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How Banning Carbon Fuels and Synthetic Products Will Hurt the Environment

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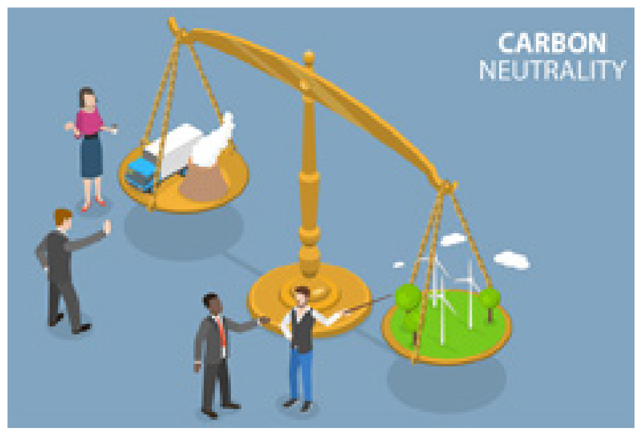
How Banning Carbon Fuels and Synthetic Products Will Hurt the Environment

Pierre Desrochers

Introduction



Numerous politicians have committed their constituents to "Net-Zero" (or carbon neutral) objectives.[1] This is to be achieved by the "electrification of everything,"—through decentralized onshore and offshore wind and solar photovoltaic (PV) power generation; substantial conversions in the transportation (e.g., cars, light trucks) and building (e.g., electric cooking, space and water heating) sectors; reduced overall consumption (e.g., consumer goods, meat); and incremental improvements of all kinds (e.g., heat pumps, building insulation) to improve efficiency in energy use. This transition is to be facilitated by various government interventions, including new or higher carbon taxes and renewable mandates; a capping of greenhouse gas emissions and new carbon trading schemes; a ban on new GHG-emitting vehicles; and significant support for the development of hitherto nonexistent transformative technologies (e.g., giant batteries, hydrogen-fueled planes and cars, large scale removal of atmospheric CO_2) (see Williams, Jones, Haley, et al., 2021; World Economic Forum, Global Future Council on Net-Zero Transition, and the Alliance of CEO Climate Leaders, 2021; and Larson, Greig, Jenkins, et al., 2021).

In parallel to these developments, many environmental activists and politicians have demonized synthetic products derived from fossil fuels, culminating in a 2019 pledge by representatives of 170 nations to "significantly reduce" the use of plastics by 2030 (UNEP, 2019).[2] The Canadian government has since then set itself the task of guiding businesses and organizations to transition away from "problematic plastics" in order to reduce pollution and support the creation of a circular economy (Canada, 2022a). This policy is justified in the name of "current scientific evidence" that "indicates that macroplastic pollution causes

physical harm to wildlife on an individual level and has the potential to adversely affect habitat integrity" (Canada, 2022b). In practice though, Canadians, like residents of other advanced economies, release very little such substances into ecosystems (Schmidt, Krauth, and Wagner, 2017; and Schmidt, Krauth, and Wagner, 2018).

Both net-zero and plastic ban policies have not gone unchallenged. Apart from what are deemed unrealistic timelines, excessive costs, and lack of scalability or adequate substitutes, critics have pointed out that so-called "green energy" will have a greater direct impact on land-based ecosystems because of immutable characteristics, including:

- low power density that requires much larger land areas (e.g., solar and wind power require on average up to 90 to 100 times more land area than natural gas for electricity generation);
- the need for additional transmission lines as the best locations for the production of electricity from wind turbines and solar panels are often far from markets;
- the building of back-up power generation capacity (typically natural gas) to make up for the intermittent character of wind and solar power;
- greatly increased mining activities (e.g., lithium, rare earths) as wind turbines, solar panels, and electric car batteries require, on average, more than 10 times the quantity of materials of hydrocarbon-based alternatives;
- questionable carbon neutrality of bioenergy as woody biomass for electricity generation, corn and sugar cane for ethanol production, and oil palm and soybeans for biodiesel production all require large growing areas and substantial carbon-fuels-based inputs (e.g., fuels for production, transport, and processing; pesticides, fertilizers);
- lethal impact on fauna (e.g., impact of wind turbines on raptors and bats).[3]

