

Policy Brief:

Advancing Green Steel in the Mon Valley

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Introduction

As heavy industry moves toward decarbonization, Allegheny County, Pennsylvania has a unique opportunity to become a global leader in producing green steel. Green steel is manufactured using hydrogen to directly reduce iron rather than traditional coal-based blast furnaces. If the hydrogen used to produce the steel is generated by electricity from renewable energy sources, such as wind or solar, then the process becomes effectively emissions-free, reducing greenhouse gas emissions and improving nearby air quality.

Green steel has tremendous economic potential. A transition to green steel would help to reshape the local economy and allow the region to regain its leadership in steel production. Additionally, investments in renewable energy and hydrogen infrastructure can provide a first-mover advantage for the region as other industries seek to decarbonize. Given the current upheaval in the traditional steel industry, globally and domestically, and the potential sale of U.S. Steel to Nippon Steel or another steel company, both the industry and the region are ripe to benefit from such a transition.

Green steel will likely dominate steel production this century, given the urgent need to decarbonize this industrial process. Steelmaking is responsible for 7% of global carbon emissions and, alongside cement production, is one of the most difficult to decarbonize. Only Chemicals and Refining emit more energy-related CO₂, according to the US Energy Information Administration (EIA).¹ The Department of Energy (DOE) has targeted steel as a key industrial sector for emissions reduction in its 2022 “[Industrial Decarbonization Roadmap](#).”²

¹ DOE Industrial Decarbonization Roadmap.

² DOE Industrial Decarbonization Roadmap.

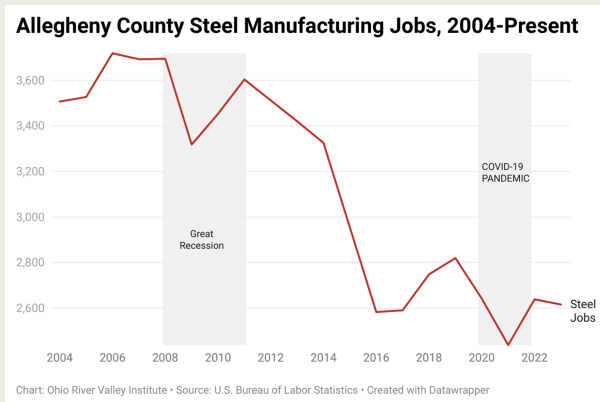
Throughout the world, governments, investors, and private firms are investing billions in green steel production, thanks to the ability to manufacture hydrogen with near-zero emissions by splitting water molecules via renewable energy-powered electrolysis. Green hydrogen does not produce CO₂ as a byproduct. The US has taken the lead in incentivizing green hydrogen production, a key component of green steel production. The tax credits for clean hydrogen in the Inflation Reduction Act, known as the [45V Clean Hydrogen Production Tax Credit](#), provide potential credits up to \$3/kg. The tax credit is expected to make low-carbon hydrogen cost-competitive with, or cheaper than, hydrogen produced from fossil fuels.

The Future of Traditional Steel Making is Bleak

Traditional steelmaking in Pennsylvania has faced intense domestic and international competition. This competition has come from other states and countries, [which have worked to lure steel companies with generous tax incentives](#) at the expense of their own tax revenues. Many of the states that compete with Pennsylvania are also so-called “[right to work](#)” states, with less protection for organized workers, which drives costs down for steel companies at the expense of workers’ wages. As the industry transitions to low-carbon steel production, this competition may only intensify as steel companies look for the most beneficial locations to make large capital investments.

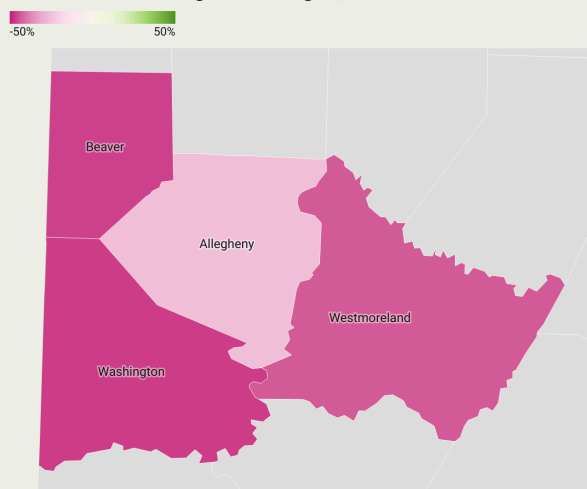
The US steel industry has already seen significant job declines since the 1980s due to both offshoring and automation. The industry has

declined from roughly 700,000 workers in 1980 to 85,000 in 2018. Regional employment in the steel industry has also declined steadily since the 1980s, with steel-manufacturing employment declines in the Mon Valley even more dire than national averages. These declines are expected to continue absent any major industry or policy shift.



