# Energy Transition Fantasies

*A story of tough sledding.*

**By Philip K. Verleger, Jr.**

The mad rush to a world in which fossil fuels would have been abandoned—the "transition"—has stalled. This development reflects Stein's law, which the late Herbert Stein first expounded in 1996: "If something cannot go on forever, it will stop." The urgent movement by environmental activists to transition the energy sector and eliminate greenhouse gas emissions by 2050, while not stopped, has at least been dramatically slowed.

Six years ago, the cover of the Spring 2018 issue of *TIE* pictured a dilapidated gasoline pump entangled in vines. In the opening symposium, eighteen economic authorities were asked to opine on whether the end of carbon fuels was on the horizon. The introduction quotes author and Silicon Valley entrepreneur Tony Seba, who, they note, had predicted that by 2030, all new energy would be provided by solar and wind, all new autos would be electric, and oil, gas, and coal would be obsolete.

Months later, Seba gave a keynote address at an Massachusetts Institute of Technology conference that began this way:

"It's over, people!" Seba said. "Solar and wind power plus storage is already the cheapest by far." As a result, he said, these greenhouse-gas-free options will inevitably take over the energy market, for purely economic reasons.

Rebutting Seba's expectation, a comment by Martin Neil Baily in *TIE*'s Spring 2018 "End of Carbon Fuels?" symposium accurately anticipated the true nature of the transition from 2018 to 2024:

> *Despite the technological progress made in renewables, fossil fuels will continue to be widely used for a long time. It is difficult and costly to operate the transportation*

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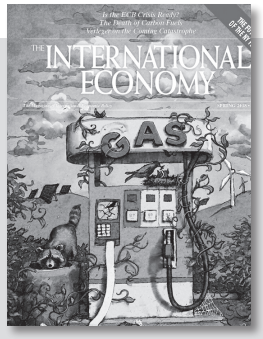


## Baily's Winning Forecast

A comment by Martin Neil Baily in *TIE*'s Spring 2018 "End of Carbon Fuels?" symposium accurately anticipated the true nature of the transition from 2018 to 2024:

> *Despite the technological progress made in renewables, fossil fuels will continue to be widely used for a long time. It is difficult and costly to operate the transportation infrastructure without fossil fuels. Airplanes and heavy trucks will continue to use them indefinitely.*
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> *There are barriers to the rapid expansion of renewables, such as finding enough cobalt and lithium for batteries and manufacturing them at sufficient scale. Meanwhile, the technology of finding and developing fossil fuels is also improving rapidly, keeping down their prices. Coal power will gradually disappear in the United States, but oil and gas will remain cost-effective and coal will continue to be used in developing countries, absent a policy shift.*

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Baily's comment was prophetic. Progress on the energy transition has stalled despite it being a prominent topic of academic, scientific, policy, and public discussions for several years. A Google search on it yields more than 101 million results. This interest was sparked initially by the 2015 Paris Accords, which called on the world to eliminate net emissions of global warming gases. The International Energy Agency promoted further interest in 2021 when it called on the oil industry to suspend exploration for oil and gas reserves, a call rejected by OPEC, multinational oil companies, and other principal oil-exporting countries.

The IEA, energy companies, and research organizations have now published forecasts with various scenarios designed to achieve the Paris goal. The Energy Transitions Commission, a nonprofit organization originally funded by Shell Oil, has also issued reports.

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An important 2019 Brookings Institution study funded by the U.K. government draws on lessons from historical technical transitions such as the shift from horses and buggies to automobiles and from coal to gas to propose business and government actions for "accelerating deep decarbonization of the world economy." For supporting data and research, the study draws on ETC analyses and the vast literature developed by economists and scientists at the International Institute for Applied Systems Analysis. The authors—David Victor, Frank Geels, and Simon Sharpe—describe a specific, almost mechanistic, three-phase process for successful adoptions of new technologies: invention, diffusion through markets, and reconfiguration of socioeconomic systems. Other studies develop and apply similar models.

Some have used the Brookings approach to predict the expanding market penetration of electric vehicles. Recent data on EV sales have confounded these projections, though, with volumes falling well under forecast levels in the United States, Europe, and China.

