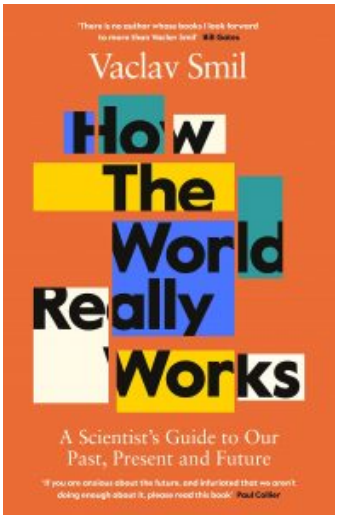
Book Review: How the World Really Works: A Scientist's Guide to Our Past, Present and Future by Vaclav Smil

In **How the World Really Works: A Scientist's Guide to Our Past, Present and Future***,* **Vaclav Smil** *explores seven fundamental areas that govern human survival and prosperity, covering topics such as food production, energy and globalisation. While Smil's educational efforts to expose some of the sinews of our modern economy are salutary,* **Iancu Daramus** *questions the book's vision of the future of energy and the sustainability revolution.*

How the World Really Works: A Scientist's Guide to Our Past, Present and Future. **Vaclav Smil. Viking. 2022.**

The sustainability revolution will not be televised



'I am neither a pessimist nor an optimist; I am a scientist trying to explain how the world really works,' we are told in the opening section of Vaclav Smil's latest book – a combination of self-professed modesty and grandiose aspiration that is emblematic of the pages to follow.

An erudite scholar with an impressive record of academic and popular publications, Smil may be more widely known as Bill Gates's *Star Wars* surrogate, not least due to a multi-book argument that energy transitions are protracted affairs. This is also a recurrent motif in *How the World Really Works*, which opens with the centrality of (fossil-based) energy to modern civilisation, turning to the production of food, plastics, steel, ammonia and cement as the drivers of globalisation and to a broad landscape of risks (viruses, diets, global warming and the 'singularity' of artificial intelligence).

The book applies what Garrett Hardin called 'the numerate filter' to amply illustrate the vastness of our material requirements as a counterpoint to the supposed dematerialisation ushered in by the information age. That China, in just two years, consumed nearly as much cement as the entire US used during the whole of the twentieth century; that the amount of air freight and the size of the largest container ships on the seas rose twelve-fold since the 1970s; that the two skewers of wild shrimp you pick up at a BBQ may have been 'marinated' in the four cups of diesel oil burnt for their catch – such statistics pervade the book, often the result of the author's bottom-up calculations.

Like the 'tough love' school of parenting that takes children to slaughterhouses to show where dinner *really* comes from, Smil devotes much of the book to exposing some of the sinews of our modern economy – the steel in our walls and our kitchenware, the fertilisers in our food, the concrete beneath our feet, the plastics in our… well, everything – and its lifeblood, energy. For all 'the proponents of a new green world naively calling for a near-instant shift from abominable, polluting, and finite fossil fuels', Smil returns time and again to the ubiquity of said fuels as literal 'prime movers' of the world.

Given the increasing demonising rhetoric suggesting 'just' a few extractive companies are responsible for climate change (or high gas prices), Smil's educational efforts are, to a point, salutary. Yet the data bombardment sometimes feels intended less at persuasion and more at numbing the senses into obedience.

Consider his contention that Germany's decades-long *Energiewende* changed 'the share of fossil fuels in the country's primary energy use only from about 84 percent to 78 percent'. The numbers are correct, but highly misleading, as the overwhelming share of primary energy generated from fossil fuels is *wasted*, primarily by dissipating as heat (a hotter engine doesn't make for a faster car). For Germany, as illustrated below, some two thirds of primary energy are 'rejected':

