U.S. DEPARTMENT OF ENERGY
Office of ENERGY EFFICIENCY & RENEWABLE ENERGY
INDUSTRIAL EFFICIENCY & DECARBONIZATION OFFICE

ITIAC Kickoff: EEII Program Overview

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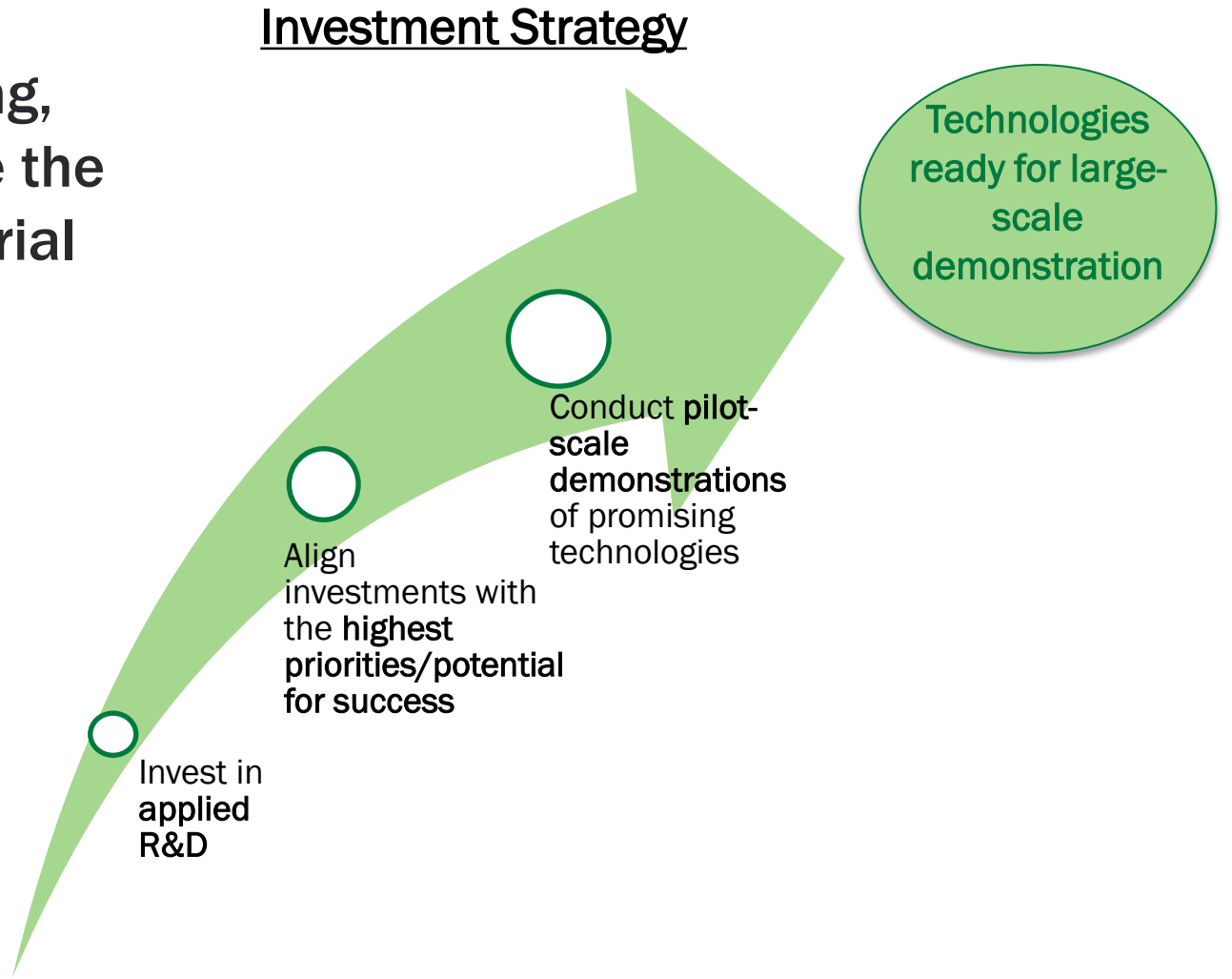
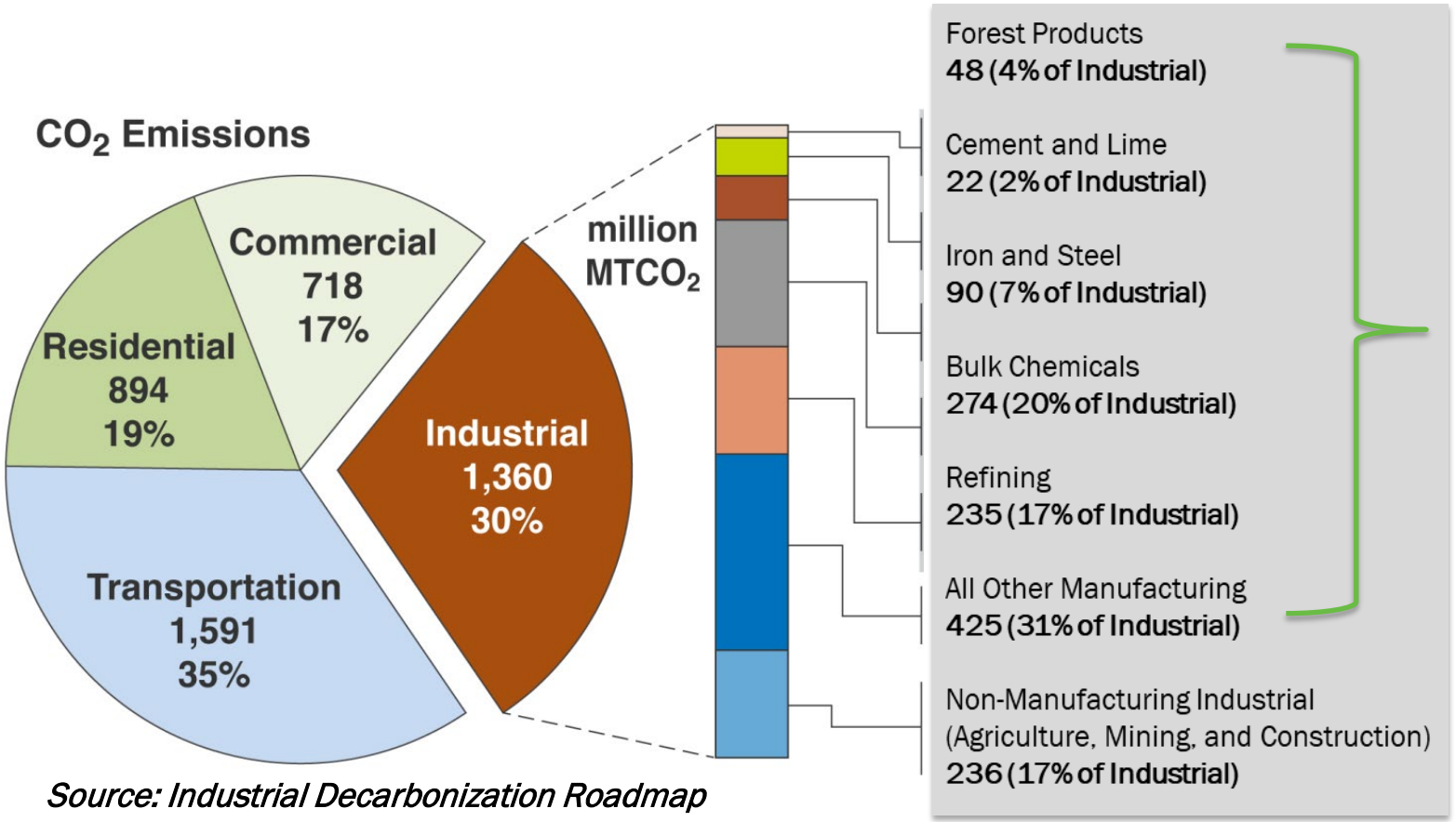
Industrial Efficiency and Decarbonization Office
March 21, 2024

