MANUFACTURING SECTOR DECARBONIZATION STRATEGIES AND IMPACTS IN THE STATE OF MARYLAND

Summary for Policymakers | October 2022

KEY FINDINGS

- **Non-federal action is a critical pillar of climate mitigation in the United States**, especially from pioneering states such as Maryland. Maryland's Climate Solutions Now Act of 2022 calls for 60% emissions reductions by 2031, the most ambitious target in the country, as well as a 2045 net-zero goal. The state must take action in all sectors to achieve its climate targets, including in the manufacturing sector.
- **The manufacturing sector in Maryland represented nearly 10% of statewide emissions in 2020.** Though a smaller sector, as Maryland's economy continues to grow and diversify, it will be necessary for the state and industry to take steps to decarbonize manufacturing.
- We find the manufacturing sector can reduce emissions by 54.8% by 2031 and 83.8% by 2050 from 2006 levels. **These reductions would account for 9.3%—roughly one-tenth—of total emissions reductions** needed to reach net-zero state-wide without compromising economic and social growth.
- Emissions from the manufacturing sector in Maryland derive from fuel use, industrial processes, and product use. Cement production and super-polluting F-gases represent the largest sources of emissions, with both significant challenges and opportunities for reductions.

Cement production is currently the largest contributor to emissions in the Maryland manufacturing sector, dominated by process emissions with limited mitigation options. Cement facilities in Maryland have already taken actions or made plans to reduce emissions, but significant efforts are required to reach sectoral net-zero emissions.

Fuel use (non-cement) is another significant source of emissions, presenting a challenge as an integral component of manufacturing production. Abatement is possible through strategies like electrification and improving energy efficiency.

F-gases, such as HFCs, are substitutes for ozone-depleting substances (ODS). Most emissions are released during product use, not manufacturing processes, requiring different strategies targeting consumer behavior in addition to technical manufacturing actions.

- **Reducing emissions from the manufacturing sector not only offers economic opportunities but also solidifies Maryland's position as a climate leader.** By including the manufacturing sector in state climate targets and regulations, and taking advantage of federal support, policymakers can facilitate the sector's low-carbon transition through market- and non-market-based policy mechanisms.

The State of Maryland advanced its national leadership on climate change with the passage of the Climate Solutions Now Act (CSNA) of 2022 and the Greenhouse Gas Reduction Act (GGRA) of 2016. These laws require Maryland to reduce state-wide greenhouse gas (GHG) emissions by 60% from a 2006 baseline by 2031 while ensuring a positive impact on Maryland's economy, protecting manufacturing jobs, and creating new jobs in the State. In addition, Maryland has set a 2045 goal for net-zero emissions. These legislative outcomes will drive rapid emissions reductions in the State and, if done well, can energize the economy and increase the state's global competitiveness as the world also shifts toward a rapid, just, and affordable clean energy transition. The State is already on a path toward rapid reductions. Statewide emissions have decreased by approximately 30% between 2006 and 2020, with the largest reductions coming from the electricity sector, road transportation, and industrial fuel use.

Maryland's manufacturing sector, while relatively small as a part of the economy, will play a critical role in the State's ability to achieve these diverse climate and economic goals. Currently, the GGRA exempts the manufacturing sector from GHG regulations due to concern regarding possible financial burdens or negative employment impacts. Nevertheless, to achieve Maryland's ambitious climate targets, the state needs to take action in all sectors, including manufacturing. To better understand the economic and social impacts of decarbonizing this sector, this report evaluates the GGRA's manufacturing exemption as the State Assembly considers whether to maintain or remove the exemption. We find that additional abatement strategies targeting the manufacturing sector—a sector that accounted for 10% of statewide emissions in 2020—specifically for cement production, fuel use, and F-gases, can significantly reduce manufacturing emissions and help put the state on a successful decarbonization pathway.

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The manufacturing sector is key for reaching Maryland's 2031 and 2045 emissions reduction goals, and our analysis demonstrates that the rapid pace and large scale of reductions needed in this sector are challenging but feasible for the State. Importantly, many industry leaders support action to decrease emissions and, in many cases, already have plans to reduce their emissions. At the same time, our cost estimates demonstrate that some mitigation strategies will require large capital investments. Regulatory frameworks that clarify expectations will be critical to underpin these significant capital allocation decisions within parts of the manufacturing sector. In this context, policymakers should focus on supporting rapid emissions reductions through appropriate regulations and incentives. **Accordingly, achieving the pace and scale of change needed may require a revisiting of the GGRA exemption for the manufacturing sector, as certain types of regulatory frameworks, pricing, or other actions may be needed to provide the appropriate long-term policy clarity for these major investments.**

MANUFACTURING SECTOR IMPACT IN MARYLAND

Emissions from the manufacturing sector in Maryland derive from industrial fuel use, industrial processes, and product use. Cement production and F-gases represent the most significant sources of emissions and are also two of the hardest to abate. Economy-wide, over 6,500 manufacturing facilities employ over 100,000 people within the state. In recent years, the manufacturing sector's real economic output has been trending upward slightly to over 20 billion in 2012 U.S. dollars. High-value activities include computer and electronic products and chemical manufacturing.

