



104

manufacturing sites across
31 countries and
12 Innovation Centers in
10 countries on four continents



~37,800

employees



\$56.9B

in net sales



\$6.6B

in operating EBIT¹



\$7.5B

in cash flow
from operations



Sales in
~170
countries

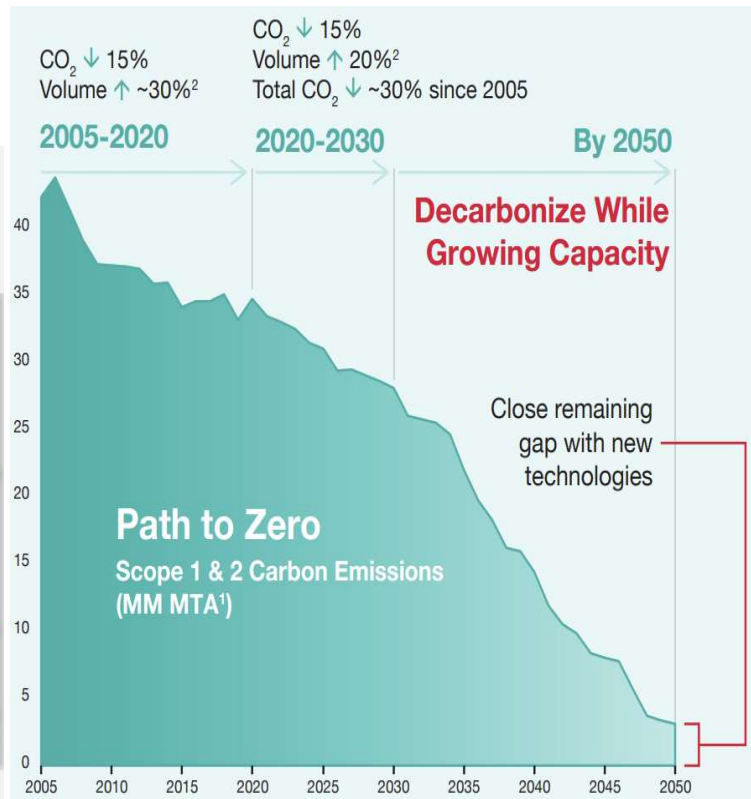
All data as of December 31, 2022.

PATH TO NET-ZERO CARBON EMISSIONS: OPPORTUNITIES, TECHNOLOGIES, AND STRATEGIES FOR DOW

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Decarbonize & Grow Strategy



Decarbonize & Grow

1. Timing

- End of life (EOL) strategy
- Regulatory requirements

2. Assets

- Replace & decarbonize
- Renew & decarbonize
- New venture (decarbonized)