The decrease in EV sales highlights a key failing of most, if not all, energy transition analyses because the authors misunderstand the underlying economics of technical change. History reveals that a few key factors determine the fate of an innovation. I identified these factors from my review of numerous important transitions, beginning with the Industrial Revolution and progressing to more specific examples such as commercial supersonic air travel, synthetic fuel production, and the advent of disposable diapers and digital photography. Some of these efforts succeeded; some did not.

Ultimately, my review suggests that the net-zero goal set in Paris in 2016 may be unachievable if present policies are not altered.

Three years ago, I wrote in these pages that the energy transition would occur "At the Speed of Light" (Spring 2021). I offered several suggestions that, if employed, could hasten the change. None have been adopted. Instead, the Biden administration and the European Union have blundered ahead, making one mistake after another. According to Reuters, at the recent CERAWeek conference in Houston, Shell's CEO accused government bureaucracy of slowing needed development of renewables. At the same meeting, Saudi Aramco's CEO asserted, "We should abandon the fantasy of phasing out oil and gas … [and instead] … invest in them adequately, reflecting realistic demand assumptions."

Today, those promoting a rapid transition away from fossil fuels are repeatedly seeing their efforts frustrated. According to the Global Sustainable Investment Alliance, investment in sustainable assets declined by 14 percent from 2022 to 2023. And the *Financial Times* has reported that oil industry executives believe "consumers are unwilling to pay the costs associated with a rapid shift to wind and solar energy."

The conclusion that consumers do not want to pay the costs of change should not be surprising. History shows that transitions can occur quickly if both producers and consumers embrace them. Such examples occur rarely and never happen unless the innovation produces a large reduction in user costs.

The switch from film to digital photography offers an example. Camera manufacturers moved rapidly to digital because they saw a sales opportunity. Consumers and professional photographers did so because their customers welcomed the almost instantaneous availability of images. The shift to digital photography allows pictures to be transmitted to editors in minutes.

Lower prices or costs also accelerate transitions. Low costs are, in fact, the key. Natural gas suppliers used price and cost incentives to convince home, apartment, and office building owners to switch from coal. Airlines used lower fares to induce travelers to fly from North America to Europe rather than sail on ships, although these efforts were slowed initially by regulations limiting tourist flights. Consumers quickly replaced landlines with mobile phones once mobile telephony became less expensive.

I note, though, that organizational inertia can slow transitions and/or raise costs. Railroads' mechanical and engineering staff had built facilities to maintain steam locomotives. They resisted diesel engines because they were an entirely different motive system that required support staff retraining and facility retooling. Hence, it took decades for diesel locomotives to replace their steam counterparts.

The difficulties associated with adopting new technologies are often blissfully overlooked by environmentalists who believe in a quick energy transition. For example, the Brookings study mentioned above describes the rapid replacement of horses by diesel tractors in the United Kingdom between 1930 and 1940 to illustrate, in the authors' view, the rapid penetration of a new technology. The example is silly. The use of diesel tractors on English farms probably represented less than one-tenth of 1 percent of diesel use. The real change was in ships and railroads. In both cases, the transition was slow because an entirely new type of mechanic needed to be trained and entirely new facilities constructed to service the diesel engines.

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The reference to British farming reveals a desperate effort by the proponents of rapid transitions to find examples to support their views.

The capacity to produce new technology also matters. Michael Porter in his Harvard Business School case study explains that the capability to make disposable diapers was limited at first. It took years for productive capacity to increase and, hence, for disposable diapers to penetrate markets. Initially, disposable diapers were also significantly more expensive than conventional cloth diapers. Over time, prices declined; only then were cloth diapers relegated to history for most families.

Economic regulations can also boost or doom a transition. The International Air Transportation Agency regulated global airfares during the transition from steamship travel to airplane travel. Its rules kept airfares high, causing most travelers to choose passenger ocean liners. Many European countries also limited the flights from the United States because their own airlines, almost all owned by the state, lacked capacity. Today, efforts to erect offshore wind

farms in the United States confront a 1920 law that requires the ships used in siting the wind turbines to be U.S.-built despite the lack of shipyards here.

Exorbitantly capital-intensive projects will almost always guarantee failure for a transition. The U.S. Synthetic Fuels Corporation was one such failure. The U.S. Congress funded the project with $20 billion in the Energy Security Act of 1980. The goal was to produce large amounts of synthetic natural gas and oil from coal and shale resources in Colorado. The effort failed because the synthetic fuels were more expensive than the conventional fuels they were meant to replace. The Synthetic Fuels Corporation was closed six years after coming into being.

