the interaction of that ban with the Biden Administration’s still undeterred, unchanged policies discouraging domestic production. If we cannot produce and distribute that critical feedstock, we would have to turn to a number of places outside the United States where we would rather not be propping up vile dictators, horrible human rights abuses, and reckless environmental practices—places like Venezuela, Iraq, and China are among the world’s leading producers.

Now, we do have some that we can produce in the United States, including the Uinta Basin. It is one of the reasons why the Administration must sign the Record of Decision approving the Uinta Basin Railway, especially now. This has never been more important than it is right now. They need to approve that, but they haven’t. They have blown past the anticipated time when they should have approved it. We have never needed that more than

right now. This is good oil. It is oil that is very useful that we desperately need right now. Thirty percent of it that would be transported on that is owned by the Ute Indian Tribe. It needs to be approved. But if we cannot get that done, where would we have to go, and what would we do to get the heavy crude we need to maintain our feedstock?

Ms. HIRSTIUS. Yes, so I think the decisions that have been made in the past were under a different context. And I think it is important that we look at the decisions that need to be made now in the context that we have now. It is a crisis that we are under, and the solutions to this current crisis need to be very quickly thought through, and urgent action needs to be taken now. And I think that spans the spectrum, from looking at what are some of the solvable problems of permitting and approvals that can take place that allow LNG exports to begin flowing more freely, both to Europe as well as our Asian allies. It also includes looking at pipelines. It also includes making sure that we continue to progress against our energy transition objectives, which include CCUS as well as leasing and permitting in the Gulf of Mexico, as well as onshore. And I think with all of those combined, we do have the resources and need to really stay focused on how we can move quickly to make sure that we both have energy security for the U.S. and our allies, as well as making sure that we are progressing against our energy transition objectives.

Senator CORTEZ MASTO [presiding]. Senator Kelly.

Senator KELLY. Thank you, Madam Chairwoman.

Ms. Hirstius, I want to follow up on Senator Lee's and Senator Cortez Masto's questions here. Like everywhere else in the country, in my state, Arizona, folks are paying way too much for a gallon of gas. It is really hurting families. They are having to make some really tough decisions. I am one who believes that we currently need an all-of-the-above strategy that includes increased domestic production of crude oil. You mentioned that this is a crisis. We need urgent action now. You started to outline a couple of the, I would say, more global options here, but I want to hear specifically from you more about your company's plans to increase production here in the United States. How much more can you increase it? When can you do it? And do you think you will be successful?

Ms. HIRSTIUS. Yes, thank you, Senator Kelly.

Yes, I think we will be successful, but let me describe a bit of what it looks like to be successful in that growth. Our largest production comes from the Gulf of Mexico. In the Gulf of Mexico, we have a 15 to 20 percent average decline rate. That means that if we just continue to produce from the wells and reservoirs that we have, year on year, that production will decline by 15 to 20 percent, and that just has to do with the dynamics of the reservoirs from which we produce. In order to maintain flat, we need to continue to drill wells, and we need to continue to acquire seismic data, and we need to continue to acquire leases that allow that conveyor belt of activity to continue. And that will sustain our production.

So this year, we will be bringing on a new field in the next couple of weeks. That is new growth, new production that will come online very soon. We have 10 rigs that we continue to run across the Gulf of Mexico that continuously drill exploration and develop-

ment wells to make sure that we are replenishing against our total production. We have a new platform, Vito, that has just sailed into the Gulf of Mexico. It is sitting on Texas shores being fitted out with the final fittings and will sail out into the Gulf of Mexico so that it can begin producing—either late this year or early next year are what our ambitions are. So there are many things that we continue to progress with to make sure that we are maintaining the production and adding new production day in and day out.

Senator KELLY. A year from now, where do you think you will be as a percentage compared to where you are today?

Ms. HIRSTIUS. So percentage-wise, because we have this decline, our objective is to remain about flat. Now, the levers that we have to significantly increase production—and we were talking about oil and gas production, as Mr. Elkind described—is really the flexibility that we have onshore. We can bring production onstream from our onshore activities more quickly than we can in the, say, Deepwater Gulf of Mexico.

Senator KELLY. Okay, well, please let us know what you need from us to facilitate that.

Ms. HIRSTIUS. Thank you, Senator. That is greatly appreciated.

Senator KELLY. Thank you.

Mr. Elkind, Senator John McCain used to say, and I love this quote, “Putin’s Russia is a giant gas station pretending to be a real country.” On Tuesday, the President signed an Executive Order banning imports of all Russian fossil fuels. I supported that as one of 10 members of this Committee. We proposed legislation to do that, and he took those steps.

Mr. Elkind, I would like to get your thoughts on how American energy production compares to Russia’s environmentally, and Senator Lee alluded to this. So for example, the International Energy Agency reports that Russia’s oil and gas production is about 30 percent more methane-intensive than the United States. Does Russia’s fossil fuel sector, which is, as I think we all know, rotten with corruption, have environmental monitoring and enforcement practices anywhere close to that of the United States?

Mr. ELKIND. Senator, thank you for that question.

I do not think that, looking at the history of the Russian oil and gas industry, the first feature you would call out would be the environmental performance of it. This, in fact, is one of the downsides of the withdrawal of the major international oil companies from their activities there, is that also what will go away is some of that environmental performance that is core to their operations. Now, having said that, in the United States we have a big honking problem, and that is called methane emissions. Yes, I think it is a reasonable suspicion to say that Russia’s methane emissions exceed those of our own, but if we want for our LNG to be purchased on global markets, as I do, we need to make sure that we are able to improve and radically reduce the methane emissions from the value chain. This is an area of huge unfinished business that needs to be attended to, sir.

Senator KELLY. All right, well, thank you. I certainly agree we need to work on that.

Thank you, Madam Chairwoman.

Senator CORTEZ MASTO. Thank you.

Senator Daines.

Senator DAINES. Thank you.

Today is an opportunity for us to discuss something the whole world is focused on, and how energy plays a pivotal role in global politics. The importance of energy security and global energy dominance cannot be overstated. It is something I have been vocal on since I first came to Congress in 2013. The United States has an abundance of energy—vast oil, natural gas, coal, water, wind, solar, and strong nuclear energy programs. This abundance should be used as a tool, not only for our own energy security, but also for supplementing and supporting our overseas partners. We do it the right way here in America in terms of environmental stewardship. The more energy that can be produced in America, the better we are overall in terms of global environmental stewardship because we do it the right way. We have the most stringent environmental standards.

This abundance should be used as a tool to drive more energy production in America to secure our future economically and geopolitically, but instead of growing this all-of-the-above energy portfolio and diversifying and strengthening our domestic supply chains, this Administration has taken action after action to weaken domestic energy and advance a very one-sided, very ideological climate agenda. This effort has weakened America's ability to respond globally, and has further emboldened Putin's weaponization of energy. Now, I have heard the White House say again and again that they have done nothing to weaken American oil and gas production. That could not be further from the truth. That is a lie. Since day one in office, this Administration has sent a chilling message to traditional energy production. Whether it is official actions from the Administration or statements by his appointees, he has made it clear that he intends to shut down domestic oil and gas production and mining.

Don't just take it from me, here are the facts. In the Democratic primary debate on CNN, President Biden himself made it a campaign promise to stop all oil and gas production, saying, and I am quoting the President, "No more drilling on federal lands. No more drilling, including offshore. No ability for the industry to continue to drill, period." Those came from President Biden. On day one of his Administration, he personally killed the Keystone XL Pipeline. Then he took action to halt federal oil and gas lease sales. By the way, Montana still has not had a lease sale despite federal law and a federal judge requiring it. Then, he revoked existing, already purchased leases in Alaska's 10-02 area.

Following all that, the Biden Administration began a regulatory deluge of rules limiting domestic production. The EPA is increasing regulations on methane emissions. The Administration is creating even more uncertainty for WOTUS regulations. FERC recently passed rules to make it more difficult to permit new natural gas pipelines and facilities. Then there was the tax-and-spend bill that the President was strongly pushing that included higher royalty rates, new methane fees, higher taxes, and more roadblocks. President Biden has also appointed a long list of far-left, anti-energy nominees that want to destroy oil and gas, close off capital markets, and stoke climate fear. John Kerry, the U.S. Special Presi-

dential Envoy for Climate, is more focused on the emissions of the war in Ukraine than the war himself, saying—I am quoting Mr. Kerry—“Obviously, you are going to have to have massive emissions as consequences of the war, but equally importantly,” he said, “You are going to lose people’s focus.” And said later that the Ukraine refugees—this is what he said in the last couple of days—“will be nothing like the climate refugees we will see.”

Secretary Haaland, Secretary of the Interior, has said, and I quote her, “I am wholeheartedly against fracking and drilling on public lands.” Gina McCarthy, former EPA Minister under Barack Obama, now the White House National Climate Advisor, said, and I quote, “This is a day of reckoning for the oil and gas sector.” Sarah Bloom Raskin, the nominee for the Federal Reserve, urged the Federal Reserve to stop investing in traditional energy. This was not a term paper from college. This was a New York Times op-ed she wrote in March 2020 saying, and I quote her, “Fossil fuels are a terrible investment,” and the feds should not, quote, “prop up and enrich oil and gas.” Ms. Omarova, the former nominee for Comptroller of Currency, said she wanted small oil and gas players to go bankrupt.

All these actions and statements have real-world market consequences. They chill the capital markets. They chill the risk and reward equation as we are looking to expand and explore new areas for American energy. Fertilizer prices are out of control. You talk to your farmers and ranchers, as I do back home in Montana—they have more than doubled. Some cannot even get it, and some are wondering, “Can I get the fertilizer in the ground this spring so I can even plant?” Investments are trending down. Domestic oil production was lower in 2021 than it was in 2019. Since President Biden’s first day in office, oil prices have steadily gone up, up, and up, and when oil prices skyrocketed and gasoline prices spiked, instead of calling on the United States—if I was President Biden, watching what’s going on, like \$5 a gallon plus gasoline—rather than reach out to Venezuela or rather than reach out to Iran, why wouldn’t the first instinct of this President be to call the oil and gas producers across America to the White House for an emergency summit and talk about how to get another three to five billion barrels a day here in America or in Canada—I mean, from trusted allies.

When his instincts were to reach out to adversaries, that tells you a lot about how captivated he is and held hostage to the climate change ideology, which is wreaking havoc right now in the global energy markets. Why on earth would the United States want to increase imports from unstable and adversarial countries? We could increase production here. Work with Canada as well as U.S. producers to increase our energy trade. We can and should be energy dominant. And by the way, this challenge is not going away in the next three to six months. We have to get back on track of a made-in-America energy strategy because peak oil—we are still 15, 20, 30 years away from peak oil in the world, not to mention in our country as well. We can do it. We should do it.

Mr. Chairman, I am going to ask one question here for Ms. Hirstius, and that is, what action can the Administration and Congress take today to spur investment in production of an all-of-the-

above energy portfolio that includes oil, gas, coal, nuclear, hydro, wind, solar, and more?

Ms. HIRSTIUS. Yes, thank you, Senator Daines.

I think that I fully agree that this is a moment in time where we can and we must do both. We need to look at the energy system as a whole. We need to invest heavily and continue against our objectives in the energy transition and make sure that we are looking at how we move forward, really in a fundamental way to get CCUS projects up and running, how we make sure that we are bringing more molecules as well as electrons into the total system. And much of that has to do with actions that can be taken on permitting and on leasing, as well as looking at infrastructure to make sure that we have the ultimate degree of flexibility that we will need and do need right now to continue to look after the totality of the energy system as a whole.

The CHAIRMAN [presiding]. Thank you so much. And we will have a second round if you need it, okay?

Senator King.

Senator KING. Thank you, Mr. Chairman.

We have been, I think, talking around the primary problem here, which is a lack of supply. I may be the only person at this dais who remembers the Arab oil embargo of the early 1970's, and the price went up because the supply went down. You were a little kid, Bar-
rasso, don't give me that.

[Laughter.]

Senator KING. The price went up because the supply went down. The price went down because we had more supply than demand during the pandemic, and production went down because of the collapse in demand. The demand came back but the supply didn't come back. Why didn't the supply come back? Because the oil industry made a conscious decision to invest in their shareholders rather than their production capability. This past year they have announced almost \$40 billion of stock buybacks, which does nothing for production or anybody else except shareholders and perhaps the executives, and about \$50 billion of dividends. That is money that could have gone into investment for production. And that is the reality. That is what is driving this. It is not lease pauses on federal land and it is not the Keystone Pipeline. My mother used to say, "you're straining at gnats and swallowing camels." The lease pause is a gnat. The Keystone Pipeline, which was mostly for export, is a gnat. The camel is the failure of the industry to respond to the increase in demand since the decline of the pandemic. An executive in the industry put it, I think, absolutely perfectly, when he said just a few weeks ago, "You have made a promise to be more disciplined"—a promise to his shareholders, getting cash back to shareholders with these dividends—"The question is, are you going to keep your promise or are you going to be patriotic?"

Well, we all know what they chose—not to be patriotic. And the production is not there. And I understand some reluctance because of the hammering that they took during the pandemic. But that is really the fundamental problem here. And what is hampering the growth of production is not federal policy and it is not scary statements from the White House about climate change, it is a failure

to invest in the production capability. And that is really what is driving this.

Mr. Elkind, you made this point, that it was the COVID recovery that has driven the increase in demand. Supply has not kept pace, and therefore prices are up. And now, the war in Ukraine has further strained supply, or at least has affected the international market. Again, prices have gone up almost 50 cents or a dollar just since the beginning of the war in Ukraine. This is all about supply and demand. And in response, I just, parenthetically, want to say, the estimate by the World Bank for climate migrants by 2050 is 200 million people. That is a national security disaster. So if anybody questions what I am saying, just Google oil buybacks and you will read about the stock buybacks and the dividends that are being paid rather than investment in production.

Mr. Elkind, am I on the right track here?

Mr. ELKIND. Senator, the interaction between investors and the oil and gas industry is a pretty nuanced one, and I would stress that it is not a really elective kind of an interaction. The oil and gas companies cannot thumb their nose at the concern of investors or investors will walk away from them. So I think that—

Senator KING. But there is a difference between—they made the highest profits in eight years last year. So it is not a question of thumbing your nose. It is a question of proportionality. And there certainly could have been greater investment in increased production rather than—and I mean, that is really what we are talking about here.

Mr. ELKIND. Well, and I think that my expectation is that you will see a change in the production levels that, in part, reflects the really acute sense that this time is different. So you know, these discussions that are taking place this week, for example, at a major conference in Houston—I think you are going to see a reply, a response. The last point that I would make is that for big companies like one represented at this witness table, revenues off their hydrocarbon activities also support, in a critical way, what they are trying to do in the decarbonized space.

