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Viewpoint

# Running out? Rethinking resource depletion

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ABSTRACT

Since the 1970s, environmentalists have warned that overconsumption, especially of minerals and fossil fuels, will lead to resource depletion. But there are compelling reasons to question the assertion that we are running out. On the one hand, new technologies and discoveries have increased the supply of petroleum and natural gas. On the other, concerns about global climate change and the competitiveness of renewable energy are turning coal into a sunset industry and threaten to transform oil reserves into stranded assets. In contrast to fossil fuels, which are consumed in the process of generating energy, virtually all of the metals excavated in the past remain available even after they have been put to use. Even though the average size and degree of mineralization of recently-discovered ore bodies is on the decline, there has never been as much copper, silver, and gold available for human consumption as there is today. Whether incorporated into digital technology or infrastructure, the majority of metals remain available for recycling, which is generally less expensive, uses less energy, and has fewer environmental impacts than extracting minerals from the earth. The threat posed by climate change from continued use of fossil fuels, and the impacts of environmental degradation caused by resource extraction, demand greater attention than the misleading specter of peak oil or running out of metals.

## 1. Introduction

A fundamental axiom of environmental thought since the 1970s is that overconsumption will lead to resource depletion, especially with regard to minerals and fossil fuels, and thereby imperil the future. Avoiding this fate requires moderating the demand for these resources to ensure that adequate supplies will be available to the members of future generations. These ideas were initially advanced by the *Limits to Growth* manifesto written by scholars affiliated with the Club of Rome (Meadows et al., 1972), and subsequently incorporated into the concepts of sustainability and sustainable development (Mitcham, 1997). Recognition of the importance of recycling and reuse are also driven by these concerns. But in recent years, the Malthusian fear of *running out* of minerals and fossil fuels has largely been overtaken by concerns about the contribution of greenhouse gas emissions to global climate change and environmental degradation resulting from resource extraction.[2]

## 2. Access to energy

There are compelling reasons to challenge the assumption that we are about to run out of fossil fuels. Engineers have been predicting the exhaustion of oil and gas supplies for over a century. When the materialist anthropologist Leslie White (1943) argued that the ability to capture ever larger amounts of energy was the driving force behind the evolution of culture, he expressed concern that the rising demand for oil was outpacing new discoveries. Although the oil crisis of the 1970s was more about cartel politics than petroleum shortages, it nonetheless provoked conversations about the end of oil. The first sentence of (Ferry and Limbert, 2008) edited volume on the temporality of resources raised the alarm about peak oil: "Oil is running out. What's more, its final depletion now seems imminent."[3] Such concerns are logical, of course, because fossil fuels are consumed in their use. If more oil is burned than discovered, eventually it will all be gone.

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[2] A preliminary version of this argument was first presented at a workshop in 2011 on "History Underground: Environmental Perspectives on Mining" organized by John McNeill and Frank Uekötter at the Rachel Carson Center for Environment and Society in Munich.

[3] Timothy Mitchell (2013, 231) also concludes *Carbon Democracy* with the assertion that we have entered the "declining decades of the fossil-fuel era" due to diminishing supplies.

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But the reality of the supply side of the equation is that proven energy reserves have increased with the development of new technology making it possible to exploit deposits that were previously unknown or inaccessible. Fracking technology has made oil and gas supplies locked into shale formations available for extraction. Deep sea oil now accounts for nearly one-third of global oil supplies, and the volume of offshore discoveries greatly outstrips new deposits found on land. While the petroleum industry has not overcome the challenges of oil extraction in the Arctic, especially the outsized risks to fragile environments, its task may be eased somewhat by the melting of the polar ice caps, which will open up formerly inaccessible terrain.

Although oil is a finite resource, there are no signs that supplies are drying up.[4] If anything, the trend is moving in the opposite direction, towards oversupply. This became apparent during the oil shock of early 2020, when Russia and Saudi Arabia broke their agreement to maintain oil prices by limiting production. With the expansion of renewable energy, which has become economically competitive with fossil fuels (Hund et al., 2020, p. 32), Saudi Arabia may be re-evaluating its long-term strategy. Protecting its petroleum reserves by capping production rates may not be advisable in the long run if competition from renewables turns these resources into stranded assets, the value of which cannot be recovered. This is already occurring in some sectors of the petroleum market as a result of plummeting demand for oil during the early months of the COVID-19 pandemic, which has meant that higher cost sources of oil, including fracking based on cheap money (Mclean 2020) and oil sands, are no longer economically competitive.