Supersonic transports are another example of a major transition failure. In the 1960s, manufacturers in Europe, Russia, and the United States raced to produce supersonic aircraft. Their advocates argued that passengers who valued their time would pay higher ticket prices for faster travel. The U.S. supersonic transport, the Boeing 2707, never flew. Debuting its passenger service in 1977, the Russian Tu-144 flew until 1999, but its passenger service lasted less than a year, and it stopped flying commercial cargo in 1983. The French-British Concorde also made it to commercial service in 1976, which lasted until the aircraft was retired in 2003.

The failures of synthetic fuel and commercial supersonic transport occurred because their technologies could not compete in the open market. Both programs were backed by excellent research and organized engineering programs. Both, though, were undermined by markets. For example, the Boeing 747SP was introduced into service simultaneously with the Concorde. The subsonic SP could fly nonstop from Los Angeles to Australia or London to Tokyo faster than the Concorde due to the supersonic transport's limited range and frequent refueling requirements.

Government mandates can sometimes force transitions, especially if large corporations see a way to increase market power and profits. However, even mandates do not guarantee success.

Numerous industries have been forced to change their products or services by mandates. Broadcast television stations were required to replace analog with digital transmissions. Refiners were required to offer unleaded gasoline and low-sulfur diesel fuel to reduce air pollution. Recently, the International Maritime Organization required shipowners to install scrubbers or use low-sulfur bunker fuels.

Large ship owners embraced sulfur removal requirements to put undercapitalized firms out of business and thereby gain market power and the ability to raise prices. Refiners liked low-sulfur fuel regulations because they blocked foreign competitors from their markets and enabled them to boost margins.

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*Americans celebrate the repeal of the Eighteenth Amendment in 1933, making the production, importation, transportation, and sale of alcoholic beverages once again legal.*

## Public Mandates Often Fail

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Mandates imposed on the public, in contrast, often fail. The 1920 Volstead Act, enacted to enforce the Eighteenth Amendment's ban on producing, transporting, and selling liquor in the United States, offers a classic example. Economists Jeffrey A. Miron and Jeffrey Zwiebel estimate that the decline in alcohol use reported by the time of the amendment's repeal can be explained entirely by the increased costs associated with getting liquor.

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The attempt to lower U.S. speed limits to fifty-five miles per hour, begun by the Nixon administration after the Arab oil embargo, was also aggressively resisted and ultimately ignored.

The effort to get consumers to voluntarily switch from leaded to unleaded gasoline, implemented in the mid-1970s, failed as well. Transportation experts Daniel Sperling and Jennifer Dill reported that the oil refiners did not resist the unleaded rules. Instead, marketers believed "the new environmental consciousness would motivate demand for these fuels, even though unleaded gasolines were priced one to four cents per gallon higher than equivalent leaded gasoline." The marketers were wrong. Sales of low-lead products amounted to only 2 or 3 percent of purchases in 1971 and, as the authors reported, had grown only to 5 percent by 1974. Sales continued to lag for more than a decade, increasing only when the price difference became *de minimus.*

## GRIM PROSPECTS FOR THE ENERGY TRANSITION

The International Energy Agency's executive director, Fatih Birol, wrote in the *Financial Times* recently that we should pay attention to the good news on the transition. Real progress was being made, especially in clean areas "where technologies like solar, wind, and electric cars are increasingly replacing the need for fossil fuels and reining in emissions." He added that the key impetus was economics. For example, he asserted that it was "cheaper to build onshore wind and solar power projects than new fossil fuel plants almost everywhere worldwide."

Birol's optimism is misplaced because many of the programs being introduced to replace fossil fuels impose higher costs on consumers. History reveals that these proposals will fail unless governments impose taxes on the old technology or offer subsidies to the new to make the innovation less expensive.

For example, Birol carefully ignored the fact that much of the power produced by the low-cost wind and solar power projects he touts cannot get to customers because the transmission lines do not exist. Birol also ignores the impact of regulations. Californians learned this lesson recently when the state's Public Utility Commission dealt a serious economic blow to home solar panel installers by drastically reducing the amount homeowners might receive for "feedback" power sold to California utilities. The Public Utility Commission was more interested in the utility system's solvency than Birol's goal of eliminating all hydrocarbon emissions.

