Testimony

of

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for the

Subcommittee on Environment and Climate Change
and the
Subcommittee on Energy

of the

U.S. House of Representatives Committee on Energy and Commerce

hearing on

"Securing America's Future: Supply Chain Solutions for a Clean Energy Economy"

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Chairman Tonko, Chairman Rush, Ranking Member McKinley, Ranking Member Upton, and members of the subcommittees, my name is Lucian Pugliaresi. I am President of the Energy Policy Research Foundation, Inc. (EPRINC), a non-profit public policy research organization. EPRINC was founded in 1944 and studies energy economics and policy issues with special emphasis on oil, natural gas, and petroleum product markets. I have worked on a broad range of energy security issues for my entire career, both in and out of government, beginning with the 1973-74 Arab oil embargo. Over the last two years EPRINC has been involved in the arduous task of understanding the limits of our ability to model energy futures.

I welcome this opportunity to provide my perspective on the tasks before us in addressing the supply chain challenges of a low carbon economy. As we proceed with a broad set of policy initiatives to implement the energy transition, we need to understand the full array of technical, economic and security uncertainties as well as the fundamental constraints that may disrupt the pace of this transition. Congress working with the Administration needs to put considerable effort in ensuring that transition policies remain robust against the full range of uncertainties and in a manner that sustains our security and economic well-being. Public support for the transition will hinge on the availability of reliable and affordable energy which remains the lifeblood of our economy and our national security.

The energy transition requires overcoming complex technical, scientific and public policy challenges. It is an enormous undertaking, fraught with setbacks, especially if attempted quickly without a careful assessment of the full range of economic and social consequences. I encourage the Congress to consider the following points as you proceed with legislation to accelerate the transition to the fuels and technologies of the future.

1. **The Energy System is highly complicated, inter-connected regionally and globally in ways that are not always apparent. The energy transition presents a new set of supply and price risks for consumers and manufacturers. Fully implementing an energy transition over the next 30 years is neither easy nor can it be assured.**

The tasks required in any transition will be enormous, difficult and expensive -- complicated by the fact that other countries around the world are attempting similar feats with little or no practical experience. Worldwide, fossil fuels continue to dominate the energy complex, providing over 80 percent of primary energy requirements (Figure 1). This will not be our first attempt to accelerate the energy transition and Figure 2 demonstrates how difficult it remains to implement ambitious plans to accelerate the deployment of wind and solar resources to support the energy transition. The deployment of these technologies have been limited even as the U.S. government has provided direct financial incentives and mandates to advance wind and solar power over the last 30 years (over $50 billion in federal expenditures in tax incentives and grants between 2005-2015 alone).[1] Today, these two technologies produce less than 4% of our primary energy requirements. In the same time period (2005-2015), gross receipts to the federal government from oil and gas leasing exceeded $110 billion.[2] Oil and gas continues to garner revenues for the federal government, a considerable portion of which is shared with the states. The differences in these two revenue streams (one from, and other to, the federal government) reflect the reality of the marketplace.

2. **Achieving net zero in the developed world will reduce carbon emissions by only a small amount, likely no more than 20 percent of expected global emissions.**

Reducing carbon emissions is a global challenge. Even if the developed world achieves net zero, our research concludes that without a massive commitment from the developing world, the net reduction in carbon emissions will be relatively small, perhaps no more than 20% less in 2050 when compared to a business-as-usual scenario (Figure 3). An important challenge for the developed world, represented by membership in the Organization for Economic Cooperation and Development (OECD), is that policies that push for a rapid energy transition will also likely be accompanied by lower rates of economic growth. This is a serious challenge for the OECD as any loss of economic expansion will also reduce public resources for research and development of new and advanced carbon free energy resources.

3. **Regulatory programs as well as private sector commitments to accelerate the energy transition – whether it be mandates, targets, financial and procurement guidelines create uncertainty and financial**

[1] *Examination of Federal Financial Assistance in the Renewable Energy Market*, November 2018.https://www.energy.gov/ne/downloads/report-examination-federal-financial-assistance-renewable-energy-market

[2] *Options for Increasing Federal Income from Crude Oil and Natural Gas on Federal Lands. Congressional Budget Office,* April 2016. https://www.cbo.gov/sites/default/files/114th-congress-2015-2016/reports/51421-oil_and_gas_options-OneCol-3.pdf

risks that limit investment commitments to current legacy fuels, many of which are likely to remain in demand for years to come.