Senator KING. I don't question that. I think that is a great output. My problem is the diversion of the record profits, or the highest profits in eight years, to non-production or non-fossil fuel alternatives.

One other minor point—not a minor point, but a separate point—everybody is talking about LNG. We are talking about LNG as we are exporting. We are helping our European allies. I just want to note, increased LNG exports beyond some certain point—which is very rapidly, we are about 15 percent of production now—is going to indubitably affect domestic prices. Again, supply and demand. If we diminish the supply available in the United States by exporting 15, 20, 30 percent, which is in the construction pipeline, domestic prices for natural gas are going to surge. That happened in Australia. It is going to happen here. And it just seems to me we need to be clear-eyed about this and understand it. It bothers me that everybody is on the LNG bandwagon without taking cognizance of the effect on domestic gas prices, which affects manufacturers and, lord knows, consumers all over the country.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you, Senator.

And now, we have Senator Murkowski.

Senator MURKOWSKI. Mr. Chairman, thank you.

I am going to go back to a phrase that you used in your opening statement. You said we need to be operating in reality. And I think part of the challenge that we have faced is everybody has really quick easy answers. Just produce more. You have leases. Just dial it up like there is some easy button that we can increase production in this country, or that, really, any other producing country can. And I want to focus in a little bit on how we operate in reality, and you used the term, Dr. Foss, we need to face reality.

So you indicated that industry knows how to deal with risk. They deal with that every day, but it is the uncertainty with policy that really puts handcuffs on the ability to move forward. So I want to understand what it is that could be done, could be said, could be messaged from this Administration, whether it is President Biden or the Secretary of the Interior. What is the message that reduces some of the uncertainty? Because when you have uncertainty, investors do not invest. The producers are not going to look at these leases that perhaps are a little more speculative. They are not going to be moving out as quickly as they might want. We are all agreeing that we need to get production up. Everybody has said we need to get production up. But you can't. There is no easy button here, and they need some level of certainty with the message that comes, because you said perception is reality.

If President Biden came out today and said that we, as an energy producing nation, need to ramp up our production—yes, we need to ensure that we are focused on lower carbon intensity, because he ran on that. But I do not think that this is a mutually exclusive proposition here. What is the signal? What is the message that could be sent that is going to help my state, as a producing state, and those in the Gulf of Mexico? What do you need to hear, Ms. Hirstius?

Ms. HIRSTIUS. Yes, thank you, Senator Murkowski.

I think a very strong message would be to quickly progress, and within the next few months have a proposal around a five-year plan. At this point, we don't have line of sight. We have gone through a period of time where we have not acquired new leases, and I think both for the funnel and the pipeline, this conveyor belt of activity, but also the very strong messages to companies like Shell and others that there is certainty that we will be able to obtain leases and continue to progress with our activities would go a long way.

Senator MURKOWSKI. So five-year plan.

Dr. Foss.

Dr. FOSS. I'm going to try to answer your question by giving some support to my colleague to my right. Jonathan is trying to get people to understand, I think, the role of the investor community in all of this. For Shell to be able to continue to build a portfolio of leases to at least hold production flat, their large institutional investors need to have confidence that they are not a sunsetted industry.

Senator MURKOWSKI. Right.

Dr. FOSS. And out there, that is the opinion. And that is why companies are under pressure to buy back shares and return money to investors. And this is a hard thing to talk about and deal with. I mean, this is not easy. We can't capture it in a data point. But we have memos. We have letters from CEOs, opinions of large fund managers, testimonies, and op-eds of the things that are going on and all of that creates an environment. I want to correct something that I said, because earlier I said for over a year this has been going on. This has actually been going on for several years. There has been growing pressure to try to use the financial markets——

Senator MURKOWSKI. Right.

Dr. FOSS [continuing]. To try to discipline energy policy or influence energy policy in ways that are making responses difficult now.

Senator MURKOWSKI. Well, the financiers on the East Coast are telling Alaskans anything in the Arctic, we are not going to finance, period.

Dr. FOSS. And Senator, as you well know, to be able to get the rigs there, to be able to get the services there, the service community has to have the same level of confidence. Stepping out of the White House and saying we have confidence in the oil and gas industry. We want the financial markets to support them. Sending that message could actually be an interesting thing.

Senator MURKOWSKI. It is kind of a dream, but you know what? We have been told these are extraordinary times that deserve extraordinary measures. In the meantime, you have war in Ukraine. You have hospitals that are being indiscriminately blown up. You have children dying and we are trying to decide whether or not we should participate in this war over energy.

Thanks, Mr. Chairman.

The CHAIRMAN. Thanks, Senator.

Senator Hirono.

Senator HIRONO. Thank you, Mr. Chairman.

Really interesting discussion. I do agree with Senator King's description of what is causing gas prices to go up. When the supply goes down, the prices go up, and he referred to the oil embargo of 1970. You know, more recently, in 2008, for example, the average national price of regular gas reached roughly \$5.37 when adjusted for inflation, which is above the current national average of \$4.22. Back in 2008, Biden was not the President. So all these efforts to blame President Biden do not make sense—very totally misplaced. And in fact, if anybody is to blame for the current situation, it should be Putin.

So the 2008 oil price shocks solidified Hawaii's commitment to move toward renewable power because we were the most oil import-dependent state in the entire country. Our effort to become energy self-sufficient is now at 30 percent, with the goal of 100 percent self-sufficiency to renewables and alternatives by 2045. So Hawaii got it. I am wondering when the rest of the country is going to get it, that we need to become energy self-sufficient. At the same time, it is very clear that our approach is all-of-the-above, which is to also rely on fossil fuels, but at the same time, to acknowledge, as Ms. Hirstius said, climate change is real. We cannot keep pump-

ing carbon into the air. We have a responsibility, I would say, to get a better handle on that.

So Mr. Elkind, do you think that at a time like this we should be accelerating the development, for example, of electric vehicles and other zero-emission transportation options, so that we will eventually not have to worry about gas prices or give Putin and other oligarchs the ability to use oil as a weapon?

Mr. ELKIND. Senator, thank you for the question. As I said in my remarks, I do think it is incredibly important that we realize both the emergency situation in which we find ourselves with war going on in Ukraine, and that we are setting the stage for another problem that we will have seen coming but we will not have responded to. So yes, continued investment in decarbonized energy systems is vital. And in fact, I think it is worth bearing in mind that underinvestment, which has rightly been focused on in this conversation today as a real issue for the oil and gas industry, is not limited to the oil and gas industry. We are underinvesting in all of our energy systems, and we do so at our peril.

Senator HIRONO. So, for example, I note that on March 6th, Germany's Finance Minister stated that Germany is now planning to spend 200 billion Euros, or about \$220 billion to fund industrial transformation between now and 2026, including climate protection, hydrogen technology, and expansion of the electric vehicle charging network. I do not consider going to electric vehicles as some sort of a pipe dream. I think it is a necessary step. So do you think—and again, this is for Mr. Elkind—the United States should take a similar step by passing the over \$550 billion in clean energy incentives that the House has passed and the Senate Committees have put forward?

Mr. ELKIND. Senator, speaking personally, yes, I strongly support that. I would note that the move to electric vehicles is not uncomplicated. Melanie Kenderdine very strongly highlighted one feature of this, but this is where the industry is going. Our own companies want to go there. We should be four-square behind it.

Senator HIRONO. This is for Ms. Hirstius. So Senator Cortez Masto and Senator King both addressed the earnings of the oil companies, but don't you have a fiduciary responsibility to your shareholders to maximize your profits?

Ms. HIRSTIUS. No. Our shareholders want to be able to invest in us for the short-, medium-, and long-term. It isn't just a short-term gain that they are looking for. And so, while it is very important that we foster and look after the shareholders and make sure that we are looking after the short-term, they really are very interested in the medium- and long-term, and that includes our oil and gas production, and we continue to invest heavily—multi-billion dollars on an annual basis—in our oil and gas business to make sure that we are continuing to supply the needed energy to the world today. And we do take the profits that we make in the upstream, as Mr. Elkind has described, and those are invested back into businesses that do not make money today. It is invested back in research. It is invested back in CCUS. It is invested back in wind—offshore wind leases in New York that we recently bid on for almost \$400 million, and that is just for the lease. And to compare that to the amount that we exposed in the last lease sale, which was \$20 mil-

lion in the Gulf of Mexico, so you see a significant difference there in the amount that we are investing in renewables to make sure that we are looking after the longer term as well as the short-term in total revenue and profitability of the company.

Senator HIRONO. Well, Mr. Chairman, perhaps that story needs to be better told, because Shell reported earnings of \$19.29 billion for 2021 and laid out plans to raise dividends and spend \$8.5 billion to buy back shares. Exxon, BP, and Chevron laid out similar share buyback programs. And the four companies, including Shell, reported \$75 billion in profits for 2021. It is no wonder that the oil industry is being looked at as really engaging in not exactly what we would a call long-term approach to this current crisis.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you, Senator.

And now we have Senator Lankford.

Senator LANKFORD. Mr. Chairman, thank you.

I would note that President Biden's EIA numbers for the next 30 years show that oil and gas usage worldwide will continue to increase past 2050, that even President Biden's numbers from his Administration as they look at oil and gas usage and the importance of oil and gas for the next 30 years, lists globally that we are going to continue to need more oil and gas. So I am grateful that companies are still exploring, are still taking the risk, are still trying to be able to find capital when people are being squeezed out from capital, because quietly the Administration is saying we need more, we need more, because the world needs more, but publicly they are saying we need less, we need less, we need less. So at some point we have to address that doublespeak in the middle of this.

Dr. Foss, you made an interesting statement at the beginning of this. You ended your opening testimony saying we have to remember that we need to put materials first. Can you expand on that some?

Dr. FOSS. Well, I want to, again, support another witness here—Jonathan's point about the amount of effort that it is going to take to do something like put electric vehicles on the road. This all-of-the-above portfolio, or idea that people walk around with, is very uneven. There are pieces of that that are going to take a very long time to do. There are some things that might take a little bit less time, but generally speaking, we are talking about really, really large changes. We need supporting infrastructure. To put an electric vehicle together, you have to have the raw materials coming into the manufacturing processes to be able to do that. You have to be able to source them. As I said, they have to be the right quality. When you make batteries, purity is a really big deal. You have to be able to deliver them cost effectively. Before the run up in nickel prices this week, automakers were already worried about the cost of nickel—\$30,000 a ton. And everything looks different when you are trying to manufacture EVs. Same thing with copper, with aluminum, with manganese, with cobalt—you name it. There are like 30 different minerals, and those associated industries and processes that we have to pay attention to, which really complicates the picture when, you know—

Senator LANKFORD. It does.

Dr. FOSS [continuing]. We are talking about oil and petroleum fuels, and refining seems so simple in comparison.

Senator LANKFORD. Right.

Dr. FOSS. And they're complicated enough.

So you have to be able to charge EVs. You have to have a power grid to support charging of EVs. If you want to use electric vehicles for demand response, for storage, you have to be able to have the equipment to do that. People have to know how to use the vehicles. There is a whole host of things that has to happen to be able to make it work. But if you cannot get the materials, you are never going to get there.

Senator LANKFORD. Right.

Dr. FOSS. So materials policy is the first place to start.

Senator LANKFORD. And we have already seen China use their ability to be able to limit access to resources to Japan, to Australia, to—they'll cut off a country if they decide they do not like a country at that point. We are extremely vulnerable the more dependent we are on any other nation for our energy production, to be able to make sure that our energy is such that if a nation decides they are going to be upset with us—especially a communist country or an authoritarian government like Russia—is that if they decide they are in a bad mood that day, they murder their neighbors or they cut off people in the supply chain just because they can. That cuts off America.

Dr. FOSS. Most of the minerals we rely on, sir, come from fragile states that we have no ability to deal with, we have no proper responses for, we do not engage with them, they are very difficult to engage with. And trying to influence them and their actions, trying to bring them into the global community is very, very difficult.

Senator LANKFORD. Thank you.

Ms. HIRSTIUS, I want to ask you about crude coming from the Gulf. If we are replacing Russian crude or Venezuelan or Iranian or whatever it may be, there is a lot of conversation about heavy crude versus light/sweet that we are often getting in the United States on land. In the Gulf, we are getting more heavy crude. Can we supply what we need for the blending that is asked for, for our refineries from what is coming from Canada, Mexico, and our own Gulf if we actually tap into those resources?

Ms. HIRSTIUS. Yes, so thank you for the question. Across the U.S. there is a variety of different types of crude that we can process in our refineries. And currently, the setup that we have right now is for the types of supplies that those refineries and those manufacturing facilities have been geared to process. There are changes that can be made within that, but there is an important piece of being able to move product around the country more easily that will help and aid in that total situation.

And maybe just to come back to a question that you asked around the need to continue to produce more oil and gas, and specifically with strong demand needs beyond 2050, I think within that there is an important part to remember that carbon capture sequestration and how we take the carbon that will be emitted from production, and use of oil and gas, which there are many needs that exist beyond just combustion in a car, many products that we are going to need for the future.

Senator LANKFORD. Right.

Ms. HIRSTIUS. We need to make sure that is a robust piece of policy that we have and that we have the tools in place, not from a technical perspective, because technically we know how to do it. This is more from the land usage and overall how the system works and that it can be incentivized to make sure that consumers are acting in a way that is consistent with reducing our need for oil and gas.

Senator LANKFORD. Thank you.

Mr. Chairman, I would just make one comment to our Committee as a whole. Six years ago, we, as a Congress, voted to allow the export of natural gas. This industry that we have, the exporting, is only six years old. It is very, very young in the process, but if we were not exporting natural gas, I cannot imagine what Europe would be facing right now and the pressure they would be facing right now, well above and beyond what they are already facing, with 38 percent of their natural gas coming from Russia. But if we were not exporting natural gas—and we had made that decision six years ago—this day would be even worse than it already is. So I am grateful that we made that decision. We need to make some more long-term decisions that will help our energy future.

The CHAIRMAN. Senator Cantwell.

Senator CANTWELL. Thank you, Mr. Chairman.

The Washington constituents I represent have always paid very high gas prices. We have been in an isolated market, mostly oil coming from Alaska and then refined in our refinery. So all these issues become very interesting, even when we see various impacts—when we have high costs because we are an isolated market and then we have high costs because we are still impacted, even though we are an isolated market. So that is why I am very ardent about trying to diversify off of that vulnerability. At \$4.63 a gallon, my constituents are already, you know, seeing the impacts and so, to me, this is an issue about our challenges in a world market. And this Committee has had lots of hearings about price and what impacts price on a global basis. But clearly, OPEC, even though a country like Saudi Arabia and the UAE have significant swing capacity, they seem to always figure out a way to not be as helpful on this issue.

The top six oil companies made \$90 billion in profits last year. So Mr. Chairman, I believe in getting them in here and getting them to raise their right hand and asking them questions about this issue, which the Energy and Commerce Committees have done before. Maybe we should do a joint hearing and do that.

