Michigan's Energy Intensive Industries: GHG Footprint & Decarbonization Pillars

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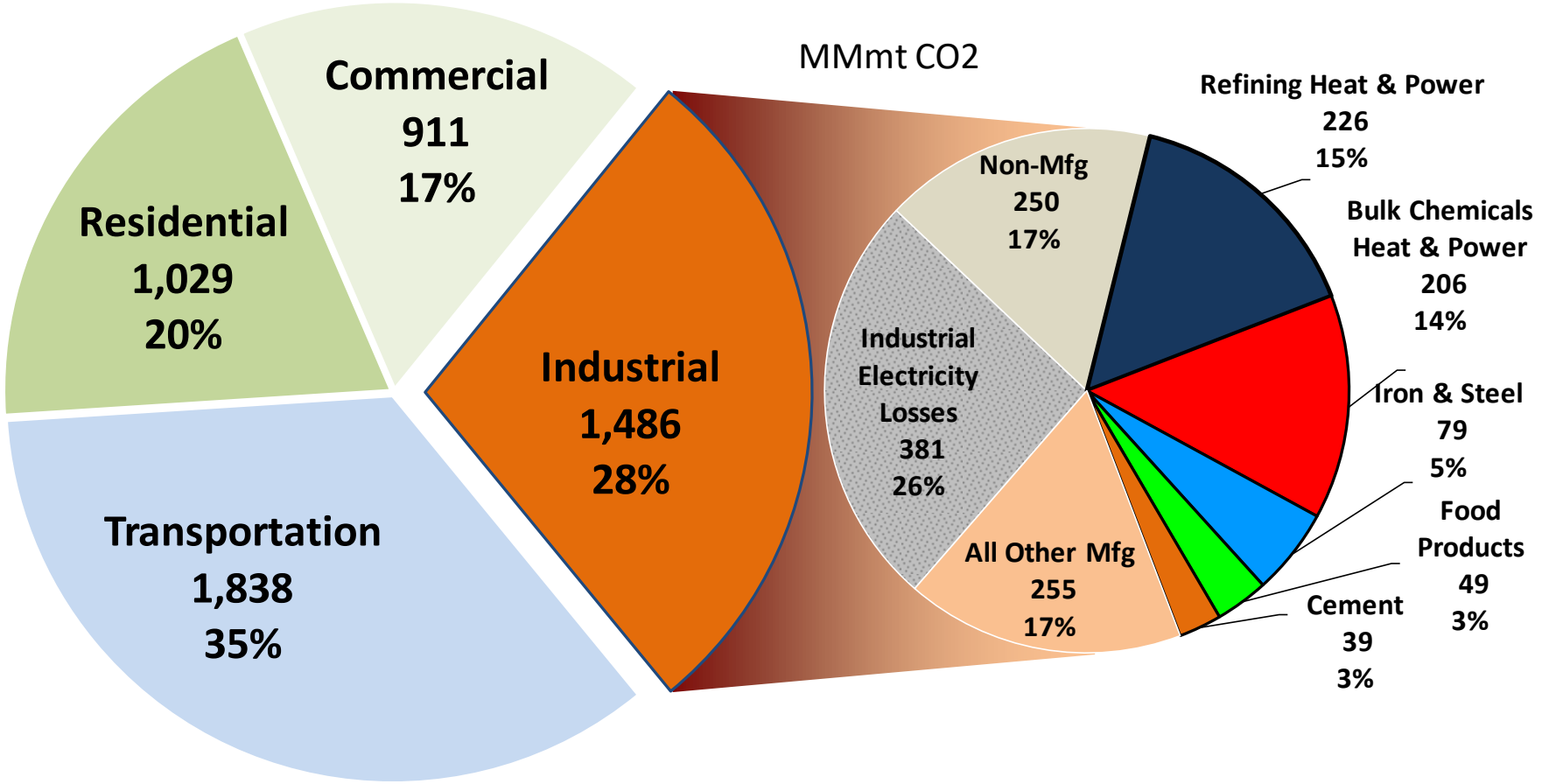
Discussion Topics

- Landscape of Industrial GHG Emissions
- GHG Reduction Strategies
- Climbing Barriers
- Policy Layers

LANDSCAPE OF ENERGY-RELATED CO_2 EMISSIONS

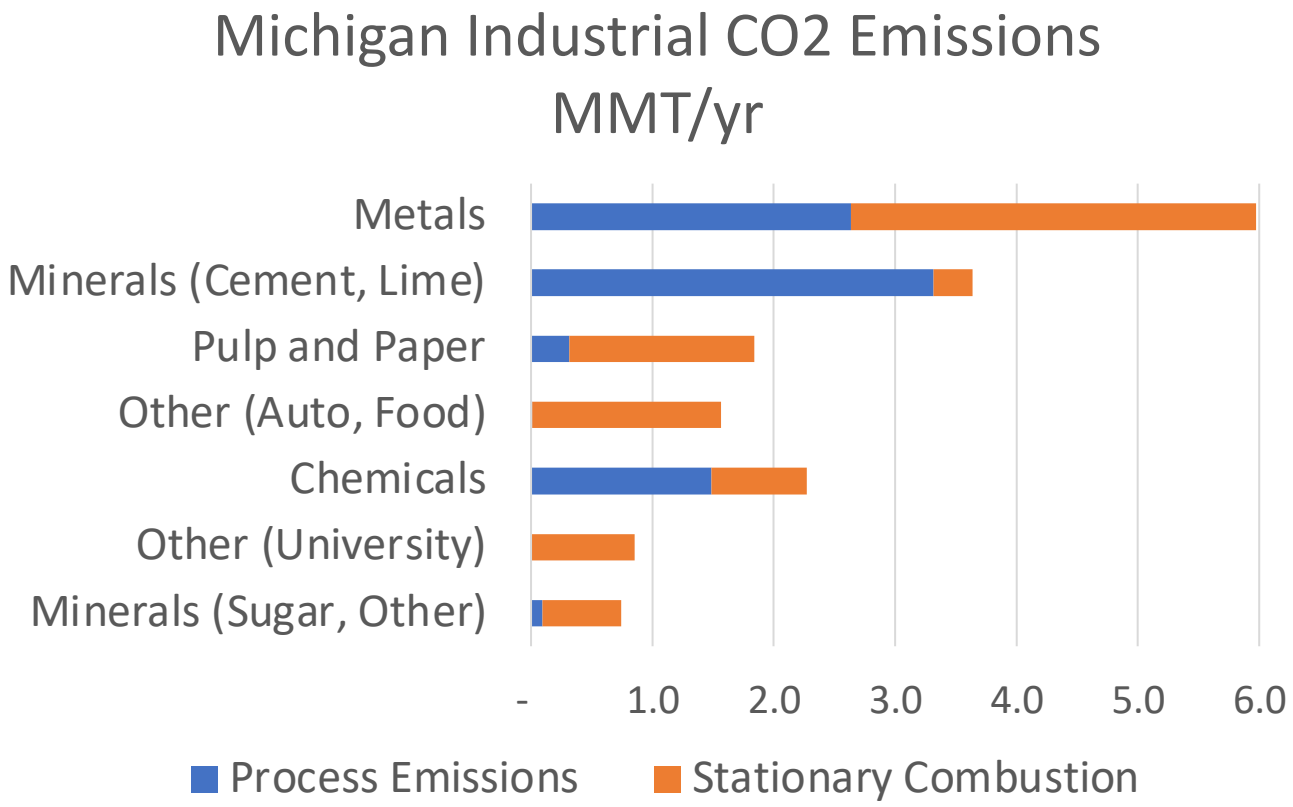
Five energy- intensive sectors account for 70% of the CO_2 emissions