Legislative, regulatory and policy decisions made today, even if relatively narrow in scope are creating expectations of rising costs and delays in extraction of oil and gas resources, and increasing the risk for capital flows to establish new oil and gas production. For example, policies by financial institutions that prohibit investments in the development of oil and gas resources may lead to temporary if not longer-term supply constraints that will affect energy prices, manufacturing and US competitiveness.

Many commentators assert that there remains a serious risk that oil and gas companies are likely to end up owning assets for which there is no market, but financial data does not support the claim that companies are holding “stranded assets” (Figure 4), nor is it likely that world demand for oil and gas will decline precipitously in the near future. Our desire for change cannot obscure the on-the-ground reality of how important energy is to our economy and the need to assure a robust supply of reliable and affordable energy.

4. **Most of the recent escalation in energy prices can be tied directly to dislocations in energy supplies (largely oil and gas) from the Covid-19 pandemic. However, government policies, such as the halt on leasing on federal lands, the cancellation of the Keystone Pipeline, the potential cancellation of line 5 from Canada, rising regulatory requirements and permitting delays are all threatening North American oil and gas production. We undermine this strategic asset at our peril if we abandon these fuels before the energy transition is well established.**

The U.S. and the rest of the world will continue to need oil and gas throughout the transition. Any policy decision based on the simple premise that the U.S. can transition simply by cutting off production of legacy fuels will backfire horribly and erode public support. Other measures under consideration, such as halting crude oil exports or a release of the Strategic Petroleum Reserve without a genuine supply disruption are likely to be counterproductive.

Recent speculation that some members of Congress and the Biden Administration are considering reinstituting a ban on U.S. crude oil exports is especially worrisome as it would likely raise gasoline prices and further disrupt supply chains. The U.S. is a large continental land mass and so minimizing transportation costs for moving crude oil to market are important. Oil prices are set in the world market so a refiner in Hawaii would rather purchase crude from Indonesia than

Houston and save on transportation costs. A Gulf coast refiner whose processing technology is tuned to heavy crude might find it cheaper to use Mexican or Canadian oil than one with alternative specifications produced in North Dakota.

Crude oil and petroleum product exports allow the entire North American production platform to minimize transportation and processing costs. Open access to markets and crude and product transportation efficiencies permit U.S. refineries to operate at high levels of capacity utilization and provides opportunities for upstream producers to maximize crude oil output. The free movement of capital, crude oil and petroleum products remain critical to sustaining the productive capacity of the U.S. petroleum industry and the entire North American oil and natural gas production platform. These efficiencies have led to rapid expansion of U.S. oil production and remain one of the central reasons that large volumes of U.S. crude imports also result in large volumes of higher value-added exports of petroleum products. One of the reasons the U.S. has achieved energy independence is that the production platform is efficient. Reinstituting the export ban would result in further reductions in U.S. production, higher stress on supply chains, and rising price risk to gasoline supplies.

5. **Policy Matters. The US should see the current energy crisis in Europe as a cautionary tale and learn from it.**

The current energy crisis in Europe, characterized by rapidly escalating natural gas prices, has been driven by constraints in electricity supplies. The European crisis has its roots in policies that sought rapid decarbonization without accounting for the associated supply risks. Germany presents a stark example as the rising demand for natural gas to support intermittent renewable supplies has contributed to a more expensive and a less resilient power sector (Figures 5 and 6). Clearly, recovery from the pandemic is a factor, but so are policies that limit fuel diversity and make power systems less resilient.

The German Commission on Growth, Structural Change and Employment, better known and referred at the Coal Commission set up by the German Government to enquire into the future of the role of coal (and lignite) in the country's low carbon energy transition released its strategy document in January 2019. The German transition strategy followed two previous policy instruments, the German Feed-In Tariff Law of 2000 and the German Nuclear Plant Shut down Directive of 2012. In early 2020, German government articulated its first draft of its Hydrogen Strategy that made a technology choice of hydrogen production through the electrolysis route over other more economically attractive technology options.