3. Technology Advancements

- New routes

Decarbonization Pillars

1. Efficiency

2. Low-carbon fuels, feedstocks, and energy sources

- H₂, biofuel, renewable feedstocks, nuclear, wind, solar

3. Carbon capture, utilization, and storage (CCUS)

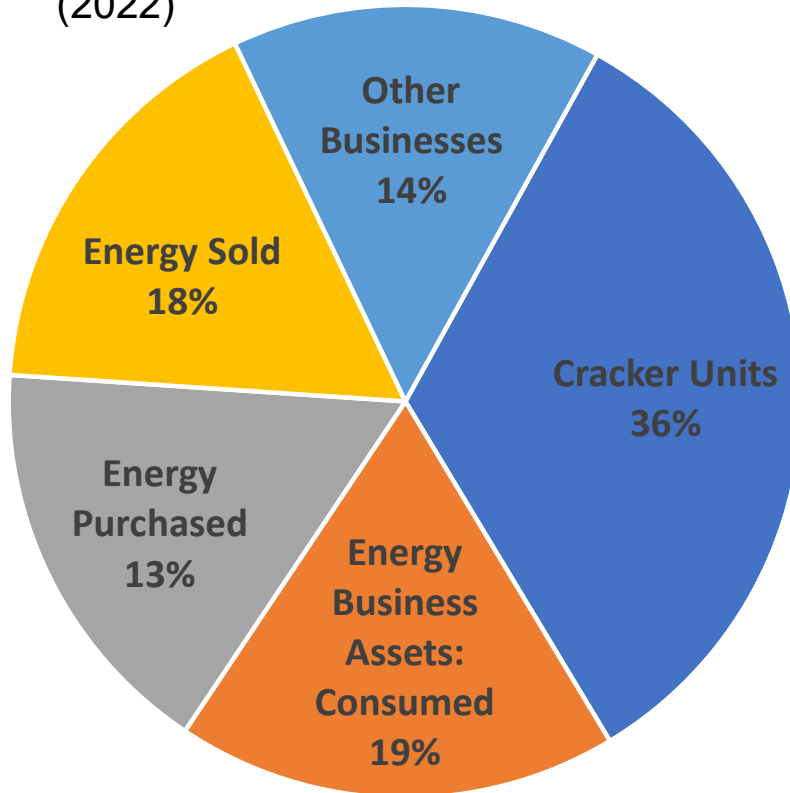
4. Electrification

- Direct or indirect heating
- Power to steam (heat)

Affordable and achievable path to zero-carbon emissions while supporting growth

Lay of the Land: Dow's 2021 Scope 1 & 2 Emissions

32 MM MT CO_{2e}
(2022)



Ethane Crackers

- 9 sites

Energy Business Asset Sites

- 9 Cogen sites
- Several large boiler sites
- Scores of small boiler sites

Energy purchased (scope 2)

- Majority consumed by 3 sites

Energy Sold

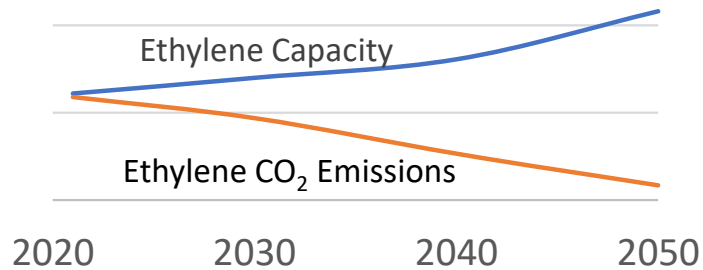
- Design reliability = extra assets
- Acquired assets > internal need

Other

- Functions other than cracker units
 - Energy & process emissions

Roadmap: Crackers

Decarbonize & Grow



GHG Sources

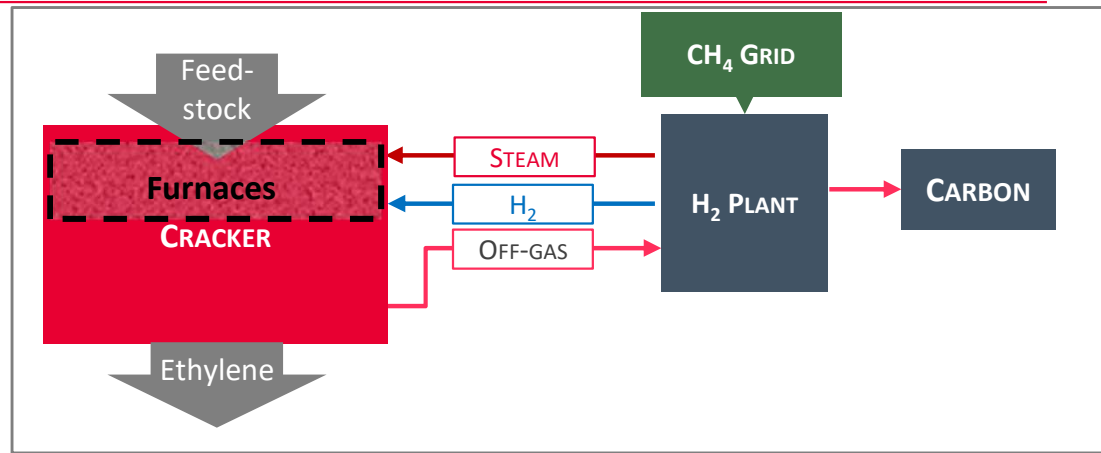
- CO₂ from flue
 - Methane off-gas from feedstock

Options

- Methane off-gas treatment to yield H₂
- Low-carbon/renewable feedstock

Efficiency

- Improved cracker design
- E-motor startup vs. steam



	Blue H ₂	Turquoise H ₂
Process	Steam methane reforming (ATR or POx)	Pyrolysis
Source	Methane	Methane
Product	H ₂ & CO ₂	H ₂ & C (solid)