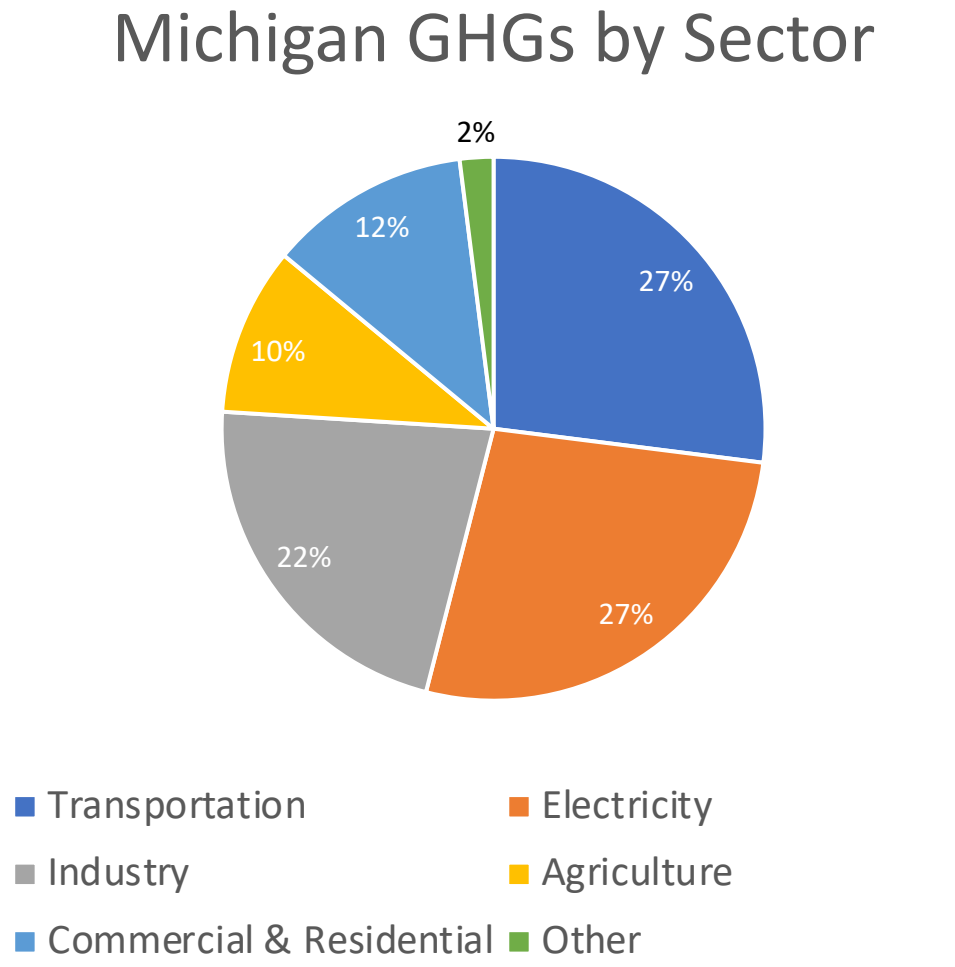
- Refining
- Chemicals
- Iron & Steel
- Food
- Cement



Data source: AEO 2020 (data from 2015)

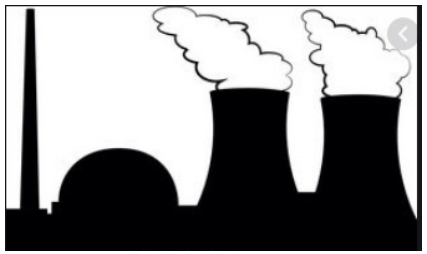
Michigan GHGs

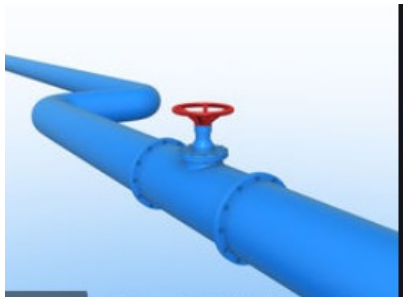


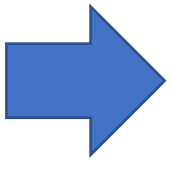


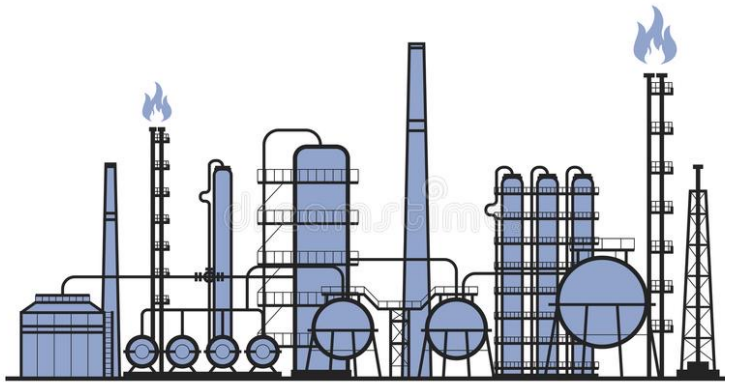
Data Source: EPA GHG Reporting Program, 2020