Although the threat of peak oil has long managed to perch comfortably on a nearby horizon, never advancing too close or receding too far into the future, it has lost most of its influence over planning or pricing. Far more troubling than running out of oil would be continued dependence on it, in part due to the risks of other accidents like the BP oil spill in the Gulf of Mexico ten years ago, which continues to surprise with the tenacity of its environmental impacts, or the oil spill in Siberia that occurred while I was writing this essay. But even more disconcerting is the contribution of fossil fuel consumption to the myriad of detrimental consequences from global climate change.

In contrast to oil, the story of coal has been one of abundance. Coal fueled the industrial revolution and subsequently provided insurance against the advent of peak oil. Despite coal being synonymous with the past, we asked it to guarantee our future. But the reduction and eventual elimination of coal consumption has become the first priority of the response to climate change due to its disproportionate contribution to greenhouse gas emissions. However, some countries have remained steadfast in their loyalty to coal. In the developing world, China, India, and Indonesia all remain heavy coal users. Australia wants to sell even more coal than it already does to both China and India, but its efforts have become a target of domestic and international criticism. In Eastern Europe, Hungary, and Poland refuse to sacrifice their coal supplies. Japan is one of the few industrialized economies to build new coal-fired power generators, which it used to replace the nuclear power plants taken offline after Fukushima in 2011. In the United States, coal mining has become iconic of the fight between Republicans and Democrats even though it is no longer economically competitive with natural gas or renewable energy (Plumer 2020). Despite the historical identification of union labor and the political left with coal, it has become the target of progressive environmental criticism, fueling climate change denialism on the right. In contrast to lingering coal pessimism on the part of some observers, the conviction that our economies will not be able to function without coal (Eriksen 2016, 2018), it now appears more likely that we will give up on coal long before it is gone. New investments in coal seek to lock in extraction before the inevitable moratorium, or receive compensation when that day arrives. As one industry observer notes, “Overall, coal is still strong but its expansion is expected to stop and its future is bleak” (Cornot-Gandolphe 2019, p. 6).[5] Like the creative destruction resulting from the digital economy, coal mining is positioned to go the way of fax machines and video stores.

A case in point is Germany, which has the largest economy in the European Union, and draws 35 percent of its power from coal, but recently established a timetable to phase out coal power by 2038 (Egenter and Wehrmann 2019). Between 2019 and 2022, the country will decrease coal use by 12.5 gigawatts. During this time, it plans to convert its reserve generators to natural gas, another 2.3 gigawatts in capacity. From 2023 until 2030, it will reduce coal use by power generators an additional 22.5 gigawatts, which will be replaced by lower-cost renewable energy. Finally, by 2038, and possibly earlier, it plans to end all coal-fired energy generation. Germany hopes to encourage the other countries in the EU still dependent on coal to follow its lead, and to offer technical assistance to developing countries to make this transition as well (see Kirsch 2021). The world is not so much running out of coal as running away from it.

## 3. Access to minerals and metals

What about metals and minerals? Are we on the verge of running out, especially when considering the demand for new infrastructure to support renewable energy (Hund et al., 2020)? Whereas proven reserves of oil and natural gas have been expanded through the application of new technologies, the conditions differ for minerals and metals. The general consensus is that many of the largest and most accessible ore bodies have already been developed. Recently-discovered ore bodies tend to be smaller in size, to have lower rates of mineralization, and to be located deeper underground. This not only increases the costs of production but also the environmental costs of extraction, as more earth and rock need to be processed per quantity of ore recovered. The disposal of overburden and tailings from open-pit mines, along with the risk from acid mine drainage, have come to haunt the mining industry both in terms of financial obligations for their environmental impacts and the resulting opposition to new projects (Kirsch 2014).