> "None of the so-called alternatives could even be built and maintained without massive amounts of carbon fuels"

Needless to say, none of the so-called alternatives could even be built and maintained without massive amounts of carbon fuels (e.g., machinery, steel and cement production, composite materials, transport, installation, maintenance (including lubricants), potential recycling, and back-up power generation). Much research has also established that banning plastic straws, bags, packaging, and other single use plastic products, to say nothing of more comprehensive future bans of synthetic materials, can only result in increased demand for biomass-based and other materials (e.g., lumber, cotton, wool, glass, metals, clay) with greater overall environmental impacts (UNEP, 2020; and Ferrara, De Feo and Picone, 2021).

This essay briefly discusses one aspect of these controversies, i.e., the incidental environmental benefits of carbon fuels and synthetic products. As it will suggest, not only were they developed for good, practical reasons, but they also drastically reduced pressures on wild flora and fauna and contributed significantly to the gradual abandonment and eventual reforestation and potential rewilding of much marginal agricultural land. Banning them, especially when the world's population is now much larger than when they first displaced other inputs and technologies, will only recreate and exacerbate the problems they once solved.

The forest transition

Three decades ago, the Scottish geographer Alexander Mather coined the term "forest transition" to describe a significant change in the relationship between human population numbers and forested areas. Until the nineteenth century, he observed, economic and demographic growth resulted in the unavoidable declines in the size and overall health of forests, often accompanied by soil erosion, defaunation, and other forms of environmental degradation (e.g., desertification, siltation). As the old slogan went, "poor people make poor land." With rapid industrialization and urbanization, however, humanity not only witnessed its most significant growth in population and income per capita in history, but also an expansion of its forest cover in all advanced economies and in an increasingly large number of developing economies, including India and China. In the process, much of the remaining marginal wetlands, grasslands, and forestlands were spared from the plough (Mather, 1992).[4] Western Europe contains many such examples. For example, the forest areas in France increased from approximately 15 percent in the mid-nineteenth century to nearly 33 percent of the total land area in 2015 while in Austria the numbers went from approximately 40 percent in 1830 to almost 50 percent in 2010.[5]

> "With rapid industrialization and urbanization, humanity not only witnessed its most significant growth in population and income per capita in history, but also an expansion of its forest cover in all advanced economies and in an increasingly large number of developing economies, including India and China."

The forest transition is typically traced back to a few key causes, most notably:[6]

- Natural regeneration and deliberate tree planting on former agricultural lands and other deforested landscapes (e.g., where hunter-gatherers had created grasslands on previously forested landscapes and on landscapes degraded as a result of excessive timber harvesting) made redundant with the intensification, increased productivity, and greater geographical concentration of agriculture (Kauppi, Sandstrom, and Lipponen, 2018; Ritchie, Roser, and Rosado, 2021).[7]

- Increased availability of atmospheric CO_2, greater rainfall since the middle of the 19th century, and, to the extent it can be traced back, a lengthening of the growing season, have contributed positively to the efficiency of photosynthesis, hence to greater plant growth and to increased agricultural productivity (Zhu, Piao, Myneni, et al., 2016).

- International trade through which increased volumes of biomass are grown more efficiently in one country and consumed in another (Pendrill, Persson, Godar, and Kastner, 2019).
- The large-scale substitution of carbon fuels for fuelwood, beginning with coal in the nineteenth century (Wrigley, 2013).

> "An ever-larger number of resources produced on the surface of the planet were replaced by better substitutes created from materials dug or pumped from below."