In the last twenty years, every county in the region has experienced a significant decline in steel manufacturing jobs.

Steel Manufacturing Job Changes, 2004-Present



One such major shift that could revitalize western Pennsylvania’s historic steel industry is

green steel production. Green steel requires green hydrogen production and investments in hydrogen electrolyzers and the associated wind and solar capacity would potentially generate a net *increase* in jobs in the region. A recent report by the Ohio River Valley Institute (ORVI) found that a transition to green steelmaking would boost jobs supported by the steel industry by roughly 27% to 43% by 2031, forestalling employment declines expected with traditional steelmaking. These job gains come from both the construction of wind turbines, solar arrays, and electrolyzers and the long-term operation of electrolyzers. Additionally, by geographically tying green steel production to renewable infrastructure in the region, a transition has the potential to decrease the likelihood that steel manufacturing facilities migrate out of state or overseas.

A large-scale buildout of industrial renewable energy infrastructure could also generate a first-mover advantage for the region, creating a potential cluster of related decarbonizing industries and businesses throughout supply chains.³ Economic and employment growth would largely be local, making new jobs and economic gains more resilient to interstate and global competition.

³ First-mover advantage in green innovation is well-documented. An empirical, peer reviewed study of S&P 500 data finds lagged returns via increased stock price for corporations who adopted early focus on green innovation in the 2010s ([Przychodzen, 2019](#)). First movers in manufacturing generally achieve competitive advantages through absolute cost advantages, growth of markets, and easier transfer of skills and knowledge across co-located or related firms ([Agarwal and Gort, 2001](#)).

Robust Domestic Demand Outlook, Spurred by Federal Legislation

Domestic demand for steel in the United States remains stable and the medium-term outlook is encouraging. Domestic demand has been resilient despite a complex global environment, which has seen shifting tariff policy proposals, a slowdown of over 10% in China, evolving technology, and global decarbonization trends.

Steel production in the US was relatively flat in 2023, after declining in 2022.⁴ The forecast for the domestic steel industry in 2024 and 2025 remains optimistic, fueled by government policies like the Inflation Reduction Act (IRA) and Infrastructure Investment and Jobs Act (IIJA). Many of the subsidies for the production of electric vehicles and renewable infrastructure include domestic content requirements, which are likely to further stimulate domestic demand. Unlike the European Union, where steel demand has been volatile, and China, where steel demand has plummeted alongside a slumping real estate market, the demand outlook for domestic steel in the US is strong.

Federal Legislation Supports Green Steel Initiatives

The passage of the IRA in 2022 and the IIJA in 2021 drastically changed the landscape for renewable energy and decarbonization. Previously, the construction of large-scale renewable energy infrastructure necessary for green steelmaking would have been financially infeasible.

However, several major subsidies now exist that substantially support the required infrastructure build outs. First, the IRA provides either the investment tax credit (ITC) or production tax credit (PTC). Developers for large-scale wind and solar

⁴<https://www.steel.org/2024/06/aisi-releases-annual-statistical-report-for-2023/>

projects in Pennsylvania would be eligible for these credits.

Table 1: Summary of Investment and Production Tax Credits for Wind and Solar Projects Over 1MW

	ITC	PTC
Base Credit	6%	0.5 ¢/kwh
Wage and Apprenticeship Requirements	+24%	+2.25 ¢/kwh
Domestic Content Requirement Bonus	+10%	+0.3 ¢/kwh
Energy Community Bonus	+10%	+0.3 ¢/kwh
Total	50%	3.35 ¢/kwh

Source: US EPA, "[Summary of Inflation Reduction Act provisions relating to renewable energy](#)"

Note that the developer elects either the PTC or ITC, not both.

