

The monumental challenge of trying to hit climate targets

By Angelo Katsoras

Introduction

To date, over 60% of all countries, including the United States, the EU and China, have in some way committed to the goal of attaining net zero carbon emissions.¹ This trend has been driven in large part by the work of the UN Intergovernmental Panel on Climate Change, which concluded that the world had to bring carbon emissions to net zero by 2050 in order to limit global warming to 1.5°C above pre-industrial levels.

However, to achieve this target even only partially, which is the most likely scenario, will require not only an unprecedented massive deployment of clean energy systems, but also the minerals needed to build this infrastructure.

This report analyzes the colossal challenges involved in trying to meet environmental targets. These include the long lead time often required to get projects approved, local opposition to these projects (with a focus on the United States), and issues related to security of supply. The impact of climate regulations on the oil sector is also examined.

The monumental scale of the task ahead

The International Energy Agency (IEA) has estimated that to meet the goal of a net zero-carbon world by 2050, the share of fossil fuels in the global energy supply would have to fall from its current 80% to 20% by 2050.

Below are examples highlighting the scale and complexity of this transition:

- U.S. Climate Envoy John Kerry recently stated: "I am told by scientists that 50 per cent of the reductions we have to make to get to net zero are going to come from technologies that we don't yet have."²
- The IEA has indicated that the measures required to attain this goal include: 1) Building the equivalent of the world's largest solar park every single day for the next three decades; and 2) Fitting ten industrial plants every month with carbon capture technology starting in 2030.³ To put this challenge into perspective, as of December 2020, there were only 26 carbon capture facilities in operation worldwide.⁴

Tensions with the developing world

Where developing countries are concerned, many have adopted the position that since they contribute a far smaller volume of greenhouse gas emissions per capita than richer industrialized countries do (see chart below), they should have to achieve much less stringent targets and should be granted additional financial assistance for their efforts.

Given that developing countries in the Asia-Pacific region alone are projected to account for almost two thirds of the growth in global energy demand between now and 2040,⁵ their views will have an outsized impact on whether environmental targets will be reached.

Speaking at a virtual meeting of the IEA last March, Indian Energy Minister Raj Kumar Singh called reaching net zero "pie in the sky." He then went on to say the following: "The developed world has occupied almost 80% of the carbon space already, [while the developing world has] 800 million people who don't have access to electricity. You can't say that they have to go to net zero, they have the right to develop, they want to build skyscrapers and have a higher standard of living, you can't stop it."⁶

¹ "Beware the looming net zero car crash," Financial Times, May 18, 2021

² "Murky carbon path threatens US\$14 trillion in oil and gas projects," Financial Post, May 26, 2021

³ "Net Zero by 2050," The International Energy Agency, May 2021

⁴ "Carbon capture and storage projects on the rise globally – Global CCS Institute," S&P Global, December 1, 2020

⁵ "Energy Security in ASEAN+6," IEA, May 2019

⁶ "Climate change: Net zero targets are 'pie in the sky,'" BBC, April 1, 2021

2018 rankings by per capita emissions

Rank	Country	CO ₂ emissions (total)
1	Saudi Arabia	18.48T
2	Kazakhstan	17.60T
3	Australia	16.92T
4	United States	16.56T
5	Canada	15.32T
6	South Korea	12.89T
7	Russian Federation	11.74T
8	Japan	9.13T
9	Germany	9.12T
10	Poland	9.08T
11	Islamic Republic of Iran	8.82T
12	South Africa	8.12T
13	China	7.05T
14	United Kingdom	5.62T
15	Italy	5.56T
16	Turkey	5.21T
17	France	5.19T
18	Mexico	3.77T
19	Indonesia	2.30T
20	Brazil	2.19T
21	India	1.96T

All emissions from 2018. Fuel combustion only. T = Metric tons

Source: Union of Concerned Scientists, 2020

Potential price tag

Below are various estimates of how much it would cost to get to net zero emissions by 2050, globally and for the United States and China:

- The International Renewable Energy Agency has estimated that reaching this goal on a global scale would cost \$115 trillion.⁷
- The IEA has asserted that the annual global investment in clean energy projects needed to more than triple its average of the past five years to reach \$4 trillion a year by 2030.⁸
- Consulting firm Wood Mackenzie has estimated that mining companies needed to invest nearly \$1.7 trillion in the next 15 years to supply enough copper, cobalt, nickel and other metals required for the shift to a low-carbon world.⁹ To put this figure into perspective, capital expenditures among the world's 45 largest miners rose 30% to \$75 billion in 2020. This was a third lower than in 2012, the end of the last commodity bull market.¹⁰

The price tag for United States and China

- According to a Princeton study, achieving net-zero emissions by 2050 in the United States would "require \$2.5 trillion in additional capital investment into energy supply, industry, buildings, and vehicles over the next decade relative to business

⁷ "Global Emissions Goals Come With Big Cost and Political Hurdles," Wall Street Journal, April 25, 2021

⁸ "Net Zero by 2050," International Energy Agency, May 2021

⁹ "GRAPHIC-Low carbon world needs \$1.7 trillion in mining investment," Reuters, May 10, 2021

¹⁰ "Commodity Prices Have Soared, but Miners Aren't Investing," Wall Street Journal, May 25, 2021

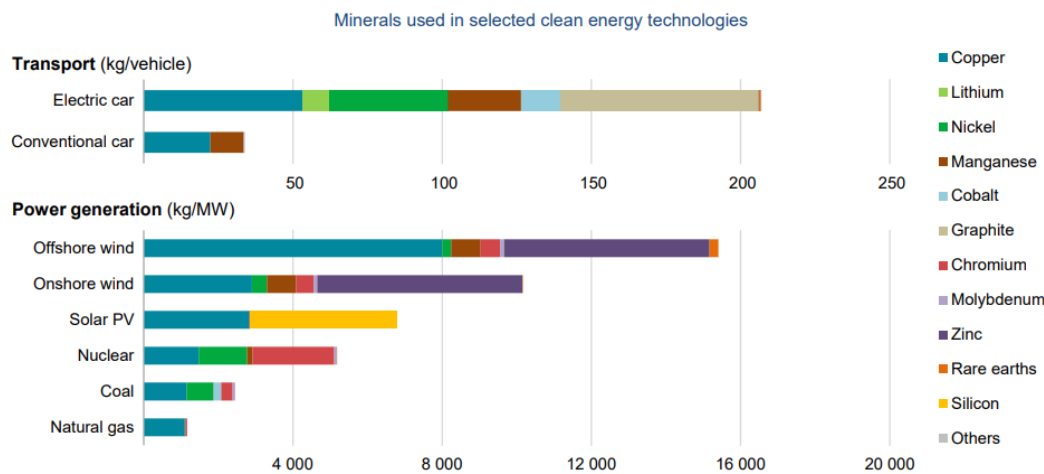
as usual.” This includes quadrupling wind and solar capacity from 10% today to 50% of total capacity and expanding electricity transmission systems by 60%.¹¹

- China would need to invest \$21 trillion over three decades to reach the goal of net zero emissions by 2060, according to a report by China’s leading climate experts at Tsinghua University.¹² TransitionZero, an environmental research firm, estimates that reaching this goal would necessitate shutting down 600¹³ of China’s 1,042¹⁴ coal plants over the next decade. In 2020, coal accounted for about 64% of electricity generation in China, versus 19% in the United States.

The massive amount of minerals needed to realize green transition

As the following chart illustrates, transitioning to green energy will require a significant increase in the production of certain minerals. The typical electric car requires six times as many minerals to build as does a combustion-engine car and an onshore wind plant requires nine times as many resources to build than a gas-fired plant.¹⁵

The rapid deployment of clean energy technologies as part of energy transitions implies a significant increase in demand for minerals



Notes: kg = kilogramme; MW = megawatt. Steel and aluminium not included. See Chapter 1 and Annex for details on the assumptions and methodologies. IEA. All rights reserved.

Source: “The Role of Critical Minerals in Clean Energy Transitions,” IEA, May 2021

Obstacles to increasing mineral production

The permitting process

One of the main challenges to meeting these clean energy goals is the amount of time it generally takes to get mining production running. Based on 35 major projects that came online in the past decade, the IEA has calculated that it takes on average over 16 years to move mining projects from the discovery to the production phase. Meanwhile, in the United States, it takes from 7 to 10 years just to secure a mining permit from the government.¹⁶

This long-drawn-out approval process raises questions about the mining sector’s ability to meet a potential surge in global demand.