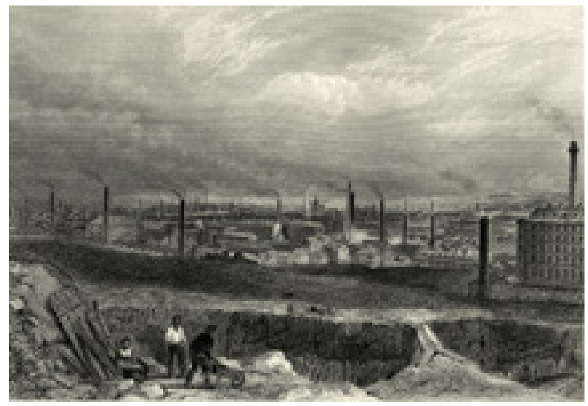
The key development underlying these beneficial advances is that an ever-larger number of resources produced on the surface of the planet were replaced by better substitutes created from materials dug or pumped from below. One of the first writers of importance to expand on this idea was the German economist and sociologist Werner Sombart (1863-1941) in his turn-of-the-twentieth-century discussion on the "Emancipation from the Limitations of the Organic" and the transition from a wooden to a coal-fueled "iron age"[8] made possible by both carbon fossil fuels and carbon fuel-derived synthetic products. In 1944, the Harvard geologist Kirtley F. Mather (1888-1978) observed that a century earlier nearly 80 percent of all products used by human beings came from living plants or animals competing for resources on the Earth's surface. By the time of his writing, however, "only about 30 per cent of the things used in industrialized countries come from things that grow; about 70 per cent have their sources in mines and quarries" (Mather, 1944: 56). The idea that surface resources were increasingly supplanted by underground ones, however, is now typically associated with the late British historical demographer and geographer Edward Anthony Wrigley (1931-2022) who argued from the 1960s onward that our ancestors broke free from the "photosynthesis constraint" by accessing the "products of photosynthesis stockpiled over a geological time span."[9] As he wrote in a typical passage:

> The [organic economy] escaped from the problem of the fixed supply of land and of its organic products by using mineral raw materials. Thus the typical industries of the [Industrial Revolution] produced iron, pottery, bricks, glass and inorganic chemicals, or secondary products made from such materials, above all an immense profusion of machines, tools and consumer products fashioned out of iron and steel. The expansion of such industries could continue to any scale without causing significant pressure on the land, whereas the major industries of an organic economy, textiles, leather and construction, for example, could only grow if more wool, hides or wood were produced which in turn implied the commitment of larger and larger acreages to such ends, and entailed fiercer and fiercer competition for a factor of production whose supply could not be increased. Meeting all

> basic human needs, for food, clothing, housing and fuel, inevitably meant mounting pressure on the same scarce resource. (Wrigley, 1988: 5)

I now turn to a discussion of some of the past incidental environmental benefits delivered by carbon fuels and synthetic products.

On the environmental benefits of carbon fuels and synthetic products



A few centuries ago, shortages and rising prices for fuelwood and charcoal in British cities and towns created the incentive for a gradual switch to coal and the development of better combustion and coking technologies.[10] With the development of the steam engine, coal made possible new economic activities and the scaling up of earlier ones to unprecedented levels because of its unparalleled capacity to deliver much more plentiful and reliable heat, power, and feedstock. In turn, new and better energy sources, new processes, and new resources paved the way to further developments and new applications (see Smil, 2017). Refined petroleum products (gasoline, diesel, kerosene, and bunker fuels) thus proved a superior alternative to coal in the transportation sector while, when available, natural gas was preferable to coal and fuel oil in electricity production and home heating. These substitutions occurred because liquid fuels and natural gas have several technical and economic advantages over coal. For instance, refined petroleum products have a higher energy density and burn more cleanly while emitting less-polluting gases and particulate matter. They can be extracted without underground human labour. They are much easier to handle, transport, and store for uses in a wide variety of applications, again resulting in lower labour costs. They also provide more affordable feedstock for the production of a wide range of synthetic items. Energy scholar Vaclav Smil has calculated that, over the last two centuries or so, the growing and increasingly efficient use of carbon fuels has led to a 3,500-fold increase in the availability of useful energy (Smil, 2022).