Cement production is the largest contributor to emissions in the Maryland manufacturing sector, with cement plants being the top two highest-emitting manufacturing facilities in Maryland. Lehigh Hanson's Union Bridge plant was the highest-emitting manufacturing facility in the state, with more than four times the emissions of the next highest-emitting facility in 2020. Combined, the two cement facilities alone represent 35% of industrial emissions. Demand for cement is expected to grow through 2050; emissions will increase along with the demand without immediate action.

Fuel use (non-cement) is another significant source of emissions in Maryland's manufacturing sector. Manufacturing accounts for most industrial fuel combustion emissions, including coal burning in cement production. Non-cement manufacturing fuel combustion emissions have declined by about 73% from 2006 to 2020. The main non-cement manufacturing sectors, in terms of GHG emissions, include chemicals, pulp, paper, wood, food processing, and other nonmetallic minerals.

Fluorinated gases (F-gases) are a category of man-made greenhouse gases that substitute for ODS (ozone-depleting substances) but can be hundreds to thousands of times more potent than carbon dioxide. F-gases were the largest source of Industrial Processes and Product Use emissions in Maryland's 2020 GHG Inventory. In Maryland, F-gas emissions are expected to grow through 2050, with refrigeration and air conditioning representing the largest contributors. Unlike cement production and fuel use, F-gases are often emitted during product use rather than during the manufacturing process itself.

MANUFACTURING SECTOR CHALLENGES

A significant challenge in decarbonizing Maryland's manufacturing sector is that the primary emissions contributors (cement production, fuel use, and F-gases) blend into other major sectors, including transportation, energy, and buildings. These overlapping emissions materialize as the transportation of raw materials, electricity usage in facility buildings, and energy use required to power manufacturing processes.

Additionally, sources of emissions in the manufacturing sector are particularly difficult to abate. In cement production, the majority of emissions occur due to process emissions in clinker production - the active ingredient required to create cement. Process emissions are a chemical byproduct of the materials used in clinker production and cannot be avoided based on the established recipe for cement. For F-gases, since emissions are mostly released during use rather than manufacturing, consumer-based abatement alternatives are needed in addition to manufacturing actions.

MANUFACTURING SECTOR ABATEMENT OPPORTUNITIES

Although the manufacturing sector poses challenges, there are also numerous opportunities to implement effective abatement strategies. For example, the Hagerstown cement facility invested nearly $100 million to improve its efficiency of cement production, leading to significant emissions reductions and increased production. Both facilities also have plans to reduce clinker reliance with new cement mixes and to phase-down coal use.

For fuel usage, there is high abatement potential through energy efficiency, demand and material efficiency, and electrification. Energy efficiency can be improved by improving manufacturing equipment and building efficiency, especially for aging and out-of-date infrastructure such as mills. An important F-gas abatement strategy focuses on consumer behaviors, leak repairs, and material substitutions. Implementing state-wide supportive policies can help facilitate the adoption of technical abatement solutions to decarbonize manufacturing. Market-based policies, circular economy principles, and supportive policies can help maintain Maryland cement manufacturers' competitiveness and support their decarbonization pathways.

