ACCELERATING NET-ZERO EMISSIONS INDUSTRY IN THE U.S.

EXECUTIVE SUMMARY

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The Challenge

Industrial activities are a major source of global CO_2 emissions, accounting for roughly a quarter of U.S. emissions in recent years.[1] Although a large share of industrial emissions can be avoided through coordinated efficiency improvements, electrification, and decarbonization of electricity generation, more than a quarter of emissions come from more difficult-to-decarbonize industries which produce large quantities of non-energy process emissions, require very high temperatures, and/or whose equipment and infrastructure are especially long-lived. Most prominent among these difficult-to-decarbonize industrial activities are the production of cement, iron and steel, and key feedstock chemicals. These challenges can be addressed through policy pathways that foster technical solutions for decarbonizing industry.

The Solution

Technologies exist to decarbonize heavy industry. Moreover, the additional costs associated with these technologies may represent modest increases in the overall cost of buildings or vehicles. However, policy will be vital to accelerating remaining research, development, and—especially—commercialization of these technologies. Specifically, policies can create lead or niche markets to reduce risk for early innovators and to build economies of scale, much as satellites, calculators and remote electronics allowed solar photovoltaic (PV) to evolve beyond the lab.[2]

Industrial processes to produce cement, steel, and chemicals are expected to be among the most challenging parts of modern economies to decarbonize.[3] Carbon capture and storage is often the modeled solution for industry process emissions, and it is indeed likely to be required for eliminating emissions from cement production. However, there are a range of other technological options available for achieving net-zero industry emissions. First, more and higher quality recycling of iron products, copper, other metals, unreacted cement, and concrete aggregates should be encouraged. Second, building renovation, retrofitting and component reuse where possible, while costing the same as new buildings, uses 1/10 the steel and cement. Third, demand for cement, steel, and chemicals can be greatly reduced by longer lived, flexible and more materials-efficient building and infrastructure designs that make the most of steel and concrete's advantages while minimizing their use, and by substitution of alternative materials. These include less emissions-intensive cementitious materials and fillers for cement clinker, wood in lieu of cement and steel in buildings, and aluminum and plastic instead of steel in vehicles. Second, there are opportunities to produce steel and chemicals by different, non-emitting processes. For example, hydrogen reduction of iron ore and chemicals synthesized with

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renewable hydrogen and atmospheric carbon. Although such technologies exist, they remain expensive relative to the current industry processes, pointing to the need for policies that boost deployment (i.e. de-risking investments and allowing learning-by-doing) and also encourage continued innovation.

Policy Recommendations

Specific recommendations include:

- Encourage and mandate vehicle, machinery, building and infrastructure designs that allow for component reuse and high purity recycling at end-of-life. A key strategy for increasing iron recycling is designing vehicles so the copper wiring looms are easy to remove.
- Revising building and infrastructure codes and best practices in design to explicitly consider life cycle construction and use carbon intensity. This would include: retrofitting and renovating existing building stock; encouragement of design for longer, flexible, multi-use building and infrastructure lives; material efficiency improvements; and substitution of carbon intense materials.
- Increase public funding of research and development of new technologies that could eliminate CO_2 emissions from the cement, steel and chemical industries, and foster public-private collaborations to support the demonstration of the most-promising technologies at commercial scale, possibly in cooperation with international partners.
- Convening and coordinating forums of key stakeholders to map out complex system transitions and develop and establish standards and supporting institutions.
- Incentivizing commercialization by establishing lead markets for more expensive green industrial products and, eventually, protecting nascent green industries with border standards or border carbon adjustments.
- Proactively addressing challenges of lock-in and environmental justice associated with existing industry infrastructure, for instance by targeted public support for “sunsetting” of emissions-intensive capital, retraining industry workers, growing new industry in affected regions.
- Establish and encourage lead markets for decarbonized industrial commodities via, e.g., green procurement policies, GHG content regulations, and guaranteed production subsidies.
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Outcomes

The economic downturn related to COVID-19 is expected to have large, lasting effects on U.S. heavy industry. Demand for industrial products often depends on economic growth (e.g., construction) or consumer spending (e.g., feedstock chemicals), though targeted stimulus efforts might alter this dynamic. This presents an opportunity for new policies that can create pathways to decarbonize industry. The coordinated implementation of such policies would not only hasten reductions of industry emissions but also reduce the need for carbon capture and storage while spurring regrowth of cleaner American industries and charting a path for net-zero emissions industry worldwide.

References

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