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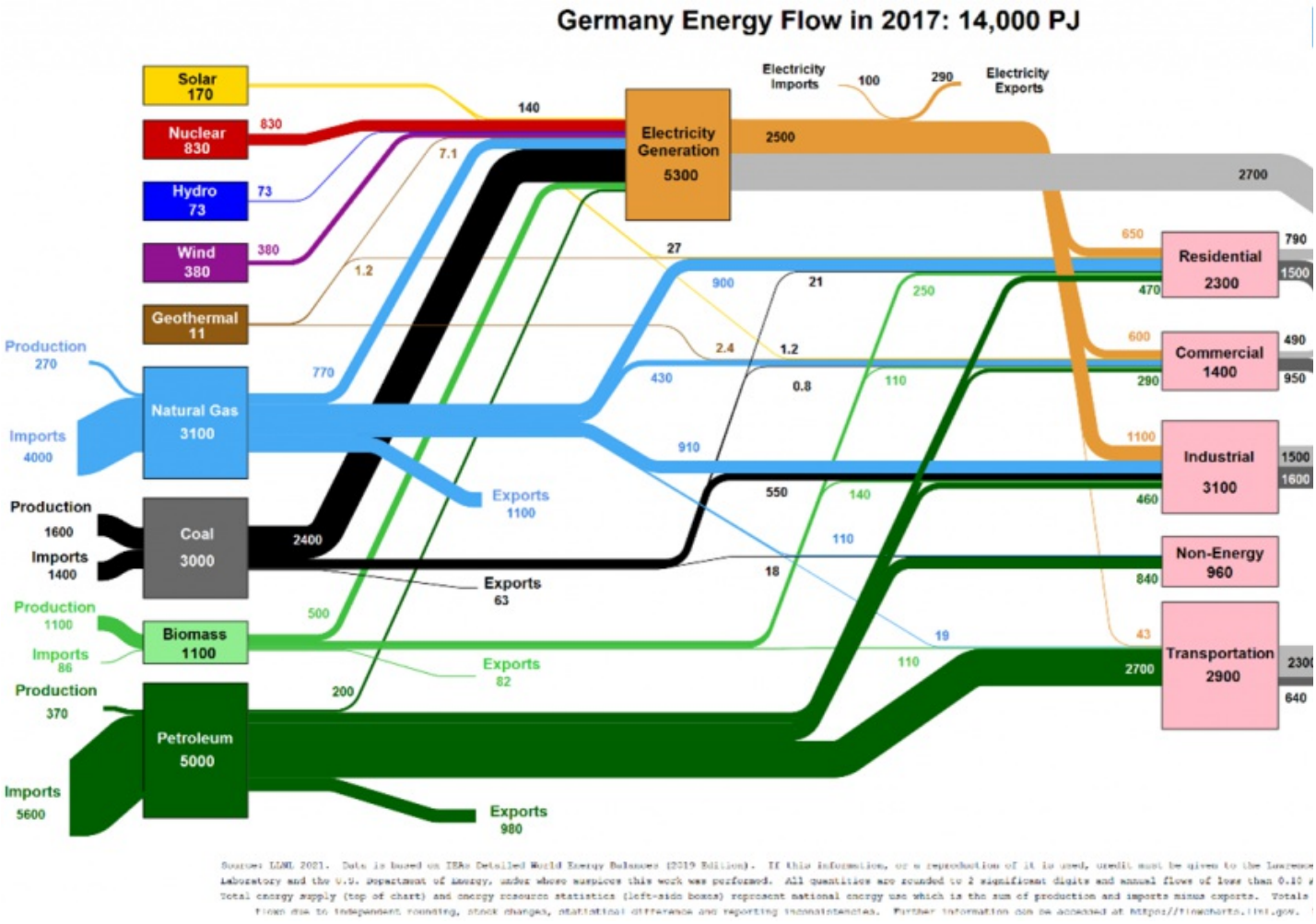

Source: Lawrence Livermore National Laboratory and US Department of Energy, https://flowcharts.llnl.gov/commodities/energy. The global average is also circa 50-60 per cent rejected energy. Graphic licensed under CC BY-NC-SA 4.0.

The right comparator for renewables is final, useful energy – or, more specifically, electricity (their main current – and growing future – use case). In 2021, 38 per cent of global power came from clean sources.

Even better: look not at total absolute usage, but at the rate of change. Last year, wind and solar met 10 per cent of the world's power needs, but 30 per cent of the growth in demand. Whilst the transition will not be linear, the general trend has been towards new – and then existing – demand being increasingly met by clean power available at falling costs. Globally, switching coal to renewables + storage could even save money, particularly at current commodity prices.

Curiously, Smil references a version of the chart above on page 19, but only to discuss how the efficiencies of converting fossil fuels to energy have improved since the industrial revolution (never mind that the result is still, as we can see, pretty dismal). Which is why one begins to suspect it is personal perspective, not just 'the numbers', that colours Smil's views of low-carbon technologies. 'Mantras of green solutions', 'green hymnals', naïve green energy CEOs making misguided comparisons with smartphone adoption – there is hardly a mention of 'green' in the book that is not followed by red-hot scorn or pale indifference. Whilst there is no shortage of unrealistic demands coming from some climate quarters ('net zero by 2025', anyone?), the book's refusal to engage meaningfully with the innovation, not just the noise, on the ground, brings to mind the proverbial driver complaining about how everyone else in his lane is driving the wrong way.

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Smil's own solution set is surprisingly slim. Energy efficiency and insulation, reducing food waste, improving agricultural productivity and increasing the proportion of renewable electricity all get honourable mentions – as they would have done in the 1970s. Is there really nothing new under the sun?

Consider that venture capital investments in climate tech are growing three times faster than those going into artificial intelligence; that banks and asset managers will add further trillions to that funding in the next decade; that consumers are increasingly choosing sustainability-marketed products; that green steel, hydrogen and ammonia are coming; that GDP growth is now decoupling from carbon emissions across both developed and some developing nations – in short, that there is genuine momentum driven by technology, policy and consumers. All this is largely ignored or given short shrift by Smil. For those tuning into his station, the sustainability revolution will not be televised.

