

At the Speed of Light

*The old shibboleths
about the slow
climate transition in
the energy sector are
about to be destroyed.*

BY PHILIP K. VERLEGER, JR.

The debate regarding the world's transition from a planet dependent on fossil fuels to one in which renewables dominate has suddenly emerged from the confines of turgid academia to front and center. The increased attention is not an accident.

Worries regarding human survival rise with each stunning, painful, and deadly environmental catastrophe. The February economic disaster inflicted on Texas by a polar vortex—which by historical standards should occur once in a hundred years but seems likely to become an annual event—only intensifies concerns.

Interest in the speed at which consumers and nations can reduce harmful global warming gas emissions escalates with each climate disruption. Discussion of how fast the world will shift from its reliance on fossil fuels to fuels and power sources that help reduce greenhouse gas emissions to net zero also rises with each event. The phrase “energy transition” is now widely used.

Reviewing the debate, one finds two schools of thought. One group believes fossil fuel consumption will linger for years. Some of its members even assert that oil and natural gas use will increase for two decades or more. Those who ascribe to the second school of thought believe fossil fuel use must and will fall quickly, with some of its members seeing consumption dropping by 20 or 30 percent by 2030.

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Some past events support the rapid decline view. This conclusion rests on a broad swath of economic history. Significant structural changes have occurred quickly in the past two centuries, causing consumers, enterprises, and governments to abandon perfectly good capital equipment and close profitable businesses. As IBM's centennial celebration advertisement stated, "Nearly all the companies our grandparents admired have disappeared."

The list of departed companies has grown since that ad came out on June 16, 2011. It now includes firms such as Eastman Kodak, Control Data, and Burroughs, among others.

The IBM copywriters might have used, but did not, this alternative headline: "Nearly all the technologies our parents used have disappeared or soon will." Indeed, anything powered by petroleum will join the extinct list swiftly, possibly followed by vehicles, electricity generating stations, and other equipment powered by natural gas.

Firms and individuals clinging to the slow transition view, primarily those with vested interests in fossil fuels, tell us the changeover will be gradual. As mentioned, some expect fossil fuel use to increase for at least another twenty years, even if that trend threatens our survival. The fossil proponents, who one might label "fossils" themselves, cite detailed historical studies, especially the work of Vaclav Smil, to support their assertion. They point to the fact that past displacements of established energy sources moved at a glacial pace. Therefore, they posit, the future dislocation will move at a similar speed despite fears that this delay will doom the planet.

Confronting the fossil fuel "defenders" today is a growing group of scientists, economists, engineers, investors, investment funds, and concerned individuals who believe we must act immediately to suppress hydrocarbon use. These advocates for change want nations to reduce harmful emissions

now to avoid a climate calamity. In support, they cite the increasingly shrill reports issued by the Intergovernmental Panel on Climate Change and other studies.

Often, discussions between the change advocates and the "old order" defenders come to dead ends. Neither group seems to listen to the other. Indeed, the two groups sometimes appear to be from different planets—Mars and Saturn, perhaps—each speaking a language the other does not understand.

Financial Times columnist Gillian Tett, a trained anthropologist with a Ph.D. from Cambridge University, described the negative impact of such self-imposed isolationism in *The Silo Effect*. The 2015 book is a great read, although a slow one for those not trained in the field. More importantly, her analysis and conclusions carry over to today's debate on the energy transition. In her introduction, Tett vividly explains her purpose in writing while referencing the 2008 financial crisis. In *The Silo Effect*, Tett sets out to determine why silos exist and propose ways to address the problem. Her effort is admirable, although a skeptic would conclude there is little chance of resolving this condition.

Here, though, I use Tett's observations to describe the mindset that plagues the energy transition issue. Today, most observers recognize the urgent crisis created by global warming. Even the strongest proponents of continued fossil fuel use predominantly recognize that greenhouse gas emissions must be reduced. Still, the "old order" defenders insist that fossil fuel use will keep increasing, and thus production must rise for ten, twenty, or thirty years to meet

The Railroad Example

Railroads have experienced the government's heavy hand in the United States, interventions that almost destroyed the rail industry here, while railroads in Asia and Europe benefited from massive government support.

