

Shifting the Phase-In: Primary and Secondary Coal Regions, the Protoanthropocene, and Early Industrializations

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The history of fossil fuel energy transition is a long-term and global historical process with a high degree of regional diversification. The intensified usage of coal can be traced back well into the early modern period and is not limited to the more recent era of industrialization, as commonly believed. This paper suggests to rather than focus on a single industrialization or industrial revolution, a more complex understanding of the phase-in to a coal-based economy is to be considered through the analysis of the very diverse processes and time frames of energy transitions on a regional level. The change in the supply and usage of energy-rich fuels is a complex interplay of social, economic, political, epistemological, technological, territorial, institutional, and material factors. In this complex interaction, knowledge played a key role in three major points: the correct use of coal; the differentiation between the many types of coal, as certain kinds are

preferred or even required for specific processes; and the identification of deposit locations, as well as the development of a more systematic and scientific approach to mining.

Though the usage of this fossil fuel rose in popularity over an extended period and varied greatly by region, there are a few key transitions that illustrate its increasing historical importance. In a global history perspective, this phase-in lasted from the late sixteenth to the early twentieth centuries although the process happened at very different speeds and on a regionally to be differentiated regional level. The various steps are not to be understood as successive stages or phases. Instead, the transitions should be understood in the regional context as potential links to other regions with more coal experience.

Hard coal as a simple fuel for heating is an example of an early usage of the material and can be studied comparatively on a global scale. From this starting point, processes diversified tremendously, such as the use of hard coal in forging and smelting metals, salt cooking, beer brewing, and lime and brick

burning, among many other usages.¹ Coal continued to be used for heating in conjunction with the newly found applications. The fuel was (and still is) employed in an adapted manner in furnaces and smelts to transform metallic materials like iron and copper. Later, coal was burned to convert its energy into mechanical power as is seen in the steam engine. Finally, the combustion of coal served to produce electricity—a secondary energy.² The invention of new chemical processes in industrial laboratories, which extracted byproducts either directly from the coal or from its waste products, further expanded the possibilities of that material.³

This material, which would have such a major impact on the world that it would ultimately give its name to the age of coal energy system, stood in competition with wood, charcoal, and peat (among others). As with any new resource, practical knowledge from long-term experience first needed to be gained before the process of dissemination, diversification, and enforcement of coal utilization could properly begin. Craftspeople all over the world, for instance, had to master temperature control so as not to overheat the material. Furthermore, pricing mechanisms became just as important as the reliable supply of the fossil fuel. Most historians see the breakthrough of coal use as coupled with James Watt's improved steam engine.⁴ Although this association is not inherently wrong, the economic base is far too thin to

account for the long-term increase in coal demand. Instead, the diverse use of hard coal was far more critical to the rise in popularity of the resource. Development also depended on the type of hard coal that was mined or acquired in a region. Furthermore, available coal types determined technical implementation, as it was learned that some mineral compositions were better suited to certain processes than others. For example, a high bitumen content and a low carbon rate was not suitable for steam engines. For smelting iron, a high phosphate content had a negative effect on the pig iron. Practical experience led to the coevolution of the field of knowledge along with the use of coal and its by-products.

Mined hard coal had to have a sales market and continuous demand so that mines would be economically viable. One approach, practiced worldwide, was that companies would not only mine coal but would also use the combustion residuals in production processes or transportation. This business model led the development of the coal and steel industry in many parts of Europe, as well as in North America, India, and China.⁵ Other industrial combinations also emerged. In parts of Scotland, one feudal enterprise used the locally-produced coal for salt cooking until the mid-eighteenth century.⁶ Several copper-coal companies based near Swansea, Wales, converted the port city into the famous *Copperopolis*.⁷ All over the world, coal mining companies merged with railway companies,

¹ Barbara Freese, *Coal. A Human History* (Cambridge: Perseus, 2003).

² Vaclav Smil, *Energy Transitions. History, Requirements, Prospects* (Santa Barbara: Praeger, 2010).

³ Franz Fischer (ed.): *Gesammelte Abhandlungen zur Kenntnis der Kohle* (Berlin: Bornträger 1917).

⁴ David S. Landes, *The Unbound Prometheus* (Cambridge: Cambridge University Press, 1969).

⁵ Kenneth Pomeranz, *The Great Divergence: China, Europe, and the Making of the Modern World Economy* (Princeton: Princeton University Press, 2000). Pomeranz; Shellen Xiao Wu, *Empires of Coal. Fueling China's Entry into the Modern World Order, 1860–1920* (Stanford: Stanford University Press, 2015).