The CHAIRMAN. I am with that.

Senator CANTWELL. Because I think we find out a lot of answers about what is going on. I will never forget the Exxon Chairman being in front of one of our committees and he basically said yes, there is no reason that oil shouldn't be at \$60, because that is exactly what it costs to produce it plus some. And that was when oil was being manipulated in other markets and he was very concerned about that. They were concerned at \$150 a barrel. They weren't the ones who were making the money, but Wall Street was driving that price up, and it was affecting our economy and ultimately undermined our economy. So I think that these record prof-

its are something to discuss with them as we all try to tighten our belts and try to have an impact on a big sector of the Russian economy.

I know that for us, thousands of dollars to fill up rigs when you are in the transportation business, which so many people in our state are, is also a big concern, and that this is about America's long-term national security. President Bush was brave enough to say this in his State of the Union address 15 years ago, but we are still here in this vulnerable position, making some traction, but not enough traction, to figure out how to get to be really, truly energy independent. As long as OPEC and the cartel can manipulate the world supply, we will definitely have challenges here at home. So to me, that is why I believe that we need to do everything we can to diversify off of the source and move forward.

In reality, President Biden's Administration approved 34 percent more permits for oil and gas in public lands in the first year of office, more than what was done in the Trump Administration. And so to me, I look at it and say, now I have one of the highest install rates of electric vehicles in the country, and instead of filling up at \$4.00 or \$4.50, I can fill up for a dollar a gallon. So that is what my constituents want to see—the reality of that and the reality of moving forward on higher adoption rates. We need to make our gas-powered cars more efficient. We need to make our boats and trucks and planes look at hydrogen. There are so many of these issues that, I believe, Mr. Chairman, we need to move forward on.

But I would like to ask the witnesses a question, because every time we get into one of these areas, and we have been here several times, lots of ideas are thrown on the table. And for the most part, they have nothing to do that is going to affect the price at the pump today. So I just want to bring up a few issues. The Occidental Petroleum CEO said this week that because of challenges like aging wells, labor shortages, supply chain crush, U.S. producers cannot ramp up production even in response to skyrocketing oil prices. Do you agree, Mr. Elkind or Ms. Kenderdine? Do you agree that U.S. production cannot be meaningfully increased, say, by 20 percent or so just to help us in the short-term?

Ms. KENDERDINE. Me?

Senator CANTWELL. Yes.

Ms. KENDERDINE. I think that there is obviously capacity to increase production, but I have been listening to all of this—

Senator CANTWELL. That would affect the price right now?

Ms. KENDERDINE. If you increase production, yes.

Senator CANTWELL. No, would it affect the price right now?

Ms. KENDERDINE. Increasing production would affect the price. I would say that the price of oil is set on global markets. It is not only about U.S. demand. And so—

Senator CANTWELL. So my point about OPEC being the big—

Ms. KENDERDINE. I worked at DOE for eight years in the Clinton Administration and four years in the Obama Administration. I spent a lot of time in OPEC countries. The U.S. oil production—and it is basically shale oil—has diminished the power of OPEC to set global prices, which, I think, is a good thing. But I think that we could fairly rapidly ramp up production in response to demand, and that is how oil and gas prices get set. It is a supply and de-

mand thing. I would say one other thing about high prices. I have been listening to a lot of this. We have had COVID. We have Ukraine. One hundred thirty countries have net-zero targets. So the financial community is very worried about additional investments in fossil fuels around the world. There are a whole lot of things that are creating uncertainty in energy markets right now, and so I am not sure that we can make hard and fast conclusions about what is going on in markets because of that.

Senator CANTWELL. Okay, Mr. Elkind, did you have a comment on that? My time is expired, I guess. I guess I talked longer there on the front end.

The CHAIRMAN. Go ahead, respond, sir.

Senator CANTWELL. Oh, okay, apparently all my colleagues have. So go ahead, let's get an answer on the record on this, this issue about can we really do something today that would affect the price today, or are we just constantly going to be jawboning with OPEC over these issues?

Mr. ELKIND. Senator, I understand Vicki Hollub's comment as being that there is no overnight fix, right? But these are issues that all of the companies, as I understand it, are dealing with and are prepared to, you know, try to respond to. But there are workforce shortages and there are supply chain issues and, yes, there is a capital issue. So overnight change? No. Directional change? Yes.

Senator CANTWELL. Thank you. Thank you, Mr. Chairman. And just to be clear, I believe in the directional change and getting my constituents the \$1.00 per gallon instead of the \$4.00 per gallon. Thank you.

The CHAIRMAN. Thank you, Senator.

Senator Cassidy.

Senator CASSIDY. Thank you, all.

First, I want to say with great pride, I have two of the panelists with strong Louisiana ties, Dr. Michot Foss—I am the only one to put in Michot before your—and you are a graduate of the University of Louisiana. And Ms. Hirstius, a graduate of Tulane. And so just thank you both.

I do not think it is accidental. Louisiana is kind of an epicenter of oil and gas. I say that, by the way, Republicans have now become known as the working-class party. I am very aware that the workers required to develop these rigs have been dispersed because of the downturn in the oil market. And to say just ramp up, just ramp up production, when the workers are now doing something else is just kind of, frankly, standing on the shore and telling the waves not to come in. So I want to credit our workers, but also point out the kind of disingenuousness that you can just reassemble that so quickly.

Second, I think what has been missing in the Biden Administration, I think it is a fair statement, there is a nexus, a nexus between energy, national security, climate, and the economy of a country and the economy of a family. Just to put in a plug for what we have been doing—we just put out yesterday something which should be online on my website that attempts to address that nexus. It is what the five of you have been discussing. And of

course, if you have a chance to look at it, we would love your feedback.

And then now, Ms.—I won't be the only one to stumble over your last name—Ms. Hirstius.

Ms. HIRSTIUS. Hirstius.

Senator CASSIDY. Hirstius. Hirstius. Ms. Hirstius, the crux of this conversation has been: is the regulatory environment of this Administration inhibiting the production of U.S. oil and gas resources, and frankly, the deployment of CCUS capability and other things, the deployment of renewable, et cetera? Is there an inefficient, even hostile regulatory environment? Let me ask you, in the Gulf of Mexico, are you waiting on permits that are preventing you from drilling new wells?

Ms. HIRSTIUS. Thank you, Senator Cassidy. And there are actually three people on the panel who have very close Louisiana ties.

Senator CASSIDY. Who is the third?

Ms. HIRSTIUS [gesturing toward Mr. Elkind]. Married to a Louisianian.

[Laughter.]

Senator CASSIDY. Clearly, he's a social climber.

Ms. HIRSTIUS. Yes.

[Laughter.]

Ms. HIRSTIUS. Let me just reinforce a couple of things that you said. One, you mentioned our workforce and you gave credit to our workforce, and I couldn't be more proud of the people who continue to support our industry. And the Shell employees as well as many other industry employees who have really gone above and beyond through COVID to make sure that we continue producing and operating. So a huge credit to them.

Second is that, on your question about are there things that are inhibiting us to produce—

Senator CASSIDY. No, no, no. Do you have permits right now, before the Federal Government, upon which you are waiting, and until you receive them, you cannot begin to drill?

Ms. HIRSTIUS. So we do have seismic permits that—

Senator CASSIDY. How many of those do you have pending?

Ms. HIRSTIUS. We currently have four seismic permits that we are waiting to get approval on.

Senator CASSIDY. And how long have you been waiting on them so far?

Ms. HIRSTIUS. I don't know exactly the amount of time we have been waiting.

Senator CASSIDY. Ballpark? A week? A month? A year?

Ms. HIRSTIUS. Longer than the normal amount of time.

Senator CASSIDY. And what is the normal amount of time?

Ms. HIRSTIUS. It depends on the size of the survey, but some of this has to do with the environmental—

Senator CASSIDY. But for these particular permits. Help me out. I am running out of time. How long? When would you expect this to be done, and how long have you been waiting?

Ms. HIRSTIUS. I think that there can be a way forward through this—

Senator CASSIDY. You're ducking—I don't know why you won't tell me. And I don't mean to be mean. How long have you been waiting on these permits?

Ms. HIRSTIUS. I don't know the exact amount.

Senator CASSIDY. Got it. And how long would you typically wait on these permits?

Ms. HIRSTIUS. Sometimes seismic permits can take—depending on the size of it—they take different amounts of time and that has to do with the environmental—

Senator CASSIDY. I get that, but what—okay—

Ms. HIRSTIUS. It can take months—one month to six to eight months.

Senator CASSIDY. If you had those permits approved today, how long would it be until you are actually producing oil and gas?

Ms. HIRSTIUS. We have rigs that are on contract, and in a very short period of time we can begin to drill those wells—

Senator CASSIDY. Could you have oil and gas hitting the shores of Louisiana for our refineries within 12 months if you had the permits today?

Ms. HIRSTIUS. We could.

Senator CASSIDY. You could. And do you anticipate getting these permits tomorrow?

Ms. HIRSTIUS. We don't have line of sight to that. We may get one.

Senator CASSIDY. You do not have line of sight to, which is a euphemistic way of saying "no."

Ms. HIRSTIUS. We may get one.

Senator CASSIDY. You may get one out of the four.

Ms. HIRSTIUS. Correct.

Senator CASSIDY. But if you got all four, you could increase it even more. What is the holdup on getting the rest of those approved?

Ms. HIRSTIUS. The holdup has to do with the environmental assessment and the marine mammal life in the area.

Senator CASSIDY. What marine mammal in particular?

Ms. HIRSTIUS. This has to do with whales in the Gulf of Mexico.

Senator CASSIDY. There are not that many whales in the north of Mexico. Is that really what is holding it up? Because I am from Louisiana. There are not that many whales in the Gulf of Mexico.

Ms. HIRSTIUS. That is my understanding.

Senator CASSIDY. And so we are not getting seismic—if you had it, we could have gas being produced in 12 months, but you are not getting it, and you do not know when you are going to get it. Now, I just want to say for the record, when Secretary Granholm says that permits are not a factor here, I think we have an example of where—and by the way, you are being incredibly diplomatic—I suspect you fear retribution, but still, nonetheless, we have a clear example of that.

Let me just quickly say one more thing. Oh, I have one for Dr. Medlock.

Dr. Medlock, there has been a lot of conversation about the profits of the super majors as regards that somehow they are being nefarious by not doing more oil and gas and that is why we have a problem. But it is my understanding that about 90 percent of the

oil that is produced is actually produced by independents—not the super majors, but the Apaches of the world. I have also understood in 2020, about 100 of them went bankrupt. So we have been talking about the role of the investor community, the ESG community that is putting pressure upon the independents with their need for capital. Seeing how they apparently control 90 percent of the production in the U.S., can you comment, as others have, upon the role of the investor community in inhibiting the development of new oil and gas leases by the group of folks that do 90 percent of it, which would be the independents?

Dr. MEDLOCK. Well, it is actually not a simple answer, but the investment community is probably the most powerful arm in determining what future production looks like. Everybody has referred to the pipeline and permits and whatnot that need to be in place so that you could actually develop oil and gas resources and deliver them to market. And that is actually something that needs to be, I think, brought farther up to the surface here because it has been alluded to, but you go back to 2020, all these companies lost a lot of money. In 2021, yes, they made tremendous profits, but they are also dealing with a tremendous amount of uncertainty with regard to what is the future direction of oil. What are the pending legal cases against them? We know, actually, of the Dutch court ruling about Shell and its decarbonization efforts. You look at how that all manifests through concerns about new variants of the pandemic, with IEA actually talking about demand reductions, perhaps, as these new variants actually emerged.

You are talking about operating through an environment that has tremendous uncertainty, and it is very difficult to convince investors to pull the trigger on massive new production options when they do not know whether or not the returns will be there. So that all is incredibly important. It is not as simple as taking a snapshot view of the oil and gas market thinking about production. And you know, the last thing I will say, what you actually have seen over the last year and a half or so is an increase in production in the U.S. alone of over a million barrels a day. So it has not been static. It has actually grown. A lot of that growth has been focused on deploying the “DUCs”—or the drilled-but-uncompleted well inventory. And so a lot of that is quite frankly because the capital is not there to go out and drill the new wells, and there is reluctance to do so because you do not know actually what the near-term brings.

And so we are in a really strange environment, and Russia’s invasion of Ukraine just sort of was the final match that lit the fire to push us well over \$100 a barrel.

Senator CASSIDY. Got you. I yield back and thank you for your indulgence.

Senator WYDEN [presiding]. I thank my colleague.

Before Senator Murkowski leaves, this reminds me of the days when I was Chair and you were Ranker and we were always doing things together and calling a lot of audibles, and that is what is going to happen now.

So I am going to recognize myself and then we will go to Senator Hyde-Smith and we will go to Senator Hickenlooper and then we’ll go to Senator Hoeven, and that will complete the first round, but I gather some of our colleagues would like a second round and we

are just going to keep this thing going. Okay? All right, colleagues, thank you.

I am going to touch briefly on two topics. This week, I introduced a bill that will modernize existing domestic mineral production. And the bill focuses on increasing the domestic supply of critical minerals, reducing our reliance on foreign energy, and supporting domestic manufacturing, which I think we all understand is critical to building the next generation of clean energy products and fueling the kind of red, white, and blue clean energy that we want with good American jobs on American soil. And the heart of my legislation is to turn existing leases—existing leases—into energy-producing sites. If we are going to wean ourselves off foreign oil and gas imports and transition to clean energy—this is a national security issue. It is an environmental issue. I look forward to talking with my colleagues about it in the days ahead, and the legislation was just introduced this week.

The other matter I want to touch on is our Clean Energy for America Act, which passed the Senate Finance Committee, which I chair, some months ago. And there has been a development this week. I just want to briefly describe the bill and talk about the development this week. This legislation was years and years in the making, something that Chairman Manchin and I talked about when he invited me to West Virginia. And what we essentially did is take the 40-some energy provisions in the federal tax code and we threw them in the garbage can. We said, “this is basically about yesteryear.” We need something that rewards innovation, and Senator Manchin and I agreed that one of the keys to the bill was to be technologically neutral. And the reason that made sense is because nobody even knows, decades from now, which will be the best carbon emission reducers.

So let’s give everybody a chance to hit that kind of target—reducing carbon emissions. So the bill is tech-neutral. It is market oriented. And what it does is, it takes that technological neutrality and says, the more you reduce carbon emissions, the bigger your tax savings. All right? The House has advanced it. We are going to advance it here. I would really like to work with all my colleagues on this. And this week, there is a report with fresh evidence on the importance of this legislation. The Rhodium Group, a well-thought-of group of energy analysts, said that these proposals would reduce how much money the United States spends on oil by nearly a quarter, and increase our capacity to export oil by nearly 30 percent, and natural gas by 15 percent. So this is an economic winner. It is an environmental winner. It is a winner for our kids and our grandkids.