"Over the last two centuries or so, the growing and increasingly efficient use of carbon fuels has led to a 3,500-fold increase in the availability of useful energy."

Needless to say, before the development of technical advances such as scrubbers and catalytic converters, carbon fuels were environmentally problematic in many respects (e.g., smoke and soot). Coal and hydrocarbons, however, also displayed a range of incidental environmental benefits. The most obvious was that they paved the way to the forest transition. As the English economist William Stanley Jevons observed in 1865, "forests of an extent two and a half times exceeding the whole area of the United Kingdom would be required to furnish

Figure 1: Haitian Deforestation

Source: Adapted from NASA Science Visualisation Study: Haitian Deforestation (Visualizations by Alex Kekesi, released on October 25, 2002 https://svs.gsfc.nasa.gov/2640).

even a theoretical equivalent to [the country's] annual coal produce" (Jevons, 1865/1866). The most striking recent illustrations of the environmental benefits of carbon fuels burned for domestic uses are satellite images of the border between biomass-based Haiti and largely propane-based Dominican Republic taken two decades ago (Figure 1). Unfortunately, much illegal logging on the Dominican side has since been conducted by impoverished Haitians.

Another reasonably well-known example of the green benefits of carbon fuels is the displacement of whale oil as a lighting fuel by petroleum-refined kerosene (McCollough and Check, 2010), a transition whose environmental significance was not lost on a *Vanity Fair* cartoonist in 1861 (Figure 2).

Writing in 1945, the agricultural economist Karl Brandt observed that, following the First World War, the internal combustion engine in the forms of trucks, tractors, and combines was brought "into general use for agriculture, first in America and later elsewhere." As a result, "millions of horses were replaced, and millions of feed acres were released for food production," some of which would in time revert back to forests (Brandt, 1945: 135-136). The displacement of urban workhorses by trucks and cars also proved environmentally beneficial. Among other problems, vermin and flies were endemic in urban stables while excrement and carcasses were a source of deadly diseases such as typhoid fever, yellow fever, cholera, and diphtheria. In the late nineteenth century, New York City horses produced well over

Figure 2: Grand Ball Given by the Whales in Honor of the Discovery of the Oil Wells of Pennsylvania (1861)

Source: Vanity Fair (1861, April 20: 186).

four million pounds of manure each day, sometimes piling up to a height of between 40 feet and 60 feet in vacant lots (Desrochers, 2015, July 10; Morris, 2007).

It is probably fair to say that the incidental environmental benefits of synthetic products are less appreciated than those of carbon fuels. In short, the history of synthetic products begins in the middle of the nineteenth century with coal tar, at first an unwanted waste product of the coal gasification process used as a source of heating and lighting fuel in the nineteenth and early twentieth century.[11] At first, coal tar found limited uses as a protective coating for the hull of wooden ships and ropes, a last-resort fuel and for roofing. The first highly significant demand for coal tar, however, followed the introduction of the wood pressure-impregnation (or Bethell) process in 1838. This pickling or creosoting of timber—a process through which dried timber was placed in a container, subjected to partial vacuum and impregnated with heavy oils from coal tar—soon thrived on a large scale as a result of the increasing demand for wooden sleepers by the railroad industry, for wooden poles by the telegraph industry, and for various coastal structures which incorporated a significant amount of timber. This industry not only solved the tar disposal problem, but also significantly reduced both the cost of maintaining wood structures and, by tripling or quadrupling its useful life, the consumption of wood (see also Barger, 1951: 100-111).