EEII Program: Mission & Strategy

Mission: accelerate the readiness of emerging, industry-specific technologies to decarbonize the most energy- and emissions-intensive industrial subsectors.



Motivation: Industrial Emissions Profile



Source: Industrial Decarbonization Roadmap Sept 2022

Energy- and Emissions-Intensive Industries

- 747 MMT CO_2 Emissions
- 55% of Industry, 80% of Manufacturing

Sector-Specific Approach

Each EEII Sector has

- BIG emissions → BIG impact potential
- Important role → hard to replace products
- Unique decarb challenges & solutions

Approach

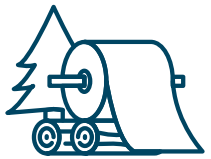
- Sectoral strategic plans → Net-Zero 2050
- Identify levers & enabling technologies
- Target multiple pathways & big RD&D impacts
- Seek transformative innovations (not incremental)


Cement


Food & Beverage

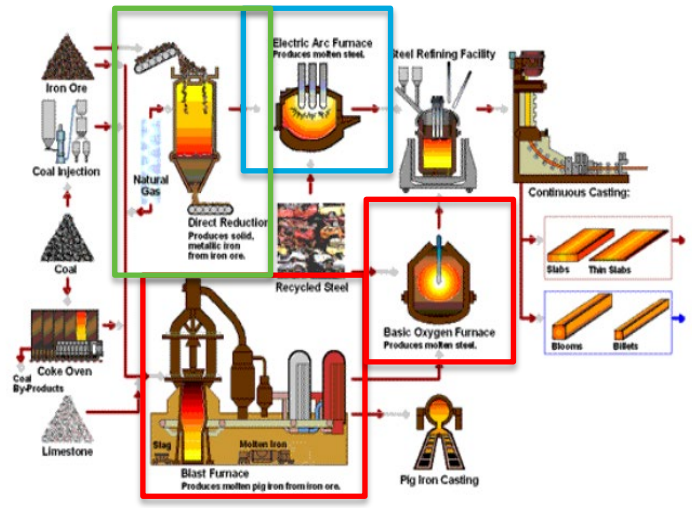

Chemicals & Fuels


Iron & Steel

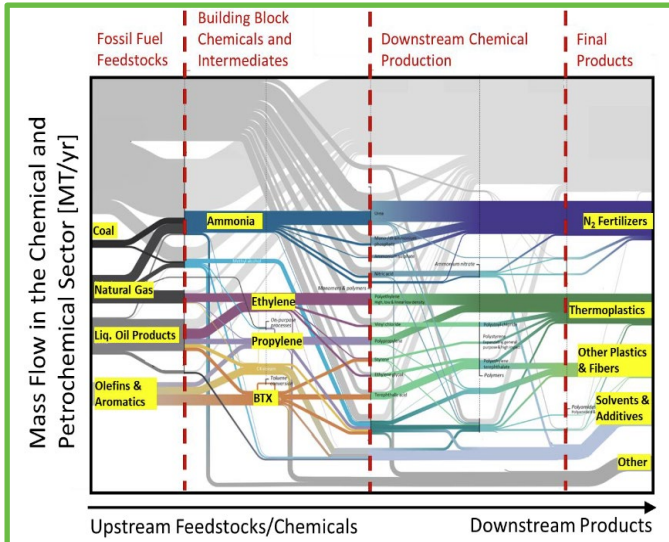

Forest Products

Sector Value Chains: Raw Materials, Process, Final Products

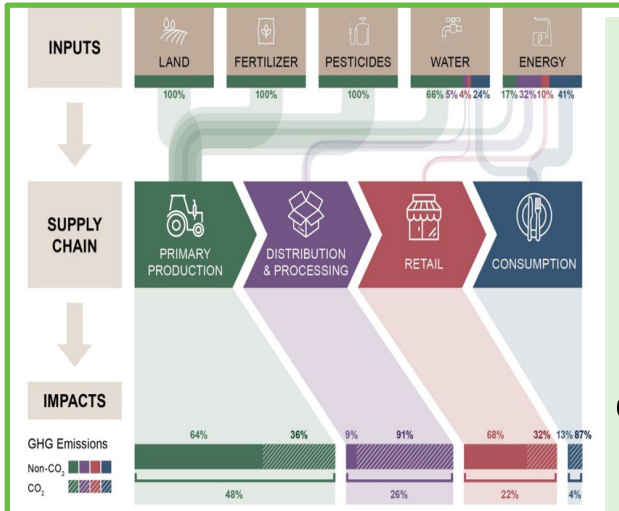
Iron and Steel



Chemicals (Refining, Fuels)