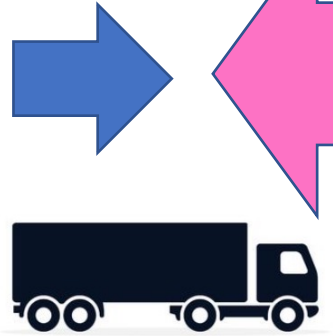
GHG REDUCTION STRATEGIES

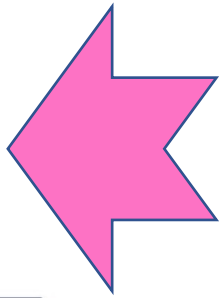












Decarbonize power inputs & feedstocks

Decarbonize processes, process heat, make every energy unit count

Decarbonize supply chain

Increase market pull for low-carbon products

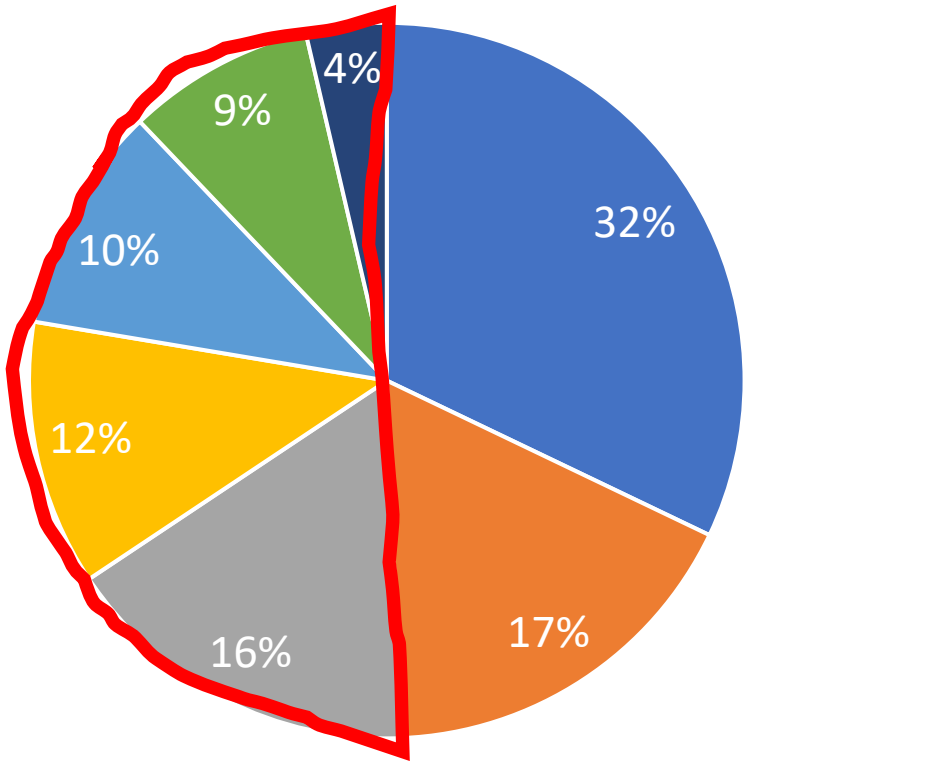
Decarbonize Fuels & Feedstocks

Half of the energy used in industry comes from heavier hydrocarbons

Immediate opportunity: transition to lower carbon fuels

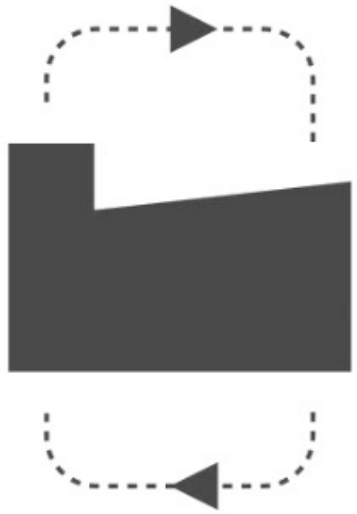
Incentivize direct use of renewable energy, biofuels, etc. in industry

Michigan Industrial Energy Sources, 2019, Tbtu

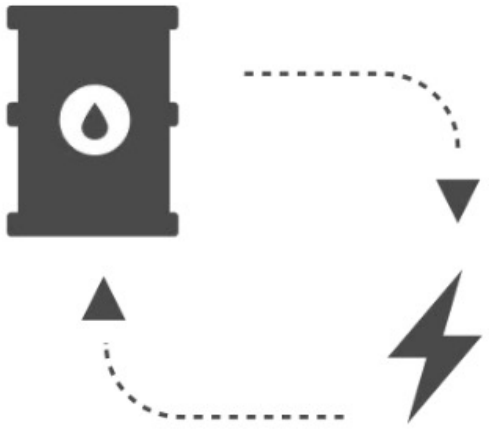


Data Source: EIA 2021

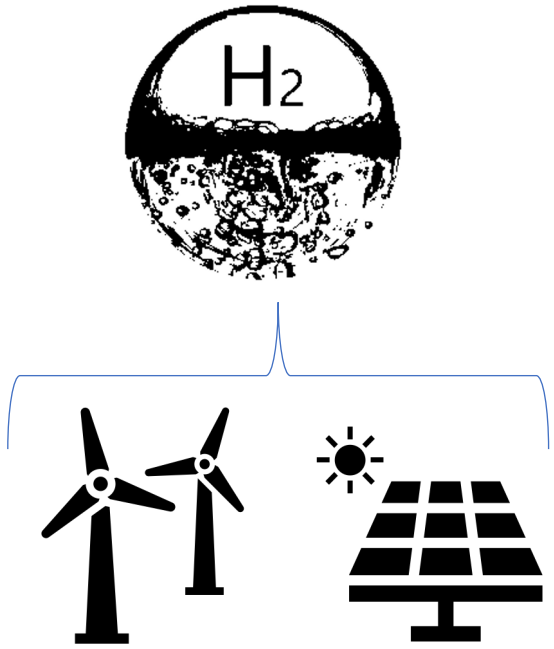
Decarbonization Pillars



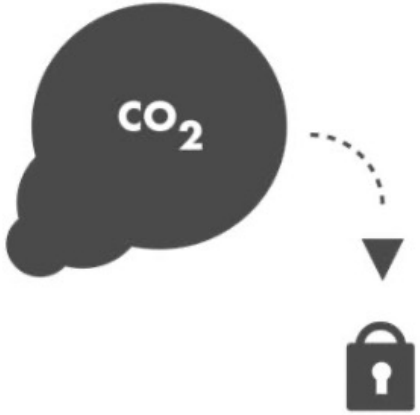
Energy Efficiency (EE)



Energy Substitution (ES)

