



BUMPS IN THE ENERGY TRANSITION

Despite a growing global consensus, obstacles to reducing net carbon emissions to zero are stark

Daniel Yergin

The global disruptions in energy markets and the war in Ukraine have added impetus to the push for renewable energy and the drive toward net-zero carbon emissions. Yet, even as the global consensus around the energy transition becomes stronger, the challenges to that transition are also becoming clearer.

In addition to the uncertain pace of technological development and deployment, four issues in particular stand out:

- The return of energy security as a prime requirement for countries
- Lack of consensus on how fast the transition should and can take place, in part because of its potential economic disruptions
- A sharpening divide between advanced and developing countries on priorities in the transition
- Obstacles to expanding mining and building supply chains for the minerals needed for the net-zero objective

The *need for energy security* was a concern that had largely faded over the past several years. The energy shock, the economic hardship that ensued, skyrocketing energy prices that could not have been imagined 18 months ago, and geopolitical conflicts—all these have combined to force many

governments to reassess strategies. This reassessment recognizes that the energy transition needs to be grounded in energy security—that is, adequate and reasonably priced supplies—to ensure public support and avoid severe economic dislocations, with the dangerous political consequences that can follow.

The current global energy crisis did not start with the February 2022 invasion of Ukraine. Rather, it began in late summer of 2021. The economic rebound that came with the ending of the global COVID-19 lockdowns fired up global energy consumption. Oil, natural gas, and coal markets all tightened in the latter part of 2021, sending prices up as demand pushed against what became apparent—insufficient supply. It was in November 2021, three months before the invasion, that the US government announced the first release from its strategic petroleum reserve. What has become clear is that “preemptive underinvestment” has constrained the development of adequate new oil and gas resources. There are a number of reasons for this underinvestment—government policies and regulations; environmental, social, and governance (ESG) considerations by investors; poor returns caused by two price collapses in seven years; and uncertainty about future demand. The shortfall in investment was “preemptive” because

Energy transitions throughout history

The first energy transition was from wood to coal in the 18th century. Although coal was used as early as the 13th century in Britain because the cost of wood had gone up, it emerged as a distinctive industrial fuel only in January 1709—when English metalworker Abraham Darby proved that coal was, as he said, “a more effective means for iron production” than wood. He noted, though, that “there are many who doubt me foolhardy.”

Yet energy transitions have hardly been swift. Although the 19th century is known as the “century of coal,” that century actually still ran, in the words of energy scholar Vaclav Smil, on “wood, charcoal, and coal residues.” It was not until 1900 that coal supplied half the world’s energy demand.

Oil was discovered in the United States in 1859. More than half a century later, on the eve of World War I, then First Lord of the Admiralty Winston Churchill directed the conversion of the Royal Navy from coal to oil for technological

reasons—speed, flexibility, ease of refueling, and the elimination of crews shoveling coal. But it took until the 1960s, a century after it was discovered, for oil to overtake coal as the world’s number one energy source.

Until now, energy transitions have unfolded over long periods of time (see “Picture This” in this issue of F&D). They also have really been energy additions rather than transitions. In the six decades since oil overtook coal as the world’s number one energy source, the global consumption of coal has almost tripled.

The current climate-driven energy transition is meant to be achieved quickly—in little more than a quarter century. And it is meant to be transformative. Coal is to disappear, and the European Union anticipates that hydrogen will provide 20 to 25 percent of its total energy by 2050. While it is the focus of increasingly intense activity and ambition, hydrogen provides less than 2 percent today.



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of what was mistakenly assumed—that sufficient alternatives to oil and gas would already be in place at scale by now. Some have described what is currently unfolding as the “first energy crisis of the energy transition”—a mismatch between supply and demand. If it does prove to be only the first, future such crises will create uncertainty, cause major economic problems, and undermine public support for the energy transition.

Speed of the transition

If energy security is the first challenge of the transition, *timing* is the second. How fast should it—and can it—proceed? There is much pressure to accelerate a significant part of the 2050 carbon emission targets toward 2030. But it sometimes seems that the scale of what is being attempted is underestimated.