So without objection, I am going to put that into the record at this time.

[The Rhodium Group report referred to follows:]

US Policy Options to Reduce Russian Energy Dependence

Russia's invasion of Ukraine has brought into stark relief the national security consequences of European reliance on Russian natural gas and global reliance on Russian oil. Russia accounts for more than a third of all natural gas consumed in Europe and is the second-largest oil exporter in the world, which is constraining US, European, and other allies' responses to Russian aggression in Ukraine. This note outlines specific policy options available to the US government to reduce EU and global dependence on Russian energy, while continuing to reduce greenhouse gas (GHG) emissions.

Key points

The current energy landscape

- **Natural gas:** When it comes to natural gas, Europe needs Russia more than Russia needs Europe. Europe (broadly defined) relies on Russia for 34-38% of its current natural gas needs. Gas plays a critical role in European energy security at present, providing flexible capacity for peak winter heating and industrial production. Gas sales to Europe are a meaningful source of Russian export revenue (accounting for 1.5-1.6% of GDP in 2020 and likely 2.3-2.6% of GDP in 2021) but significantly less important than oil export revenue, which reached 11% of GDP last year. Reducing dependence on Russian gas is critical for European energy security but less likely to on its own compel Moscow to change course.
- **Oil:** Reducing Russian oil export revenue would put greater economic pressure on Moscow but also presents significant risks for oil consumers in the US and elsewhere in the world, with implications for the global economic recovery. Russia exports 7.4 million barrels a day of oil—11% of all internationally traded oil globally. Markets were already relatively tight before Russia invaded Ukraine, and complete elimination of Russian supply—an amount three times larger than Iranian oil exports in 2011 when those sanctions were adopted—would be massively disruptive (as indicated by the recent run-up in global oil prices).

Short-term US policy options

In the coming months, the most pressing priority is to reduce European natural gas demand and identify alternative sources of gas supply. While most of this burden falls on European policymakers, there are concrete actions US policymakers can take to lend support. The US will play a more central role in the effort to reduce Russian oil revenue (and global dependence on Russian oil exports), while limiting the impact on global oil prices through its expertise in administering financial sanctions.

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- **Reducing European dependence on Russian gas:** Options for delivering large-scale reductions in European gas demand over the next 6-9 months ahead of the 2022/2023 winter heating season are largely limited to a) redirecting existing LNG supply from other parts of the world to Europe, b) maximizing the use of existing non-gas power generation resources, and c) implementing an aggressive demand response program. Some of these measures may increase GHG emissions, but the effect will be small (less than 0.1% of total global emissions) and temporary. The US can help support European efforts through diplomatic engagement with LNG importers, by providing manufacturing and technical support for a widespread European demand response campaign in buildings, and by ensuring that gas-price driven reductions in European industrial production have as limited an economic and national security cost as possible.
- **Reducing Russian oil revenue while minimizing global price risk:** US policymakers have a more central role to play in efforts to reduce Russian oil revenue at as little cost as possible to consumers in the US and around the world. The US ban on oil imports from Russia currently being considered in Congress would have a modest impact—both on Russian revenue and global oil prices—as the US only accounts for 9% of Russian oil exports. Were Europe to follow suit the impact (and risk) would be much larger—more than half of Russian oil exports go to Europe, with a large share being shipped by pipeline (and thus harder to quickly replace). The most important role for US policymakers in the weeks and months ahead is to steward the new sanctions regime, leveraging the Treasury Department's deep sanctions expertise, including implementation of the 2011-2015 Iranian oil sanctions. There are important differences between that situation and the current crisis, but the Iran sanctions playbook still has a lot to offer on how to effectively reduce Russian oil export revenue while limiting the increase in global oil prices.

Medium-term US policy strategy

While short-term options to reduce dependence on Russian energy are largely limited to the redirection of existing supply and reductions in demand, investments in new energy capacity starting today can substantially improve the options available over the next 5-10 years. Here the most attractive US policy options for reducing dependence on Russian energy will also reduce GHG emissions, helping both the US and Europe stay on track to meeting their international climate commitments.

- **Reduce US oil and gas demand to reduce economic vulnerability and diversify European supply:** Accelerating clean energy deployment reduces US economic vulnerability to supply disruptions in Russia or elsewhere in the world and frees up oil and gas for export to Europe and other allies. For example, [in our modeling](#) of a policy pathway to the US's 2030 climate target—a combination of federal clean energy tax incentives and grant programs, and additional actions by the executive branch and subnational actors—we find significant associated energy security benefits. US oil expenditures fall by up to 24% by 2030 compared to current policy, and US oil and LNG exports increase by up to 29% and 15% respectively.
- **Scale US production of emerging low-carbon alternatives to Russian oil and gas:** Providing Europe and other countries with alternative sources of oil and gas will only go so far in reducing Russian economic leverage. There are a number of options available to US policymakers to significantly accelerate the research, development, demonstration and deployment of the low-emissions technologies that will be most effective in substantially reducing European dependence on Russian gas while still meeting their climate commitments. These include technology investments in hydrogen, sustainable aviation fuels, long-duration electricity storage and advanced battery technology, and manufacturing and deployment incentives to get these technologies to scale.

- **Directly support an accelerated energy transition in Europe:** Alongside investments in scaling the production of key low-emissions technological alternatives to Russian oil and gas in Europe, the US can directly support the export and installation of those technologies. This can include grant programs, loan guarantees, technical assistance and trade and project finance—a Marshall Plan of sorts for energy. This could be particularly important if the current confrontation with Russia proves economically costly for Europe and limits their ability to entirely self-finance their own energy transition.
- **Use the anti-Russia coalition to secure critical material supply chains for a low-carbon economy:** While in general, low-carbon alternatives to current oil and gas markets provide more price stability and economic security, new clean energy technologies do come with some of their own security risks given their reliance on critical minerals like lithium, cobalt and nickel. Diversifying global supplies of these critical minerals over the next few years will be crucial to securing the clean energy economy. The current coalition of countries countering Russian aggression in Europe is an excellent group to develop a coordinated international strategy, once the immediate crisis has passed.

The current energy landscape

There are two ways in which Russia's role as a global energy supplier is factoring into the calculus of policymakers in Washington, Brussels, and allied capitals around the world as they respond to Russia's invasion of Ukraine. The first is offensive: Russia's reliance on energy export revenue gives the West a weapon to pressure President Vladimir Putin (through import bans, energy sanctions, etc.) to withdraw from Ukraine and/or limit further aggression in Europe. The second (and inverse) is defensive: global dependence on Russian energy exports gives Moscow a weapon it can use in its campaign of aggression, threatening energy security in Europe and economic stability around the world. The balance of opportunity (offensive action) and risk (defensive considerations) varies across fuels, and between the short and medium term.

Natural gas: Europe needs Russia more than Russia needs Europe

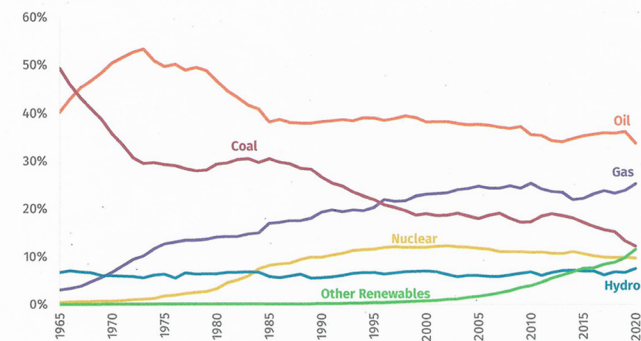
The importance of natural gas in the European¹ energy system has grown in recent decades, in response to a decline in the use of coal and, to a lesser extent, nuclear power (Figure 1). Gas now accounts for one-quarter of total European energy supply, but plays a far greater role in European energy security than that statistic suggests. Gas provides almost all flexible seasonal energy supply to meet peak winter heating demand in homes, offices, schools, and stores, particularly in Northern Europe (Figure 2). It is a major fuel source for European industry as well, which also experiences peak demand during the winter.

Russia is the single largest supplier of natural gas to Europe, accounting for 57% of total imports and 34% of total European gas supply in 2020 (and 40% in EU member states). That share has held relatively constant over the past two decades. Russian gas is delivered to Europe primarily by pipeline (91% of all Russia-Europe gas trade in 2020) as opposed to the more flexible LNG market. This further complicates Europe's ability to rapidly shift away from Russian gas if there is a large and sudden disruption in supply. Even before Russia invaded Ukraine, Europe was experiencing something of a natural gas supply crisis. A cold winter in 2020, a rebounding economy after the COVID recession, lower than usual Russian deliveries, and increased LNG competition from Asia put a strain on European gas storage going into the 2021/2022 winter heating season. By the fourth

¹ In this note, unless otherwise specified "Europe" is defined broadly as the European members of the OECD plus Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Cyprus, North Macedonia, Georgia, Gibraltar, Malta, Montenegro, North Macedonia, Romania, and Serbia.

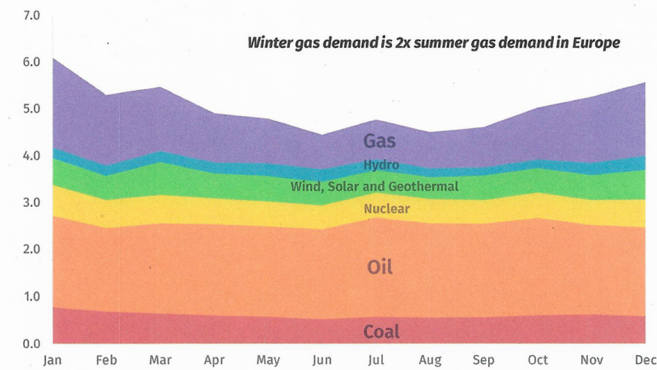
quarter of last year, European natural gas was trading at well over €75 per MWh (\$24 per MMBTU) in futures markets, sharply above the sub-€30 prices experienced for the past ten years. The increased risk of supply disruption from Russia's Ukraine invasion has caused price spikes above €200 per MWh, with futures prices reaching €265 per MWh on Monday (\$85 per MMBTU).

FIGURE 1
European total primary energy consumption by fuel
Percent of total



Source: BP statistical review. Europe here includes European members of the OECD plus Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Cyprus, North Macedonia, Georgia, Gibraltar, Malta, Montenegro, North Macedonia, Romania, and Serbia.

FIGURE 2
EU-27 energy consumption by month in 2019
Exajoules



Source: Eurostat, BP statistical review, and Rhodium Group estimates.

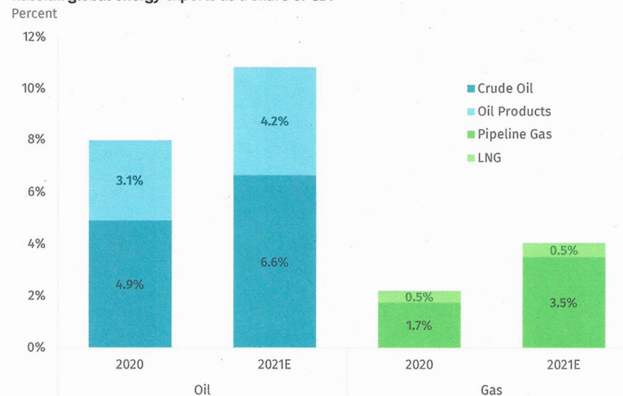
Gas exports are important to the Russian economy, but not as important as they are to European energy security. According to the Central Bank of Russia (CBR), the country earned \$32 billion exporting natural gas (both pipeline and LNG) in 2020, down from \$49 billion in 2019. Sales to Europe likely accounted for between two-thirds and three-quarters of that total—or 1.5-1.6% of Russian GDP. Based on Q1-Q3 data from the CBR and oil and gas price trends during Q4 of last year, we estimate that total Russian gas export revenue rose to \$67 billion in 2021, the highest annual total since 2013. That likely puts Russian gas exports to Europe at 2.3-2.6% of GDP in 2021. Losing that revenue would certainly not be painless for Moscow, but it is relatively modest in comparison to Russian oil revenue (see the next section). Therefore, for gas we see defensive considerations (how to protect Europe from Russia using gas supply as a weapon) as more important than offensive considerations (Europe proactively halting Russian imports to coerce Putin to change course).

Oil: Greater costs for Russia, but also for the rest of the world

Russia is the world's second-largest oil exporter at 7.4 million barrels per day in 2020—just behind Saudi Arabia at 8 million barrels per day. That's 11% of all internationally traded oil globally. In 2020, Russia earned \$118 billion on its oil exports, according to the CBR, or 8% of GDP. Of this, 62% was crude oil and 28% refined petroleum products (Figure 3). We estimate that in 2021, Russian oil export revenue grew to \$180 billion, or 10.8% of GDP.

Given that oil exports are four times more important to the Russian economy than gas, a coordinated offensive effort by the US and its allies to reduce Russian oil exports could put considerable economic pressure on Moscow. But it also comes with significant economic risk for both Europe and the rest of the world. Global oil markets were already relatively tight ahead of Russia's invasion of Ukraine, as post-COVID demand recovered faster than supply, and inflation in the US is at its highest level since the early 1980s.

FIGURE 3
Russian global energy exports as a share of GDP



Source: Central Bank of Russia, IMF and Rhodium Group estimates

Fully removing Russia's 7.4 million barrels a day from the global market would be massively disruptive. For a sense of scale, Russia exports almost as much oil as the overall drop in global oil

demand in the first year of the COVID-19 pandemic—a period when airline and passenger vehicle travel were severely constrained and the global economy was in a deep recession. The ability to significantly increase supply elsewhere in a matter of months is limited. Total OPEC spare production capacity [had fallen](#) to 5 million barrels per day by the end of 2021, with analysts projecting it would continue to decline prior to Russia's invasion of Ukraine. The International Energy Agency (IEA) and Energy Information Administration (EIA) both expect US oil production to increase by more than 1 million barrels per day this year, but much of that is needed to meet expected pre-Ukraine global demand growth. There is the potential for Iranian sanctions relief, but that will only add another 1 million barrels at most to the global market. As a result, [some analysts](#) are starting to project crude oil prices reaching between \$150 and \$200 a barrel this year if the increase in Russian economic isolation continues. Every \$10 increase in oil prices costs global oil consumers nearly \$400 billion a year on an annualized basis, so that kind of run-up would impose significant costs on the global economic recovery.

Don't forget coal

While oil and gas are Russia's most important energy exports, the country is also an important coal exporter, particularly to Europe. In 2020, imports of Russian coal accounted for just over 20% of European coal consumption. While Europe has more short term-options for replacing Russian coal than gas (or oil shipped from Russia via pipeline), the fact that this import source could also be under pressure just further complicates Europe's energy picture.