As Table 1 shows, the ITC and PTC offer substantial federal subsidies for the types of renewable energy projects that would be necessary for green steel production in Western Pennsylvania. In addition to accelerated depreciation benefits, if a renewable project was sited in an energy community, met IRA domestic content requirements, and met wage and salary requirements set out by the federal government, it could stand to receive hundreds of millions of dollars in tax credits. Estimates for some proposed projects around the country show that these credits could potentially offset over 60% of the total cost of a project.

In addition to subsidizing the renewable energy build outs necessary for clean hydrogen production, the IRA offers a separate Clean Hydrogen Production Tax Credit. Tax incentives at every step of the green steel transition –

renewable energy construction and hydrogen production— means that the time for investment has never been better.

region have become even more uncertain given the recent sale of U.S. Steel that is pending federal approval.

The Full Picture: A Transition Stems Job Losses and Creates New Opportunities

When comparing the economic impact of a green steel transition to the status quo, it is necessary to make an “apples-to-apples” comparison. Given the multi-decade trend of declining steel employment in the Mon Valley, comparing a 10-year outlook requires the extrapolation of trends absent any intervention. In fact, future levels of steel employment in the

[The recent ORVI report](#) extrapolated traditional steel trends as well as a transition to green steel by 2031. The assumptions used about capacity and construction employment are included in the appendix of that report. The ultimate finding is that a transition to green steel could support 3,820 jobs in the region, representing a 42.8% total increase in employment, as compared to 1,858 under the 'business as usual' scenario and current trajectory of traditional steel making—a decline of over 30%

In- and Out- of Region Direct Jobs Impact (FTE)					
The Present... Full-time direct jobs		If Employment Trends Continue through 2031... Full-time direct jobs		Under Fossil Fuel-Free DRI-EAF Investment Full-time direct jobs	
Mining		Mining		Hydrogen & renewables	
Iron ore (out of region)	365	Iron ore (out of region)	256	Hydrogen	328
Coal mining	175	Coal mining	123	Wind	15
Total Mining	540	Total Mining	379	Solar	406
Iron and steelmaking		Iron and steelmaking		Total hydrogen & renewables	
Coking	413	Coking	286	749	
BF-BOF	482	BF-BOF	334	Mining	
Total iron and steel making	895	Total iron and steel making	620	DR-grade iron ore (out of region)	
Estimated Regional Direct Jobs	1070	Estimated Regional Direct Jobs	743	365	
Total Direct Jobs, including iron ore	1,435	Total Direct Jobs, including iron ore	999	Total Mining	
				365	
In-Region Direct, Indirect and Induced Jobs Impact (FTE)					
The Present...		If Employment Trends Continue through 2031...		Under Fossil Fuel-Free Hydrogen DRI-EAF Investment	
Estimated Current Regional Direct Jobs	1070	Estimated Regional Direct Jobs	743	Estimated Regional Direct Jobs	1,528
Estimated Current Indirect & Induced Regional Jobs	1,605	Estimated Indirect & Induced Regional Jobs	1,115	Estimated Indirect & Induced Regional Jobs	2,292
Total Regional Jobs	2,675	Total Regional Jobs	1,858	Total Regional Jobs	3,820

Source: The Ohio River Valley Institute, “Green Steel in the Ohio River Valley”

The Mon Valley: Well-Positioned to Lead the World in Green Steel

Allegheny County is particularly well-suited to lead the world in green steel production due to its:

- History of steelmaking and the associated pre-existing workforce knowledge and skills.
- Access to water needed for hydrogen electrolysis.
- Ideal locale for transporting both inputs and finished steel by existing river, rail, or roadway infrastructure.
- Existing steel sites, including the Mon Valley Works near Pittsburgh.
- 150-year-old supply chain from the Midwest for iron ore, a key input for green steel and for secondary steel manufacturing.
- Potential to develop its wind and solar assets with bonus federal tax credits due to the region's history as an energy community.

Enhanced Global Competitiveness

As the world moves towards stricter environmental regulations and carbon pricing mechanisms, the demand for low-carbon steel products will only increase. Regions that transition to green steel early will be better positioned to meet this demand, enhancing their competitiveness in the global market. This first-mover advantage will be particularly important as industries across the board seek to reduce their carbon footprints. This transition is likely to stimulate investment in new technologies, create high-quality jobs, and foster innovation in related industries. The green steel sector is expected to be a major driver of economic growth, particularly in regions that adopt these technologies early.