In my book *The New Map* (2021), I looked at the previous energy transitions, and it is clear that this one is like no other. All previous transitions were driven largely by economic and technological advantages—not by policy, which is the primary driver this time. Each of the preceding transitions unfolded over a century or more, and none were the type of transition currently envisioned. The objective of this transition is not just to bring on new energy sources, but to entirely change the energy foundations of what today is a \$100 trillion global economy—and do so in little more than a quarter century. It is a very big ambition, and nothing on this scale has ever been attempted up to now.

Some have warned that because the scale of the transition is so large and far-reaching, the macroeconomic impact needs deeper analysis. The economist Jean Pisani-Ferry, cofounder of Bruegel, Europe’s leading economic think tank, has observed that accelerating the targets for net carbon

emission reductions too aggressively could create much larger economic disruptions than generally anticipated—what he called “an adverse supply shock—very much like the shocks of the 1970s.” Such a transition, Pisani-Ferry presciently wrote in 2021, just before the current energy crisis began, is “unlikely to be benign and policymakers should get ready for tough choices.” He subsequently added, in 2022: “Climate action has become a major macroeconomic issue, but the macroeconomics of climate action are far from the level of rigor and precision that is now necessary to provide a sound basis for public discussions and to guide policymakers adequately. For understandable reasons, advocacy has too often taken precedence over analysis. But at this stage of the discussion, complacent scenarios have become counterproductive. The policy conversation now needs methodical, peer-examined assessments of the potential costs and benefits of alternative plans for action.”

North-South divide

The third challenge is the *emergence of a new North-South divide*—a sharpening difference between developed and developing countries on how the transition should proceed. The original North-South divide of the 1970s was a collision between developed and developing nations over the distribution of wealth and, in particular, the pricing of commodities and raw materials. That division faded with globalization and advances in technology, as reflected in the shift in nomenclature to “emerging market” nations.

The new North-South divide reflects disagreement over climate and transition policies, their impact on development, and who is responsible for cumulative and new emissions and who pays. The global commodity shocks triggered by the



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war in Ukraine and the interest rate increases and currency devaluations that have ensued have only deepened the pressures on developing countries.

For developing countries, what seems a singular emphasis on reducing emissions needs to be balanced against other urgent priorities—health, poverty, and economic growth. Billions of people still cook with wood and waste, resulting in indoor pollution and poor health. Many of these countries are looking to increased use of hydrocarbons as integral to raising standards of living. As former Indian Petroleum Minister Dharmendra Pradhan put it, there are multiple paths for energy transitions. India, while making a big commitment to renewables, is also building a \$60 billion natural gas distribution system. Developing countries are seeking to initiate and expand the use of natural gas to reduce indoor pollution, promote economic development and job creation, and, in many cases, eliminate the emissions and pollution that come from burning coal and biomass.

There may be a tendency in countries with advanced economies to wave away this divide, but the reality was sharply captured in September 2022, when the European Parliament voted, in an unusual expression of extraterritoriality, to condemn a proposed oil pipeline from Uganda through Tanzania to the Indian Ocean. The parliament denounced the project for what it said would be the pipeline’s detrimental impact on climate, environment, and “human rights.” The parliament is headquartered in France and Belgium, where the per capita income is about 20 times greater than in Uganda. Not unexpectedly, the condemnation set off a furious reaction in Uganda, where the pipeline is viewed as crucial to economic development. The deputy speaker of the parliament

denounced the European resolution as “the highest level of neocolonialism and imperialism against the sovereignty of Uganda and Tanzania.” The energy minister added, “Africa has been green, but people are cutting down trees because they are poor.” The national student union in Uganda took to the streets to demonstrate against the European Parliament, with one of the student leaders saying, “The Europeans have no moral superiority.” Whatever the specific issues, it’s hard to deny the sharp difference in perspectives.

The split is particularly evident when it comes to finance. Western banks and multilateral financial institutions have shut off finance for pipelines as well as for ports and other infrastructure related to hydrocarbon development. One African energy minister summed up the impact of the denial of access to finance as akin to “removing the ladder and asking us to jump or fly.” Finding a balance between the perspectives of the developing world, where 80 percent of the globe’s population live, and Western Europe and North America will take on increasing urgency.