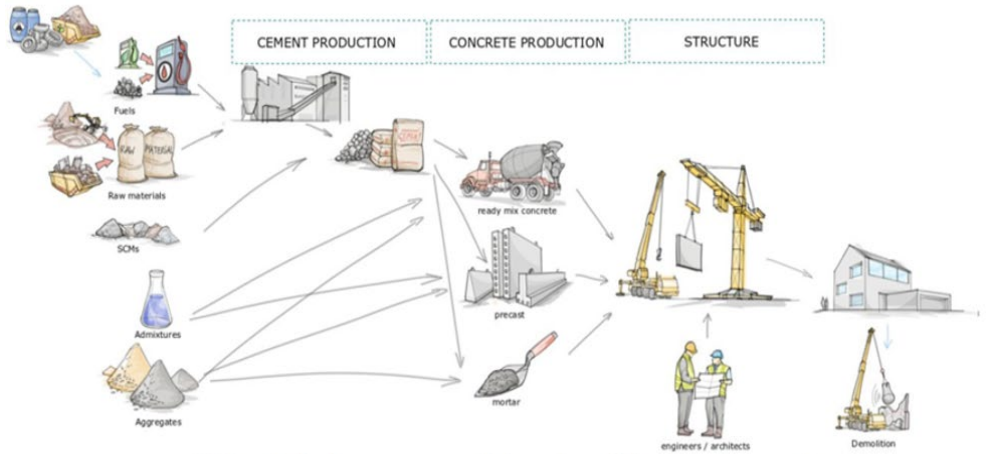


Food and Beverage

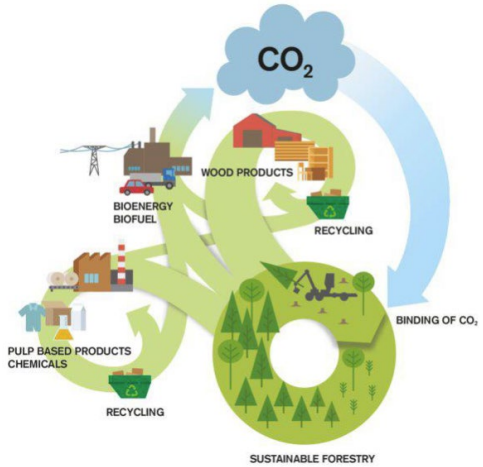


USDA *"Manufacturing: Food and Beverage Manufacturing"*

Cement and Concrete



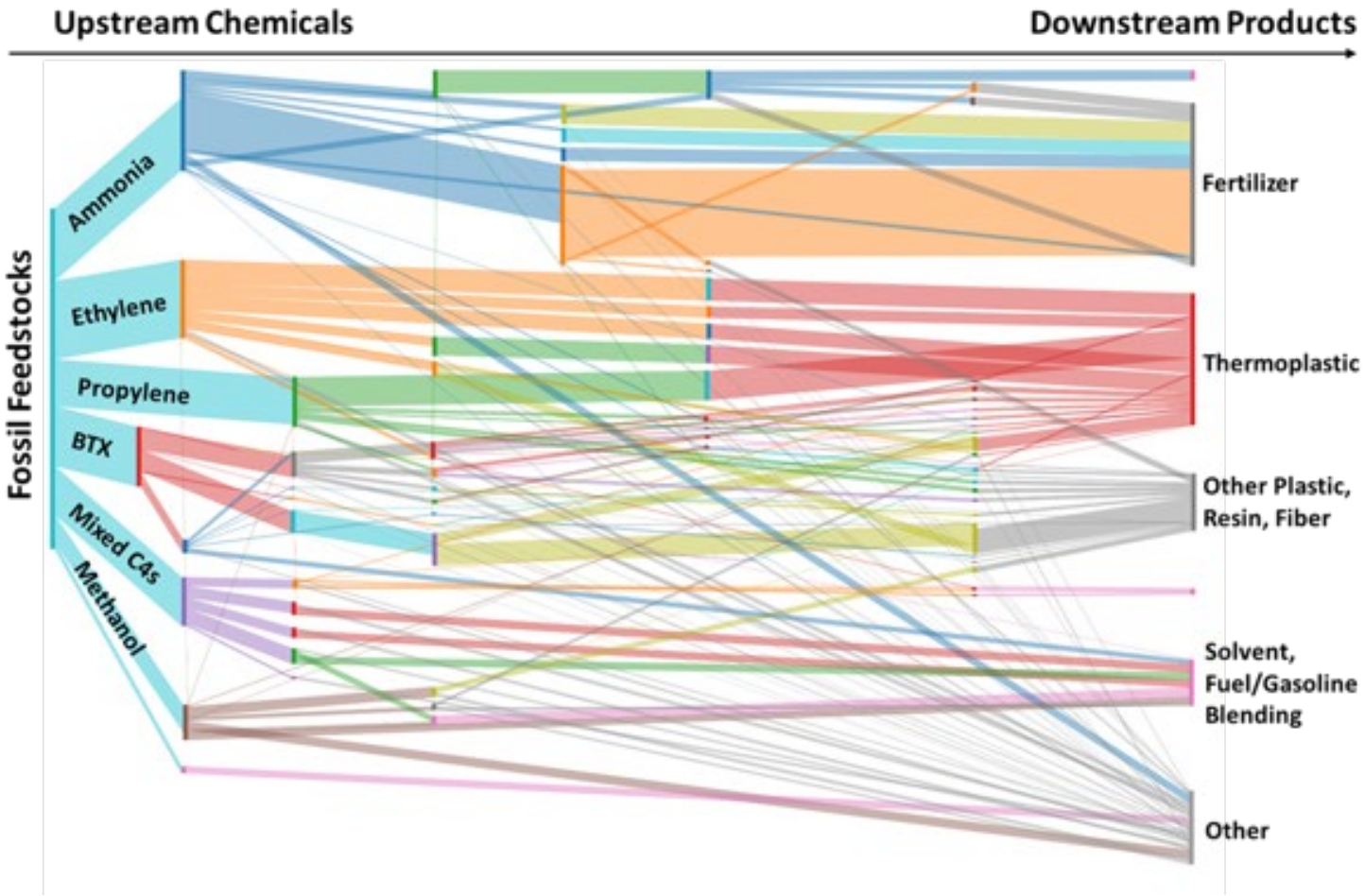
Paper and forest product



American Forest & Paper Association https://www.afandpa.org/about-afpa data from Bureau of Economic Analysis

Chemicals and Fuels Priorities

70,000 Products
70 > 0.5MT/yr CO2
~70% of Emissions from top 6



Project Awarded to E2H2Nano – Novel Ammonia Synthesis