Short-term policy options

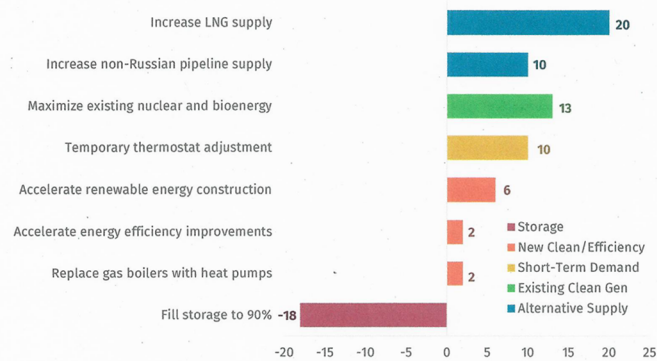
In the coming months, Europe and US policymakers have two overarching energy priorities. The first is to reduce European consumption of Russian gas as fast as possible to protect European citizens and the European economy as much as possible from a potential disruption in Russian supply. The second is to reduce Russian oil revenue (and gas as well if Europe can reduce demand enough) in a bid to persuade Moscow to change course, while limiting the resulting increase in global oil prices. Given the short time horizon for both, most solutions will have to rely on redirecting existing assets (such as LNG or crude tankers currently headed elsewhere in the world) or increasing output from existing assets (e.g. by keeping nuclear power plants online). Some of these solutions will reduce GHG emissions, some will increase emissions. Either way, the effect will be relatively small and temporary, as time is too short for the kind of large-scale infrastructure investment that locks in energy pathways for years to come. This section focuses on the short-term policy options available to the US specifically. We then turn to discussing medium-term options where there is a more natural alignment between policies that reduce Russian energy dependence and GHG emissions.

Reducing European reliance on Russian gas

Fortunately, the coldest months of winter are behind us and, as a result, European gas demand is starting to decline. That gives European leaders—and US policymakers looking to provide support—6-9 months to take aggressive steps to reduce gas demand and diversify gas supply before the next winter heating season. Last week, the IEA [published a 10-point plan](#) for how the EU could potentially reduce Russian gas imports by one-third over the coming year. Of the interventions they identify, half of the potential savings come through alternative sources of gas supply. The IEA estimates that the EU could potentially increase LNG imports this year by up to 60 bcm (which would by itself reduce Russian imports by one-third), but that due to limited available short-term supply in the global LNG market, the most the EU could hope to secure is 20 bcm (Figure 4). Another 10 bcm could potentially come from increasing pipeline imports from non-Russian suppliers. The next largest category of intervention—at 13 bcm—is to ramp up production of (or delay the closing of)

existing nuclear and bioenergy power plants. Temporary demand response measures (in this case reducing thermostats by 1 degree Celsius) could deliver an additional 10 bcm in savings. Due to the lead times involved in building new clean energy generation or reducing demand through efficiency and end-use electrification investments, the IEA estimates these categories combined would likely deliver only 10 bcm of savings in the short term. On top of these measures, the EU also plans to resupply gas storage from currently low levels, which the IEA estimates will require an additional 18 bcm.

FIGURE 4
Short-term interventions identified by the IEA
Annualized reduction in Russian gas imports, BCM



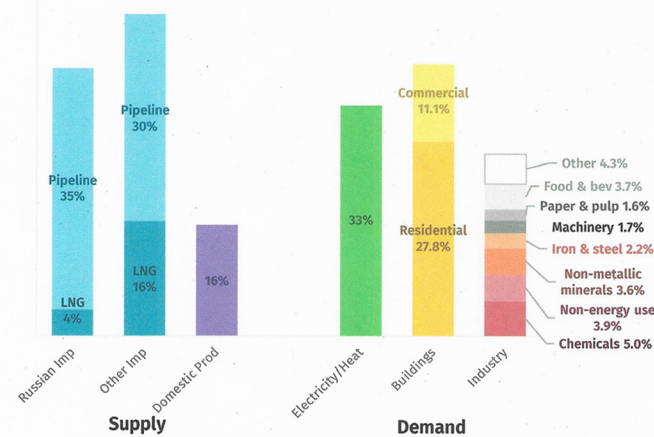
There are additional interventions the IEA didn't consider. Europe could increase generation from existing coal-fired power plants, though coal prices are rising quickly as well, given European reliance on imports from Russia. The EU Emissions Trading System also impacts the relative economics of coal vs. natural gas, though allowance prices have fallen over the past few weeks. More promising is the potential for additional demand response measures beyond the 1 degree C° reduction in thermostat levels explored in the IEA report. Much of this can come from buildings, which accounted for almost 40% of European gas consumption in 2019 (Figure 5). The gas savings benefits of demand response apply both to heating demand (which is met with both gas and electricity) and cooling demand (which is met entirely with electricity), given that gas is a significant source of electricity generation in Europe. Demand response needs to begin immediately to maximize gas storage builds ahead of the next winter heating season.

In theory, currently record-high natural gas prices in Europe would on their own drive large-scale demand response measures. Evidence suggests, however, that European household heating and cooling demand is relatively unresponsive to price increases over the short term. This is due to several factors. First, households generally receive their power and gas bills weeks after demand occurs. Second, fixed transmission and distribution costs account for a large share of total utility bills, which weakens the price signal of variable energy costs. Third, regulatory structures in retail electricity and natural gas markets often mitigate direct passthrough of wholesale energy price changes. As a result, proactive policy is required. Smart thermostats give utilities the ability to

directly control building energy demand and are quicker, cheaper, and easier to install than efficiency retrofits or electric heat-pump installations. Europe could launch an aggressive campaign to procure and distribute smart thermostats, focusing on the most gas-intensive parts of the continent. While quicker than other demand-side measures, it will still take time to roll smart thermostats out at scale. European policymakers will therefore likely need to complement this technological approach with an aggressive public awareness campaign encouraging households and businesses to cut consumption.

The other option for demand response is in industry, which accounted for 26% of European gas demand in 2019. The majority of industrial gas demand comes from the production of energy-intensive materials: chemicals (both energy use and non-energy feedstock), iron and steel, cement, lime, glass, paper, and pulp. These sectors are far more price-sensitive than gas consumers in the buildings sector. They pay close attention to spot prices, wholesale energy costs account for a larger share of their utility bills, and they operate in competitive global markets with limited ability to pass region-specific energy price increases onto consumers. European energy-intensive industrial production is already declining in response to higher gas prices, a trend that will accelerate if Russian gas supplies are disrupted. Leaving this to market dynamics alone could have significant negative consequences—beyond the economic and employment costs of European industrial closures. Russia is also a major exporter of a range of energy-intensive products, so a decline in European manufacturing could leave Europe—and the world—more dependent on Russian supply. European policymakers could get ahead of this by working with industry to idle production in less economically and national security-sensitive sectors, and by providing fiscal compensation for lost revenue where appropriate.

FIGURE 5
European gas supply and demand
Percent share of total, 2019



Source: IEA, Eurostat, BP and Rhodium Group estimates

Europe's success in reducing Russian gas demand this year will primarily depend on the actions of policymakers in Brussels and member-state capitals, but Washington can play an important supporting role.

- ***Diplomatic engagement on LNG*** Natural gas remains relatively abundant in the US (as evidenced by the more than 10x difference between US and EU spot gas prices currently). Existing US LNG export capacity is completely maxed, however, and it takes years to build new terminals, so US supply offers no short-term relief. Getting additional LNG into Europe will require redirecting existing LNG shipments from other markets. The US has an important role to play in supporting European diplomatic efforts in identifying redirection opportunities among allied countries that reduce Russian leverage with minimal economic damage to LNG importers elsewhere in the world. Most LNG exports go to Asia, and there might be short-term opportunities for Asian importers to use other fuels for power generation instead of LNG. If Japan were able to restart some of its nuclear reactors, this switch would reduce emissions. If Japan, Korea, India, or China switch from LNG to coal or oil, it will lead to an increase in emissions, but it would be relatively small and temporary. Citigroup estimates that if all excess coal and oil power generation capacity in LNG-importing countries is deployed this year, it could free up to 70 bcm of LNG supply. In this scenario, we estimate that global emissions would increase by roughly 50 million metric tons. That's less than 0.1% of global GHG emissions, and will be more than offset by the impact of higher oil prices this year due to Russia's invasion on global oil demand and resulting emissions.
- ***Demand response support*** The US government has an important role to play in supporting European demand response efforts. The Department of Energy and national labs have deep technical expertise that can be shared with European policymakers. The US government can also help support a smart thermostat installation campaign in Europe by working with US manufacturers to ramp production, and by potentially redirecting existing supply from US markets.
- ***Energy-intensive industrial coordination*** The US government should also, in partnership with other allies, support European governments in focusing industrial demand response on the least economically and national security damaging areas. This could include identifying industries where the US has the potential to quickly ramp production to offset declines in European output, and providing financial support to help offset short-term economic losses in Europe from idled factories.

Reducing Russian oil revenue while minimizing global price risk

There are two direct mechanisms through which US policymakers can reduce Russian oil export volumes this year:

1. Ban imports of Russian crude oil and/or refined product into the US and work with other countries to do the same.
2. Extend sanctions to cover Russian crude and/or refined product exports, with the threat of secondary sanctions for countries and companies that continue to buy Russian oil.

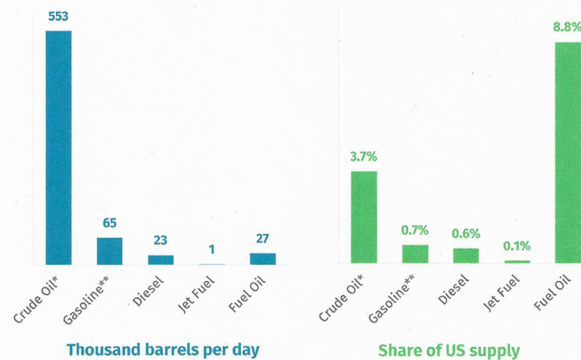
Both carry considerable oil price risk, with the potential to impose significant costs on households and businesses in the US and around the world. That could not only threaten the current global economic recovery, but also undermine public support for countering Russian aggression. The worst-case scenario is one in which import bans or sanctions increase oil prices enough to more than offset the decline in Russian export volumes, overall Russian export revenue increases as a

result, and securing additional LNG supply is made more difficult because high oil prices make it tougher for other LNG importers to switch. Thoughtful design and implementation is required.

Import ban considerations

Over the past week, a growing number of members of Congress [have called for legislation](#) that would ban the importation of Russian energy into the US. The US does not currently import any natural gas from Russia and only imported two tons of coal in 2021 according to the Energy Information Administration (EIA), so this would primarily impact oil. The US imported 670,000 barrels per day of crude oil and refined product from Russia in 2021, accounting for 9% of Russia's net export total. Most of this was crude oil or a semi-finished oil product call Mazut that is used as a refinery input and alternative to heavy crude from Venezuela. This accounts for 3.7% of total crude oil used in the US (Figure 6). The US imports some finished petroleum product from Russia, but this amounted to less than 1% of domestic supply in 2021.

FIGURE 6
US imports of Russian oil, 2021
Thousand barrels per day (left) and share of total supply (right)



Source: EIA. * includes semifinished "Mazut" used as a refinery input. ** includes gasoline blending agents.

Both US refineries and the global oil market should be able to accommodate a US ban on Russian oil imports without too much disruption. The adjustment costs would be concentrated in the US refineries currently using Mazut and can be mitigated through proactive outreach to alternative suppliers. Such outreach appears to already be occurring, with [news over the weekend](#) that the Biden administration is sending a delegation to Venezuela.

The bigger risk with a US import ban is that it could threaten the close coordination between the US and Europe in countering Russia that has occurred to date, if European policymakers feel pressure to follow suit but cannot move as quickly due to their substantially greater dependence on Russian oil. While only 9% of Russian oil exports go to the US, more than half goes to Europe. Russian crude accounts for 25% of all crude used in European refineries (compared to less than 4% in the US) and imported Russian gasoline, diesel and other refined product accounts for roughly 10% of European refined product demand. About one-quarter of Russian crude exports to Europe

are shipped via the [Drubzha pipeline](#), making it more difficult to quickly replace than seaborne shipments. There is also a non-zero risk that Moscow could retaliate against a European ban on oil imports with an immediate cut-off of gas exports, before Europe has had time to reduce demand and secure alternative sources of supply. Given all this, it's important that an oil import ban in the US be closely coordinated with allies in Europe, [as appears to have begun happening](#) over the weekend.

Sanction considerations

The US federal government is now quite experienced in the effective design and implementation of financial sanctions, including against major oil-exporting countries. At the end of 2011, Congress [passed an amendment](#) to the National Defense Authorization Act that required the US Treasury Department to sanction the Central Bank of Iran, in an attempt to force the Iranian government to abandon its nuclear weapons program. At the time, Iran was the third-largest net oil exporter in the world, after Saudi Arabia and Russia, at 2.7 million barrels per day. When the sanctions were adopted, oil prices were around \$135 a barrel in today's dollars and OPEC spare capacity was very low. Then, as now, there was considerable concern among US policymakers that cutting off Iranian exports through sanctions would spike global oil prices and threaten the still-fragile economic recovery that was occurring at the time.

To address these concerns, Congress included in the sanctions regime a phased approach for oil. Oil transactions were only subject to sanction if the Treasury Department determined that a) the importing country had sufficient alternative supplies, and b) the country had not taken steps to significantly reduce its purchase of Iranian oil. This proved a largely successful strategy, both in limiting the risk to global oil prices and maintaining a broad coalition behind the sanctions. Iranian net exports fell from 2.7 million barrels per day in 2011 to 2.05 in 2012, to 1.73 in 2013—giving the market time to adjust. Iranian revenue declined even faster. As the number of buyers willing to buy Iranian oil declined, those buyers were able to negotiate steep discounts on the crude. This decline in revenue played an important role in persuading Tehran to agree to the 2015 Joint Comprehensive Plan of Action (JCPOA) with the US, Europe, and other allies.

There are a number of important differences between the Iran sanctions experience and what the US now faces with Russia. First, Russia exports nearly three times as much oil as Iran did in 2011, so the same percent reduction in exports could have a much larger impact on global oil prices. Second, Russia sells most of its oil in the spot market, compared to Iran which relied more on long-term contracts. Third, Russia is a large exporter of refined products as well as a crude exporter, while Iran exported mostly crude. And fourth, the high-profile conflict in Ukraine is creating significant reputational risk for Western companies buying Russian oil, even if there are no sanctions preventing them from doing so.

Indeed, though [the sanctions](#) the Treasury Department imposed on the Central Bank of Russia on February 28 explicitly exclude energy, there have been news reports over the past week that Russian companies are struggling to find buyers for their spot cargoes, with storage filling quickly and a reduction in production likely to occur in the weeks ahead unless conditions change. This is likely due in part to uncertainty about the scope of the new sanctions regime (the Treasury put out [a Q&A on this question](#) last Friday) as well as reputational concerns among European oil companies in particular (see the [criticism](#) Shell recently received for buying Russian barrels).