¹¹ “Net-Zero America,” Princeton University, December 15, 2020

¹² “Global Emissions Goals Come With Big Cost and Political Hurdles,” Wall Street Journal, April 25, 2021

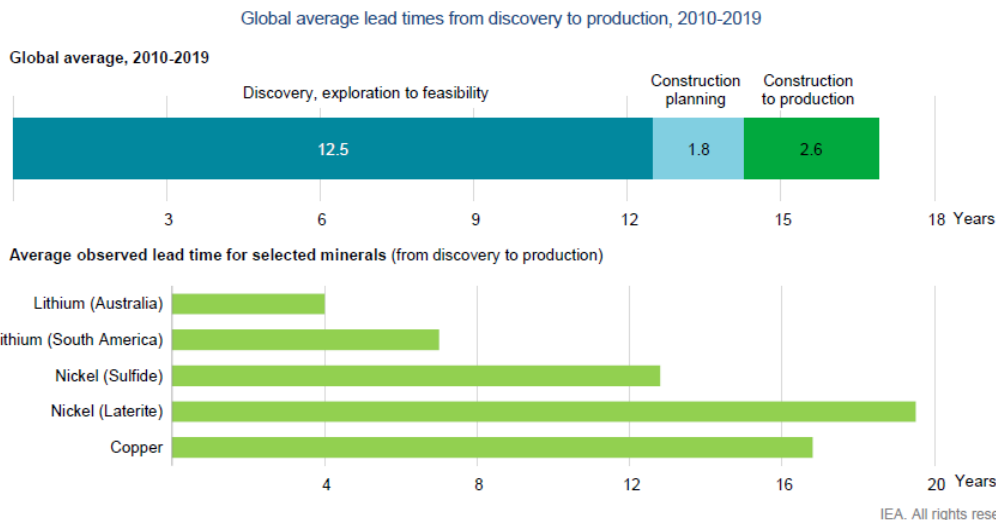
¹³ “China ‘must shut 600 coal-fired plants’ to hit climate target,” The Guardian, April 15, 2021

¹⁴ “Bloomberg Global Coal Countdown,” 2021

¹⁵ “The Role of Critical Minerals in Clean Energy Transitions,” IEA, May 2021

¹⁶ “U.S. Minerals mining permitting process,” Mining, May 17, 2020

Project development lead times: Market tightness can appear much more quickly than new projects



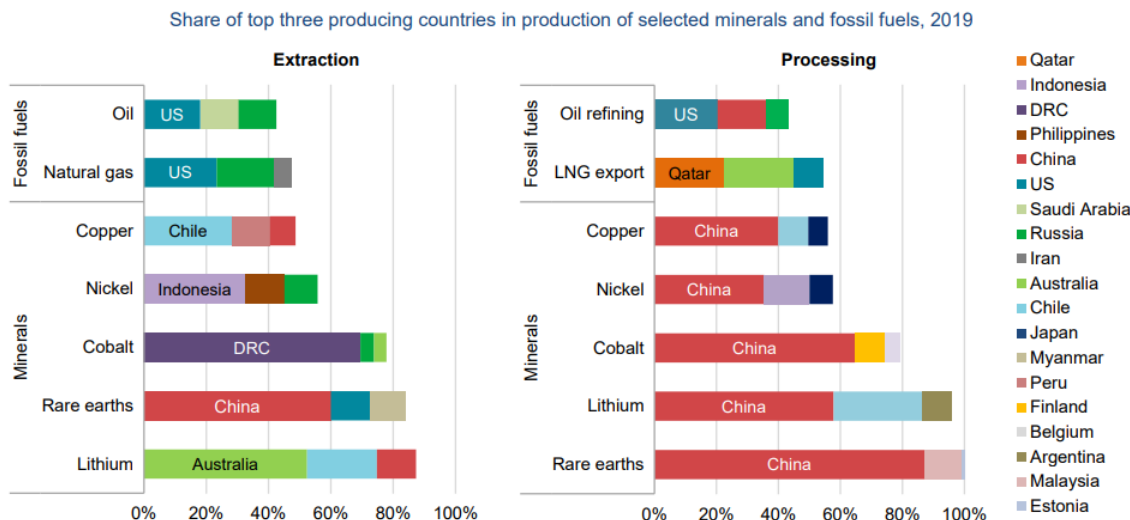
Note: Global average values are based on the top 35 mining projects that came online between 2010 and 2019. Source: IEA analysis based on S&P Global (2020), S&P Global (2019a) and Schodde (2017).