The German energy transition plan is now directed by these new policy instruments and despite support for the transition initiative by several leading figures (including the Head of the IEA, Dr Fatih Birol) these policy initiatives are delivering higher systemic risk into the German power sector.

Two risky features are now prevalent in the German power sector:

1. The transition to a low carbon economy in Germany - driven mainly by policy instruments around highly attractive feed-in tariffs for renewables, a shut-down of coal and nuclear plants by 2024 and 2038 respectively and the introduction of hydrogen by a specifically chosen technology route. These policy initiatives will not be sufficient to meet demand for electricity in Germany in 2030. The energy transition in Germany has been a policy driven exercise that has been expensive and yet unable to achieve its stated aims.

2. The only remaining fuel vector for Germany to close the gap in its electricity demand then remains natural gas/LNG.

These policy instruments, directed at rapidly bringing down carbon emissions will continue to be expensive, unable to meet its stated decarbonization targets and drive rising, instead of reduced, demand for natural gas.

6. Policy initiatives that seek to accelerate the U.S. to a fully renewable energy complex will have global implications for energy security.

Much of the world will remain dependent on oil and gas with a growing dependence on producers from the Middle East and Russia. Recent trends in upstream oil and gas capital expenditures are especially worrisome (Figure 7). While the reluctance to increase capital expenditures among the major oil companies may be tied to concerns on strengthening their balance sheets, rising development costs, other forces may be at play as well including government directives discouraging investment by financial institutions in upstream oil and gas development. Should this trend continue, we might find ourselves in the midst of a two-speed transition process. Rapid transition (at least an attempted rapid transition) in the OECD, but limited progress in the developing world. China, Russia and the Middle East will gain positional advantage leaving the U.S. and its allies vulnerable to strategic threats. We may end up with an energy transition which will see the U.S. move from our current position of energy independence to dependence on a broad set of critical minerals from insecure sources, while at the same time experiencing growing reliance on traditional oil and gas supplies from insecure and expensive sources.

7. **The transition will establish new environmental challenges and energy security issues in addition to the old.**

Figures 8, 9, and 10 show the challenges facing the U.S. Today, the U.S. is the largest producer of oil and gas worldwide. This provides strategic advantages and energy independence. A rapid shift to reliance on electric vehicles (and batteries), solar, wind and related renewable energy sources will also require large quantities of copper, lithium, manganese, cobalt, and molybdenum. While many of these minerals can be developed through potential mining sites in the U.S., these minerals will also require new processing facilities to be developed into useable materials. Permitting constraints and environmental reviews will likely make the development of these resources a long and arduous effort.

In addition, it is not a trivial effort to construct large scale wind and solar farms and to accelerate the production of electric vehicles. Mark Mills, Senior Fellow at the Manhattan Institute, has outlined the formidable requirements for replacing the energy output from a single 100 megawatt natural gas-fired turbine with wind turbines.

> *It would require at least 20 wind turbines, each one about the size of the Washington Monument, occupying some 10 square miles of land. Building those wind machines consumes enormous quantities of conventional materials, including concrete, steel, and fiberglass, along with less common materials, including 'rare earth' elements such as dysprosium…. All forms of green energy require roughly comparable quantities of materials in order to build machines that capture nature's flows: sun, wind, and water. Wind farms come close to matching hydro dams in material consumption, and solar farms outstrip both. In all three cases, the largest share of the tonnage is found in conventional materials like concrete, steel, and glass. Compared with a natural gas power plant, all three require at least 10 times as many total tons mined, moved, and converted into machines to deliver the same quantity of energy.*[3]

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[3] Mills, M. P. (2020, July 9). *Green Energy Reality Check: It's not as clean as you think.* Manhattan Institute. https://www.manhattan-institute.org/mines-minerals-and-green-energy-reality-check Page 6

8. **Policy measures should be robust against uncertainty**.

We are heading into a largely uncharted world full of enormous, price, energy security risks. We have an extraordinary responsibility to consider the vast and array of risks and to develop policies that are robust under the uncertainties that cannot be easily predicted. Expect failures, cost over-runs and the unexpected. As shown in Figure 11, experienced analysts with long experience in modeling our future of energy requirements disagree on worldwide requirements over the next 30 years.