Image Credit: Photo by Ashes Sitoula on Unsplash

Smil's insistence on supposedly missed forecasts of electric passenger car adoption (contrasted with 'combustion engines [that] keep improving their efficiency') is similarly puzzling. Not only is the very company that invented it calling time on further developing the combustion engine, but all major automakers are racing for a massive ramp-up of electric vehicles, whose sales have steadily kept doubling over the past years (now meeting all the growth in new passenger vehicles). If anything, mainstream energy forecasts (made by industry insiders, not utopian green social planners) have actually tended to underestimate the growth of clean energy over the past decades.

Smil is right to remind us of the many uncertainties and difficulties that make the energy transition different from smartphones replacing landlines. But the historical lessons are not as one-sided and the transitions not all as lengthy as Smil portrays them. And, as always, the question of whether the future will resemble the past remains underdetermined.

That the policy environment may be enabling and accelerating this transition is something Smil has little patience for, noting that 'three decades of large-scale international climate conferences have had no effect on the course of global CO_2 emissions'. Yet if just a decade ago our best understanding suggested the world would be on track for catastrophic 3 or 4 degrees of global warming by the end of the twenty-first century, the policies we now have in place globally have likely ruled out these more extreme scenarios. If governments fully implement all their announced targets and pledges (certainly a big if!), they would even bring the temperature goals of the Paris Agreement within reach. Yes, this is not overnight progress, but to not acknowledge it is to literally ignore the course of emissions – a curve which, in now familiar language, is showing signs of bending.

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Today, over 90 per cent of the world's economy and 80 per cent of its population are covered by a net zero target. Granted, some, perhaps many, of those targets will not be met on time. But others will; some even surpassed. It takes pessimism to consider the vast waves of funding, incentives, regulation and research being deployed towards low-carbon innovation as primarily doomed to failure, rather than as a catalyst for creativity. From cities to corporations, from the strikers in the streets to financial analysts with their spreadsheets, the signs of the polycentrism that Elinor Ostrom reminded us is the solution to the 'tragedy of the commons' are visible to those willing to learn where and particularly *how* to look.

To take a different example on the importance of perspective, Smil's chapter on risk includes the misleading comparison of terrorism versus car crashes, and the flawed psychology that makes us fear the former more, despite 'the numbers'. This overlooks the question of which classes of risk are comparable. There is zero chance of US roadside deaths growing, in a single year, by 37,500 per cent – tragically unlike the case of victims of terrorism in 2001. Therefore, one cannot meaningfully calculate, as Smil does, a supposed 'baseline' of terrorism deaths. First, single-point estimates cannot capture fat-tailed, potentially multiplicative phenomena like wars, terrorism, pandemics or the cost of chessboards. More importantly, accidents are a by-product of traffic, but terrorism is the *intentional* result of human intelligence working for (and against) the enacting of large-scale violence. To just present 'the numbers', whilst ignoring the explanation, or lack thereof, is the hallmark of scientism, not of science.

It is a personal heuristic that when someone claims to lay bare the 'true' workings of the system and what the world is *really* all about, you are likely to find out much more about the speaker's priorities, values and biases than you are about the world. The trouble comes when pretending that this personal filtering is not happening, that, as Smil repeatedly claims, 'there is no agenda in understanding how the world *really* works'.

It seems to me this position is untenable purely as a matter of scholarship, at least since Karl Popper's work on how science proceeds from theory to observation and not the other way around. Richard Rudner also argued that those theories themselves are necessarily and inescapably – though not overwhelmingly – linked to some set of values. For instance, in deciding 'how strong is strong enough' for evidence to be admissible under a given hypothesis, scientists cannot but be aware of the ethical, social and political context in which their research exists as well as its likely uses or misuses.

It is this context which also leads me to view Smil's position as open to dangerous interpretations and applications, given how some of the arguments from *How the World Really Works* work in the world. In more meetings with energy companies than I care to remember, I was attempting to discuss whether the emissions and economics of a particular oil project or power plant stack up, only to be told 'we can't stop fossil fuels overnight'. On one memorable occasion, I heard that 'even Bill Gates says we need fossil fuels'.

There is little debate that we will continue to extract, process and burn significant amounts of gas and oil for decades, even in ambitious 'net zero' scenarios (the clue is in the 'net'). The real debate is on whether some parts of the system will change faster than expected and what the likely consequences are – which investors will feel the heat from stranded assets in their portfolios (or the cool breeze of riding 'carbon unicorns' to billion-dollar valuations), and how much all of us will end up feeling the heat from a warming atmosphere. In other words, the debate lies precisely in all the details that Smil glosses over.

A quote often attributed to Gates is that 'we tend to overestimate the change that will occur in the next two years, and underestimate the change happening in the next ten'. It feels like, for once, Smil should read more of Gates, not (as usually happens) the other way round. And, when it comes to understanding the *future* of energy, perhaps more readers should look elsewhere.

Note: This review gives the views of the author, and not the position of the LSE Review of Books blog, or of the London School of Economics and Political Science.

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