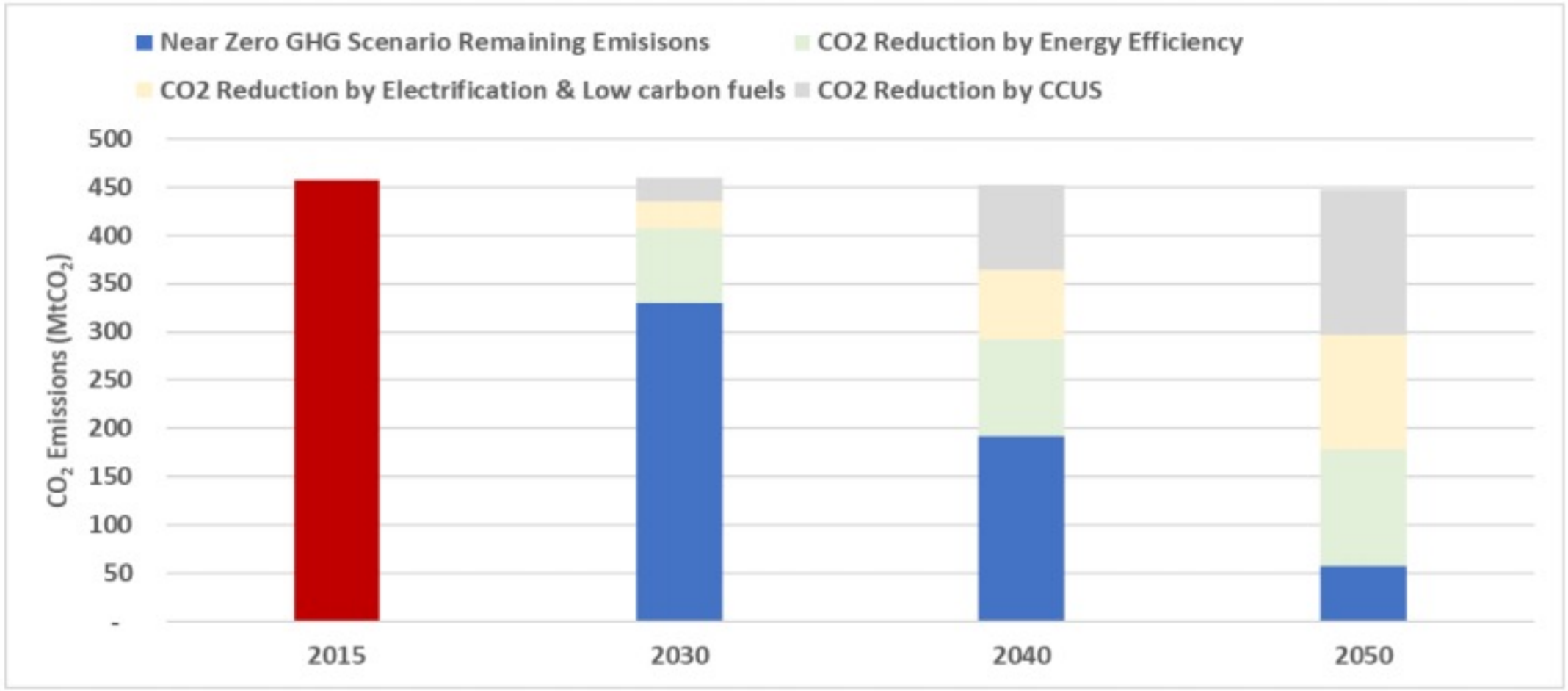


Low-Carbon Fuels & Feedstocks (LCFF)