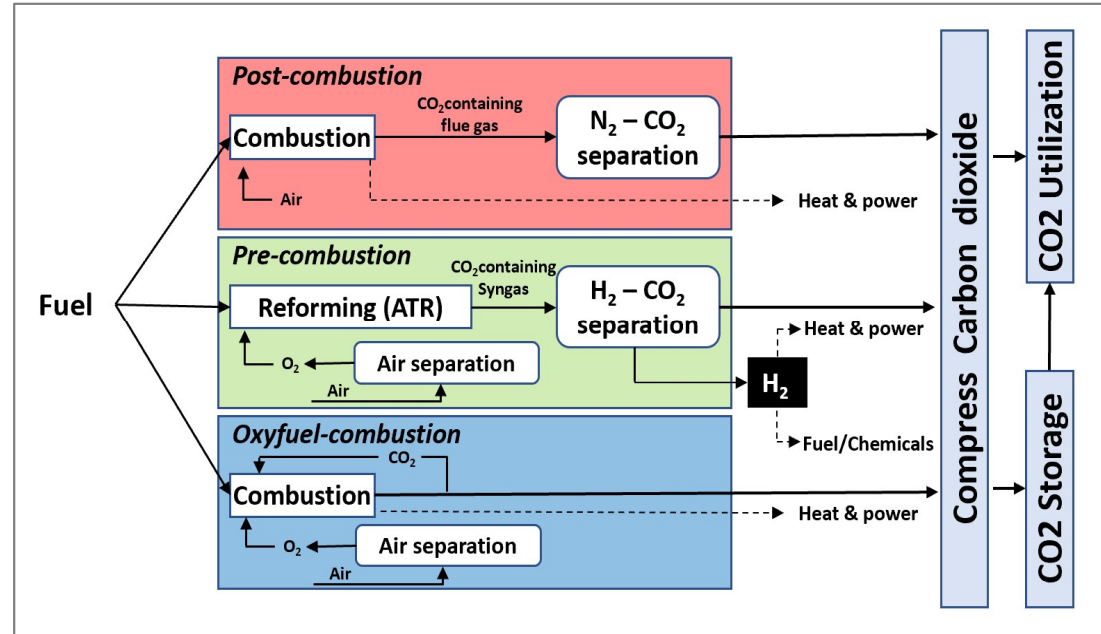
Roadmap: Energy Production/Decarbonization Options

Source

- Natural gas combustion

Options

- Post-combustion CCS
- Pre-combustion CCS
- Oxy-fuel combustion CCS
- Hydrogen grid (low-carbon)
- Power to heat (steam)
- Renewable fuel (Limited)
- Advanced nuclear