U.S. railroads' post-war efforts to expand were constrained by government policies that favored other transportation modes. Massive public expenditures on airports, air traffic control systems, interstate highways, and interstate waterways provided substantial economic incentives to the railroads' competitors. Meanwhile, the nineteenth-century regulations created to control rail's monopolistic tendencies prevented the industry from evolving and avoiding the financial ruin that came in 1980.

—P. Verleger



Cash for Clunkers II

Establishing a second “cash for clunkers” program also could produce a considerable reduction in transportation sector emissions. The “cash for clunkers” idea was introduced by the Obama administration as part of a program to boost auto sales. The economic benefits of the program were not great.

A “cash for clunkers” program that rewarded internal combustion engine vehicle owners with a payment if they scrapped the vehicles and replaced them with electric vehicles would be much different from the Obama program because it would help society reduce emissions of global warming gases.

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global demand. Also, they assert that constraints that might limit higher fossil fuel consumption will slow economic growth dramatically. The transition, they warn, must proceed slowly and carefully.

United against the defenders from the advocates’ silo are scientists, economists, engineers, and environmentalists who assert that any adjustment short of a herculean effort to eliminate most fossil fuel use in ten or, at the latest, twenty years imperils humankind’s existence. Some of the group’s members want to starve the fossil fuel defenders of the capital needed to continue drilling and developing oil and gas reserves.

When I examined the issue closely, it seems the adjustment can take place rapidly in many areas. As explained below, the “slow and steady” promoters fail to account for economic factors such as deregulation that can accelerate change. Likewise, the change advocates seem not to

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Some “old order” defenders envision a slow transition away from fossil fuels because equipment manufactured and plants built to produce or consume energy must, once completed, stay in use until they wear out. This contrasts with investments in other businesses such as telecommunications, some manufacturing types, computers, or transportation in which equipment and devices can be easily and quickly abandoned. In his 2021 book, *How to Avoid a Climate Disaster*, Bill Gates explained the “Energy Investment Is Different” view by contrasting investments in software or vaccines with investments in energy:

Now compare both with the energy industry. First, you have huge capital costs that never go away. If you spend \$1 billion building a coal plant, the next plant you build will not be any cheaper. And your investors put up that money with the expectation that the plant will run for 30 years or more. If someone comes along with a better technology 10 years down the road, you’re not going to just shut down your old plant and build a new one. At least not without a very good reason—like a big financial payoff, or government regulations that force you to.

Gates’ thinking reflects the view of those who have followed and worked in the energy sector for decades, the “old order” defenders. In offering his conclusion, Gates references the work of Vaclav Smil.

Smil’s position is not unique. Sir Nicholas Stern warned in his monumental *The Economics of Climate Change* that, once built or manufactured, fossil

fuel-powered plants, equipment, and vehicles could operate for a prolonged time:

Power generation infrastructure typically has a very long lifespan, as does much energy using capital stock. Examples are given below.

Infrastructure	Expected Lifetime (Years)
Hydro Station	75++
Building	45+++
Coal Station	45+
Nuclear Station	30–60
Gas Turbine	25
Aircraft	25–35
Motor Vehicle	12–20

This means that once an investment is made, it can last for decades. A high-carbon or low-efficiency piece of capital stock will tend to lock the economy into a high emissions pathway. The only options are then early retirement of capital stock, which is usually uneconomic; or “retrofitting” cleaner technologies, which is invariably more expensive than building them in from the start. This highlights the need for policy to recognise the importance of capital stock replacement cycles, particularly at key moments, such as the next two decades when a large volume of the world’s energy generation infrastructure is being built or replaced.