Background:

- Ammonia global production capacity: ~235 million metric tons in 2019
  - ~2% of global energy consumption
  - ~1% of global CO_2 emission
  - Produced using energy-intensive Haber-Bosch process

Innovation:

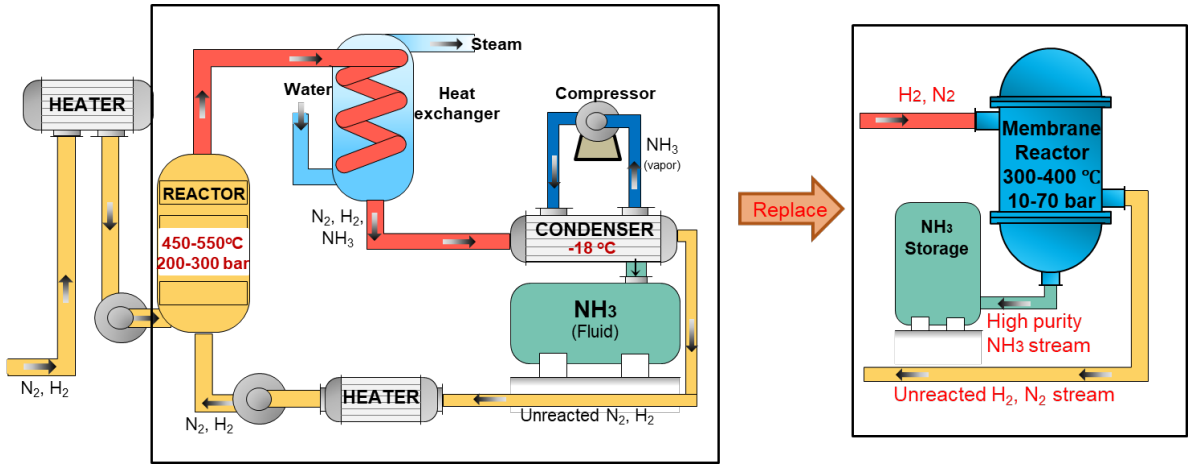
- Compact catalytic membrane reactor incorporating
  - **High activity, low-cost catalyst**
  - lower process temperatures and pressures
  - **Revolutionary membrane reactor** improves efficiency and eliminates need for cryogenic separations