Source: "The Role of Critical Minerals in Clean Energy Transitions," IEA, May 2021

The risks of geographic concentration

Another challenge facing the United States and other Western countries is China's dominance in the processing of minerals required to build alternative energy infrastructure and electric vehicles.¹⁷ This means that regardless of America's mining and manufacturing capabilities in the relevant sectors, it must still often ship the minerals to China for processing. For instance, the United States today relies on China, its primary geopolitical rival, to process the rare earth minerals needed to manufacture its advanced weapons systems.

Production of many energy transition minerals today is more geographically concentrated than that of oil or natural gas



Notes: LNG = liquefied natural gas; US = United States. The values for copper processing are for refining operations. Sources: IEA (2020a); USGS (2021), World Bureau of Metal Statistics (2020); Adamas Intelligence (2020).

¹⁷ "The Role of Critical Minerals in Clean Energy Transitions," IEA, May 2021

Chinese companies also have substantial control over the mining of these minerals even though the bulk of reserves is in other countries. Below are two examples:

Cobalt: Both China and the United States produce virtually no cobalt within their borders. The Democratic Republic of the Congo currently accounts for over 70% of the world's supply.¹⁸ China controls nearly half of that country's output.

Lithium: While China produces only about 9% of the world's lithium (versus 1–2% for the United States), it has acquired significant equity positions in local companies and/or mining operations in the major producer states.¹⁹

LITHIUM	
Argentina	Bolivia
PRODUCTION: 10%	PRODUCTION: None
RESERVES: 14%	RESERVES: Believed to be among the world's largest
CHINA'S INFLUENCE: Stakes in 41% of major planned projects accounting for 37% of reserves	CHINA'S INFLUENCE: Stakes in 100% of development via an equity agreement
Australia	Chile
PRODUCTION: 58%	PRODUCTION: 21%
RESERVES: 19%	RESERVES: 57%
CHINA'S INFLUENCE: Stakes in 61% of production	CHINA'S INFLUENCE: Stakes in 67% of Chile's output

Source: "Mining the Future," Foreign Policy, May 2019

If the United States fails to make significant progress to build up its own domestic supply chain capacity, transitioning to green energy will in effect imply trading oil and gas independence for dependence on China for key inputs. In our opinion, this means Washington will have no choice but to try to implement measures to rebuild domestic mineral production and processing capacity in relevant areas, even if it entails higher costs in the near term. But as the following section illustrates, increasing domestic production substantially will not be easy.

America's attempt to expand lithium mining runs into resistance

Even though the United States has significant reserves of lithium, it has only one active large-scale mine (in Nevada) producing 5,000 tons a year. This means that most of the 35,000 tons of lithium that America uses annually, an amount projected to increase significantly over the next decade, must be imported.²⁰

Attempts to increase domestic production by opening a second mine in Nevada have run into two obstacles:

1. Many Native Americans and ranchers living nearby oppose the project for the impact it would have on the local environment. The mining process involves extracting lithium by mixing clay dug out from the mountainside with as much as 5,800 tons a day of sulfuric acid. Over the projected 41-year life of the mine, 354 million cubic yards of mining waste would be created.²¹ To put this into perspective, one cubic yard equals about 765 litres of water.
2. The U.S. Fish and Wildlife Service found that a rare wildflower growing in the targeted region was entitled to protection under the Endangered Species Act. The mining project now has until September 30 to submit a proposal for doing this.²²

¹⁸ "Green trend stirs copper and nickel markets as supply tightens," Nikkei Asian Review, November 30, 2020

¹⁹ "The Commanding Heights of Global Transportation," Securing America's Future Energy, November 2020