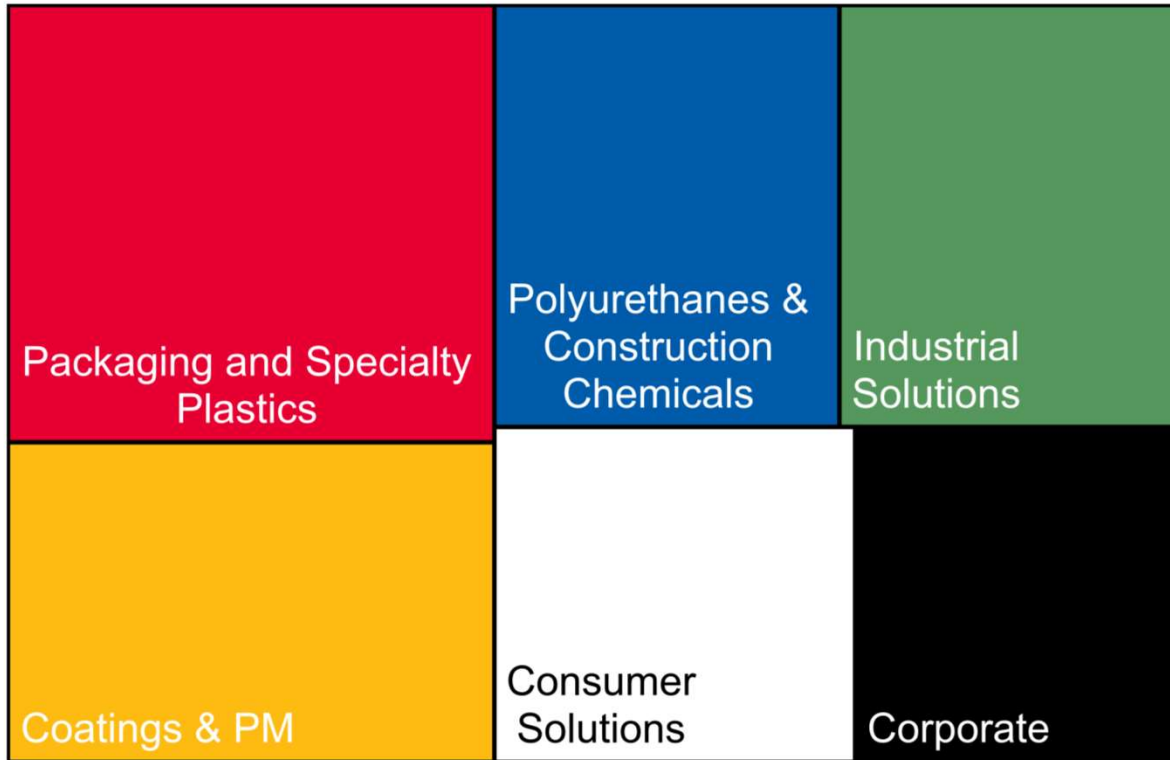


Efficiency

- H₂ & Oxy Combustion: Water + Heat recovery
- GEN III vs. GEN IV nuclear

Roadmap: Other Businesses

4.4 MM MT CO_{2e} (2022)



Sources (MM MT)

- Combustion
 - NG for site energy assets
 - NG for incineration
 - Organic stream contents
- Vented process CO₂

Options

- Process improvements & redesign
- Leverage technologies such as:
 - Carbon capture
 - Clean hydrogen
 - Direct electrification for heat
 - Power to steam

Efficiency

- Several opportunities - Need a program

Energy Efficiency & Decarbonization

Roadmap to Reduce >90% of Scope 1 & 2 Carbon Emissions

Dow's Current Emissions
32 MM mta

Target of >5MM mta (15%) by 2030

Details & Target

- Scope 1 & 2 emissions mostly from power & steam generation and olefins production
- Target reducing these emissions by >90% by 2050 while enabling business growth

Through 2030

- Implement Alberta project
- On-purpose circular H₂; CCS
- Deploy advanced small nuclear reactors (SMRs)
- Site efficiency improvements
- Renewable power

2030 – 2050

- Optimize H₂ allocation & production
- Additional carbon capture and storage capabilities
- Retrofit turbines for H₂ fueling or electrical drivers
- New cracking technologies
- Leverage most competitive clean H₂ and zero-carbon emissions e-cracking technologies
- Connect to H₂ infrastructure

2022

- Validate existing projects
- Identify new projects
- Integrate into emission reduction plans

2023

- Establish project prioritization and funding mechanism.
- Prepare process to assign funding to new project ideas.





EFFICIENCY SPECIFIC EXAMPLE:

SAINT CHARLES OPERATIONS BOILER OD IMPROVEMENT

SCO Boiler OD Improvement

The Problem

- Two boilers (250klb/hr) were kept at low running rates (30klb/hr) instead of hot stand-by mode (6klb/hr)
- No clear guidance when to place into stand-by mode

Consequences

- More natural gas used than needed
- Boiler steam vented during low demand



- 2,000 acres
- 25 miles from New Orleans
- Highly integrated chemical processing facility

SCO Boiler OD Improvement

Opportunities

- Boiler natural gas savings
- Reduce emissions

Required for hot-standby

- Move portion of off-gas fuel from boilers to HRSG duct burner, which allows 1 MW power generation via steam turbine



SCO Boiler OD Improvement

Solution

1. Create OD that defines when to place into stand-by mode
 - *routine procedure to review conditions permissible for running in hot standby*
 - *weekly task review of procedure with operations staff*
 - *new high steam demand alarm set at 1120 klb/hr.*