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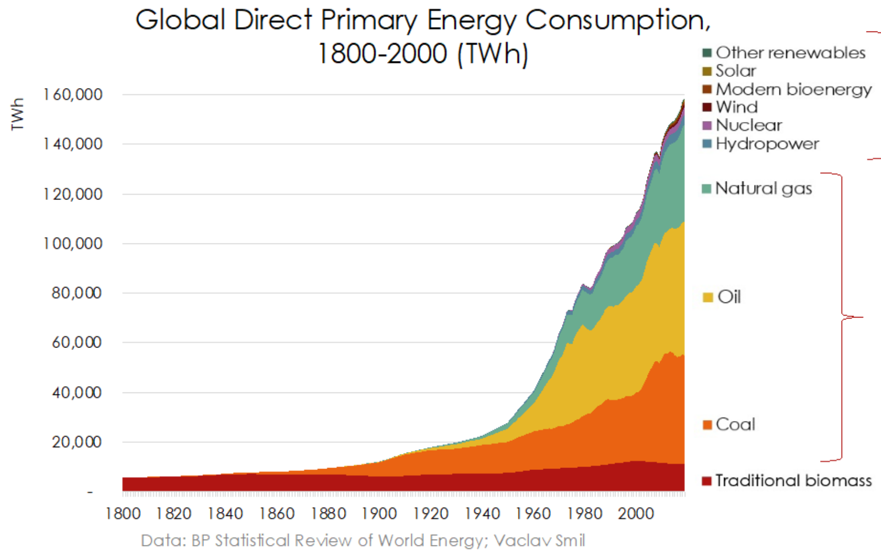
FIGURE 1
Energy Transition is Hard and Rare

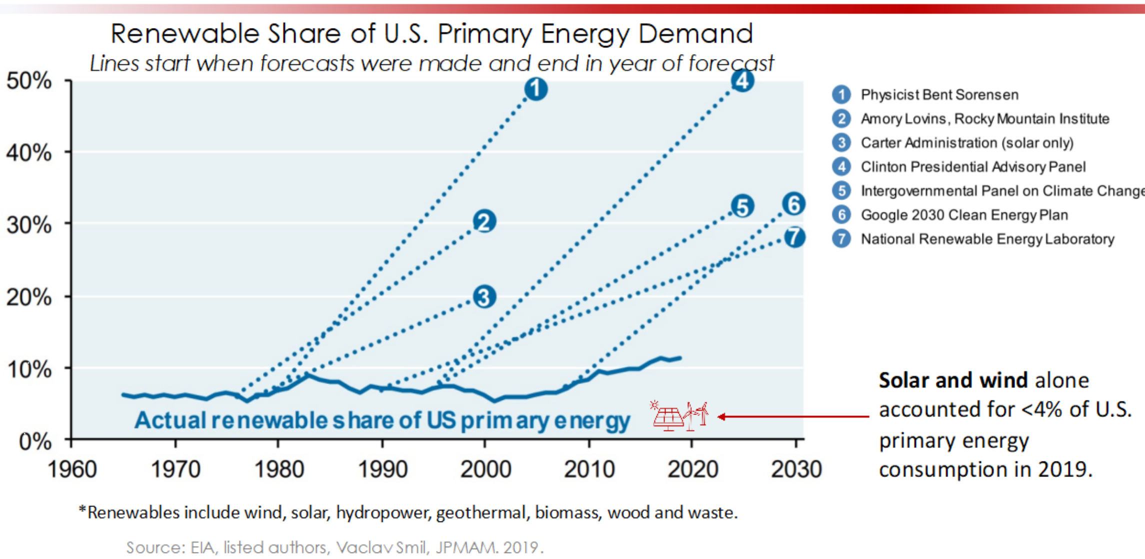


Lots of money, global impact limited so far

Fossil fuels still dominate 80-90% of world direct primary consumption; use is driven by cost, energy density, convenience, and reliability