The situation in Europe is no different. The European Commission published a detailed study entitled "Grids, the Missing Link." In it, the Commission estimates that €584 billion will be required for electricity grids by 2030 and that this money must come from the private sector. Reporters Tom Wilson and Alice Hancock, commenting on the estimate in *Financial Times,* noted that funding for transmission lines usually comes from network tariffs charged to domestic customers. The money is not there today.

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In the United States, the problem for renewable power development is regulatory approvals. For example, work on an important system carrying power from Wyoming to Arizona, California, and Nevada took eighteen years from its initial proposal to begin. The delay resulted from the need to get permits from federal, state, and local governments and agreements from large private landowners.

Separately, the construction of the SunZia wind and transmission project to deliver power to Arizona's expanding market from New Mexico did not start until the end of 2023, sixteen years after the first permit was sought.

Simultaneously, electricity demand is surging, driven by the construction of data centers to support artificial intelligence and cryptocurrency computing requirements. The builders of these centers are pressuring utilities to provide needed power, in some cases prolonging the life of fossil fuel plants.

Electricity produced from renewable sources is seen as essential to the transition. Electricity will power the heat pumps that replace oil and natural gas-fired heating units in homes. Renewable electricity will produce steel and cement. Renewable electricity will also power most transportation.

This future may materialize. However, as I learned from my review of past transitions, this will happen only if the delivered cost of renewable power is less than the cost of alternatives. Today, such savings are not in sight.

Firms seeking to build new renewable generating facilities also confront financing difficulties. Some European firms sold power forward for ten or more years on commodity markets to fund their projects before Russia attacked Ukraine. These forward sales proved financially crippling when prices rose tenfold after the invasion, reaching €300 per megawatt hour at the peak. The lack of long-term contracts constrains investment.

Seba's 2018 assertion that "It's over, people" still applies—but not in the way he intended. Given the growth in power demand, the use of fossil fuels to provide electricity could increase for more than a decade due to the regulatory obstacles to building power lines and the reductions in payments for power produced by renewable sources.

The adoption of electric vehicles, once seen as a tidal wave that would overwhelm the world's legacy automakers, has slowed and even stalled in some areas. This was not expected. A feature in the August 8, 2017, issue of *The Economist* displayed an image of an internal combustion engine lying prone on the ground under the headline "roadkill." The editors made this comment:

> *The internal combustion engine has had a good run—and could still dominate shipping and aviation for decades to come. But on land electric motors will soon offer freedom and convenience more cheaply and cleanly.*

*The Economist* editors believed the "end for the machine that changed the world" was in sight, noting that "electric propulsion, along with ride-hailing and self-driving technology" might replace car ownership with "transport as a service." They added that the automobile industry could shrink by 90 percent, according to one estimate.

Seven years later, this commentary reads like a fantasy. Yes, there were early electric vehicle successes. Norway's effort stands out. In 2023, almost a quarter of the passenger cars registered there were electric, and EVs accounted for 82.4 percent of all new passenger cars sold. The country achieved these numbers by offering incentives to EV owners such as lower purchase taxes, lower parking charges, access to bus lanes in cities, and no toll payments on highways. These inducements made the costs of owning EVs less than those for conventional vehicles. As my research shows, such motivations facilitate a rapid transition.

Many have also highlighted the rapid increase in EV sales in China. In 2023, EVs accounted for 25 percent of all car sales there. Behind the sales surge was an aggressive price war that made electric cars and trucks less expensive than internal combustion engine vehicles. At the same time, however, EV and plug-in hybrid registrations accounted for only 5 percent of China's total registrations. The same source, ourworlddata.org, reports that EVs and plug-in hybrids accounted for just 2 percent of total global registrations in 2022, the latest year for which data are available. Most of the latter were undoubtedly plug-in hybrids rather than fully electric vehicles.

EV market penetration slowed in 2023 in many countries. The publication *InsideEVs* reported that German sales plunged 30 percent from the year earlier due to the end of tax incentives offered to business buyers. Sales dropped sharply in December 2023, a decline the *Wall Street Journal* attributed to the country's "abrupt cancellations of EV subsidies."

Again and again, one finds that EV penetration is tied to price. Sales jump when costs are lower due to price reductions or subsidies and privileges awarded to owners. Without lower prices or incentives, consumers stick with the old internal combustion-powered cars.

