

Lowell Mills and the History of Climate Change

Historic Context Statement

Lowell Mills National Historical Park preserves the history of America's industrial revolution. The industrial revolution is frequently referenced in scientific papers about climate change as a key factor in the acceleration of fossil fuel use and carbon emissions. What can Lowell teach us about the history of the climate crisis and how the transition to fossil fuels took place? Lowell offers an example of how the causes of the climate crisis emerged from and affected the histories of specific places and people.

This statement is an overview of the connections between the climate crisis and the industrial activities in Lowell during the nineteenth and twentieth centuries and is therefore limited in scope. Further research is needed to connect Lowell's story with the climate implications of cotton production, slavery, and colonization of the northeastern United States.

Water Powered Industrial Revolution

Industrial production without fossil fuels

1823 - 1875

Lowell was founded in 1823 as a new manufacturing center on the Merrimack River, whose dramatic change in elevation offered a source of waterpower significantly greater than other rivers in the area (such as the Charles).¹ During the mid-nineteenth century, Lowell grew into the largest textile manufacturing city in the northeast, based primarily on power from its waterways.

Starting in the middle of the nineteenth century, Lowell's mills begin to add coal-powered steam engines, which were generally used only during periods of low water flow. The steam engines allowed the mills to expand beyond the reliable energy capacity of the river using extra water on days it was available. The steam engines provided backup power to ensure the expanded capacity of the mill stayed in operation regardless of flow. Through coal was a small fraction of the power used in Lowell during this period, it enabled mill owners to invest in expansion and purchase more water power, knowing their new equipment would still make profit during dry periods. Waterpower continued to be preferred because it remained cheaper than steam, and it was adequate for production most days of the year.² Lowell's water management company, the Proprietors of Locks and Canals, continued to improve the canal system and purchased rights to additional water upstream to increase the water power available as Lowell expanded.³

Climate Impact:

From 1823-1875, Lowell's power primarily came from water, even after the introduction of coal-powered steam engines. The carbon impact of Lowell's manufacturing during this period was possibly

¹ Room 1, Core Exhibition, Lowell National Historical Park, viewed November 15, 2022.

² Patrick M. Malone, "Surplus Water, Hybrid Power Systems, and Industrial Expansion in Lowell," *IA. The Journal of the Society for Industrial Archeology* 31, no. 1 (2005): 32.

³ Patrick M. Malone, "Surplus Water, Hybrid Power Systems, and Industrial Expansion in Lowell," *IA. The Journal of the Society for Industrial Archeology* 31, no. 1 (2005): 35.

more due to deforestation – for materials to build the factories, and to clear land for the cotton they purchased from the Southeast United States.⁴ This aligns with global trends: emissions sources during this era were primarily from clearing land for agriculture and harvesting wood for fuel and construction.⁵ In the nineteenth century, the accumulation of global CO₂ in the atmosphere increased rapidly, with the United States leading global CO₂ emissions by 1850.⁶

Fossil Fueled Growth and Competition

Lowell's contribution to the climate crisis

1875 - 1920

During the late nineteenth and early twentieth centuries, coal-powered steam engines enabled Lowell's industrial output and population to continue to grow, but coal also brought new competitors. The national railroad network expanded dramatically following the Civil War. The resulting geographic connections created a national market for consumer goods such as textiles and drove up demand for Lowell's industries.⁷ Railroads also opened vast new territory for coal mining, driving the price down and the supply up.⁸ Though meeting new demand consumer demand through waterpower would have been the most affordable option, the Merrimack River's supply was fully utilized already. Mill owners had to turn to another power source to profit from the new demand: steam powered by coal, which they already used intermittently to augment waterpower. In 1866, the mills in Lowell had 29 steam engines that provided 2,885 hp of steam power, and by 1881, 88 engines provided 11,950 hp.⁹

However, Lowell also faced new competition because of the availability of coal. Cheap, abundant coal meant a mill could be located anywhere, not only near select waterways. Coal freed mills to locate near existing urban areas with plentiful labor and near large ports that provided cheap transit options for finished goods and fuel.¹⁰

Climate Impact:

The expansion of coal usage at Lowell and across the textile industry is part of the larger story of America's early contribution to the climate crisis. As the nineteenth century progressed, carbon emissions increased and the United States maintained its position as top emitter of atmospheric carbon, but the source of emissions shifted. By 1900 bituminous coal had replaced wood as the main source of energy in the United States (see Figure 1). While American companies mined 2.5 million tons of coal 1840, by 1880 American coal companies produced 80 million tons of coal.¹¹ This coal heated homes, fueled trains

⁴ *Deforestation and The Industrial Revolution* (National Park Service), accessed January 20, 2023, <https://www.nps.gov/lowe/learn/nature/climatechange.htm>.

⁵ Simon Evans, "Analysis: Which Countries Are Historically Responsible for Climate Change?," Carbon Brief, October 5, 2021, <https://www.carbonbrief.org/analysis-which-countries-are-historically-responsible-for-climate-change>.

⁶ Ibid.

⁷ Introductory film, Core Exhibition, Lowell National Historical Park, viewed November 17, 2022.

⁸ Sean Patrick Adams, "The US Coal Industry in the Nineteenth Century," Economic History Association Encyclopedia, edited by Robert Whaples., 2003, <https://eh.net/encyclopedia/the-us-coal-industry-in-the-nineteenth-century/>.