TWh=terawatt hours

FIGURE 2
Ambitious Goals Need Sober Assessment

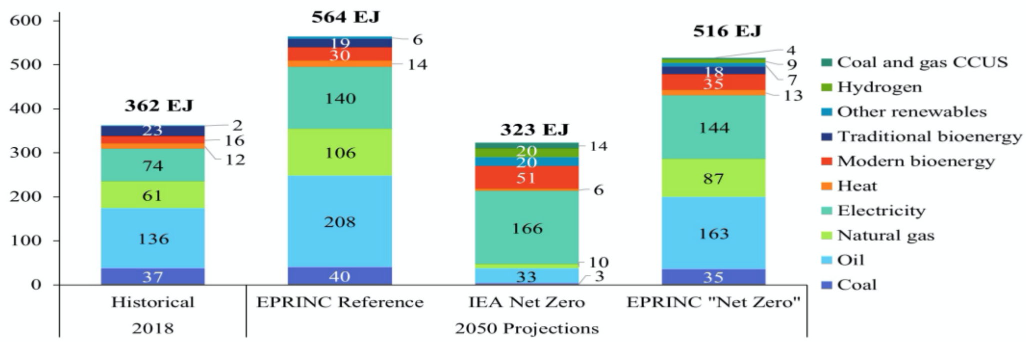


Solar and wind alone accounted for <4% of U.S. primary energy consumption in 2019.

FIGURE 3

EPRINC's Optimistic Scenario Still Falls Short of Net Zero (Exajoules)

(Industry, Buildings, and Transport)



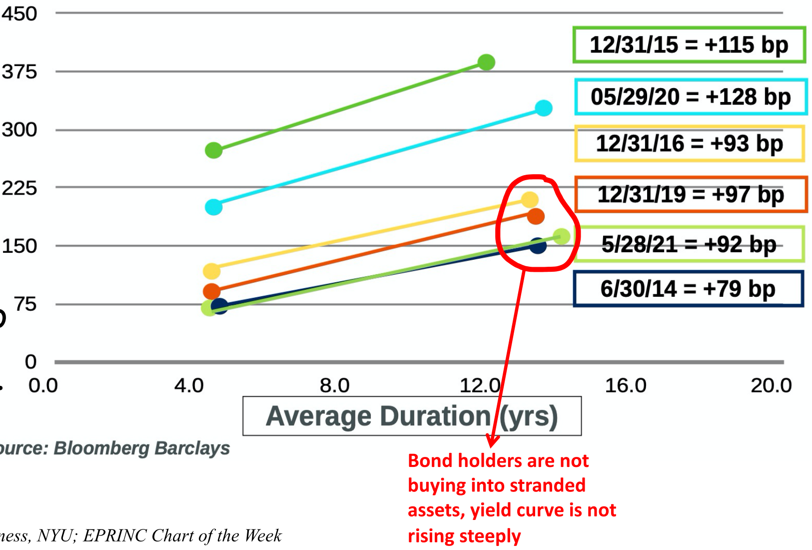
	OECD	Non-OECD
Power	Renewables replace **100%** of coal and **75%** of natural gas	Renewables replace **10%** of coal and **10%** of natural gas
Buildings	Increased building efficiency reduces **50%** of all fuels	Increased building efficiency reduces **10%** of all fuels
Industry	Increased efficiency and new processes replace **25%** of all fuels	Increased efficiency and new processes replace **10%** of all fuels
Transport	Electric vehicles replace **50%** of internal combustion engine (ICE) highway miles	Electric vehicles replace **10%** of internal combustion engine (ICE) highway miles

FIGURE 4

Stranded Assets?

Risk Averse Long Dated Investment Grade Bondholders Like Oil & Gas

Since the shale-related reset of world oil prices that began in mid-2014, the IG energy credit spread curve has not steepened meaningfully, other than temporary spikes caused by oil price volatility (mainly the 2020 pandemic and related OPEC+ market share war).



