Pathways to Commercial Liftoff
Industrial Decarbonization

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Pathway to Commercial Liftoff

The pathway to net zero will require the U.S. economy to eliminate or capture emissions associated with industrial production processes. In 2021, the energy and process-related emissions from the eight sectors of focus in IRA – chemicals, refining, iron and steel, food and beverage processing, pulp and paper, cement, aluminum, and glass – accounted for 14% of all domestic CO_2 emissions. The Liftoff report found that, despite these sectors being considered "hard-to-abate," there were promising opportunities to deploy industrial decarbonization technologies today.

Technologies are ready: Based on 2023 least-cost modeling of currently available technologies, three decarbonization strategies could account for ~55% of emissions abatement potential by 2030 in the industrial sectors of focus: carbon capture and storage (~30%), adoption of clean onsite electricity and storage (~15%), and industrial electrification (~10%).

Projects can make money: Approximately 10-15% of the required industrial-sector abatement by 2030 could be accomplished via net-positive decarbonization measures (costing <$0/t CO_2e and defined as a ~10%+ estimated IRR) such as energy efficiency retrofits, electrification, and the use of alternative feedstocks like clean hydrogen or waste-based fuels. DOE is also performing the Pathways to U.S. Industrial Transformation study to understand how to address the portion of emissions that are not currently cost-effective to abate and how full decarbonization might still be achieved.

Grid decarbonization is key: External factors outside of industrial leaders' immediate control are also a critical dependency for fully decarbonizing U.S. industry. Approximately 15% of total industrial emissions abatement potential by 2030 depends on grid decarbonization and 10-15% depends on general demand reduction due to other market trends (e.g., transport electrification).

Market Status

Metric	Value	2030 Target
Total Clean Electricity Generation Connected to the Grid[1] Source: EIA EPM August 2024	~1,800 GWh	- [2]
Expected Capacity of Operational CCS Projects[3] Source: GCCSI 2024 Q2	~19 MTPA[4]	73 MTPA[5]
Clean Hydrogen for Industrial Decarbonization (Ammonia and Refining Offtake) Source: BNEF 2024 Q2	~1.4 MTPA[6]	~5 MTPA
Levelized Cost of Solar + Storage at Commercial & Industrial Sites Source: Lazard LCOE+ 2023	$133-$166/MWh	$72/MWh[7]
Capital Mobilized for Domestic Industrial Decarbonization Source: DOE 2024	~$21.5B [8]	- [9]

1. Trailing 12-month average 2. While no formal target for this metric has been established, Liftoff analysis suggests that it would require 180 TWh of clean firm capacity by 2030 to fully electrify the domestic chemicals and refining industry 3. Includes CCS for hydrogen, ammonia, fertilizer, and natural gas processing 4. Million metric tons per annum 5. MT estimated to cost below $50/ton of CO_2 by 2030 6. Includes non-binding agreements 7. Renewable + storage cost target based on $22/MWh LCOE for Class 5 Onshore Wind in 2030 & DOE's Long Duration Storage Shot target of $50/MWh by 2030 8. Value represents minimum investment in projects for industrial decarbonization that includes OCED's ~$6B industrial demonstration awards, $500M of 48C tax credits for industrial decarbonization, and anticipated private sector crowd-in from cost-share agreements 9. Liftoff analysis suggests that $700B to $1.1T capital investment required to decarbonize the eight industrial sectors of focus

Possible Near-term Actions

1. Reduce the premium on decarbonized technology by de-risking investment and promoting cost reductions via demonstrations
2. Integrate decarbonization strategy into near- and long-term capital planning, facility retrofits, and equipment downtime
3. Diversify decarbonization portfolios via R&D and pilot projects for promising alternative technologies or production methods
4. Continue to build and expand existing infrastructure and supporting ecosystem by expediting permitting bottlenecks, building public acceptance, and building or expanding regional hubs and common-carrier infrastructure
5. Facilitate lowering the cost of capital investment by proving the business case for decarbonization measures and providing loans or cooperative agreements