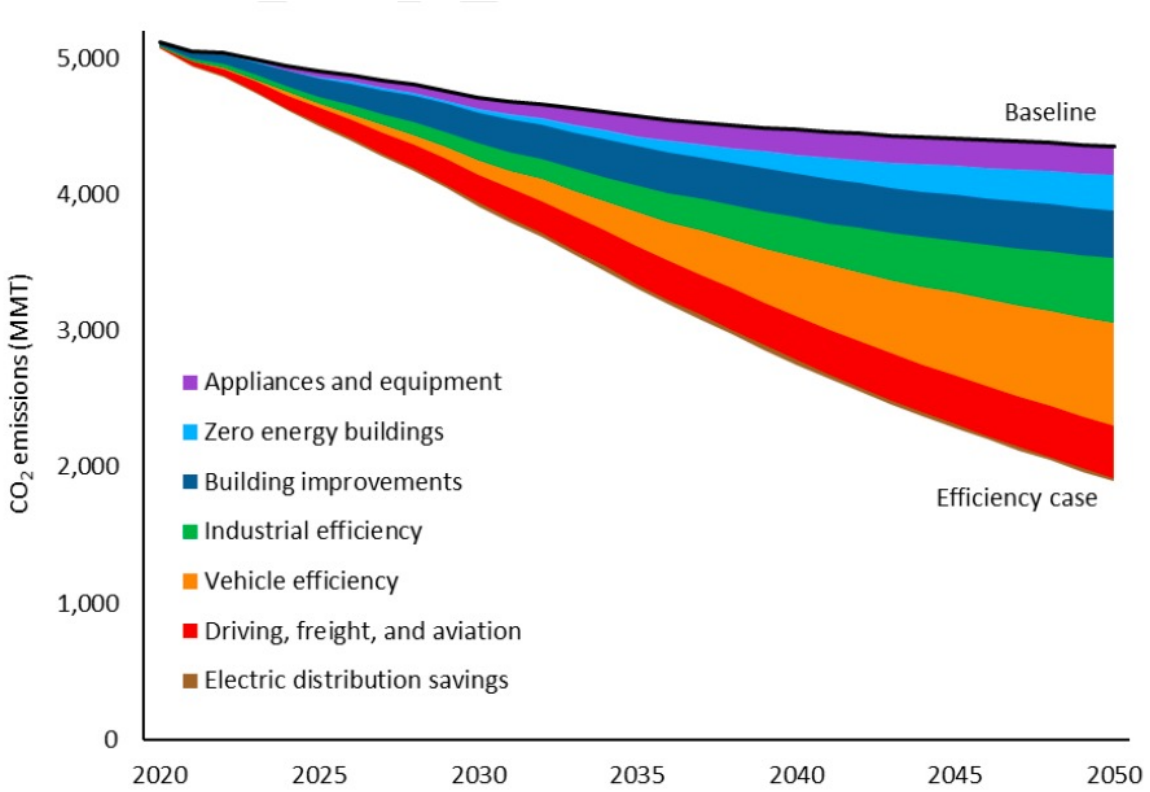
Carbon Capture Utilization & Storage

GHG Reduction Potential Across Pillars



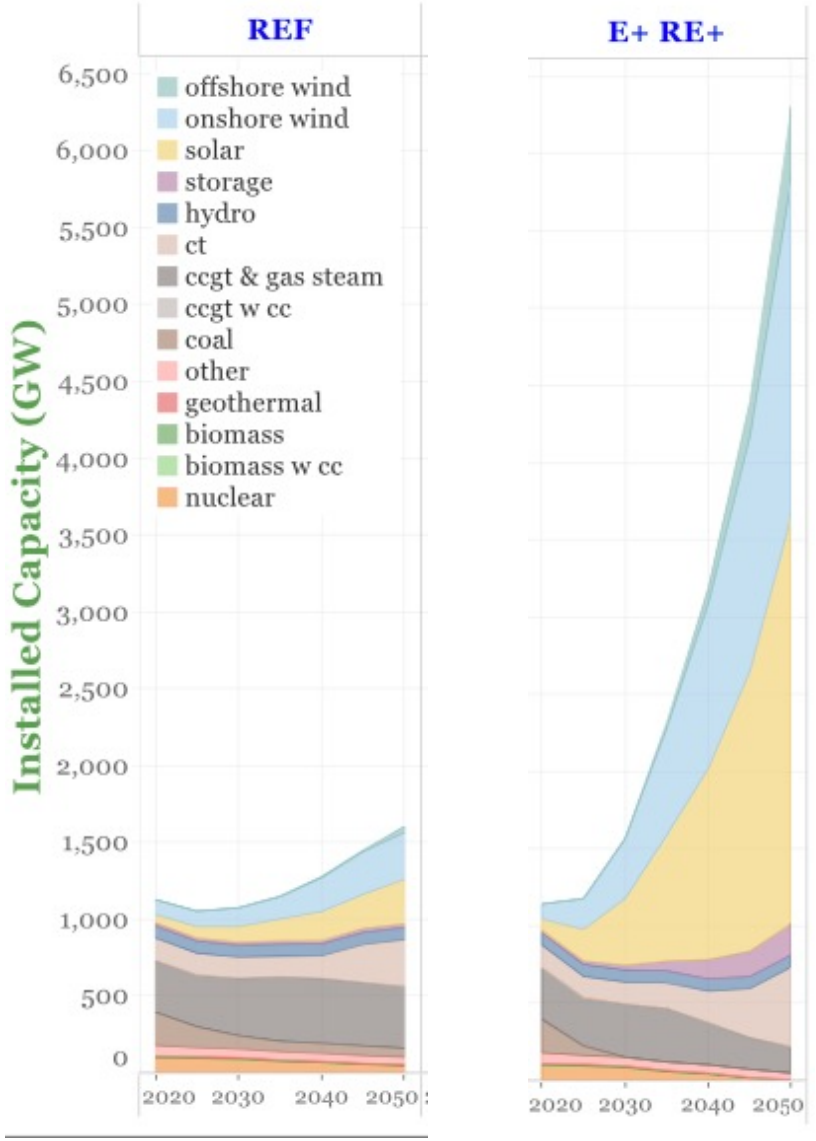
Source: Cresko, 2020

Pursuing the Pillars



Energy Efficiency can deliver ½ of the needed reductions
Industry EE, 12 Quads, 467 MMt by 2050

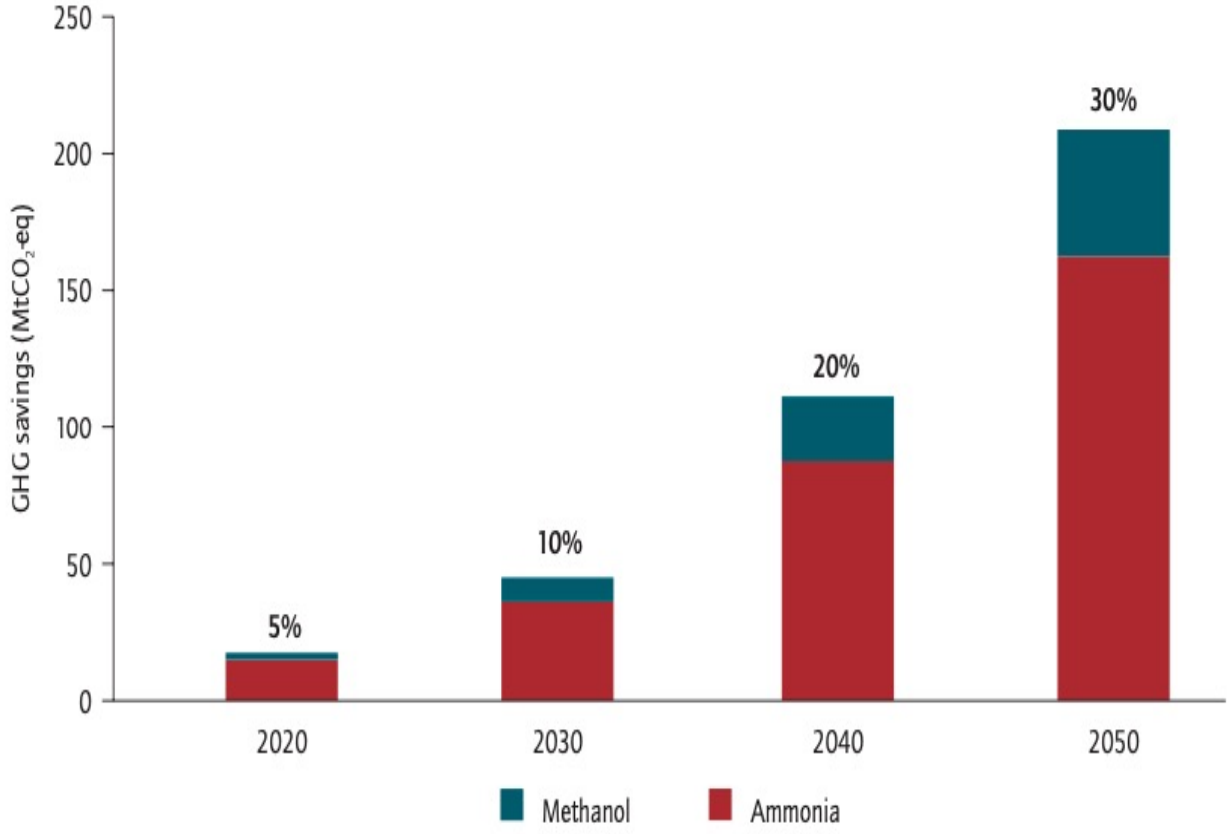
Source: Nadel, Ungar 2019



Energy substitution, by 2050 delivering 85-98% of generation
By 2050 installed solar capacity is 9-39 X today
wind capacity 6- 28X larger