It would take a few additional decades before the lighter fractions of coal tar found significant markets. The most significant breakthrough in this respect was William Henry Perkin's use of it in his development of mauve dye in 1856, which was followed in short order by the creation of an ever-expanding range of synthetic dyes. Up until then, various dyeing substances had been extracted from plants (principally madder for reds, oranges, and browns, and indigo for blue), lichens, trees, insects, mollusks, minerals and guano. Synthetic dyes quickly put their natural competitors out of business as they offered a much greater range of colours (along the lines of a 10-to-1 ratio by the turn of the twentieth century), were cheaper, easier to apply, and delivered better finished products. They also liberated large swathes of agricultural land, then available for other agricultural productions, some of which eventually reverted to its natural state. At its peak in 1868, madder cultivation required between 300,000 and 400,000 acres while indigo plants could be found on more than 1,583,808 acres in 1897. On a local scale, the introduction of artificial scarlets resulted in the abandonment of the cultivation of cochineal in the Canary Islands and its replacement by sugar and tobacco plantations, while pressures on dyewoods and logwoods in other parts of the world were largely eliminated.[12] Reverting back to natural dyes would obviously entail significant environmental damage. Suffice it to say that several million acres would be required to make up for the approximately 20,000 tonnes annual consumption of synthetic indigo alone.

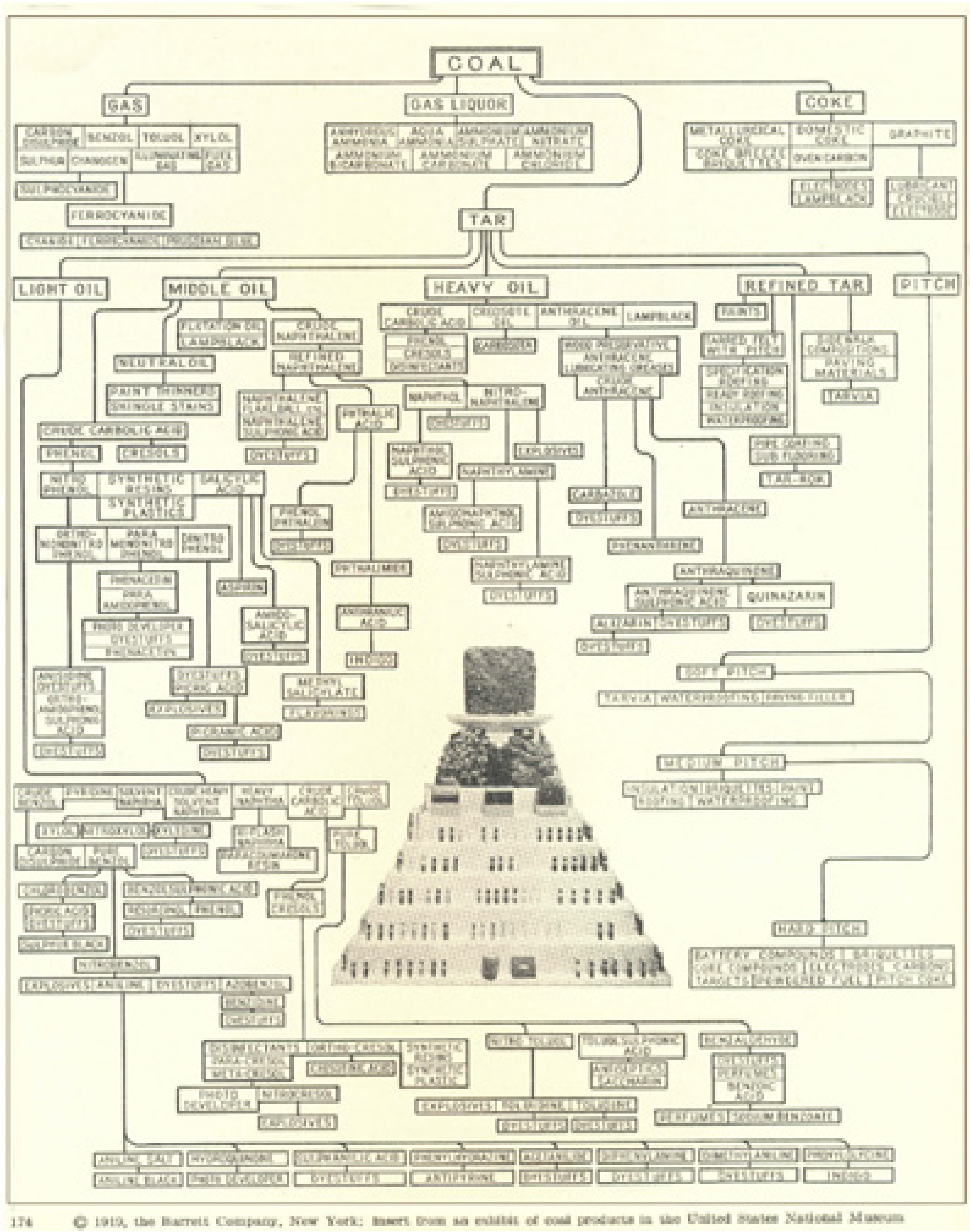
In time, advances in synthetic dye making served as a technological springboard for the creation of other tar-derived products ranging from explosives, medicines, and perfumes, to flavoring materials, sweeteners, disinfectants, and antitoxins, as well as tracing and photographic agents (Figure 3).