Finance shut off

The fourth challenge will be *ensuring new supply chains for net zero*. The passage in the United States of the Inflation Reduction Act, with its massive incentives and subsidies for renewable sources of energy; the REPowerEU plan in Europe; and similar initiatives elsewhere will accelerate the demand for the minerals that are the building blocks for renewable energy, which requires wind turbines, electric vehicles, and solar panels, among other things. A host of organizations—the IMF, the World Bank, the International Energy Agency (IEA), the US government, the European Union,

Japan—have all issued studies on the urgency of those supply chains. The IEA projects that the world economy will be moving from “a fuel intensive to a mineral intensive energy system” that will “supercharge demand for critical minerals.” In *The New Map*, I summarize this as the move from “Big Oil” to “Big Shovels.”

S&P Global, the financial and analytical firm of which I am vice chairman, has sought to build upon those studies and quantify what that “supercharged demand” for minerals might be. S&P Global’s study “The Future of Copper: Will the Looming Supply Gap Short-Circuit the Energy Transition?” (2022) focused on that metal because the thrust of the energy transition is toward electrification, and copper is “the metal of electrification.” The study took the types of year 2050 targets advanced by the US administration and the EU and assessed what realizing those targets would require for specific applications—for instance, the different components of an offshore wind system or electric vehicles. An electric car, for example will require at least two-and-a-half times more copper than a vehicle with a conventional internal combustion engine. The conclusion of this analysis is that copper demand would have to double by the mid-2030s to achieve the 2050 goals

The choke point is supply. At the current rate of supply growth—which encompasses new mines, mine expansion and greater efficiency, and recycling, as well as substitution—the amount of copper available will be significantly smaller than the copper supply requirements. For instance, the IEA estimates that it takes 16 years from discovery to first production for a new mine. Some mining companies say more than 20 years. Permitting and environmental issues are major constraints around the world. Also, copper production is more concentrated than, say, oil. Three countries produced 40 percent of world oil in 2021—the United States, Saudi Arabia, and Russia. Just two countries produced 38 percent of copper—Chile and Peru.

Copper is crucial

Copper prices have fallen about 20 percent from their high point this year. That reflects the metal’s oft-noted role as “Dr. Copper”—its price as a predictor of economic slowdowns and recessions. And indeed, the IMF sees a sharp slowdown in global

growth in 2022 and projects further slowing in 2023 and potential recession—as do many other forecasters. But, post-recession, the coming flood of demand from the energy transition will cause copper prices to rise again. As has been the historical pattern, the surge in demand and prices will likely create new tensions between resource-holding countries and mining companies, which in turn will affect the rate of investment. Moreover, as the race to net zero intensifies, there is a risk that the competition for minerals will become caught up in what has become known as the “great power competition” between China and the United States.

S&P Global’s copper study is meant to contribute to a deeper analysis of the physical challenges to the energy transition. The wind industry has what a 12th century English champion of windmills called “the free benefit of wind.” And solar has the free benefit of the sun. But the physical inputs that go into harnessing wind and solar power are not costless. The effort to push a significant part of the 2050 goals toward 2030 will likely have to contend with significant physical constraints.

These four challenges—energy security, macroeconomic impacts, the North-South divide, and minerals—will each have significant effects on how the energy transition unfolds. None are easy to grapple with—and they will interact with each other, which will compound their impacts. But recognizing them will promote deeper understanding of the issues and requirements in seeking to achieve the energy transition. **FD**

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References:

Pisani-Ferry, Jean. 2021. “Climate Policy Is Macroeconomic Policy, and the Implications Will Be Significant.” Peterson Institute for International Economics Policy Brief 21-20, Washington, DC.

Pisani-Ferry, Jean. 2022. “The Missing Macroeconomics in Climate Action.” In *Greening Europe’s Post-Covid-19 Recovery*, edited by S. Tagliapietra, G. Wolff, and G. Zachman, Brussels: Bruegel.

S&P Global. 2022. “The Future of Copper: Will the Looming Supply Gap Short-Circuit the Energy Transition?” New York.

Yergin, Daniel. 2021. *The New Map: Energy, Climate, and the Clash of Nations*. New York: Penguin.