There is a problem with this view. Investments made in any system, whether fossil fuels or other capital goods, become sunk costs once the project is completed. Financial theorists describe the decision to invest as exercising a real option. The investor always confronts the chance of a project becoming obsolete before it earns its expected return. In many cases, the investment must be scrapped far ahead of the end of its usefulness.

History is replete with transitions that have extended or cut short the lives of expensive capital equipment. Transportation offers one of the best examples. Railroads, steamship lines, and airlines provide helpful illustrations of how capital equipment lifespans can be lengthened or shortened by technical change, war, or economic circumstances. Rail, steamship lines, and airlines are capital intensive, like energy. All also have experienced massive technological shifts.

While the airline industry has benefited from large federal expenditures that contributed to its rapid growth,

the railroads have experienced the government’s heavy hand in the United States, interventions that almost destroyed the rail industry here, while railroads in Asia and Europe benefited from massive government support. Steamship lines lost to innovation subsidized by government spending and technical change. Thus, the occurrences in transportation demonstrate the influence a government and technological change can have in speeding or slowing transitions in capital-intensive industries.

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Joseph R. Daughen and Peter Binzen described the direct impact of federal programs on U.S. railroads in their 1971 book *The Wreck of the Penn Central*. In the volume, they chronicle efforts by investors and executives to salvage the Pennsylvania and New York Central railroads, two once-successful rail lines forced into bankruptcy following an ill-fated merger. They write, for example, that the highways sapped business from the Penn Central line:

By making it possible for cars and trucks to get from New York to Chicago without encountering a single traffic light, the government guaranteed problems for the Central and the PRR [Pennsylvania Railroad]. ... [W]ithin two years of the opening in 1954 of the New York Thruway from Newburg to Buffalo, the Central’s long-haul traffic fell by 51 percent.

According to the American Society of Civil Engineers, between 1950 and 2020, the United States spent approximately \$500 billion (in 2016 dollars) constructing the interstate highway system. The freeways made it possible for the trucking industry to capture much of the high-valued cargos formerly moved by rail. The impact can be seen in the ubiquitous warehouses constructed across the country. For decades, warehouses had been built on rail sidings. Switch engines would drop off and pick up freight cars daily. Today, warehouses line the interstate highways with no rail connections. Trucks deliver and pick up the goods.

The data tell the story. Tables 1 and 2 show the impact of government intervention on railroads. Table 1 presents the share of total travel miles accounted for by

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cars, trucks, air travel, and rail travel from 1940 to 2000. Rail passenger miles accounted for 10 percent of total miles in 1940. By 2000, this number had dropped to 0.2 percent.

Table 2 presents the share of freight miles accounted for by trucks, barges, railroads, and airlines for the same period. In 1940, the railroads carried almost 70 percent of the freight transported. By 2000, they tallied only 38 percent.

Railroad industry executives deserve much of the blame for the industry’s loss of market share after World War II. Management had become ossified. Furthermore, the time-consuming regulatory process enforced by the Interstate Commerce Commission, which governed freight rates, decisions on abandoning trackage, and passenger and freight services in general, contributed to the lack of entrepreneurship.

In the process of shrinking, the railroads wrote off billions of capital investments because technical change, regulation, and the government’s support of other transportation modes devalued investments in rail. Tracks, railcars, stations, engines, and many other types of capital assets were scrapped or torn down well before their useful lives would have ended.

Table 1 Transportation Mode Share of Total U.S. Travel Miles (Percent)

	1940	1950	1960	1970	1980	1990	2000
Cars	64.2	72.5	77.3	72.6	69.8	51.8	49.5
Trucks	25.3	17.8	16.5	18.6	18.0	31.2	34.9
Airlines	0.4	3.4	4.0	8.3	12.0	16.7	15.5
Rail Passenger	10.1	6.3	2.2	0.5	0.3	0.3	0.2

Sources: U.S. Bureau of Transportation statistics; PKVerleger LLC.