Coal tar was eventually supplemented and then largely displaced by cheaper, more easily available and more flexible petroleum refining by-products and natural gas (methane and natural gas liquids). To summarize some key chapters of a complex history, early kerosene producers were left with about 50 percent of the original material that was then of no commercial value. Beginning in the mid-1860s, a few by-products were created out of the liquid residue, most notably lubricating oils, greases, paraffin, petrolatum (or petroleum jelly, better known by the trademark Vaseline), candles, insect repellents, and solvents. Paraffin replaced vegetable and animal products (e.g., beeswax, tallow, spermaceti, vegetable oils, natural rubber) in the manufacture of candles, chewing gum, laundry sizing, as a sealant in wide range of uses (e.g., preserves, pharmaceutical, medical, and electrical equipment) and as a waterproofing agent for tents, boots, and coats (Williamson and Daum, 1959: 249-250).

Early petroleum by-products, however, were largely extracted from what was referred to as the "middle of the barrel." By contrast, lighter gasoline and most heavy residuals remained problematic.[13] The internal combustion engine (gasoline) and new furnace technology (heavy oil) soon changed the situation and created lesser problems than those that had existed before. By the turn of the century, the refining industry (and especially the Standard Oil Company) was selling over 200 by-products made from what had once been production residuals (Copp and Zanella, 1993: 156). Today over 6,000 products are manufactured from petroleum (Figure 4), ranging from fuels and lubricants to vitamins and textiles.