⁹ Malone, "Surplus Water, Hybrid Power Systems, and Industrial Expansion in Lowell."

¹⁰ Marti Frank, "Water and Steam: How Industrial Power Shaped the New England Landscape," in *A Landscape History of New England*, ed. Blake A. Harrison and Richard William Judd (Cambridge, Mass: MIT Press, 2011).

¹¹ Adams, "The US Coal Industry in the Nineteenth Century."

and ships, produced iron and steel, powered the expansion of industry like Lowell’s, and created greenhouse gas emissions that accumulated in the atmosphere at an exponential rate (see Figure 2).

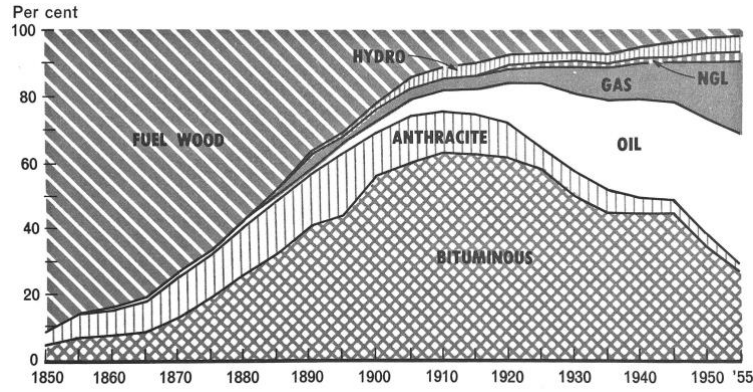


Figure 1: Specific energy sources as percentages of aggregate consumption in the United States. *Energy in the American Economy, 1850-1975; an Economic Study of its History and Prospects*, by Sam H. Schurr and Bruce C. Netschert, with Vera F. Eliasberg, Joseph Lerner and Hans H. Landsberg, 37.

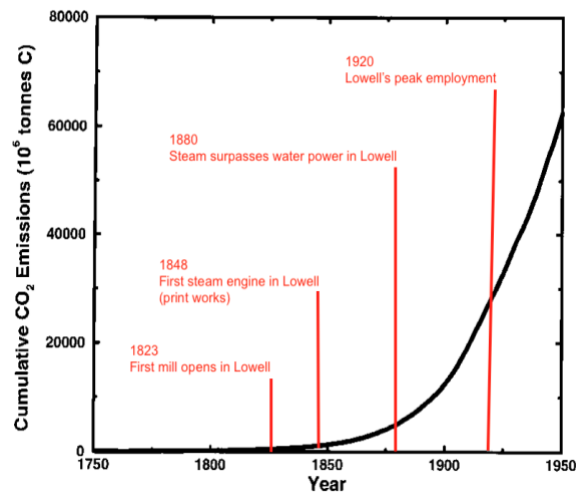


Figure 2: Cumulative emissions of CO₂ from the production of fossil fuels, 1750-1950. Andres, R. J., D. J. Fielding, G. Marland, T. A. Boden, N. Kumar, and A. T. Kearney. “Carbon Dioxide Emissions from Fossil-Fuel Use, 1751–1950.” *Tellus B: Chemical and Physical Meteorology* 51, no. 4 (January 1, 1999): 759–65. <https://doi.org/10.3402/tellusb.v51i4.16483>.

Energy Mobility and the Decline of Lowell's Mills

The fossil fuel economy leaves Lowell behind

1920 – 1970 and beyond

Thanks to coal, the textile industries based in Lowell were no longer reliant on the Merrimack River for power. During this period, most of them moved to the Southeastern United States to take advantage of lower taxes and labor costs. The mills in Lowell needed upgrades to keep them competitive, but the mill companies decided to invest in new facilities elsewhere instead.¹² Lowell's industrial output and population declined.

Climate Impact:

Labor costs and taxes created an economic incentive to move, enabled by the portability of new energy sources. Textile mills proliferated in the Southeastern United States and then eventually relocated to Asia, in both cases motivated by cheaper labor and other inputs. Though the United States is still responsible for the majority of carbon in the atmosphere, China has surpassed the United States in annual emissions since 2000, due to a rapid expansion in coal power plants.¹³ China has replaced the United States as a global textile manufacturing center, and carbon emissions have followed.

Summary

Lowell's mill industries primarily used waterpower for decades, even after the introduction of coal-fueled steam power. Eventually, the demand for textiles outpaced the supply of waterpower, and coal became the primary source of power in Lowell. In time, the cost savings of cheap labor and taxes drew the mills away from Lowell, enabled by the mobility of fossil fuel.

Questions for Additional Research

- Where did the coal for Lowell's steam engines come from?
- When did the mills in Lowell convert from on-site steam engines to electricity (which, like the mills, may have been generated from a combination of water and coal), and how did this affect their emissions?
- How were the new southern textile mills that replaced Lowell powered, and what was their carbon footprint?
- How does Lowell fit into the larger legacy of extraction on the East Coast?
- How does the climate impact of powering Lowell's textile mills compare to the climate implications of cotton production?
- Do Lowell's existing interpretive sources cited in this report (signage, core exhibition, handbook) meet Lowell NHP/TIHC's current standards for research accuracy?

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¹²Core Exhibition, Lowell National Historical Park, viewed November 15, 2022.

¹³ Evans, "Analysis."