Source: Paul Tice, Stern Shool of Business, NYU; EPRINC Chart of the Week

FIGURE 5

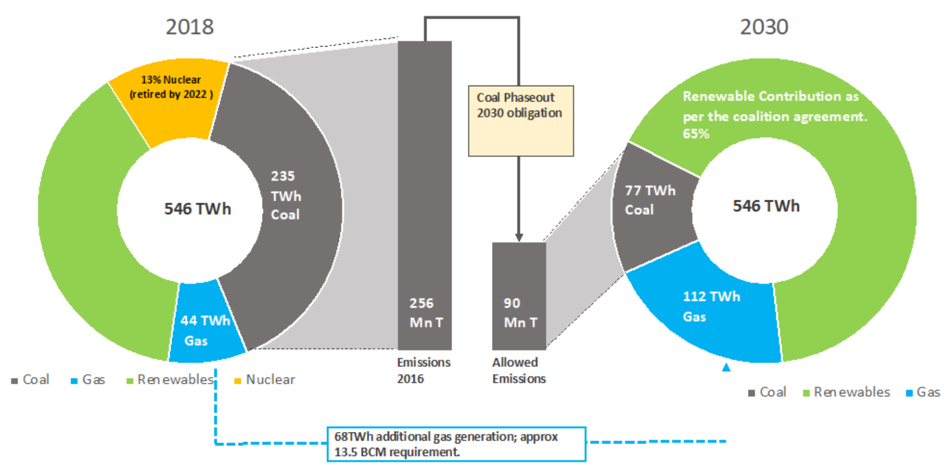
GERMAN ENERGY TRANSITION DIFFICULTIES ARE ‘POLICY DRIVEN’

Policy Instruments	Stated Aim/Objective of the Policy
“Feed In” tariff mechanism	Introduced in 2000, this policy guaranteed high tariffs for early investors which produced a solar boom.
Nuclear Plant Retirements	Following the Fukushima Accident, Germany was the first country to ban all future nuclear power and enforce a shutdown of its nuclear fleet by 2022
Coal Plant Retirements	The “Coal Commission” policy proposals advocate a retirement of entire 45GW coal capacity by 2038
German Hydrogen Strategy	The Hydrogen policy seeks to utilise the renewable overcapacity for hydrogen production through promoting commercial scale electrolysers- a technology choice made by policy, ignoring the cost-competitiveness of hydrogen production through the natural gas steam reformation route.

Source: Ash Shastri, EPRINC Distinguished Fellow

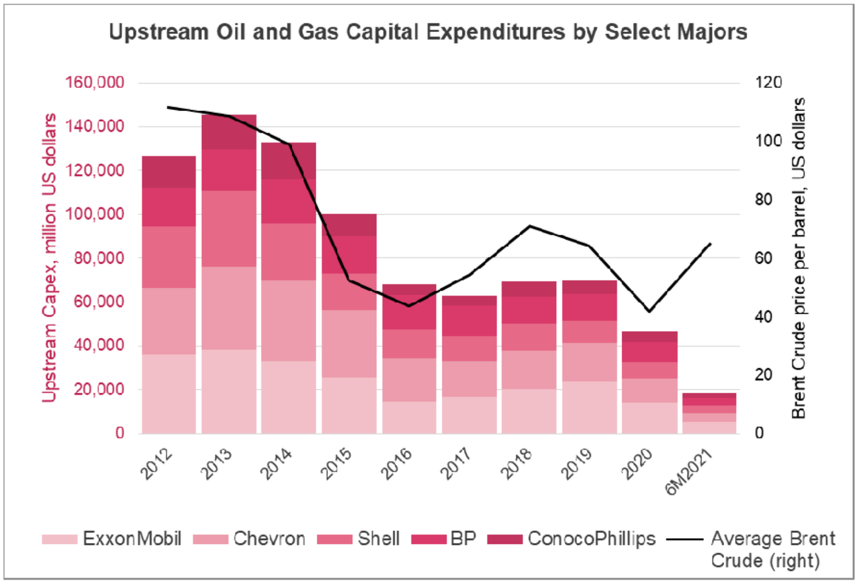
FIGURE 6

GERMAN ENERGY TRANSITION PLANS FORESEE A SIGNIFICANT ROLE FOR RENEWABLES BUT GAS WILL STILL REMAIN A CRITICAL FUEL BEYOND 2030



Source: Coal Commission Documents, Press Reports, Fraunhofer Charts and EPRINC Team Analysis