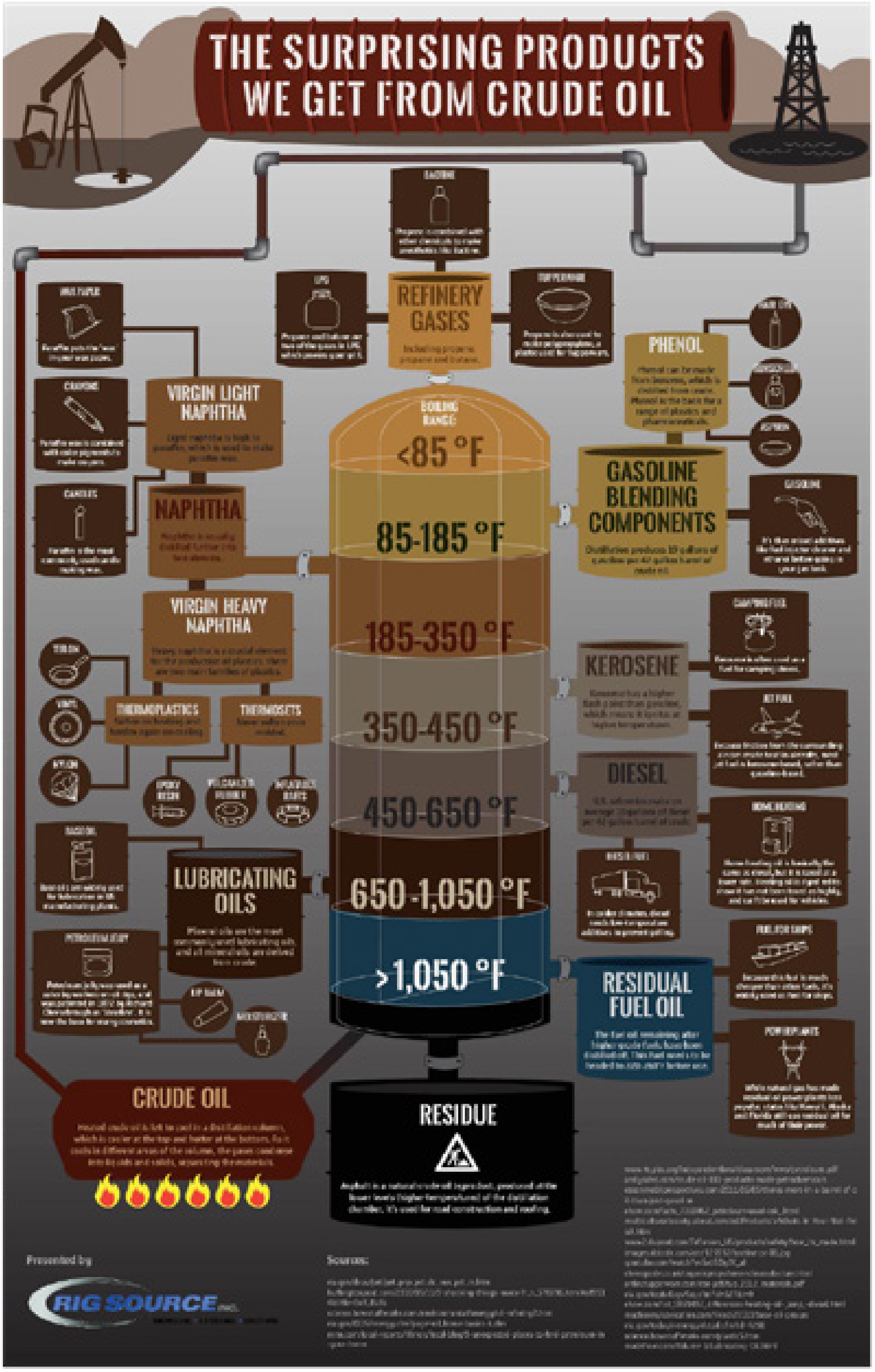
Most controversial today, the boom in plastics production can be traced back one century to the development of the "cracking" of crude oil to produce high quality gasoline, a process

Figure 3: Coal Products, 1919.



Source: The Barrett Company, New York, from an exhibit of coal products displayed at the United States National Museum.

Figure 4: The Surprising Products We Get from Crude Oil



that generated residual gases first burnt as waste, but that were eventually turned into a cheap feedstock for the production of polymers (Lox, 1992). The worldwide production of plastics grew from 20,000 tons in 1925 to 2 million tons in 1950, 150 million tons in 2000, and 370 million tons in 2019 (Smil, 2022). Energy scholar Vaclav Smil has recently suggested that poor countries replicating China's economic success would result in a 30-fold expansion of plastic manufacturing over the next 30 years (Smil, 2022). While many commentators will view this as a cause for concern, one should keep in mind that the development of plastics and other synthetic products has drastically reduced demand for wild fauna such as whales (e.g., whale oil, baleen, perfume base), birds (e.g., feathers), elephants, polar bears, alligators, and countless other wild animals (e.g., ivory, fur, skin); trees and other plants (e.g., lumber, firewood, charcoal, rubber, pulp, dyes, green manure); and agricultural products (e.g., fats and fibers from livestock and crops, wool, leather, dyes, and pesticides from plants). Far from being an environmental problem, plastics are part of the solution, provided their disposal is handled properly.