Table 2 Transportation Mode Share of U.S. Freight Moved (Percent)

	1940	1950	1960	1970	1980	1990	2000
Railroad	69.6	65.1	54.1	51.2	38.2	34.3	37.9
Motor Vehicles	10.5	17.9	25.9	27.4	49.8	53.7	52.4
Inland Waterways	19.9	16.9	20.0	21.2	11.8	11.7	9.3
Air	0.0	0.0	0.1	0.2	0.2	0.3	0.4

Sources: U.S. Bureau of Transportation statistics; PKVerleger LLC.

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THE LIGHTNING-SPEED TRANSITION

Today, the number of electric vehicle charging stations is probably on par with the number of miles of interstate highway or toll roads existing before 1955. By 2035 or sooner, the charging networks in the United States and Europe may have surpassed the equivalent mileage achieved by the interstate highway system. At that point, diesel and gasoline sales may have declined by as much as 80 percent, especially if governments offer more and more EV incentives and increase penalties for fossil-fuel vehicle ownership. Such actions may prompt automakers to push EVs and accelerate older vehicle scrappage, further depressing fossil fuel use.

The experience of U.S. railroads from 1950 to 1980, then, may indicate the future of gasoline and diesel usage over the next ten to twenty years. The emissions reduction plan announced in April by President Joe Biden could accelerate the transition. It may even put oil out of business in the United States by 2040.

President Biden revealed his policy on global warming on April 22, almost exactly forty-four years after President Jimmy Carter’s first speech on energy. Carter introduced his grandiose energy plan in April 1977. He characterized it as “the moral equivalent of war.” The Carter strategy included detailed programs to impose taxes on crude oil, extend price controls on natural gas, and boost coal use. Little came of the effort, dubbed MEOW by its critics (MEOW for “Moral Equivalent Of War”), except for the Carter stimulus of coal consumption.

President Biden avoided the Carter pitfall of specificity by speaking in generalities. Thus, the industry that will be most affected by the program,

oil, had little to attack last week. In 1977, in contrast, lobbyists and advertising agencies ripped Carter’s plan apart. The Biden administration officials understand that, by not offering detailed analyses upfront, they can build support among proponents, as the Carter program did, while neutralizing those adversely affected.

Oil will bear the greatest brunt of Biden’s environmental program. For it to succeed, oil use must decline by six million barrels per day by 2030. Gasoline consumption must decrease by five million barrels per day, or 55 percent, from 2019 levels, and diesel 35 percent, or around 2.5 million barrels per day, to six million barrels per day.

These reductions are what is required to cut U.S. emissions to 50 percent below 2005 levels, as I do the numbers. The crude oil and petroleum products reductions will be accompanied by coal’s banishment from electricity generation.

Millions of other scenarios could reduce domestic emissions by 50 percent. A massive effort to capture and sequester carbon would, for example, lower the onus on oil. However, on present trends, oil use, particularly gasoline consumption, must bear a large part of the burden. The Biden administration understands this fact. Thus, the oil industry should expect it to move aggressively and quickly to curtail motor fuel use.

The possible impact on gasoline consumption in 2030 can be seen in Table 3. The table shows the emissions for each principal fuel used in the transportation sector in 2019 (in million metric tons) and the level of emissions in 2030 required to achieve the 50 percent reduction from 2005 announced by President Biden and encouraged by the We

Mean Business Coalition, a group of more than five hundred companies, including Amazon, Apple, Ford, General Electric, General Motors, Google, IHS Markit (owner of CERA), Microsoft, National Grid, PG&E, and Shell—the only oil company to sign.

In preparing Table 3, we examined detailed data on distillate fuel use published by the U.S. Department of

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Energy. On-highway use accounted for two-thirds of 2019 sales. These data provide a means of projecting distillate use in 2030. In our calculations, we assumed that electrification or possibly the use of hydrogen would help reduce distillate use (primarily diesel).

Several steps can be taken to bring gasoline use down quickly, presumably to be replaced by electric vehicles.