²⁰ "Biden's Green Energy Dilemma On Critical Minerals," Forbes, May 25, 2021

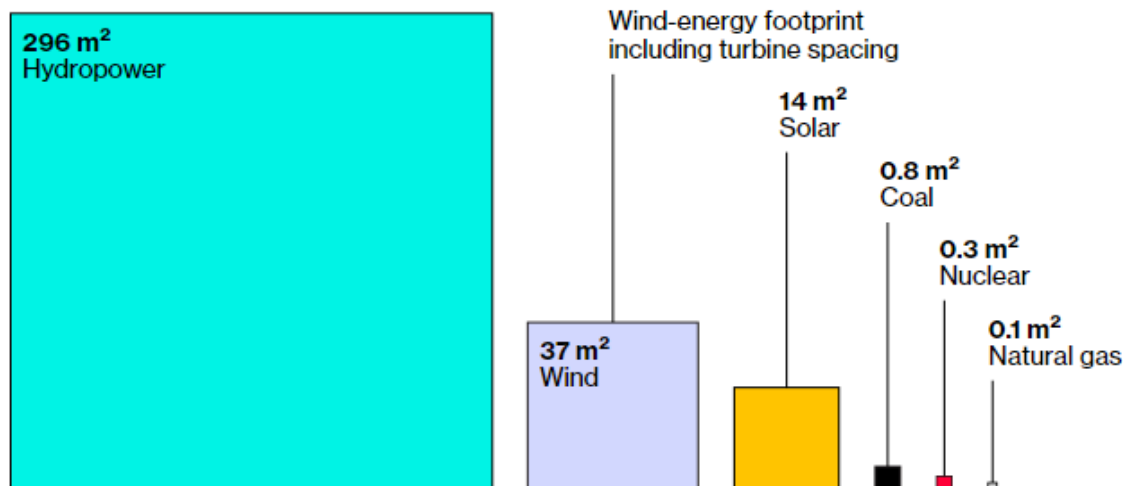
²¹ "The Lithium Gold Rush: Inside the Race to Power Electric Vehicles," New York Times, May 6, 2021

²² "Wildflower and lithium mine compete for space in Nevada desert," Associated Press, June 4, 2021

Acquiring land yet another challenge

Local resistance also stems sometimes from the fact that wind farms, solar plants and other forms of clean power take up far more space on a per-watt basis than their fossil-fuel-burning counterparts. For example, a 200-megawatt wind farm requires installing turbines over 49 square kilometres, whereas a natural gas power plant with the same generating capacity fits on a single city block.²³

Power Densities: Renewables Need More Space Land area needed to power a flat-screen TV, by energy source



Sources: Leiden University, John van Zalk, Paul Behrens
Note: Assumes 100-watt television operating year-round

Source: "The U.S. Will Need a Lot of Land for a Zero-Carbon Economy," BusinessWeek, April 29, 2021

Not in my backyard: opposition to electricity projects in the United States

Local residents and environmental groups often oppose these projects because they want to keep the land unspoiled and protected for endangered species. Below are three specific examples:

- A proposed solar plant by California-based Arevia Power about 50 miles from Las Vegas is being opposed on account of its potential impact on the local environment. The project would cover 14 square miles of land with more than a million solar panels 10–20 feet tall.
- Another proposed solar plant in Nevada by the same company is opposed by several environmental groups, including the Sierra Club, because it would endanger a tortoise habitat.²⁴ The 7,100-acre project would generate 690 megawatts of electricity.²⁵
- More alternative energy means expanding the electricity grid. Unfortunately, many people do not want to live near high-voltage wires. For instance, New Hampshire refuses to serve as a path for Canadian hydropower to reach Massachusetts, and a referendum is to be held in Maine soon on this very issue.²⁶ "In America a transmission line must receive approval from each state it crosses and, in some states, approval from each county. The result is that [even when successful] such projects can take more than a decade to build."²⁷

²³ "The U.S. Will Need a Lot of Land for a Zero-Carbon Economy," BusinessWeek, April 29, 2021

²⁴ "Solar Power's Land Grab Hits a Snag: Environmentalists," Wall Street Journal, June 4, 2021

²⁵ "Trump administration says it will approve largest U.S. solar farm," Los Angeles Times, January 1, 2020

²⁶ "The Electrification of Everything: What You Need to Know," Wall Street Journal, May 15, 2021

²⁷ "The bottlenecks which could constrain emission cuts," The Economist, June 12, 2021

These disputes have the potential to tie up solar and wind projects in regulatory reviews or court battles for years. For example, a wind project to be built off the coast of Martha's Vineyard recently received the go-ahead from the Interior and Commerce Department 12 years after being proposed.