Prospects for hydrogen are even worse than those for EVs. The Biden administration has announced funding for a national zero-emission freight corridor. Hydrogen fueling stations will be built along the corridor to ensure fuel availability for heavy-duty hydrogen-powered trucks.

There is, though, a fundamental problem with using hydrogen as truck fuel, as the *Wall Street Journal* explains:

## Fantasy Predictions

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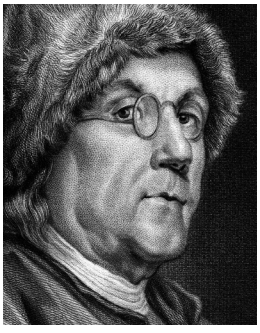
*Battery-electric and hydrogen fuel-cell big rigs start at about $450,000, triple the cost of a diesel truck. Truckers say they are only able to afford the rigs with subsidies from the state of California and local agencies such as the region's ports.*

It is hard to see how hydrogen or electric trucks will replace conventional diesels in the United States or any country absent generous government subsidies, given the industry's fragmented nature. Once again, transformation efforts will be slowed by the new technology being far more expensive than the old. Hydrogen trucks likely will suffer the same fate as the supersonic transports unless costs drop.

Other proposals to reduce emissions of global warming gases face even higher barriers. For more than a decade now, carbon capture has been advocated as a key solution by many in the fossil fuel industry. Yet at the March 2024 CERAWeek energy conference, ExxonMobil CEO Darren Woods, long a proponent of hydrogen, said his firm "won't move forward with one of the world's largest, low-carbon hydrogen projects if the Biden administration withholds tax incentives for natural gas-fed facilities," according to Kevin Crowley of Bloomberg.

Another reporter, Julie Hyman of *Yahoo Finance Live,* noted that Exxon has contracts with fertilizer maker CF Industries, steelmaker Nucor, and industrial gas manufacturer Linde to capture carbon dioxide from their facilities using carbon capture, utilization, and sequestration processes. The projects are due to become operational in 2025 and 2026. However, the report adds, the projects "aren't yet financially viable, many executives say—putting a big question mark around its future."



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From a historical perspective, carbon capture looks to be the twenty-first-century clone of synthetic fuels, a process that requires large governmental subsidies to become feasible. Absent a technological breakthrough, it is hard to see how it will offer significant long-term benefits.

Low prices for oil, natural gas, and coal are largely responsible for complicating and delaying the transition. A substantial price or cost advantage for a new technology is by far the best driver of change. The transition away from fossil fuels would be happening faster if their prices were high. Such conditions, however, have not materialized. Despite projections of high prices, crude oil and petroleum products have remained in a narrow range, well below predictions, as costs keep falling and supplies continue to increase. Natural gas prices have declined as well, falling to record lows in the United States when adjusted for inflation. Coal prices have also remained low.

Those hoping to speed up the transition cannot count on this situation to change. While the oil industry's future is not sunny, it certainly is not bleak. Over the next decade, prices are more likely to fall than rise because consumption will probably decrease modestly, eclipsing any supply reduction. This stable fossil fuel price environment will slow efforts to introduce new non-fossil-fuel technologies that cannot compete with oil, gas, and coal on price, especially projects that require substantive capital investment.

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Limited government resources will further slow the transition. Many projects aimed at reducing global emissions today can proceed only with significant government funding. Proponents of a rapid transition have, for example, been strong supporters of the 2022 U.S. Inflation Reduction Act, which offers various incentives for renewable energy projects that have an estimated worth of as much as $1.2 trillion.

Given current laws, the increased cost must be financed by debt. Phillip Swagel, director of the Congressional Budget Office, has warned that "ballooning federal debt" risks creating a financial crisis. This threat makes the adoption of additional programs like those authorized by the IRA unlikely. Indeed, further steps or actions may be taken that limit the scope of programs already sanctioned.

Fiscal constraints also affect programs in Europe. I noted the uncertainty regarding constructing additional electrical grid capacity above.

The much-advertised energy transition, then, confronts a future identified more than two hundred years ago by the American philosopher and statesman Benjamin Franklin. Franklin purportedly said, "One of the greatest tragedies of life is the murder of a beautiful theory by a gang of brutal facts." The approach to achieving the energy transition requires significant revisions. Adopting a significant tax on fossil fuel carbon content is one possibility. By making the economics of many new innovations more favorable, it would speed change. ◆