Project Impact:

Energy & Emissions: Reduce >80% energy consumption	**Cost & Competitiveness:** Reduce > 80% operating cost
Technical & Scientific: >50 % N_2 conversion in single-pass	**Other Impacts:** Compact, simplified modular design

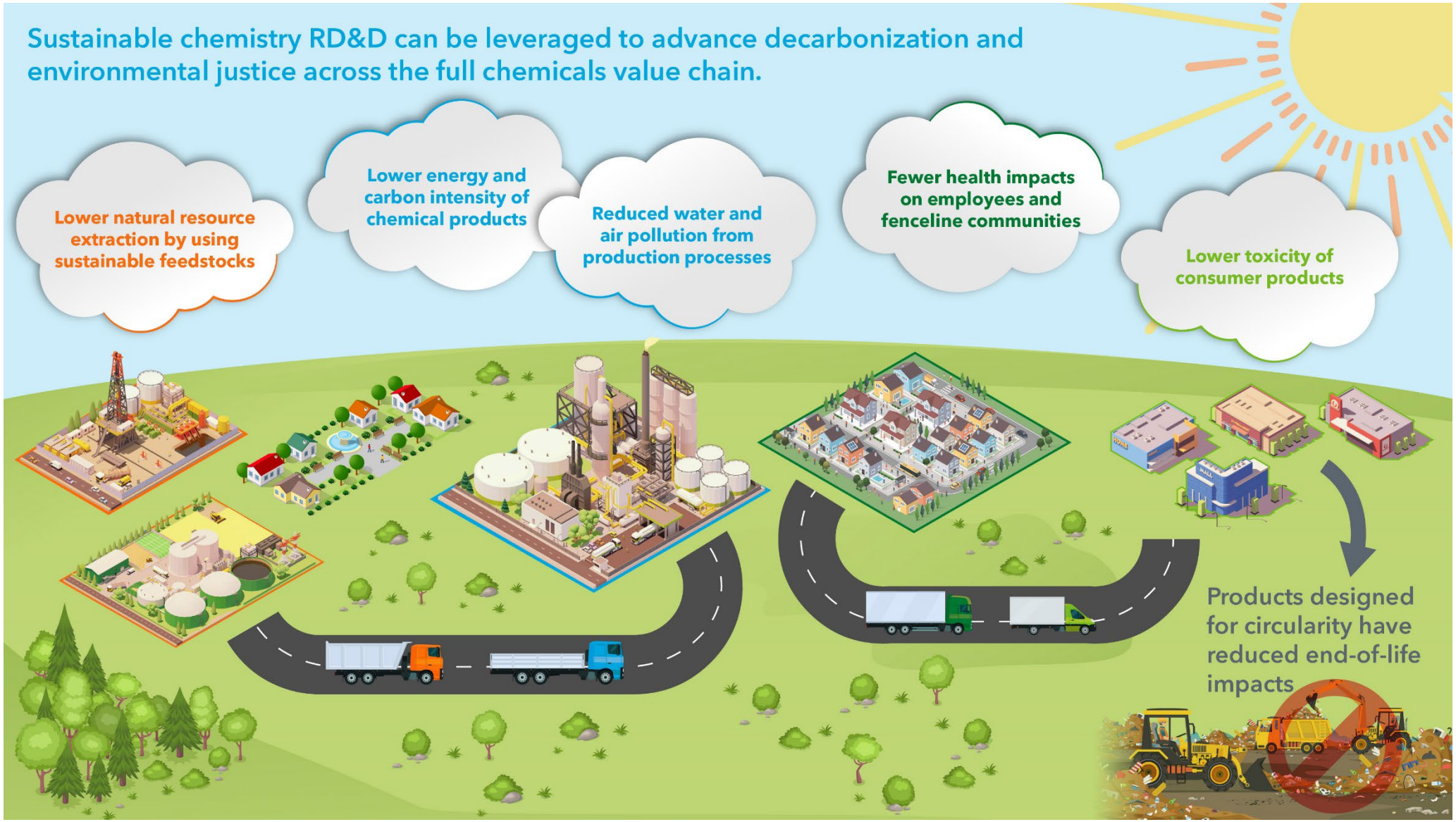
End of Project Goal:

- 0.2 kg/day prototype system

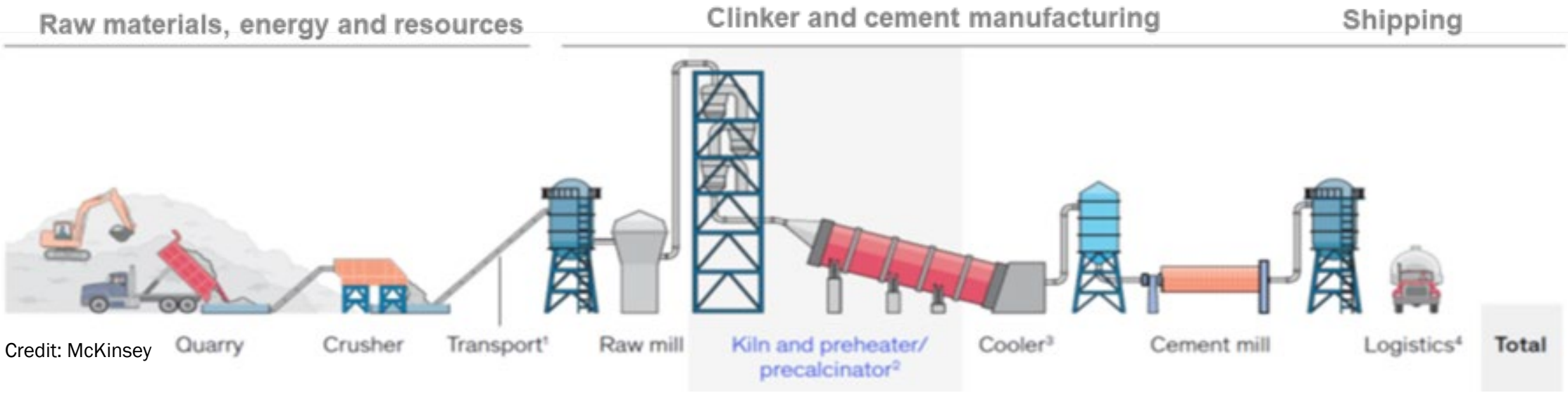


Commercial Process: Haber-Bosch	Proposed Technology: Compact membrane reactor
Operating conditions: 450-550 °C, 200-300 bar	Mild operating conditions: 300-400 °C, 10-70 bar
N_2 conversion: ~15% single pass, large quantity of unreacted gas recycling and reheating	High N_2 conversion: >50% single pass
Cryogenic condensation: (-18 – -24 °C) for NH_3 recovery	Cryogenic condensation: eliminated
High cost and energy consumption	Low cost, energy efficient

Sustainable Chemistry



Cement and Concrete Priorities



Credit: McKinsey

Cement & Concrete Decarbonization Project

Advanced Electrolytic Cement production W/ alternative calcium sources (FY23)

