THE WALL STREET JOURNAL.
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Engines of Commerce

The unheralded machine power that moves manufactured goods and raw materials around the world.

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DECEMBER 1, 2010

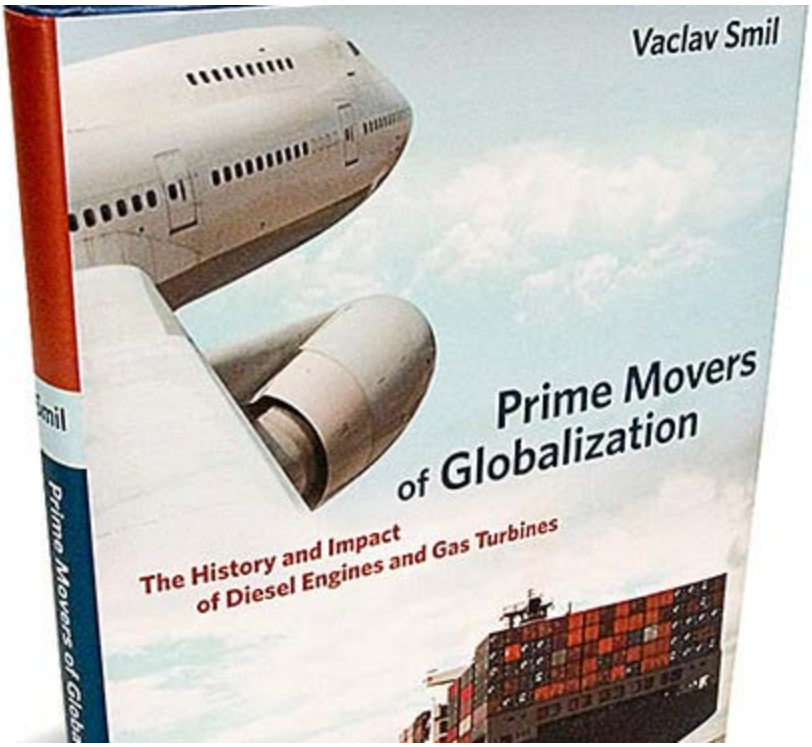
It's no secret that Al Gore and other hard-line environmentalists hate the internal-combustion engine. In 1992, Mr. Gore in his book "Earth in the Balance" called for a program that would lead to the engine's elimination by 2017. He believed this was no fanciful goal; it was just a matter of practical engineering harnessed to political will.

Vaclav Smil doesn't mention Mr. Gore in "Prime Movers of Globalization," a detailed, fascinating account of, as the subtitle has it, "The History and Impact of Diesel Engines and Gas Turbines." But somehow I suspect that the Nobel laureate and scourge of fossil-fuel consumption was not far from the author's mind. For if the story of these remarkable machines reveals anything, it is that Mr. Gore's vision is utterly untethered to reality.

The technological achievement alone is extraordinary, never mind (for the moment) the commercial effect. In the late 19th century, the German engineer Rudolf Diesel developed an engine that operated by injecting fuel into cylinders containing air compressed by pistons (fuel ignites more easily in compressed air). The pistons, in turn, were driven by the gases released in the fuel's ignition. The inventor himself imagined something on the scale of diesel-powered sewing machines. These days the engines power almost all sizable ocean-going vessels as well as major rail and truck transport. "When measured in tons per kilometer," Mr. Smil notes, "about 94 percent of global trade is now diesel-powered." The engines dominate global trade because "the cost, efficiency, reliability, and durability of diesel engines offer a combination that has not been surpassed by any other energy converter."

The gas turbine—invented by Frank Whittle, a British engineer, in the early 20th century—relies on a process of continuous combustion, with spinning fan-blades driving a compressor or turning a shaft (e.g., a ship's propeller) or producing powerful thrust through a nozzle, enough to send an airplane into the sky. Orville and Wilbur Wright are the first fathers of flight, but Frank Whittle is the mostly unheralded father of globe-spanning air travel.

"In 1930," Mr. Smil writes, "there could be no such thing as a non-stop transatlantic commercial flight." But the gas turbine dramatically changed that state of affairs. "In 1950, the crossing took twelve hours," he notes. Eight years later, it could be made in six hours, though only a small number of first-generation jetliners were in operation. By 1960, such flights "became an increasingly common event, and so, figuratively, the world shrank by half in a single decade."



These two internal-combustion engines—diesel and turbine—soon became "prime movers" as Mr. Smil dubs them. They are now the "indispensable driving forces of the global economy." Without them, "trade would not have achieved its truly planetwide scope or have done so at such massive scales, at such rapid speed, and at such affordable costs."

When most Americans think of the internal- combustion engine, they naturally think of the one under the hood of their car. And indeed, gasoline- powered engines are "the most common prime mover of modern civilization. . . . There are now roughly 1 billion of these engines installed in cars, trucks, motorcycles and garden machines, boats, snowmobiles" and so on.

Why did this "impressive machine" fail to become the force behind globalization, moving goods long distances? It is "not practical in very large sizes," Mr. Smil says. The global transport of large quantities of goods and people requires much more massive engines. The inventions of Messrs. Diesel and Whittle—refined, modified and extended countless times by later engineers—picked up where the conventional gasoline engine left off.

Mr. Smil's account of the engineering advances throughout the late 19th and 20th centuries—advances that brought the world large marine diesels and gas turbines—is first-rate history, both thorough and compelling. It is also fairly technical for the lay reader. But the rich detail doesn't just explain the intricacies of the engines and how they work. It also helps to show how easily we take for granted machine-power of such marvelous sophistication and, relatedly, why an environmental dreamer might mistakenly imagine its disappearance within a quarter-century.

"Who does not know (indeed, has not seen) a Boeing 747, the first wide-body jet?" Mr. Smil asks. "Who is not aware of Wal-Mart's China supply pipeline, and who has not seen the images of container ships laden with what seem to be gravity-defying layers of steel boxes? But for how many people would the JT9D or the K98MC7 (the engines that have made those remarkable airplanes and vessels possible) ring any bell, and how many educated adults could cogently and accurately describe how a turbofan works . . . or why diesels endure?"

Readers of "Prime Movers of Globalization" will know the answers to such question better than most when they are done, and they will understand why these massive machines will not disappear soon. It is true that diesels and jet turbines are not without their problems. They have added to environmental pressures by enabling the release of large quantities of greenhouse gases into the atmosphere and the dumping of plastic debris into the North Pacific; and, with the creative destruction caused by global trade, they have created social disruptions that their inventors could hardly have imagined. Mr. Smil acknowledges such problems; he is no Pollyanna and is even something of an environmentalist. But he has been mugged by the reality of physics and engineering.

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