To increase its chances of meeting environmental targets, the Biden administration will have to do something that its environmental supporters might find uncomfortable, which is to speed up the permitting process for key green energy projects.

A Carbon border tax is being proposed as way to stay competitive

Another challenge related to implementing strict climate regulations is how to compete with countries that have less stringent environmental regulations. The solution being proposed by some countries to level the playing field is a carbon border tax (CBT) on imports from regions with laxer climate standards.

The European Commission will reportedly propose a CBT in July to go into effect in 2023. It will apply initially to steel, iron, cement, fertilizers, aluminum, and electricity.²⁸ Imports from these sectors would be required to participate in the European Emissions Trading System. **While EU members are divided on many issues, there is strong support in favour of a cross-border tax.**

Indeed, certain European industrial groups, such as steel producer Mittal, have stepped up calls for the EU to hasten the introduction of a CBT so that they can remain competitive vis-à-vis foreign competitors based in regions with lower environmental standards.²⁹

As for the United States, it has recently stated that a CBT is one of several regulatory approaches under consideration to address the issue of imports from regions with lower environmental standards. Biden supported this policy during his campaign for president.

However, such a tax would present its share of complications. For starters, poorer countries will argue that they contribute a far smaller volume of greenhouse gas emissions per capita than richer industrialized countries do and, therefore, should not be penalized. Second, figuring out how much carbon is in each product and which country's imports to target would be very challenging from both a technical and political perspective. This underscores the risk of seeing companies contest the accuracy of the carbon footprint ascribed to their products.

Yet another challenge is how to reconcile the Paris Climate Accord with a carbon border tax. The Paris agreement allows less stringent targets for developing countries, while a CBT in theory would punish these very same countries for having weaker standards.

Despite these challenges, we feel that many developed countries will implement a CBT to lower the risk of a political backlash associated with concerns that climate regulations are rendering domestic industries uncompetitive. Martin Callanan, U.K. minister for climate change, recently stated that without a carbon border tax: "There is a big danger that we make ourselves uncompetitive."³⁰

As for China, the fact that its exports tend to be more carbon intensive on account of high coal usage and that geopolitical relations with the West are deteriorating makes it vulnerable to being targeted by CBTs.

What does green transition mean for the oil sector?

Oil companies in the West have been facing growing pressure from environmentalists, investors, and politicians regarding climate change. On the legal front, the United Nations has estimated that the number of climate-related litigation cases increased from 884 in 24 countries in 2017 to 1,550 in 38 countries by the end of 2020.³¹

Recent events that have garnered significant media attention include ExxonMobil, Chevron and Royal Dutch Shell all losing legal cases or shareholder votes forcing them to take a more aggressive approach to cutting emissions. These companies are unlikely to be able to achieve this goal without cutting production.

²⁸ "LEAK: EU's carbon border tariff to target steel, cement, power," EURACTIV, June 3, 2021

²⁹ "Who will pay? Europe's bold plan on emissions risks political blowback," Financial Times, June 1, 2021

³⁰ "U.K. Considers Carbon Border Tax to Protect Domestic Industry," Bloomberg, May 28, 2021

³¹ "Climate litigation spikes, giving courts an 'essential role' in addressing climate crisis," UN, January 26, 2021

Indeed, even before these rulings, Exxon had announced its intention to maintain production at its lowest level in two decades until at least 2025, while BP indicated that it would cut its oil and gas production by 40% by the end of this decade.