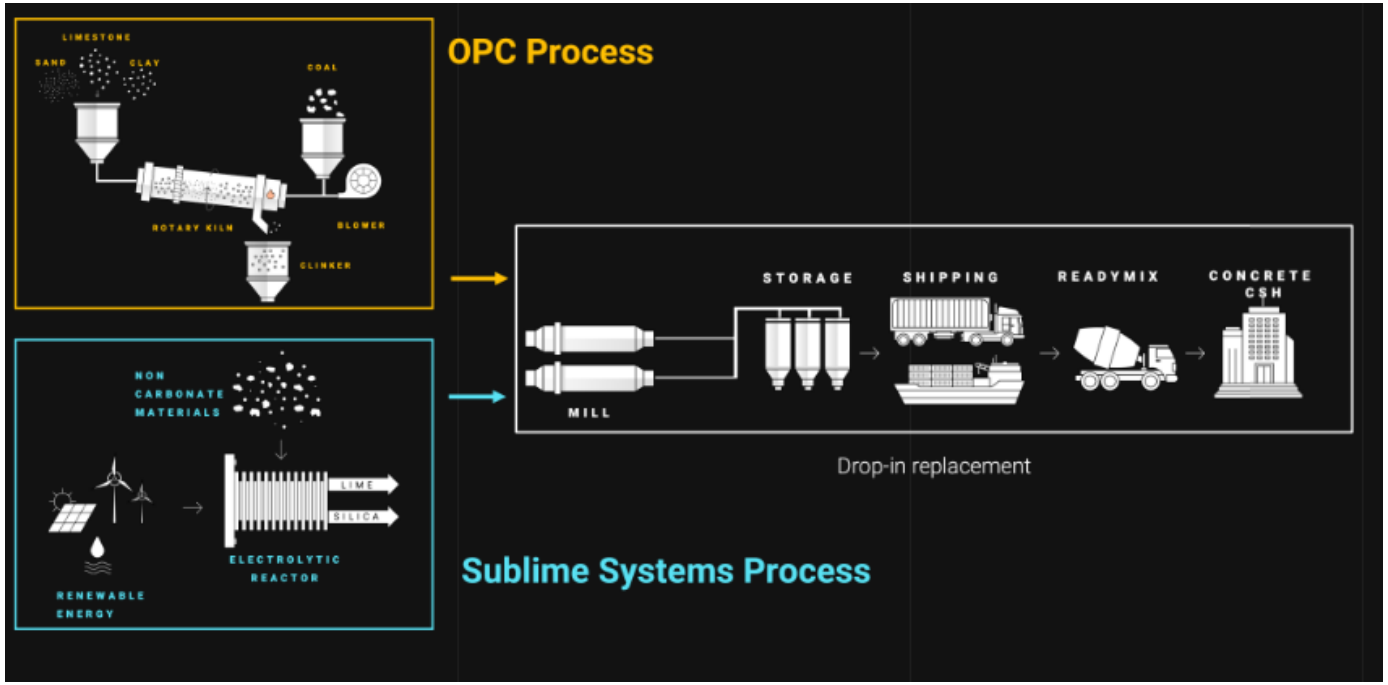
$6.7M Federal Awarded to Sublime Systems

Innovation:

- Scale up and Integration of a novel electrolyzer to produce hydraulic cement binder and SCMs
- Use of industrial waste as feedstock for cement production (non-carbonates)
- Low temperature, aqueous process (no kiln)
- Fully electrified process (electrolysis)

Project Impact:

- Reduced energy demand
- Reduced CapEx & OpEx
- Increase in feedstock availability (no limestone)
- Reduced CO2 emissions (~90% vs OPC clinker)



Funding Opportunity: FY24 EEII FOA

$83M for Applied RD&D to Decarbonize Heavy Industry

Date	Milestone
Jan 25	FOA Issue Date
Mar 19	**Concept Papers Due**
Jun 11,	Full Application Due
Oct '24	Award Announcements

Topic 1: Chemicals & Fuels

1. Sustainable feedstocks → chem/fuel
2. Non-hydrocarbon products
3. Value chain approach

Topic 2: Iron and Steel

1. Alternative ironmaking (non-H_2 DRI)
2. Ore beneficiation
3. Recycling (tramp metal solutions)
4. Steelmaking with low-carbon iron

Topic 3: Food and Beverage

1. Food packaging
2. Commercial food services
3. Energy recovery/redistribution
4. Post-Harvesting activities

Topic 4: Cement, Asphalt, Glass

1. Binders & SCMS → Concrete
2. Novel lime/OPC processing
3. Asphalt
4. Glass

Topic 5: Forest Products

1. Dewatering & drying
2. Fiber prep, pulping, chemical recovery

Topic 6: Industrial Pre-FEEDs

1. H_2 feedstock integration **(HFTO)**
2. Carbon Capture, heavy industry **(FECM)**
3. Process integration **(IEDO, FECM, HFTO)**

www.energy.gov/eere/iedo/iedo-fy24-energy-and-emissions-intensive-industries-foa

Vision of Future

EEII Program to play leading role in industrial transformation

Vision of the future

- Net-zero industrial emissions (2050)
- Sustainable transformation of EEII industries
  - Circularity, CO_2/waste feedstocks, low environmental impact
- Improve energy & material efficiency
- US leadership in clean manufacturing
- Strong stakeholder partnerships & collaborations
- Transformative technologies enabled by RD&D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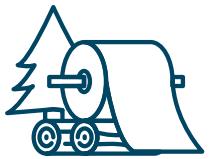
Forest Products