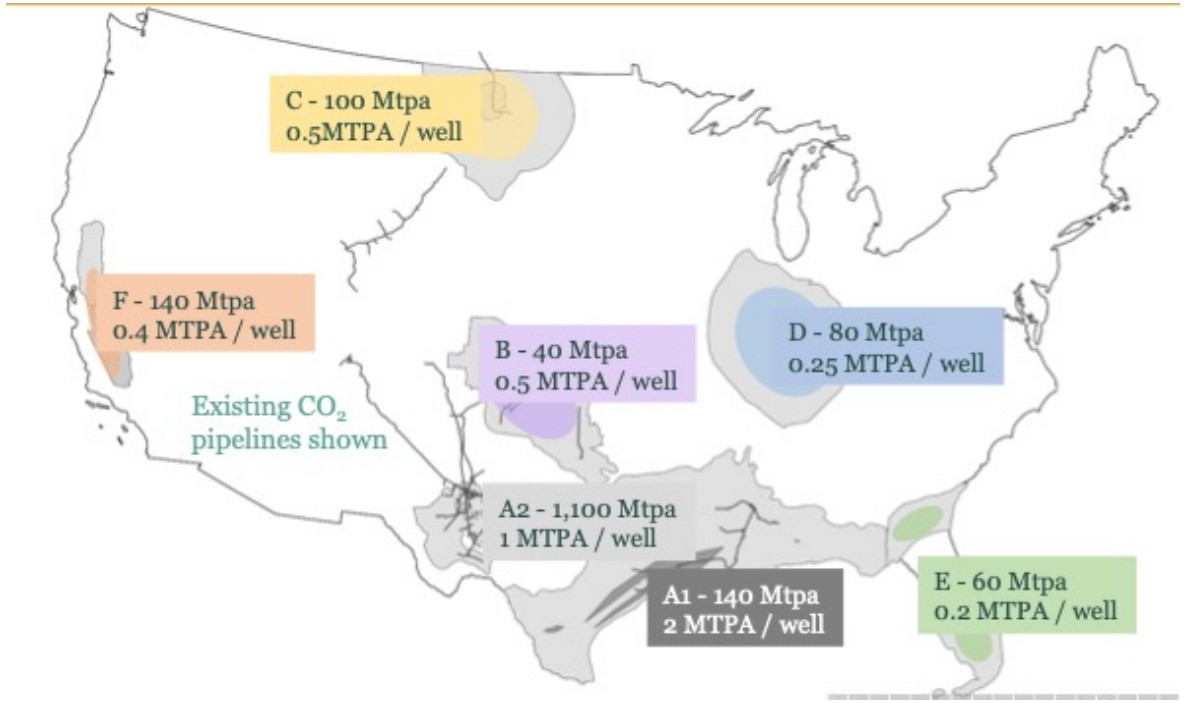
Source: Larson et al. 2020

Pursing Pillars, continued



Zero carbon Hydrogen could reduce GHGs for key chemical syntheses by >200 MMT/yr by 2050 @ 30% adoption

Source: ICCA 2013



Carbon Capture Utilization & Storage (CCUS) could store 1.8 billion MT/yr, mostly in Gulf Coast. Pipeline network (8500 km) transports 80 MMt/yr CO2

Source: Larson et al. 2020

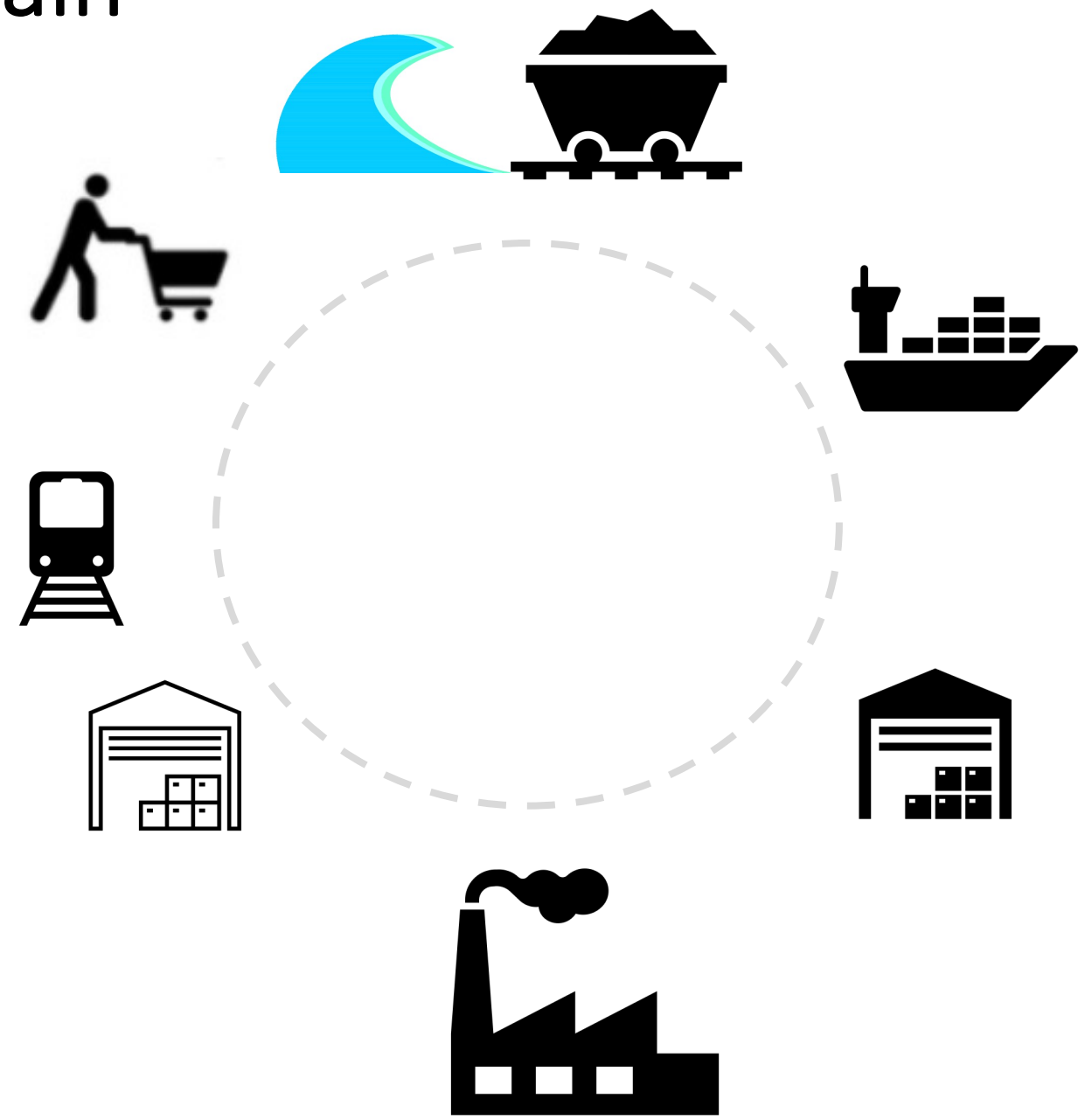
Decarbonize Supply Chain

Manufacturing - key to a dizzying array of supply chain interactions

Multiple leverage points & cross-cutting opportunities

Companies working with supply chain
- Energy efficiency
- Renewable power…

Michigan *examples include;*
- auto supply chain partnerships
- Renewable power (largely PPAs today)
- Energy and water…