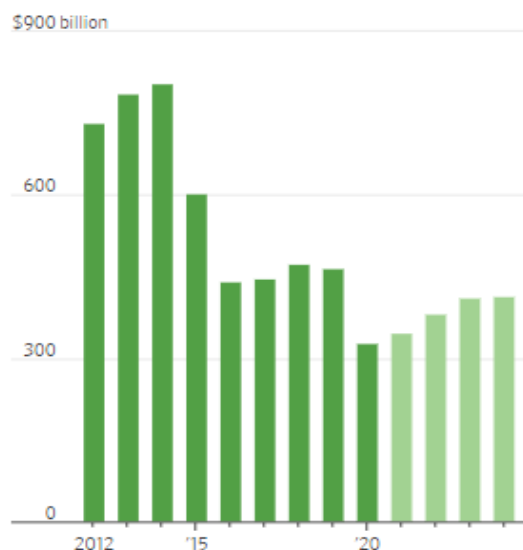
Some analysts are warning that this new regulatory landscape risks starving fossil fuel production before the global economy has managed in large part to transition to renewable energy sources. Despite the fast-growing market share of alternative energy, fossil fuels are still being used to meet over 80% of global energy demand.

Global capital investments on oil production has declined significantly

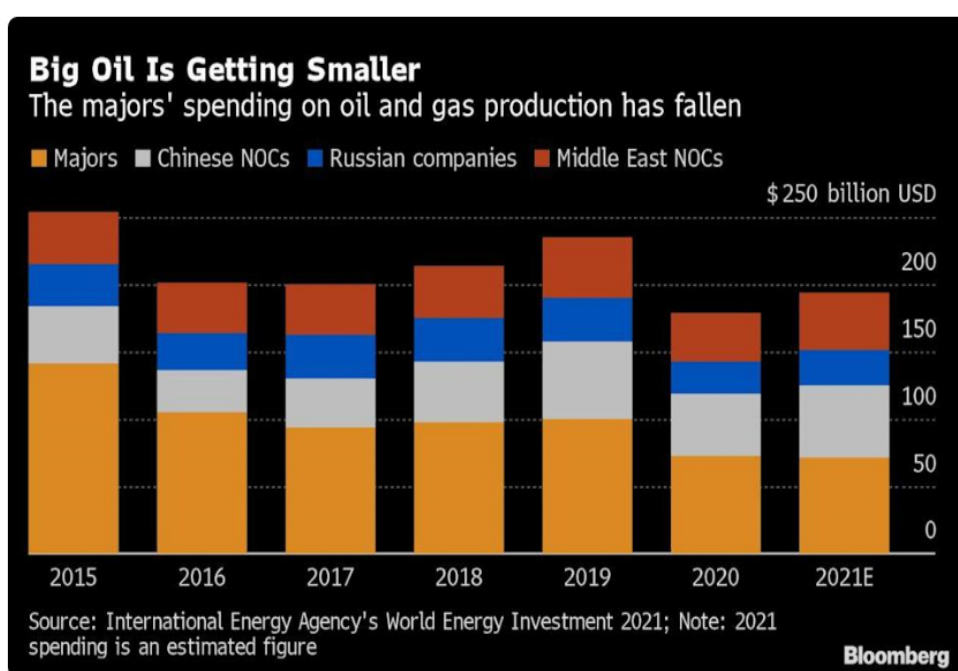
As recently as 2014, oil investments by the world's energy companies totalled about \$807 billion. Consulting firm Wood Mackenzie has projected it will be only \$348 billion in 2021, which is only a bit more than the year before.

The chart on the left focuses on total global spending for oil extraction, while the one on the right compares the spending levels for oil and gas production by the West's seven largest publicly traded oil companies to their state-owned counterparts in China, Russia, and the Middle East.

Annual global spending on oil extraction



Note: Figures beyond 2020 are projections
Source: Wood Mackenzie



Sources: "Oil Price Hits Pandemic High as Investors Bet on Green Energy," Wall Street Journal, June 14, 2021 & "The Retreat of Exxon and the Oil Majors Won't Stop Fossil Fuel," Bloomberg, June 9, 2021

OPEC and Russia positioned to take advantage of new regulatory landscape, at least until demand for oil begins to drop

While most of the legal and regulatory pressure has been directed at the West's seven largest publicly traded oil companies, it is important to note that they control only about 15% of global oil output, versus 40% for OPEC and Russia,³² and a 50% market share for national oil companies worldwide.³³ These countries and their state-owned firms tend to place a much heavier emphasis on production and revenues than on environmental concerns. This means that, until global demand for oil begins to decline, production will likely shift from Western oil companies to regions with state-dominated oil sectors.