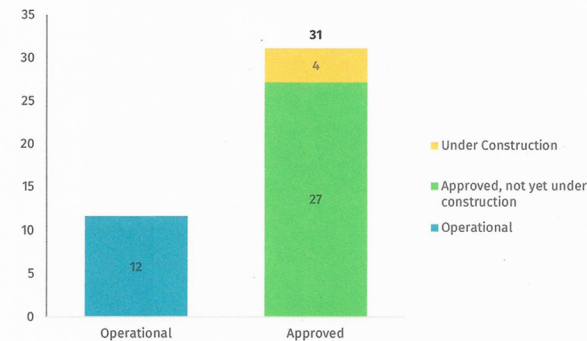
The good news is that the difficulty in finding buyers has already resulted in a steep discount in the price of Russian crude relative to global oil prices. The trick for US policymakers is to implement the sanctions regime in a way that maintains this price discount, but does not lead to a decline in overall Russian export volumes faster than the market can handle.

Medium-term strategies

While the primary focus of US policymakers is, correctly, how to most successfully reduce dependence on Russian energy and minimize price increases over the coming year, it's important to begin considering medium-term strategies as well. The current crisis is demonstrating how vulnerable European energy security and the global economy is to Russian supply disruptions, and how hard it is to find large enough substitutes in a short period of time. Those large-scale substitutes take time to build, but are available with focused policy attention starting now.

Undoubtedly part of any medium-term reduction in global dependence on Russian oil and gas will come from an increase in US oil and gas production. That will start to occur this year as US oil production growth accelerates in response to higher oil prices. With increasingly tight global gas markets, US LNG capacity will continue to expand. While these are both important, they require relatively little policy attention. Most shale production occurs on private land, with relatively easy access to domestic refineries and export capacity. New LNG export terminals require approval by the Department of Energy and the Federal Energy Regulatory Commission (FERC), but all credit-worthy terminals have been approved, under both Democratic and Republican administrations. Indeed, there are [15 fully approved export terminals](#) projects that have yet to commence construction representing 27 billion cubic feet per day (bcf/day) of expanded capacity (or 278 bcm). Add in nearly 4 bcf/day of capacity currently under construction and US export capacity is on track to expand by nearly three-fold just from projects already approved. At a combined 443 bcm, this would be more than double current European imports from Russia (Figure 7).

FIGURE 7
US current operating and approved liquified natural gas export capacity
 Billion cubic feet per day



Source: EIA.

What requires more policy focus is the development and deployment of technologies that reduce both dependence on Russian energy and GHG emissions. This is critical in Europe, where there is strong and broad-based public support for addressing climate change. Continued American action on climate change is also essential for the credibility of US leadership globally, particularly in a world where we are competing with Russia for influence. Finally, left unchecked, climate change will introduce myriad new threats to the security of both the US and allied countries, all while increasing

Russian economic strength and influence. Recent research suggests that Russia is one of the few countries that stands to potentially gain from climate change, whether through [higher rates of economic growth](#), [reduced mortality rates](#), [increased agricultural production](#) or [improved shipping routes](#).

In this section, we offer a four-part framework for policy that will significantly reduce US and European dependence on Russian energy and reduce global GHG emissions between now and 2030.

1. Reduce US oil and gas demand to reduce economic vulnerability and diversify European supply

Growth in US oil production over the past decade has mitigated the overall cost to the US economy of global oil price spikes like the one currently occurring, but price spikes still have important distributional effects. Increases in global oil prices are positive for American oil companies, employees, and states and localities dependent on oil-related tax revenue. But since the price Americans pay at the pump is still determined by global market dynamics, price spikes impose significant costs on households, businesses, and states and localities outside the oil patch. Price spikes are particularly difficult for low-income and rural households who spend a larger share of their income on gasoline.

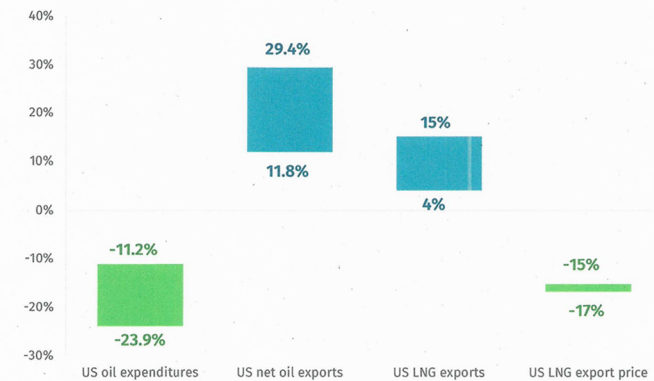
Policies that reduce US oil demand through the development and deployment of alternative transportation technology like electric cars and hydrogen trucks mitigate these costs. They shield US consumers from oil price spikes and free up additional US oil supply for export that can substitute for Russian supply.

For example, [in our modeling](#) of our “Joint Action” policy scenario—federal clean energy tax incentives and grant programs, combined with additional actions by the executive branch and subnational actors, which together can put the US within striking distance of its 2030 climate target—we find significant associated energy security benefits. Thanks to accelerated deployment of vehicle efficiency and electric and hydrogen vehicle technology, fueled in large part by grant programs and tax credits like those contained in the Build Back Better Act (BBBA), by 2030 the amount American households and businesses spend on oil products declines by 11-24%, depending on how renewable energy and electric vehicle costs evolve and uncertainty in the domestic oil and gas resource base (Figure 8). Lower demand frees up more oil for export, with net crude and refined product exports expanding by 12-29% by 2030 relative to current policy. BBBA tax credits and grant programs accelerate renewable energy deployment, retention of at-risk nuclear plants, and improved building efficiency. All of these shifts reduce US natural gas consumption, freeing up additional gas for export to Europe or elsewhere. By 2030, US LNG export volumes are 4-15% higher than under current policy, and LNG export prices are 15-17% lower. All told, US consumer exposure to fossil fuel price volatility based on fuel expenditures as a share of GDP drops by 11-15% compared to current policy in 2030.

FIGURE 8

Change in key US energy security metrics in 2030 under the Joint Action scenario

Relative to current policy. Range reflects uncertainty in oil and gas resource base and renewable energy and EV vehicle costs.



Source: Rhodium Group. Our Joint Action policy scenario is detailed in our report, [Pathways to Paris: A Policy Assessment of the 2030 US Climate Target](#).

2. Scale US production of emerging low-carbon alternatives to Russian oil and gas

Providing Europe and other countries with alternative sources of oil and gas will only go so far in reducing Russian economic leverage. As long as Russia is connected to the global oil and gas market, Moscow will have the ability to impact the prices that both Europeans and Americans pay at the pump. And meeting global climate goals will require considerably reducing overall oil and natural gas consumption in the decades ahead. There are a number of options available to US policymakers to significantly accelerate the research, development, demonstration, and deployment of the low-emissions technologies that will be most effective in substantially reducing European dependence on Russian gas, while still meeting their climate commitments.

The US is already off to a strong start on this front. The enactment of the bipartisan Infrastructure Investment and Jobs Act (IIJA) devotes tens of billions of dollars in new programs to advance clean alternatives to natural gas and oil. These include \$9 billion for hydrogen hub demonstration projects and research to cut the cost of producing clean hydrogen through electrolysis (Table 1). Enactment of policies like those contained in the climate portions of the BBBA will put in place a suite of new policies that have the potential to greatly accelerate the innovation of a number of clean energy technologies that could reduce US and European reliance on natural gas and oil. These include tax credits for the production of sustainable aviation fuel, clean hydrogen, and the construction and expansion of US manufacturing of clean energy equipment. There are new programs to accelerate building electrification and heat pump deployment. New programs that reduce the cost of using clean hydrogen in industrial facilities and increase the US government's use of clean fuels can also drive down the cost of these technologies and facilitate uptake in Europe. The same goes for policies that scale electric heat pump manufacturing and deployment.

Some of these policies directly support production of these technologies in a way that will lower costs and increase supply for Europe (e.g. manufacturing tax credits and demonstration projects). Others (including those discussed in point 1 above) do so implicitly by driving deployment in the US that helps build out a lower cost, larger-scale manufacturing base and supply chain.

TABLE 1

Select policies that can expand oil and natural gas substitute technologies to Europe

Policy	Description	Fuel displaced	Status
Hydrogen Hubs	\$8 billion for demonstration projects that expand supply and use of clean hydrogen	Oil and natural gas	Enacted as part of IIJA
Clean Hydrogen Electrolysis Program	\$1 billion for tech that cuts the cost of H2 from clean electricity	Oil and natural gas	Enacted as part of IIJA
SAF production tax credit	Tax credit of up to \$1.75/gallon for clean aviation fuels	Oil	Currently in BBBA
H2 production tax credit	Tech neutral clean H2 production incentive of up to \$3/kg for cleanest producers	Oil and natural gas	Currently in BBBA
Manufacturing conversion grants	\$3.5 billion to convert facilities to manufacture fuel cell vehicles	Oil	Currently in BBBA
Clean manufacturing tax credit	48C tax credit for investments in clean energy equipment manufacturing include H2	Oil and natural gas	Currently in BBBA
Building efficiency and electrification	\$12.5 billion in consumer rebates for home efficiency and heat pump installation	Natural gas	Currently in BBBA
H2 retrofit grants	Investments to cut the cost of retrofitting industrial facilities to use clean H2 instead of fossil fuels	Oil and natural gas	Not currently in legislation
Federal clean H2 procurement	Federal government purchase of clean H2 for civilian and military use	Oil and natural gas	Not currently in legislation

Source: Rhodium Group. Note: List is not intended to be comprehensive.

3. Directly support an accelerated energy transition in Europe

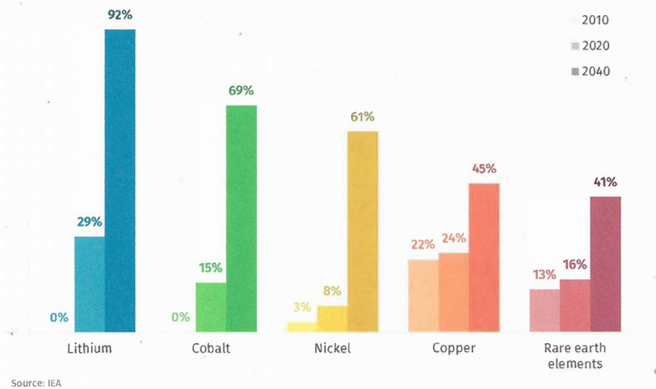
Alongside investments in scaling the production of key low-emissions technological alternatives to Russian oil and gas in Europe, the US can directly support the export and installation of those technologies. On February 28, Reps. Slotkin (MI-08) and Fletcher (TX-07) [introduced a bill](#) that would provide funding to the Department of Energy to support the development, export and installation in Europe of US technology that can reduce European dependence on Russian energy. The US Export-Import Bank and Development Finance Corporation also have potentially powerful roles to play in helping to finance large-scale deployment of US-made, low-emissions alternatives to Russian oil and gas in Europe—a Marshall Plan of sorts for energy. This could be particularly important if the current confrontation with Russia proves economically costly for Europe and limits their ability to entirely self-finance their own energy transition.

4. Use the anti-Russia coalition to secure critical material supply chains for a low-carbon economy

While in general, low-carbon alternatives to current oil and gas markets provide more price stability and economic security, new clean energy technologies do come with some of their own security risks. For example, lithium, nickel, cobalt, manganese and graphite are critical minerals used to manufacture large batteries used in electric vehicles and grid storage. The IEA estimates that as part

of a low-carbon transition, clean energy technologies will account for 92% of global lithium demand by 2040, 69% of global cobalt demand, 61% of global nickel demand, 45% of global copper demand, and 41% of global rare earth element demand (Figure 9). Russia is a major producer of cobalt, nickel, and copper. Diversifying global supplies of these critical minerals over the next few years will be crucial to securing the clean energy economy

FIGURE 9
Share of clean energy technologies in total demand for selected minerals
 Global, 2010-2040, Sustainable Development Scenario



The US government [has begun](#) work on this through investments in new domestic production. That effort needs to be expanded to include key allies. The current coalition of countries countering Russian aggression in Europe is an excellent group to develop a coordinated international strategy. That work should begin in earnest as soon as the immediate crisis has passed.

Disclosure Appendix

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Senator WYDEN. And the order for the completion of the first round will now be our colleague from Mississippi, Senator Hyde-Smith, and Senator Hickenlooper would be the next to follow—I hope he can return, and then Senator Hoeven.

Senator Hyde-Smith.

Senator HYDE-SMITH. Thank you, Mr. Chairman, and I want to thank all of our witnesses today. You have done a tremendous job and this is long and enduring, but I certainly appreciate your willingness to come and testify before the U.S. Senate. That says a lot about you.

Long before Putin ever invaded Ukraine, last fall—and this is for you, Dr. Medlock—President Biden finally began recognizing the high gasoline prices paid by families and businesses last fall. But instead of increasing production here at home, the President blamed U.S. energy companies, OPEC, and Russia for weeks before releasing 50 million barrels from the Strategic Petroleum Reserve, or about two and a half days' worth of U.S. consumption. Last Tuesday, the President again, instead of increasing U.S. production, announced another release of 30 million barrels.

Dr. Medlock, briefly, what is the short- and the long-term impact we can expect from pulling from the Strategic Petroleum Reserve?

Dr. MEDLOCK. Well, use of the SPR is actually warranted, I would argue in this case. So it is a stopgap measure. It is really meant to bridge the very near-term needs of the marketplace to sort of help quell price hikes and volatility. But longer term, there does need to be an increase in production because, you know, absent that, you can deplete the SPR very quickly and then where are you? So it is really a short-term mechanism. It is a classic inventory withdrawal sort of discussion.

Senator HYDE-SMITH. So do you believe it is wise and in the best interest of our national security to repeatedly return to the emergency stockpile just to lower gas prices for just a few days?

Dr. MEDLOCK. Well, the impact in terms of a few days, it is really wise to use it to help bridge the gap until you can actually get new production online, because at the end of the day, if you are going to use inventory, as an inventory it has to be replenished as well. And I think Melanie actually referred to backwardation on the curve as an argument for actually pulling more crude into the present, which means withdrawal from inventory and then refill later. So it is a wise move, absolutely.

Senator HYDE-SMITH. Thank you for that.