Environmental and Health Benefits from the Transition to Green Steel

Lower Emissions

The transition to green steel offers significant environmental benefits, primarily by reducing carbon emissions. Traditional steelmaking processes are carbon-intensive, contributing substantially to global greenhouse gas emissions. In contrast, green steel production, particularly through processes like hydrogen-based reduction, emits far less carbon dioxide. Instead of producing carbon dioxide as a byproduct, hydrogen-based processes emit only water, significantly lowering the industry's carbon footprint. This shift is crucial in meeting global climate targets and mitigating the impacts of climate change.

Health Benefits & Air Quality

The environmental benefits of green steel extend directly to public health. Traditional steel production often releases harmful pollutants, including particulate matter, sulfur dioxide, and nitrogen oxides, which can have severe health impacts on surrounding communities and can raise healthcare costs, particularly for at-risk populations such as infants and the elderly⁵⁶⁷. These pollutants are linked to respiratory illnesses, cardiovascular diseases, and other health problems.⁸ By adopting cleaner green steel production, the industry can reduce these

⁵ Romley, J. A., Hackbarth, A., & Goldman, D. P. (2012). The impact of air quality on hospital spending. *Rand Health Quarterly*, 2(3).

⁶ Sheffield, P., Roy, A., Wong, K., & Trasande, L. (2011). Fine particulate matter pollution linked to respiratory illness in infants and increased hospital costs. *Health Affairs*, 30(5), 871-878.

⁷ Van Den Eeden, S., Alexeeff, S., Shan, J., Sidney, S., Ray, G., Messier, K., ... & Roy, A. (2019). Air Pollution and Health Care Costs in Oakland, CA. *Environmental Epidemiology*, 3, 406.

⁸ Synapse Energy Economics (Synapse) for Sierra Club, "Coming Clean on Industrial Emissions" <https://www.sierraclub.org/sites/default/files/2023-09/Coming-Clean-On-Industrial-Emissions.pdf>

emissions, creating better air quality and, consequently, better public health outcomes.

Green steel production processes contribute to cleaner air, especially in industrial regions historically suffering from steel plant emissions. Reducing harmful pollutants enhances the overall quality of life, leading to long-term economic and social benefits. Cleaner air is associated with lower healthcare costs for residents and reduced environmental degradation.⁹

Improved Water Quality

In addition to improving air quality, the transition to green steel can also lead to better water quality. Traditional steelmaking requires significant water and can contaminate local water sources with heavy metals and other pollutants¹⁰. Green steel production, by reducing harmful emissions and adopting more sustainable practices, minimizes the risk of water pollution. This shift can help protect aquatic ecosystems, preserve biodiversity, and ensure local communities can access clean water.

Energy Efficiency and Cost Savings

Green steel production processes are generally more energy-efficient than traditional methods¹¹. By using renewable energy sources and innovative technologies, green steel can be produced with lower energy inputs, leading to cost savings in the long term. These savings can be reinvested in further improving production processes, making the industry more sustainable and economically viable.

⁹ Industrious Labs, "Dirty Steel, Dangerous Air" <https://cdn.sanity.io/files/xdjws328/production/71057afa03f9784a6599a762149bd87fe735c06a.pdf>

¹⁰ Conejo, A. N., Birat, J. P., & Dutta, A. (2020). A review of the current environmental challenges of the steel industry and its value chain. *Journal of environmental management*, 259, 109782.

¹¹ Kim, J., Sovacool, B. K., Bazilian, M., Griffiths, S., Lee, J., Yang, M., & Lee, J. (2022). Decarbonizing the iron and steel industry: A systematic review of sociotechnical systems, technological innovations, and policy options. *Energy Research & Social Science*, 89, 102565.

Conclusion

While the U.S. steel industry faces challenges related to global overcapacity and the need to decarbonize, domestic demand remains strong, driven by federal policies that support investment in industrial decarbonization. The transition to green steel offers a dual benefit of environmental sustainability and economic and job growth, providing an opportunity to lead in this emerging global market while simultaneously improving health and environmental quality for residents in the region. The transition also offers the opportunity to utilize latent infrastructure and leverage existing workforce knowledge and supply chains, providing the region with a competitive advantage. There is an immense opportunity to reestablish the Mon Valley as a global leader in both green steel and industrial decarbonization. Policymakers, alongside business and labor leaders, should seize it.

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