⁶ Baron F. Duckham, *A History of the Scottish Coal Industry. Vol. 1: 1700–1815* (Newton Abbot: David & Charles, 1970).

⁷ Stephen Hughes, *Copperopolis: Landscapes of the Early Industrial Period in Swansea* (Aberystwyth: Royal Commission on the Ancient and Historical Monuments of Wales, 2000); Edmund Newell, „'Copperopolis': The Rise and Fall of the Copper Industry in the Swansea District, 1826–1921“, *Business History* 32, Nr. 3 (1990): 75–97.

underlining the highly mobile and transregional potentials of the fuel.

These partnerships helped developing factories outside the coal regions and transformed coal into the most important source of energy on a global level. The industrial sites in London, in the iron-smelting region of Burgundy, France, in the late eighteenth century,⁸ and in Monterrey, Mexico, in the early twentieth century⁹ show that industrial development was determined by regional differentiations of using this resource. This regional development of the coal industry outside coal basin areas should be considered the second phase-in.

These long-term transformation and adaptation of protoindustrial and industrial societies, required a transformation of how technology, labor organization, and energy were considered. These changes gave rise to new methods of production in agriculture, craftsmanship, and manufacturing. As coal became the chief material in production and transportation sectors, production chains expanded considerably. The regions outside the coal basin that belong to the second phase-in should be included in the historiography of (proto-)industrialization and industrialized mining.¹⁰ The supply of the fossil

fuel to certain sectors of production was an important prerequisite for these regional and interregional production chains that mark the age of the protoanthropocene and the anthropocene.¹¹ Early industrial coal mining provided a relatively high concentration of mining and processing sites, as well as an early division of labor for extraction and onward transport.¹² During the phase-in of protoindustrialization, the hard coal operation was often run as an exclusive business in which coal mining businesses could also be involved in further processing, for instance, smelting ores at other sites outside the mining region. Lastly, coal mining regions helped the development of other industrialized regions where this combustible resource was not mined. For a global history of regional industrialization, the development of such secondary coal regions allows for more complex and varied histories of the phase-in to the fossil fuel period. Primary and secondary coal regions depended on each other and interpretations of fossil fuel history should reflect that relationship. The mobilization of energy, work organization, technology, and knowledge regarding coal in one region had an impact on the other regions with which they conducted business.

8 C. Javey, *Recensement et localisation des anciens puits de mine des houillères du Creusot (71)* (Dijon: Bureau de recherches géologiques et minières, 1989).

9 Mario Cerutti, *Proprietarios, empresarios y empresa en el norte de México. Monterrey: de 1848 a la globalización* (Mexico: Siglo Veintiuno Editores, 2000). Helge Wendt, „Interrelations and Disruptions in the Exchange of Knowledge: Coal, Geology, and Industrialisation in Mexico.“, *History of Technology* 34 (2019).

10 Pierre Deyon, „Proto-Industrialization in France“, in *European Proto-Industrialization*, hg. von Sheilagh C. Ogilvie und Markus Cerman (Cambridge: Cambridge University Press, 1996), 38–48; Pat Hudson, „Proto-Industrialization in England“, in *European Proto-Industrialization*, hg. von Sheilagh C. Ogilvie und Markus Cerman (Cambridge: Cambridge University Press, 1996), 49–66; Sheilagh C. Ogilvie und Markus Cerman, „Proto-Industrialization, Economic Development and Social Change in Early Modern Europe“, in *European Proto-Industrialization*, hg. von Sheilagh C. Ogilvie und Markus Cerman (Cambridge: Cambridge University Press, 1996), 227–239; Jürgen Schlumbohm, „‘Proto-Industrialization’ as a Research Strategy and a Historical Period – a Balance-Sheet“, in *European Proto-Industrialization*, hg. von Sheilagh C. Ogilvie und Markus Cerman (Cambridge: Cambridge University Press, 1996), 12–22.

11 Erle C. Ellis, *Anthropocene. A Very Short Introduction* (Oxford: OUP, 2018); Jürgen Renn, *The Evolution of Knowledge. Rethinking Science for the Anthropocene* (Princeton, Oxford: Princeton University Press, 2020); Helge Wendt, „Epilogue: The Iberian Way into the Anthropocene“, in *The Globalization of Knowledge in The Iberian Colonial World*, hg. von Helge Wendt (Berlin: Edition Open Access, 2016), 297–314.

12 Franz-Josef Brüggemeier und Thomas Rommelspacher, *Blauer Himmel über der Ruhr. Geschichte der Umwelt im Ruhrgebiet (1840-1990)* (Essen: Klartext, 1992).