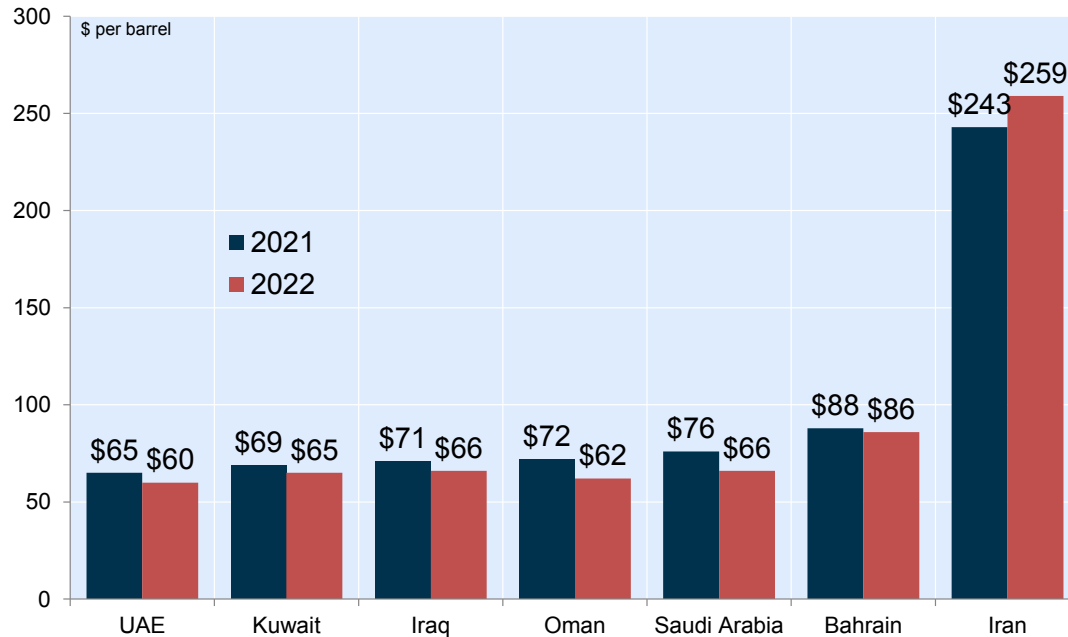
According to some analysts, this demand will continue to increase for at least another decade, while others argue that past projections have often proven to be wrong and breakthrough technologies will bend the demand curve for oil much sooner than widely anticipated.

³² "OPEC, Russia seen gaining from climate activist wins," Reuters, June 1, 2021

³³ "The Retreat of Exxon and the Oil Majors Won't Stop Fossil Fuel," Bloomberg, June 9, 2021

While some OPEC members have spare capacity to bring online, they might be in no rush to crank up production. This is because the current price of oil is finally allowing them to come close to balancing their budgets without further draining their foreign reserves.

The fiscal breakeven oil price for major Middle Eastern countries



NBF Economics and Strategy (data via IMF)

Conclusion: Reality check

From a geopolitical perspective, the ambitious environmental targets adopted by many countries, particularly in the West, places them between a rock and a hard place.

On the one hand, the long lead times associated with building up energy and mining infrastructure means that the greater the effort to meet environmental targets in the near term, the higher the likelihood that these Western countries will become even more dependent on China's green energy supply chains.

On the other hand, if the United States and Europe decide to transition more slowly in order to give their domestic supply chains time to reach a critical mass, they will likely miss their environmental targets by a very wide margin.

Meanwhile, the cost of implementing stricter climate regulations will likely lead more and more developed countries to conclude that a carbon border tax is necessary to level the playing field. Indeed, maintaining political support for stricter climate regulation over the long term will depend on investment not migrating abroad to regions with weaker environmental regulations.

Finally, while alternative energy's growing market share will ultimately erode demand for oil in the longer term, over the next few years regulatory and legal impediments preventing Western oil companies from producing more oil, combined with a longer transition to alternative energy than many people expect, will translate into more volatile and tighter markets pushing oil prices higher.



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