Despite the higher costs and greater environmental impacts, new discoveries of metals and minerals have thus far kept pace with demand. Periodic shortages are almost always revealed to be the result of political bottlenecks or strategic stockpiling. This holds true for most, if not all, minerals. Bauxite, for example, the precursor to aluminum, is a very common element, and the limiting factor for the supply of aluminum is not access to bauxite but rather the accessibility of low-cost energy, as the process of production is energy intensive. Even “rare earth” metals, in demand for everything from cell phones to wind power, are hardly rare. Almost all are refined in China or Malaysia, not because that is where the only deposits are located, but because of differences in environmental regulations and their enforcement. The limiting factor in access to rare earth metals is that they are found in conjunction with radioactive materials, including uranium and thorium, which make them uneconomical to extract and refine according to stricter environmental and health standards.

But even more germane to the question whether we are running out of metals is the fact that, in contrast to fossil fuels, which are consumed in the process of generating energy, the total stock of metals remains largely unchanged by extraction and use rather than being exhausted by it. There has never been more copper, silver, or gold available for human consumption than there is today. Of course, a great deal of the stock of metals is tied up in the cities of the world, but as infrastructure

[4] Proven reserves of natural gas have also increased over the last two decades as a result of fracking and offshore drilling, driving prices down.

[5] Investment in new coal-powered generators declined 75 percent from 2015 to 2018 (Fickling, 2019). Decreased energy demand due to the coronavirus pandemic has further reduced coal consumption (Plumer, 2020).

and architecture are renewed, these materials become available again. Whether incorporated into today's digital technology, used for infrastructure, or discarded, the majority of these metals may eventually be recycled, which is generally less expensive, uses less energy, and has fewer environmental impacts than extracting metals from the earth.

## 4. Conclusion

For nearly fifty years, concerns about resource depletion have motivated environmental politics by advancing the view that human society is at imminent risk of exhausting the supply of fossil fuels and metals needed to maintain our way of life. This concern is manifest in rhetoric about peak oil that continues to circulate despite new discoveries and the availability of econmically competitive forms of renewable energy that threaten to transform existing oil reserves into stranded assets. Coal has already made this transition in many post-industrial countries, and despite its symbolic significance for both the right and the left, is already seen as a sunset industry by most external observers (Cornot-Gandolphe, 2019, p. 6).

Metals and minerals have different life-cycles than energy sources like coal and oil, as they are not consumed in their use. That many recent discoveries are smaller in size and yield lower returns does not mean that we are running out. In contrast, available stocks of metals have been increasing ever since humans first began to exploit them. Virtually all of the metals excavated throughout the course of human history remain available for use through recycling and reuse. We are also gradually transitioning towards a more circular economy in which recycled materials play an expanded role in new production. This trend has already spawned a new movement in design that anticipates the reuse of an object's components in future commodities.

This does not mean that the analysis of the problems posed by unlimited growth identified in the 1970s was wrong then, or should be ignored today, but rather that the risks from climate change and environmental degradation resulting from resource extraction have eclipsed the threat of resource depletion. Moreover, the response to climate change alters the way we make use of fossil fuels. To limit the global temperature rise to 2 °C, while staying as close to 1.5° above preindustrial levels as possible, as stipulated by the Paris Agreement, it will be necessary to replace fossil fuels with renewable sources of energy. Some of these changes will come about as a result of social movement pressure and political change, but they are also being driven by the economic competitiveness of renewables (Hund et al., 2020, p. 32). Similarly, we are less at risk of running out of metals, supplies of which are available through recycling, than we are vulnerable to the environmental impacts from the mining industry (Kirsch 2014).

Rethinking the risk of resource depletion does not imply that we no longer need to manage the earth's resources sustainably. Rather, it encourages us to think about the problems caused by resource extraction in different ways: that the risks posed by the continued use of fossil fuels and the environmental impacts of resource extraction demand greater attention than the misleading specter of peak oil or that the world will run out of these important resources. The shift to renewable sources of energy and the increase in recycling and reuse of metals can help keep the world on track to minimize climate change while limiting environmental degradation from resource extraction.

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