Conclusion

The development of valuable resources from substances extracted from below our planet's surface paved the way for the creation of a wide range of superior substitutes for products once manufactured from plants and animals such as biomass-based fuels, lubricants, fertilizers, building materials, fibers, leather, and other products. Although they are now often demonized, carbon fuels such as coal, refined petroleum products and natural gas, along with synthetic products such as plastics and composite materials, made it possible to meet the needs of growing and increasingly wealthier populations while gradually diminishing the human footprint on the landscape. The result has been a world increasingly more hospitable to humans and wildlife. Reverting back to biomass-based products on large scale can only undermine advances made in terms of expanded habitat for wildlife and greater biodiversity.

> "Carbon fuels such as coal, refined petroleum products and natural gas, along with synthetic products… made it possible to meet the needs of growing and increasingly wealthier populations while gradually diminishing the human footprint on the landscape."

Endnotes

1 Remaining emissions can be compensated by removing carbon from the atmosphere through other anthropogenic actions, permanent underground CO2 storage, and the planting of trees. For additional details for Canada, see the Canadian Net-Zero Emissions Accountability Act (2021).

2 For concise discussions of the key issues, see Bailey, 2018; and Bailey, 2022.

3 For a recent, in-depth, and abundantly illustrated discussions of some key issues, see Larson, Greig, and Jenkins et al., 2021. For accessible synthesis and more critical discussions, see Zehner, 2012; Kiefer, 2013; Montford, 2019; and Mills, 2020.

4 For more detailed introductions and additional references, see, among others, Rudel, Coomes, Moran, et al., 2005; and Meyfroidt and Lambin, 2011.

5 Data for France and Austria are from Gingrich, Magerl, Matej, and Le Noe, 2022. For an interactive model of the evolution of the Western European forest cover between 1900 and 2010 and other data, see Wageningen University, Undated.

6 For a recent overview of the less controversial causes, see Gingrich, Magerl, Matej, and Le Noe, 2022.

7 The latter source was first published in 2017; the most recent revision is from June 2021.

8 Sombart's "limitation of the organic" thesis was discussed in both the first volume of his magnum opus *Der moderne Kapitalismus* [Modern Capitalism] from 1902 and his 1903 *Die deutsche Volkswirtschaft im neunzehnten Jahrhundert* [The German Economy in the Nineteenth Century]. The man most responsible for spreading Sombart's thesis in the United States was probably Lewis Mumford (1934).

9 For a short introduction to his work, see Wrigley, 2011.

10 In the same basic way charcoal is made out of wood, coke is a solid fuel made by heating metallurgical (bituminous) coal in the absence of air so that the volatile components are driven off.

11 For contemporary accounts, see, among others, Lunge, 1887; and Findlay, 1917.

12 For a more detailed account, see Desrochers, 2008.

13 In this context, air-gas machines refer to gas machines used to illuminate mills, factories, public institutions of all kinds and large mansions. Crude naphtha also found a market for gas illumination at the time.

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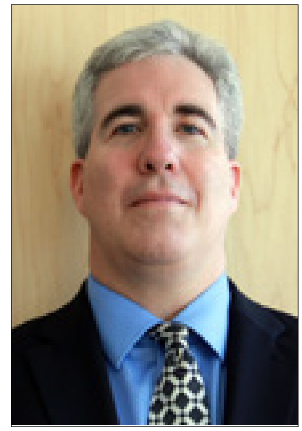

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