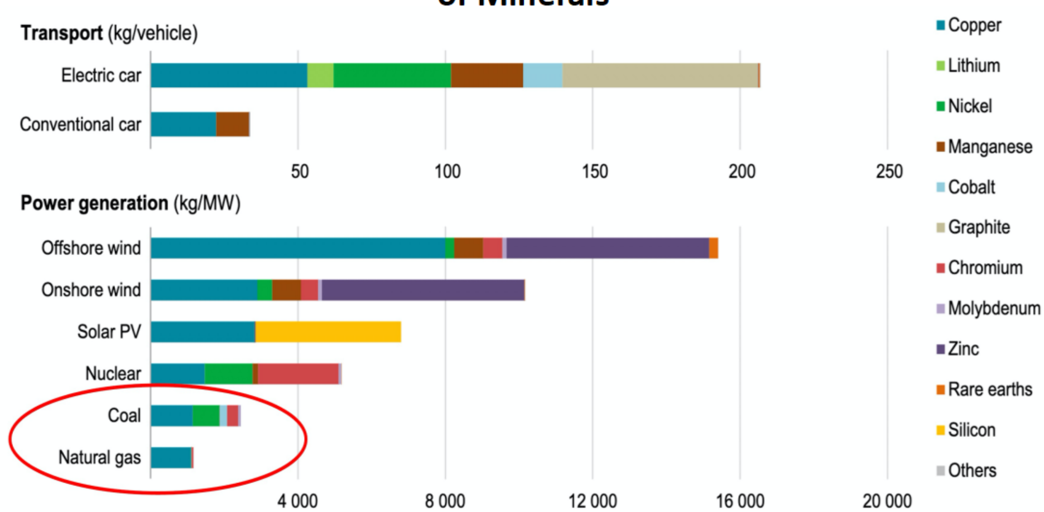
FIGURE 7



Source: Battulga Odgerel, EPRINC; Data: Company SEC filings, EIA historical pricing data

Annual financial reports from some of the major oil and gas companies show that despite growing oil prices, upstream capital expenditures continue to remain low, exacerbating the already tight market and contributing to a prolonged price rally in the coming years.

Figure 8
Energy Transition Will Require Acquisition of Higher Volumes & Broad Range of Minerals

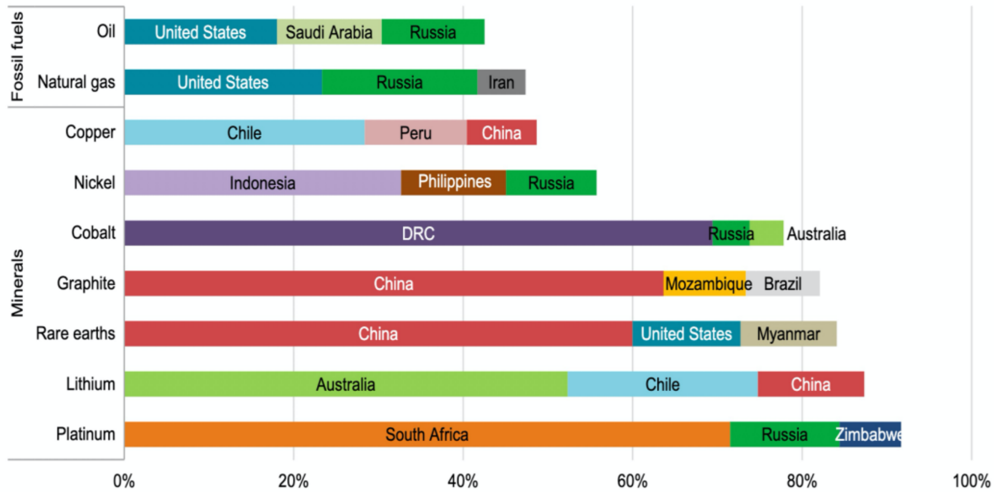


Source: IEA

FIGURE 9

The U.S. is a Leader in Oil and Gas Production

(In specialty minerals, U.S. is highly dependent on foreign sources of supply)



Source: IEA

Figure 10

Is this the new Energy Security Problem?
Rare earth mine production (metric tons), 2019, 2020