- Achieve 100 percent electrification in “last mile deliveries” and freight movement.
- Enact a new “cash for clunkers” program.
- Aggressively raise the renewable fuel target for gasoline and diesel.

Electrification of the last mile delivery or even a substantial amount of freight movement could achieve hefty reductions in gasoline and diesel use. A 2018 study published by the University of California at Davis provides detailed analyses of the costs and savings of electrifying deliveries in the United

Table 3 U.S. Co₂ Emissions from Transportation Sector Primary Sources, 2019 and 2030 Target (million metric tons)

	2019	2030	Percent Reduction
Natural gas	54.9	50.1	8.9
Aviation gasoline	1.6	1.0	37.5
Distillate fuel oil (excl. biodiesel)	462.0	300.0	35.1
Jet fuel	255.7	220.0	14.0
Motor gasoline (excl. ethanol)	947.7	425.0	55.2
Residual fuel oil	32.5	32.0	1.5
Total	1,754.4	1,028.0	41.4

Sources: U.S. Energy Information Administration; PKVerleger LLC.

States. The authors do not, though, offer specific estimates of reductions in use.

The number of delivery trucks in operation in the United States is uncertain. One source puts it at 15.5 million, another at a higher figure. Many of the trucks are heavy-duty vehicles.

It seems possible, though, that there are between five and ten million vans being used in the United States for deliveries and the movement of service providers such as cleaners and plumbers. If one does a rough calculation, one

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finds that between six hundred thousand barrels per day and perhaps as much as two million barrels per day could be saved by electrifying the entire fleet.

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The administration and auto manufacturers might also work together to implement a Japanese-type program of auto inspections. They could accomplish this goal by tightening environmental regulations and initiating frequent inspections of older vehicles. A one-paragraph story published by Bloomberg in 1998 describes how Japan put policies in place that increased new car sales:

It is a little-known fact that Japan's car market is propped up by the government's strict inspection policy.... Three years after purchase, every new car has to go through an expensive inspection process, and once every two years after that. Furthermore, vehicles older than ten years have to pass the inspection every year. As

a result, most car owners in Japan write off their cars after ten years and buy new ones. Hundreds of thousands of perfectly fine automobiles are demolished every year. This practice has been used to boost car sales in Japan and give carmakers advantages to compete in the international market.

Using the Renewable Fuel Standard program to accelerate the displacement of petroleum products may offer the best option for reaching the 50 percent reduction goal. The Energy Independence and Security Act of 2007 set volumetric requirements for how much renewable fuel must be used in gasoline and diesel up to 2022. Section 202(a) (2) iii of the act stipulates that the EPA administrator will have the authority to set standards after 2022 based on a set of criteria. One of the criteria is global warming. If all other avenues to achieving a 50 percent reduction by 2030 are blocked, the Biden administration could raise the blending requirements imposed on refiners and marketers beginning in 2023.

Given the current balkanization of politics in Washington, D.C., and the miniscule Democrat majority in the House of Representatives and Senate, the most workable way to reduce emissions 50 percent by 2030 seems to be boosting renewable fuel blending requirements aggressively through the Renewable Fuel Standard. While environmentalists will object to the resulting short-run increase in lifecycle emissions from biofuel production, the RFS program appears to provide the best way, in current circumstances, to increase fossil fuel costs, thus driving more internal combustion engine vehicles off the road.

We will soon know if the Biden administration will take this approach because the Environmental Protection

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Agency's administrator must issue renewable fuel blending standards for 2023 and the years after by this fall. Should the EPA act aggressively—as we expect they will—and should the Biden administration succeed in rapidly expanding the use of electric vehicles—particularly in the last mile of delivery—the old shibboleths about the slow transition in the energy sector will be destroyed. Fossil fuels will be rapidly relegated to history, and trillions of Btu of oil, gas, and coal reserves will be left to be developed in the twenty-second century. ◆