Catalyze demand pull for Low-Carbon Products

Establish markets for low-carbon products

- Procurement by Public entities (Buy Clean)
- Private procurement
- Low-carbon product standards
- Support innovation
  - Demonstrations/ pilots
  - Infrastructure
- Invest in workforce

Image Source: Skanska 2021

CLIMBING THE BARRIERS

Barriers = Innovation Opportunities

Industrial heterogeneity

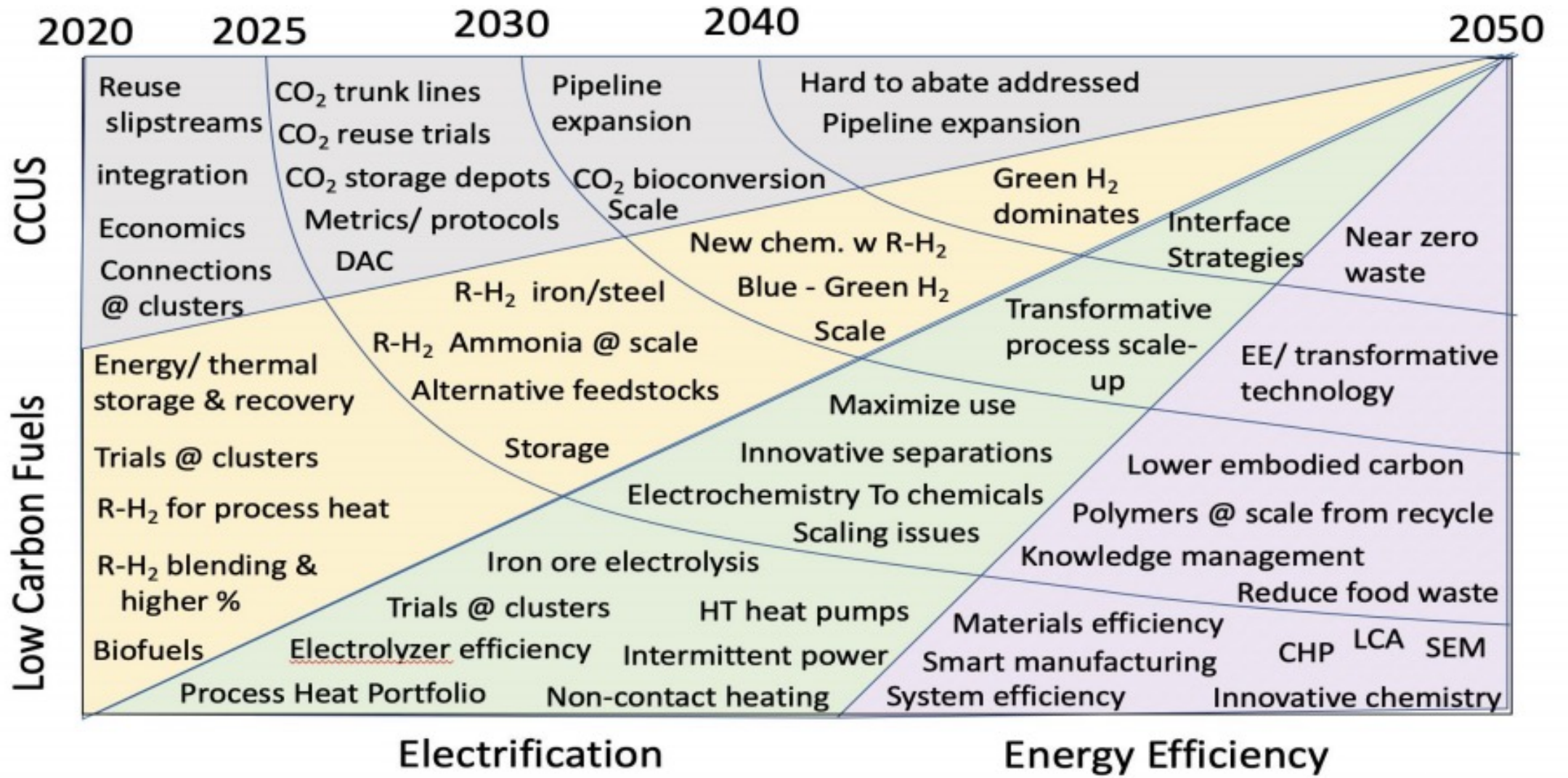
Incumbent technology & practices

High technology costs … and Low current energy costs

Scale-up

Generation of market demand for low-carbon products