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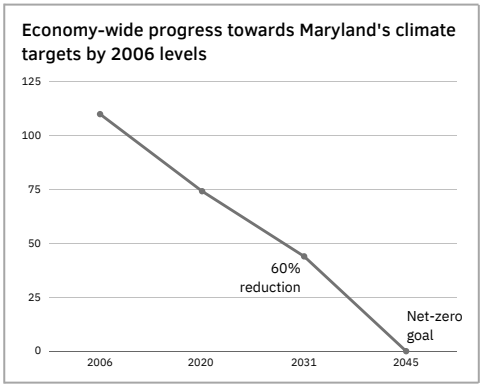
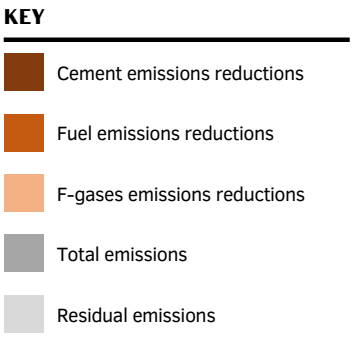
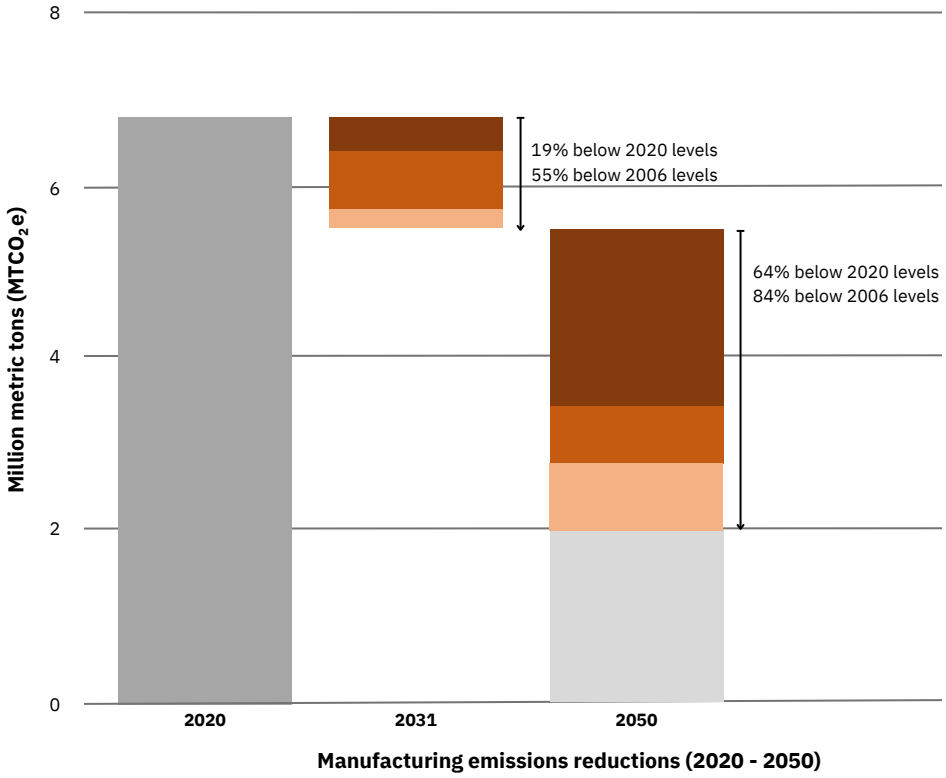
FIGURE 1 | Maryland manufacturing emissions reductions potential from 2020 to 2050 with potential contribution to Maryland's climate targets







PATHWAY TO DECARBONIZATION

Beginning this year, the state can take action on demand and material efficiency, energy efficiency, electrification, and clean product procurement in the manufacturing sector. The analysis presented in this report shows that by 2031, these steps can potentially reduce sector emissions 55% below 2006 levels. Fuel use emissions in the manufacturing sector could reduce 50% relative to 2020, and 87% relative to the 2006 baseline. Cement sector emissions and F-gas emissions are likely to remain above the 2006 baseline through 2031, but could contribute to emissions reductions toward net-zero goals in the longer term.

By 2050, the cement sector could reduce emissions by 82% through fuel switching and carbon capture and storage. F-gas emissions could reduce 25% relative to 2006, and fuel use could reach near net-zero emissions. Altogether, these strategies can reduce sector emissions by 84% relative to 2006 by 2050. Significant reductions can be achieved in the near term with cost-saving measures, but longer-term deep decarbonization will require large capital investments.

When decarbonizing any sector—let alone one that is growing and employing many skilled workers—a major concern is the economic impact on industry, labor, and communities. All of the strategies mentioned above could potentially create direct jobs on-site and indirect jobs across the supply chain. For example, adding carbon capture and storage to cement facilities is predicted to create hundreds of construction jobs, plus 20 to 30 permanent operational jobs at each location.

CONCLUSION

Manufacturing emissions can be difficult to abate, but options do exist, especially in a state such as Maryland that is leading the nation on climate and has the political will and interest from the private sector to take ambitious action. The manufacturing sector comprises many diverse opportunities for abatement that present unique challenges. Yet we find that the state can take near-term action to help deliver significant reductions toward the 2031 goal. Through a robust, multifaceted approach with some residual emissions left to be offset by other sectors, Maryland is primed to be a national leader in manufacturing decarbonization through 2050.

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