A Roadmap for Industrial Decarbonization in Pennsylvania

Strategen Consulting and the Ohio River Valley Institute
February 22, 2024
One-third of Pennsylvania’s current emissions come from the industrial sector.

Source: 2022 PA GHG Inventory Report
Methodology

In a base case scenario, industrial emissions are projected to increase despite new regulations to reduce fugitive emissions.

Pennsylvania’s Industrial Sector Emissions – 2005, 2019, and projected

The EPA’s GHGRP was utilized as a complement to the PA GHG Inventory Report to characterize emissions.

+ Total emissions were kept constant from PA GHG Inventory.
+ Emissions from GHGRP were adjusted for subsectors where only largest facilities are required to report (assume 30% not reported). Kept constant for subsectors where all facilities report.
+ The remaining gap was attributed to a set of other industries based on the inventory’s methodology.
+ Added emissions from new industrial facilities not yet considered in reports.
Decarbonization levers were identified to reduce industrial emissions.

<table>
<thead>
<tr>
<th>Year</th>
<th>Energy Efficiency</th>
<th>Material Efficiency</th>
<th>Electricification</th>
<th>Hydrogen Fuel Switching</th>
<th>Carbon Capture and Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>2025</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2030</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2035</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2040</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2045</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2050</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: This figure excludes production ramp-downs and facility retirements, which were considered on a case-by-case basis.
This roadmap will reduce emissions by 21% in 2030 and 84% in 2050, compared to 2019.
The subsectors contributing the most to overall emissions reductions are fossil fuel extraction and delivery, low heat subsectors, and metals.
Iron and Steel Decarbonization Pathway

Results

GHG Emissions (Tonnes CO₂e)

- Remaining Emissions
- Efficiency
- Gas DRI-EAF
- Scrap EAF
- H2 DRI-EAF
- Gas DRI-EAF w/ CCS
- Fabrication: Electrification
- Fabrication: Hydrogen
- BAU Emissions
Decarbonization Pathway for “Other Low Heat Subsectors”
This roadmap will lead to economic, equity, and environmental benefits.

+ Across all subsectors, Strategen calculates that the proposed industrial sector roadmap will cost approximately $30-35 billion.
  + Of the subsectors analyzed, minerals (primarily cement and lime production), iron and steel, and oil and gas are estimated to be the most expensive to decarbonize.

+ Failing to decarbonize Pennsylvania’s industrial sector would result in $16.88 billion in damages in 2050 alone.
  + In contrast, Strategen’s decarbonization pathway would reduce 2050 emissions by 68.6 MMT compared to business as usual, avoiding annual damages valued at just over $14 billion by 2050.

+ Industrial efficiency, electrification, and fuel switching will have strong equity benefits by reducing disproportionate air pollution impacts of industrial facilities in Pennsylvania.
  + The air quality impacts of hydrogen fuel switching and CCS in the industrial sector warrant further study.

+ National-level analysis from DOE suggests that industrial decarbonization efforts will create hundreds of thousands of direct and indirect jobs.
  + Employment shifts will occur in fossil fuel production subsectors, which will need to be proactively managed.
  + Industrial energy efficiency is particularly likely to have a strong, locally rooted economic impact in Pennsylvania.
The following enabling actions for both industry and state government can serve to drive forward industrial decarbonization in the commonwealth.

### Advancing Decarbonization

- Focus on energy efficiency and electrification investments across all industrial subsectors.
- Develop a comprehensive approach to decarbonize the natural gas subsector.
- Accelerate decarbonization of the power sector.

### Planning & Funding

- Create broad incentive programs to which any subsector may apply.
- Focus subsidies on solutions that industrial actors would not have already implemented due to policy and economics.

### Community Benefits

- Pursue community and worker engagement and benefits planning for decarbonization projects and policies.
- Invest in training and job placement programs that can channel existing workers’ skills to growth industries.
- Explore options for state procurement of low-carbon industrial products to foster demand and in-state economic growth.

**Recommendations**

<table>
<thead>
<tr>
<th>Near-Term Actions</th>
<th>Longer-Term Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Conduct further study regarding the air quality impacts and infrastructure needs of clean hydrogen and carbon capture.</td>
<td>• Fully decarbonize the power sector.</td>
</tr>
<tr>
<td>• Fully decarbonize the power sector.</td>
<td>• Continue to seek and take advantage of federal funding opportunities and incentives.</td>
</tr>
<tr>
<td>• Explore additional funding opportunities for R&amp;D</td>
<td>• Explore options for state procurement of low-carbon industrial products to foster demand and in-state economic growth.</td>
</tr>
</tbody>
</table>