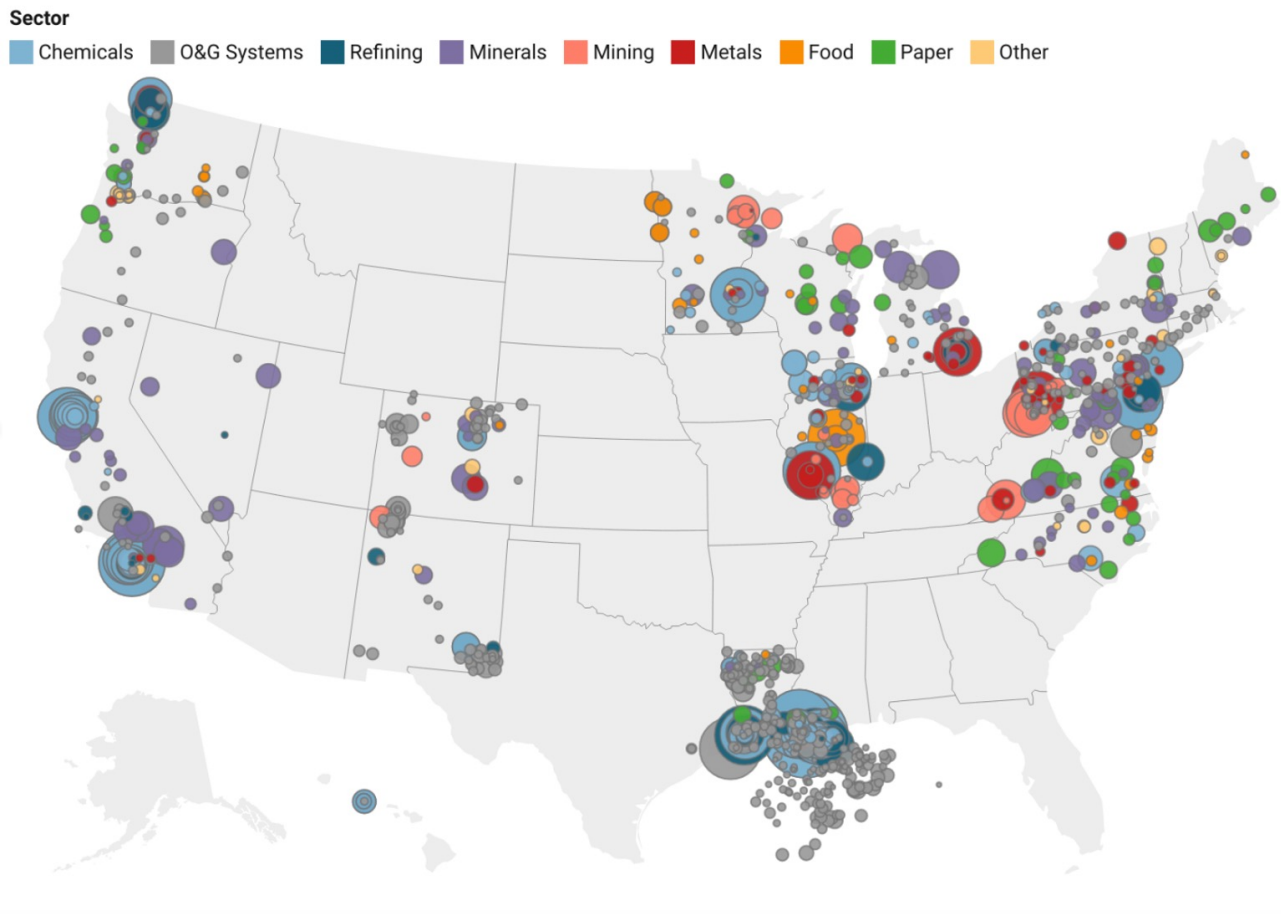
Landscape of RD&D Decarbonization Opportunities



Source: Cresko, 2020

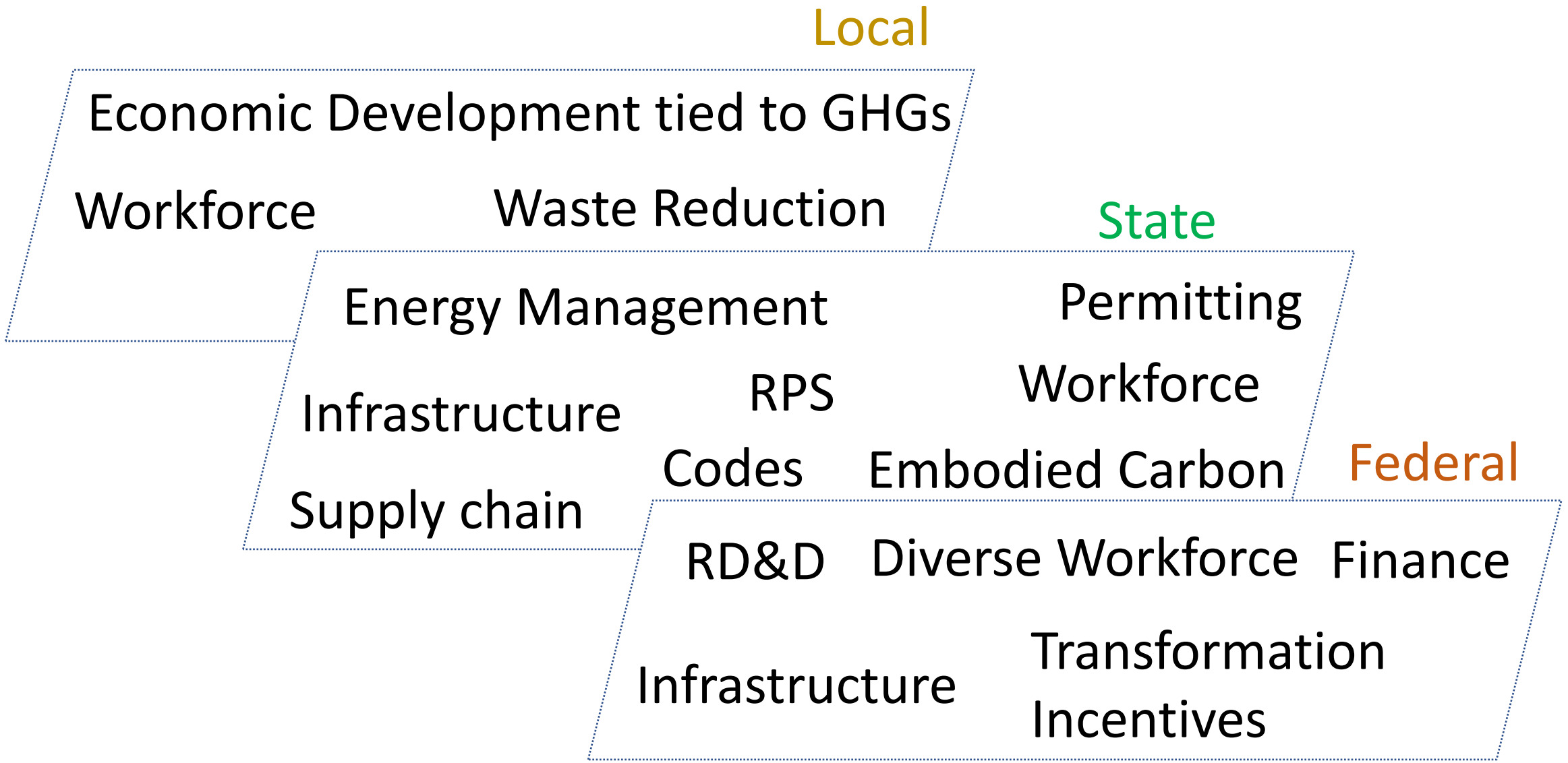
Leveraging Decarbonization Lessons from Clusters

- Clusters - a linchpin for reducing energy & GHGs
  - crossroads of multiple supply chains
  - route to spur partnerships, adoption develop effective policy
  - key for addressing competitiveness, workforce, equity, environmental justice…



Data from: EPA FLIGHT tool

POLICY LAYERS



For a policy primer, see NAS 2021

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