And Ms. Hirstius, I find it difficult to believe we would not be facing an energy crisis if we had maintained greater independence, including exporting significant amounts of LNG. After President Biden's ban on new oil and gas lease sales on federal lands and offshore, the Administration continually gaslit Americans by saying there are 9,000 approved drilling permits not being used. However, we know it is one thing to have a lease, it is another for it to actually have the green light to produce on the lease after jumping through the ever-increasing regulatory hoops. All this to say we are nowhere close to realizing our nation's full potential as a global energy producer. And how would that maximize oil and gas production help stabilize these markets right now?

Ms. HIRSTIUS. Thank you, Senator, for the question.

I think the environment that we are in, and I will speak about the Gulf of Mexico with regard to permits—we get permits on a regular basis. Every activity that we have has oversight by the regulator and requires a permit, and currently we are in an environment where the majority of those permits are issued regularly and do not disrupt our business. There are a few areas where, like I mentioned before, like in seismic permitting, where we do see a disruption, and on the leasing—the leasing is very important to keep this conveyor belt of activities going and make sure that we have the feedstock of opportunities that we can evaluate to determine where we need to explore and where our barrels of tomorrow will come from. So it is very important that we keep the conveyor belt going.

As far as additional supply that we can bring online and how to do that more quickly, I think there is an important step that needs to be taken to look at how we can accelerate the permitting and approval process because that will result in faster activity and more oil and gas coming online. And that is really across all aspects of our industry—oil and gas, as well as renewables, because really everything has a permitting component to it. So I think that is a consistent thread that can be improved, and really those are solvable problems. There are not technical aspects that stand in the way of improving on that aspect to the system.

Senator HYDE-SMITH. Thank you very much.

And Dr. Foss, before the President announced a U.S. ban on Russian oil, the United States was importing about 700,000 barrels per day of Russian crude and petroleum products. Europe, which has a much heavier reliance, imports about four million barrels per day. With this ban in place, what vacuum are we going to see in the oil and gas market and how best can the United States contribute to stabilizing and returning domestic and global prices back to a more economically sustainable level?

Dr. FOSS. In fact, our Russian import history is even more interesting than that. We have been talking about it internally. I was looking at it the other day. We imported for a few years, 2010 to about 2014. Then we were flush with our own production and nothing arrived. Then we started taking a bit more to close gaps because of what everyone has pointed out. We had a surge that caught a lot of people off guard and economic activity, as people started coming out of the COVID closets and, of course, you know, we have the issue with Ukraine now affecting that.

What companies are doing to make up that gap is—fortunately, it is a small one—they are striving to source oil from different places. A lot of that is going to come from domestic production because there are ways of doing that. As Ken pointed out, we have managed to grow domestic production, other suppliers around the world—other inventories are available around the world. We haven't talked about the trader component of this. They also own physical inventory, and they are actively in the market looking at how to move some of those short-term cargoes into some of the refiner's locations for use.

The two places that happen to be most impacted are the East and the West Coast because most Russian oil was going to the eastern refineries and the West Coast refineries to close gaps there.

That is where most of those barrels were going, and those locations are not well served by pipelines that can deliver our own domestic supply. So that puts the pipeline conduit picture back on the table. What can we do to help de-bottleneck? How can we better serve our own communities? Over what time period could we get that done? We have efforts underway that people have been working on for a while to try to expand capacity out of the Permian, out of Texas, out of the Gulf Coast. We have had a lot of changes in how oil flows around the country with our own domestic production growth.

And then we have one more thing that I am going to put on the table, and I know that it is really controversial. We could sell more of our own oil to our own markets if we could ship it in our own waters. So I know that talking about the Jones Act is not anything that anyone ever wants to do, but we have to acknowledge it is there and at a time like this, you know, we have to put everything on the table.

And I want to say that in light of the conversation today, and especially since we are going to have a second round—what if it gets worse? None of us have talked about that. I am sure you all are thinking about it. I have all kinds of personal scenarios of what could happen with this event or what could dovetail with it. We may be in an extended, protracted period that we need to be thinking about for quite a while. We have to deliver to our defense forces. We have to be able to be sure that we can run the global fleets of cars, trucks, trains, railroads, everything else. So thinking about how we move our own production to ourselves is something that we could be doing along with other things.

Senator HYDE-SMITH. Thank you very much.

Thank you, Mr. Chairman.

Senator HOEVEN [presiding]. Thank you, Senator.

So I think you covered it, but Dr. Foss, we need to produce more oil and gas in this country—things we can do right now that would move the needle far.

Dr. FOSS. Well, again, we have put a lot of things on the table with regard to leasing, helping all of you and everyone here in town and in state houses around the country and governor's offices to understand all the things that the industry has to do to be able to get wells drilled, get them on production, get them hooked up, you know, logistically, so that production can get delivered, you know, understanding what it takes.

Let me talk about the private producer side for a minute—the small producer side, smaller than the publicly traded independents like Apache and Pioneer and so on because there is a large fleet still of independent producers active in the United States. We probably still have, oh, 7,000—it gets smaller every day—of small producers who have to go out and contract for services, lease land most of the time. They are in the private minerals market, but they have to be served. They have to be able to borrow money. They have to be able to finance their activities as well. Do not forget about them. They could actually move pretty quickly, except that one of the issues is getting the service industry to be able to supply locations that are not well-served because the service industry contracted in 2020 in such a harsh way. So we do have that that we have to think about. But the independent producers—many of

them are drilling and pursuing projects that will make a difference at the margin. If they could get a vote of confidence as well, you know, stepping out of the White House, giving a vote of confidence to the industry—the service industry, the service suppliers, the financial community—would go a long way.

Senator HOEVEN. So if the Biden Administration would remove a lot of these restrictions and so forth, that would help galvanize our industry right away—have both an immediate impact as well as a medium- and longer-term impact in terms of more energy production, specifically as regards both oil and natural gas.

Dr. FOSS. Yes, and I think it can be done responsibly. I agree with Colette on that.

Senator HOEVEN. You would agree we have the best environmental standards in the world, wouldn't you?

Dr. FOSS. Yes.

Senator HOEVEN. In terms of our energy production?

Dr. FOSS. I think that we are responsible anyway, you know?

Senator HOEVEN. Right.

Dr. FOSS. The industry is a very responsible industry.

Senator HOEVEN. Right, and thank you.

Dr. Medlock, wouldn't you agree that that is also not only vitally important for getting at inflation here at home, but very important in terms of working with our allies as well, specifically relative to what is going on in Ukraine?

Dr. MEDLOCK. Yes, I 100 percent agree with that. Working with our allies, I mean, look, I mentioned in my opening remarks that for the last 10 years, except for the last two of course because of COVID, you know, we had hosted 23 different delegations from countries all over the world. These are ministerial level delegations, and the one thing they all had in common, because the things were different, but they wanted to talk about U.S. oil and gas, and it had a lot to do with their own energy security motivations and what moving product from this country out into the open water actually meant for the diversity of supply that's available on the global scene because they all view that as critically important to their own energy security, even if barrels or molecules of gas are not landing in their country, it actually increases liquidity in the entire global atmosphere, and that bears energy security benefits like nothing else. So anything we can do, particularly in this current environment, to continue to increase production in a responsible way is going to pay dividends.

Senator HOEVEN. Thank you.

Ms. Hirstius, did I say your name reasonably close to right?

Ms. HIRSTIUS. Pretty close.

Senator HOEVEN. Okay. How do you say it?

Ms. HIRSTIUS. Hirstius.

Senator HOEVEN. Hirstius, thank you. I'm sorry.

You know, we have seen states that have historically been large energy producers of oil and gas—for example, California—that have throttled way back. Doesn't it make sense for us to be producing the energy here at home, even in states like California? Again, we have the best environmental standards, versus going to Maduro in Venezuela or going to Iran or going to OPEC or anywhere else?

Ms. HIRSTIUS. Yes, thank you for the question, Senator.

I think it is a moment in time when we need to look at all options domestically, and I agree with you that I think we do have the highest environmental standards, and need to feel comfort in that, and to know that a barrel that comes from the Gulf of Mexico has amongst the lowest greenhouse gas intensity of a barrel in the world. And that is something that is really important to us. Specifically with regard to California, I think that there are things that we need to look at across all of the states to determine what actions can be taken to increase supply, and California does have a significant amount of natural resources—oil and gas—that we can be able to bring onto the market if the conditions are right.

Senator HOEVEN. Thank you.

And then, finally, Ms. Kenderdine, isn't it true that we, in fact, have the best environmental standards? So for example, if we send LNG to our European allies, I believe, on a life cycle basis, they have 41 percent less greenhouse gas emissions than getting natural gas from Russia. So again, isn't the argument not only that we can produce more energy, but we will actually have better environmental stewardship rather than relying on other parts of the world who are antagonistic to us?

Ms. KENDERDINE. Senator, we do have excellent environmental standards and I think that that's a given. The Russian system—the gas pipelines leak methane like crazy. It is highly problematic. And so I think that our exports, relative to Russian exports, are much more environmentally responsible and sensitive than you would get from Russia. I would also say that in many parts of the world—and we are sending our LNG to Korea, Japan—our biggest customers. A lot of it—and India is now a fairly significant importer of U.S. LNG—depends on what it's replacing as well. So India has a lot of coal generation, and they now allow the use of imported LNG for power generation. So if you were replacing that coal generation with gas generation, you are getting lower emissions as well.

And so we do have much better environmental regulations, much better than Russia, for sure.

Senator HOEVEN. All right. Thanks to all the members of the panel. I appreciate the responses.

At this point I'd better check, is there anyone else that wanted questions on a second round?

[No response.]

Senator HOEVEN. Okay. Then, if not, thanks again to our witnesses for joining us this morning.

Members will have until the close of business tomorrow to submit additional questions for the record.

And with that, the Committee stands adjourned. Thank you.

[Whereupon, at 12:36 p.m., the hearing was adjourned.]

APPENDIX MATERIAL SUBMITTED

U.S. Senate Committee on Energy and Natural Resources
March 10, 2022 Hearing
Energy as a Tool and a Weapon: Ensuring Energy Security for the U.S. and Our Allies
Questions for the Record Submitted to Dr. Michelle Michot Foss

Questions from Ranking Member John Barrasso

Question 1: It has been suggested that the way out of the current energy crisis is to accelerate the energy transition away from fossil fuels. What are some of the risks of defunding hydrocarbon fuels before alternatives are ready to fill the gap? Is that a good strategy?

Not only is this not a good strategy, it's a dumb one (pardon my French). Hydrocarbons are intricately interwoven with all other materials and applications – energy and non-energy, defense, non-defense. Scarce hydrocarbon supplies in the face of growing demand means higher prices – as we are experiencing now – for energy, heat and materials. That translates into higher costs for other basic raw materials – ranging from minerals to agriculture to chemicals; more expensive manufacturing – for energy, heat and raw and intermediate materials and components; to finished industrial and consumer goods. The gamut of interactions feeds the inflationary spiral.

The balance is a delicate one. “Defunding” can happen through overt policy and/or regulatory mandates as well as, and more insidiously, through perceptions and cues. An industry that is being pressured to defund itself is one that will return profits to investors rather than reinvest in its core businesses, accelerating the spiral.

Question 2: For all of the talk about eliminating fossil fuels, is it possible to produce solar panels, wind turbines, and batteries without fossil fuels?

Absolutely not. No commercially acceptable substitutes exist for the plastics and resins that underlie the composites that are essential ingredients for these components, from wind turbine blades to Plexiglass on solar PV to plastic housings for battery packaging and related parts. Steel, cement and the array of ingredients all require fossil fuels for sourcing, energy and heat for manufacturing. No large scale substitutes are on the horizon. Nor can any of these technologies be deployed without reliable, dispatchable thermal generation from fossil fuels. Indeed, there is *no other way* to look at the growth curve for wind and solar accept as a consequence of the years of cheap oil and natural gas production that resulted from the US “shale gale” (even as investors in shale companies and projects were unhappy with low prices and returns). Those lower cost hydrocarbons made wind turbines, solar panel and battery components cheap by default, with cheaper energy for manufacturing, and much easier to deploy given the lower cost thermal generation required for back up and balancing to ensure reliability. No brainer.

Question 3: Are alternative technologies more resource intensive or less resource intensive than hydrocarbon-based technologies?

They are, unfortunately, more resource intensive. And, in contrast to some opinions, it is not a matter of simply manufacturing initial equipment and being done with it. The lifetimes of alt energy tech tend to be shorter – durability is an issue, one that many labs and companies are struggling to address. Thus, components need to be constantly manufactured for replacement. Finally, because alt energy tech is less energy dense – we need more of it to produce and dispatch an equivalent amount of Btus – the resource intensity follows. It's a tough tandem.

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Question 4: China has a stranglehold on the supply of such strategic materials as rare earths, copper, nickel, vanadium, and others that are instrumental in EV batteries and renewable energy technologies. Has China ever used its control over strategic resources as a geopolitical tool or weapon before?

In 2010, China restricted releases from its rare earths stockpile creating tensions with Japan and Korea and disrupting the vital NE Asia refining industry. The standoff was made more complicated by geopolitical tensions in the region associated with territorial rivalries (Senkaku Islands). An intense diplomatic effort eventually smoothed over the dispute but that incident and related events have set the tone for a much more unsettled A-P region, where underlying balance of power politics already are at work. China's reorganization of its REE industry and consolidation of companies into a dominant state owned enterprise (SOE) will, we think, aggravate the situation going forward. We are concerned about several aspects of supply chain dominance and control. These include: undue influence over governments that are targets of outbound Chinese investment; ability to control strategic minerals abroad (Chinese interests are consolidating control of cobalt in the Democratic Republic of Congo or DRC); trading and warehousing. It is hard to ignore the combination of Chinese ownership of the London Metals Exchange via Hong Kong Exchange & Clearing, the role of Shanghai trading and domestic interests; the prevalence of Chinese ownership of physical warehousing for metals (probably around half in China and elsewhere); and the aggressive short trade positioning of Tsingshan Holding which controls major new nickel projects in Indonesia in the collapse of LME nickel trading after an historic \$100,000/tonne price!

Question 5: China has made a strategic decision to control not just the mining and production of critical materials, but also the value-added downstream segments of the supply chain. Chinese firms, for example, control at least 60 percent of global wind turbine, solar panel, and EV battery production. That presents a very serious energy security challenge for the United States. What are some of the challenges of relocating to the United States the supply chains for these materials and the downstream manufacturing that uses them?

The very hard reality for all of us in the U.S. is that the cost of "reshoring" will be quite high. After all, we pursued global platforms for efficiency and cost saving. These businesses along many other manufacturing industries exited the U.S. in search of cheaper labor and materials and more accommodating regulatory environments. In the meantime, it has only become more expensive to develop and/or expand energy and transportation infrastructure, much less mining and minerals processing, and locate and build manufacturing capacity. Again, an assertive reshoring effort will feed the inflationary spiral. In order to keep costs and inflation from spiraling out of control, there will be no choice but to go slow. There is great competition for U.S. taxpayer dollars to make up the difference – that resource, the U.S. taxpayer pocketbook, is becoming increasingly stretched with the threat of higher inflation and in the midst of other, even harder, realities as our population ages. Our government serves at the will of the people. The people have to be willing! For all of these reasons, and more, the timeline lengthens. If we want to pursue "green new deals" as advertised with meaningful American content, the timeframe extends to well over a century (150 years?) to reach the vaunted "zero" milestone, if that is even possible. I have no idea how to estimate the cost, but even the most outlandish views on total cost are, I am sure, underestimating the level of effort.