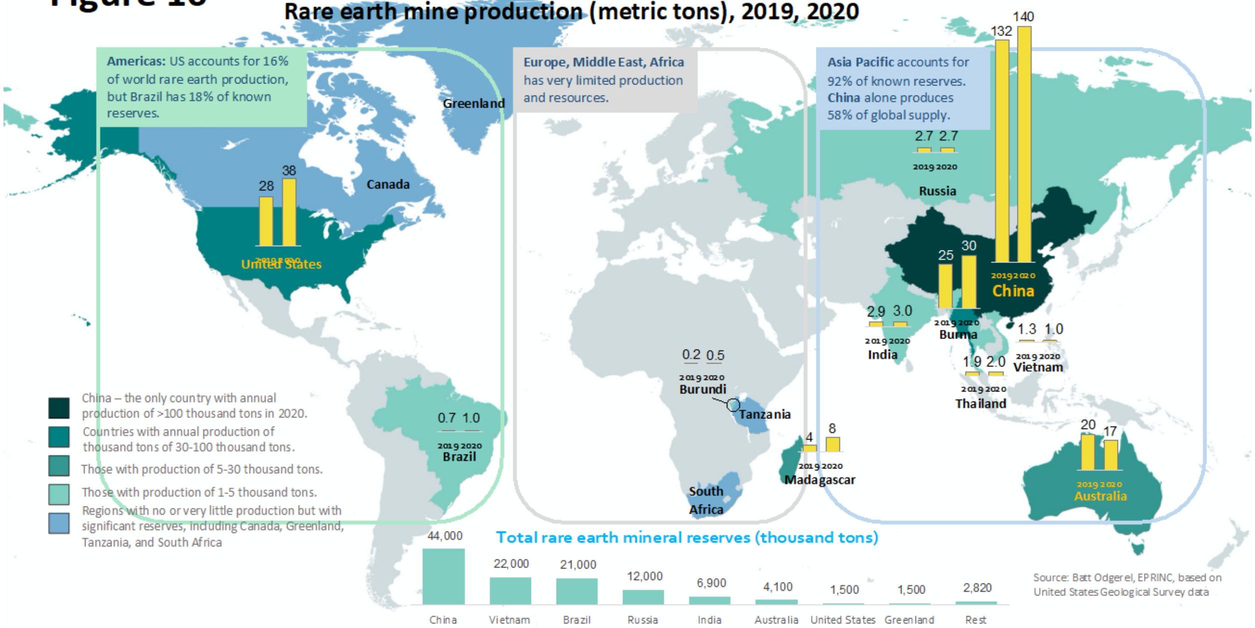
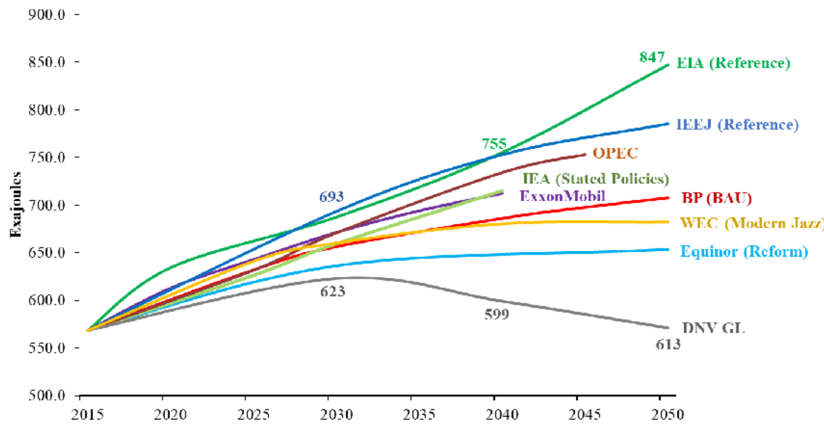


Figure 11
Recent Primary Energy Supply Scenarios to 2050 (Exajoules)

There are wide differences in energy outlooks?



Note: Exajoule (EJ) is a comprehensive unit of energy, roughly equivalent to 1.05 quadrillion British thermal units (quads). One EJ equals 10^{18} (one quintillion) joules, and one joule equals the amount of work done on a body by a 1 Newton force that moves the body over 1 meter. One exajoule per year = 447,000 barrels of oil equivalent per day.
Source: EPRINC, compiled from industry and think tank reports