U.S. Senate Committee on Energy and Natural Resources

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Energy as a Tool and a Weapon: Ensuring Energy Security for the U.S. and Our Allies

Questions for the Record Submitted to Dr. Michelle Michot Foss

Question 6: The administration pulled its support for the EastMed pipeline project over concerns about climate change. Do you agree that, whether by pipeline or liquefaction, we should support getting this gas to Europe to help them diversify their sources of natural gas supply?

I do. No question on that one.

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 and Ensuring Energy Security for the United States and Its Allies*
 Questions for the Record Submitted to Ms. Colette Hirstius

Questions from Senator John Hickenlooper

Questions: In the wake of recent events in Europe, some of my colleagues have argued that advantaging US oil and gas production over production abroad would be a win on both energy security and climate. Gulf production in particular is among the lowest emissions intensity worldwide. Can you speak to the merits of an economy-wide carbon price as a tool for advantaging lower carbon sources, both at home and abroad? Would a border-adjusted carbon price advantage US production?

Answer: *An economy-wide price on carbon advantages lower carbon fuels over higher carbon fuels where there is a meaningful difference in lifecycle emissions. For example, a carbon price advantages natural gas over coal and renewables over gas. In 2020, Shell published a scenario sketch called "A U.S. Net-Zero CO₂ Energy System by 2050." The sketch described the economically and technically possible, albeit very challenging, pathways for the U.S. to decarbonize its energy system by 2050. A robust and escalating economy-wide carbon price was identified as a critical pathway because it drives the reallocation of resources across the economy to lower-carbon fuels and technologies. Investors can make decisions with the certainty that lower emissions will be rewarded in the future. That makes a rising carbon price a key lever for change, particularly when coupled with additional measures that reduce emissions from sectors that may not respond to a carbon price alone, particularly in the early years. A carbon price that includes a border adjustment encourages countries that export to the United States to reduce the emissions associated with the production, transport, and use of their products in order remain competitive.*

Whether a border-adjusted carbon price would advantage U.S. production would depend on the carbon intensity of the imported product, which could vary across a variety of energy sources. Because the U.S. Gulf of Mexico production is among the lowest in emission intensities in the world, it would be advantaged over most other oil and gas production. Importantly, upon factoring in emissions associated with the transport of oil from more distant and GHG intensive sources to meet U.S. demand, continuing to withhold lease sales could have the counterproductive effect – even if marginal – of contributing to global emissions if that lost production is replaced with oil that has higher emissions associated with both its production and its transport to the U.S. This is certainly true when accounting for the rise in U.S. demand since 2020. And while I have stated that I do not think the absence of lease sales for the past year has yet directly impacted commodity prices - simply because it has not yet likely constrained physical supply of this GHG-advantaged production - resuming lease sales soon would help to avoid those negative outcomes.

U.S. Senate Committee on Energy and Natural Resources
March 10, 2022 Hearing: *The Use of Energy as a Tool and a Weapon,*
and Ensuring Energy Security for the United States and Its Allies
Questions for the Record Submitted to Ms. Melanie Kenderdine

Questions from Senator John Hickenlooper

Questions: As we talk energy security here, Reuters just reported that China plans to build 450 gigawatts – nearly half of US generating capacity! – of just solar and wind in the Gobi and other deserts. Renewables once you build them, automatically produce energy for decades, after which point key materials are recyclable. They are the surest and best way to secure true energy independence. In your assessment, does China's world-leading investment in renewables promote their domestic energy security? What should the U.S. do to similarly rise to this moment and meet this challenge?

Wind and solar are clearly very important components of our electricity supply now and in the decades ahead. China's plans are also an important move to help decarbonize its power system. It should be noted however that China's population in 2020, estimated at around 1,439 billion, is over 4.3 times that of the US at 331 million. These are important data for context about the energy systems of both countries.

In 2020, according to the IEA, total power generation in China was 7747 TWh compared to 4243 for the US; per capita electricity consumption in China is 5.4 MWh compared to 12.8 MWh for the US. On power generation by source: in 2020, China's solar generation was 270 TWh (3.5% of total) compared to 117 in the U.S. (2.8% of total). Wind generation in China was 471 TWh (6% of total) compared to 340 TWh (8% of total).

While wind and solar generation in the US and China were comparable on a percentage basis, there are large differences in other generation sources. In China in 2020, coal was 64% of its power generation; in the US, coal was 20%. Nuclear, a carbon free generation source, was 4.7% of China's total generation that year; in the US it was 20%. China generated 3% of its power with natural gas, the US was 39% – and CO2 emissions from gas generation are roughly half those of coal. Clearly, China has a great deal of work to do in its power sector for deep decarbonization.

Costs are also important. EIA's numbers show costs of generation by source entering service in 2026 (see figure 1). It should be noted here that both onshore wind and solar generation are cheaper than combined cycle gas and advanced nuclear generation on a total system basis; hydro and geothermal are as well but are location specific and there are growing concerns about hydro availability because of drought and melting glaciers. The costs for wind (both

Figure 1. Unsubsidized Levelized Cost of Electricity (LCOE) & Storage (LCOS) for Plants Entering Service in 2026

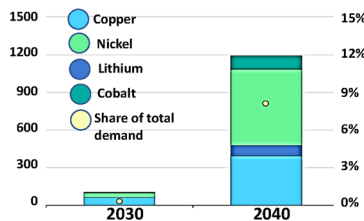


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onshore and offshore) and solar generation in Figure 1 do not however include the costs of storage; battery and other forms of storage are essential for ensuring system reliability for variable renewable generation and storage costs must be included in overall generation costs. It should also be noted that grid scale battery storage currently has a duration of around four hours; EIA analysis of wind and solar generation showed that in 2017, California had 90 days with no wind, as many as 10 days in a row with no wind (that same year, Texas also had 90 days with no wind; times of the year were different but overall numbers were similar). These data illustrate why DOE's "Long Duration Storage Shot" is so important for a clean energy future.

IEA, in a recent analysis, also noted that key materials for batteries, if recycled, can meet nine percent of demand in 2040 (Figure 2). On lifespan of renewable technologies, my written testimony specifically noted that:

Figure 2. Contribution of recycling/reuse of batteries to reducing primary supply in IEA's Sustainable Development Scenario, 2030-2040



"I would like to raise a final energy security issue in the metals and minerals space. We tend to think of energy security in terms of "fuels". Beyond the costs of commodities such as copper, the metals and minerals needed for clean energy technologies represent capital, not fuel costs. The lifespan of clean energy technologies will determine the draw on many critical metals and minerals. Accurate assessments of clean energy technology lifespans will become indicators of energy security; analysis, standards, and updated methods and metrics for may be necessary for ensuring energy security as technologies evolve."

In closing, more needs to be done in both countries – deploying more wind and solar is essential for both the US and China to meet deep decarbonization goals. The US should clearly do all it can to increase deployment of wind

and solar. It should also invest in innovation to increase the duration of battery storage and support other storage technologies; support advanced nuclear generation technologies; support the buildout of a domestic uranium enrichment capability and capacity (the US imports a significant percentage of our enriched uranium from Russia); increase both blue and green hydrogen production; support capture and sequestration of carbon from fossil generation; and provide incentives for the infrastructure we need for a range of clean energy technologies.

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Energy as a Tool and a Weapon: Ensuring Energy Security for the U.S. and Our Allies
Questions for the Record Submitted to Dr. Kenneth B. Medlock, III

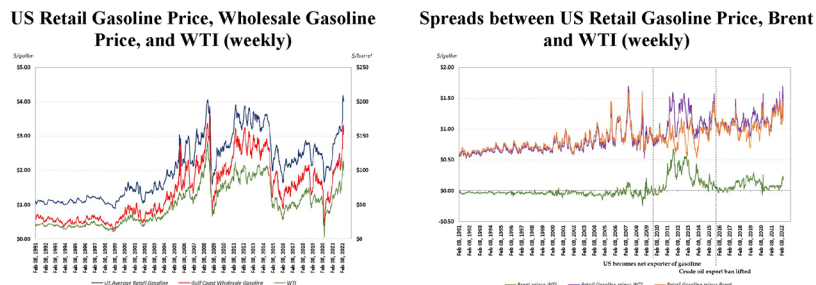
Questions from Ranking Member John Barrasso

Question 1: The prices of crude oil and gasoline are set in the global market. It has been suggested that re-imposing the ban on U.S. crude oil exports would lower the cost of gasoline for U.S. consumers. To your knowledge, does allowing the export of U.S. crude oil affect the price of gasoline and would banning exports lower the price of gasoline?

Banning crude oil exports would not lower the price of gasoline domestically. This was addressed in a 2015 study, “To Lift or not to Lift? The U.S. Crude Oil Export Ban: Implications for Price and Energy Security” (see <https://www.bakerinstitute.org/research/lift-or-not-lift-us-crude-oil-export-ban-implications-price-and-energy-security/>). That work highlighted the effect of the ban on exports (that was in place) on domestic crude oil prices and domestic gasoline prices. The price of domestic crude oil was discounted relative to world prices, but that did not translate into lower gasoline prices. This follows from the fact that gasoline and other petroleum products are traded internationally. Hence, if crude oil price domestically is lower, refiners will buy more US crude, refine it, and sell into a global market. So, any ban on crude oil exports creates an arbitrage window for gasoline producers to sell into and capture profit. This does not translate into lower prices at the pump, a point that has been reinforced in the literature and by the data (see Figure 1).

We see in Figure 1 that the prices of gasoline (at the wholesale and retail level) move with the price of crude oil. WTI is pictured, but the co-movement with Brent is similar, except during the period 2010 through 2015. In fact, statistical analysis (and a long list of peer-reviewed literature) reveals that prices of gasoline and the price of crude oil (regardless of the crude) are *cointegrated*. This is a powerful result that underscores the tightness of the relationship between crude oil price and gasoline price.

Figure 1



Source: Data are from the US Energy Information Administration

We also see in Figure 1 the spreads between Brent and WTI, average US retail gasoline price and Brent, and average US retail gasoline price and WTI. We see the Brent price rise above the WTI price in 2011, only to fall back close to parity in 2015. Notably, US crude oil production began to rise dramatically in 2010, and the

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crude oil export ban was lifted in December 2015. While the spread between the average US retail gasoline price and WTI rose during this period, the spread between average US retail gasoline price and Brent did not break trend. This follows if the price of gasoline is set in the international market. Brent is an internationally traded crude oil with no constraint on physical flows, which was not the case for WTI. In fact, literature has shown that the WTI-Brent spread tends to widen when infrastructure to move WTI is constrained. Yet, even when WTI flows are constrained, the price of gasoline does not deviate from its long run relationship with Brent, but does so with WTI. This indicates that the price of WTI (or US crude more generally) does not set the average US retail price of gasoline. Rather, the unconstrained international crude oil price does. Hence, banning exports of crude oil from the US will not lower the price of gasoline domestically; however, it will increase the spread between domestic crude oil price and domestic gasoline price.

Question 2: The United States is the world's largest producer of natural gas. We also have the potential to become the world's biggest supplier of liquefied natural gas. It has been argued, however, that U.S. LNG exports are bad for the economy and consumers. What has your work in this area shown?

We performed a study, "The Macroeconomic Impact of Increasing U.S. LNG Exports" (available at <https://www.bakerinstitute.org/research/macroeconomic-impact-increasing-us-lng-exports/>) for the US DOE in 2015. The study found that there are tangible gains from trade to the U.S. economy associated with increasing exports of LNG. Notably, the results of that study have been consistent with every study that has been done for DOE in its national interest review that is conducted prior to issuing export licenses. The argument that exports are bad for the US economy is not supported by the work that has been commissioned by DOE, and performed by academics, consultants and the US Energy Information Administration. In point of fact, US LNG exports will only occur if US natural gas is economically advantaged. A tenet of international trade is that the principle of comparative advantage dictates the direction of trade, unless constraints exist. Constraints on exports may or may not be supported by market conditions, but if they are supported by market conditions then they are not necessary because the market would dictate trade not occur anyway.

Question 3: What would be the consequences of the United States curtailing LNG exports at this time, when the global market is already very tight?

If the US were to curtail LNG exports, it would drive more gas into domestic storage. It would also have negative impacts on domestic pricing. If severe enough, it could lead to either more flaring at oil-producing wells, where any associated gas would be flared when its price is low, or lower oil production where flaring is not allowed. The implications would be different across producing regions in the US, with local infrastructure and local regulation dictating outcomes.

The global price of natural gas would rise if US LNG were curtailed. US LNG exports have risen significantly over the last few years, and removing them from the market would have enormous implications for LNG prices in Asia and Europe. Given current events, this would compromise the energy and national security of European and Asian nations because there is a lack of near-term alternatives. A real near-term concern is the macroeconomic implications of fuel shortages and high prices in US trading partners, which US LNG can help to ameliorate. Longer term, markets would adjust, but only after significant short-term pain.

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Question 4: What role does limited gas pipeline capacity play in rising natural gas prices?

To the extent that pipeline capacity is limited, the ability to move domestic natural gas to domestic consumers, long haul pipeline corridors (some of which support exports to the Canada and Mexico) and/or LNG export terminals is compromised. While this would suppress natural gas prices in producing regions, because local supply would be very robust relative to local demand due to an inability to export gas from the region, it would raise natural gas prices in end-of-pipe consuming markets domestically, such as New England, and drive such regions to rely more heavily on imported LNG, which usually happens during the winter months. This can connect price in those regions to the global price as they must compete for LNG supplies. This is a textbook example of what happens when deliverability capacity is constrained in a market.

Question 5: The administration pulled its support for the EastMed pipeline project over concerns about climate change. Do you agree that, whether by pipeline or liquefaction, we should support getting this gas to Europe to help them diversify their sources of natural gas supply?

Pipeline development limits optionality for EastMed resources by tying them explicitly to Europe. LNG development allows those resources to flow to Asia and other regions longer term. LNG would certainly allow EastMed gas to help Europe diversify away from Russian supplies, and it would also allow more gas to flow into the global LNG market, which, all else equal, would reduce global LNG price and encourage fuel switching away from coal. This would be good for climate objectives, especially considering the fact that coal is still a significant part of the energy mix in developing Asian countries that lack domestic natural gas resources. In the end, EastMed natural gas resources will be developed, with or without US support, but a statement of US government support could be beneficial for project development.