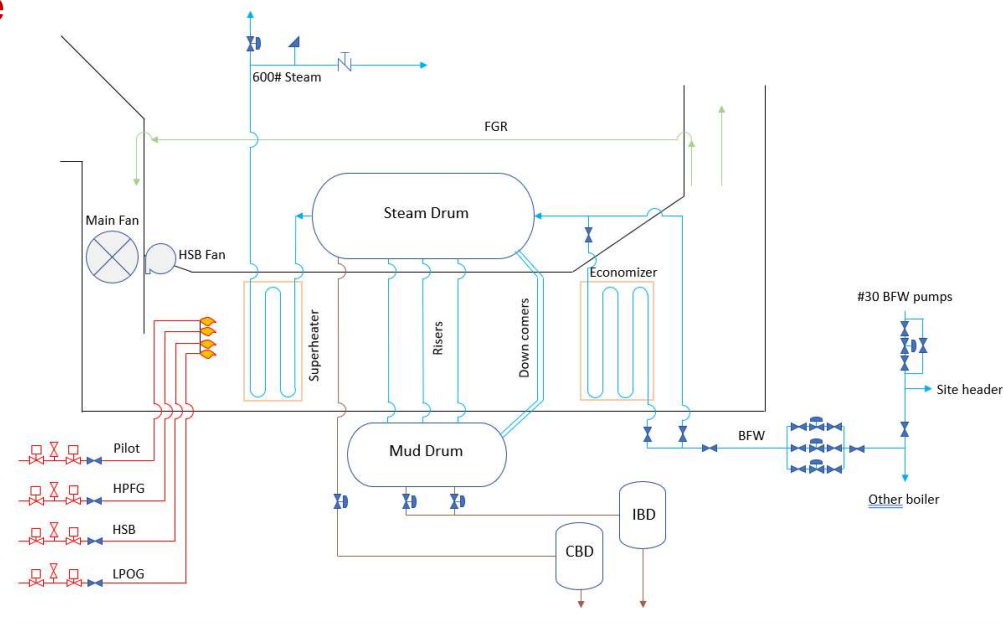
SCO Boiler OD Improvement

Findings

- Can not reliably be placed in stand-by mode
- slow transition from stand-by to full firing

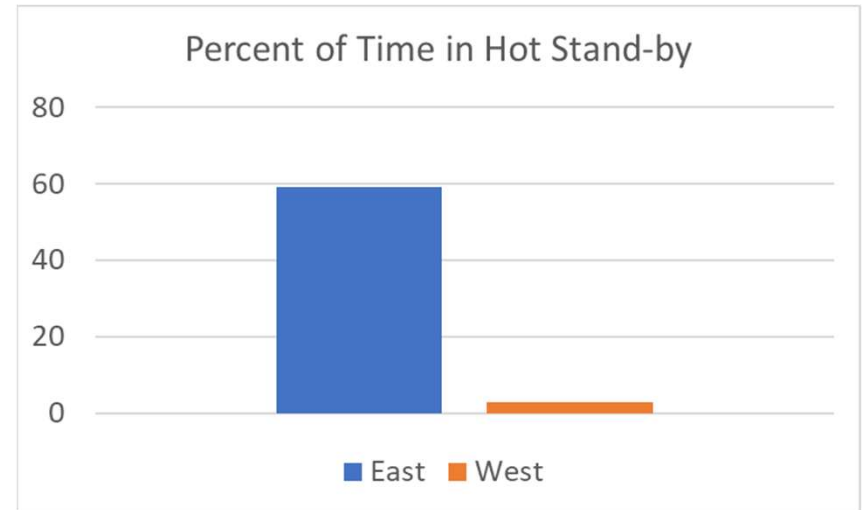
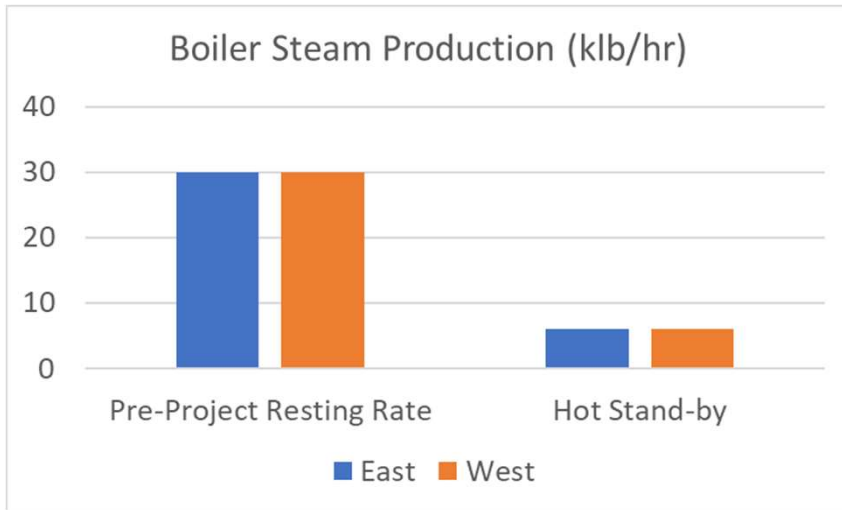
Fixes

- Overhauled boiler feedwater control valves
- Replaced boiler outlet flow transmitters
- Repaired multilins on main force draft fan
- Repaired hot stand-by fan



SCO Boiler OD Improvement

Results



Natural gas Savings: 291,000 MMBTU/yr

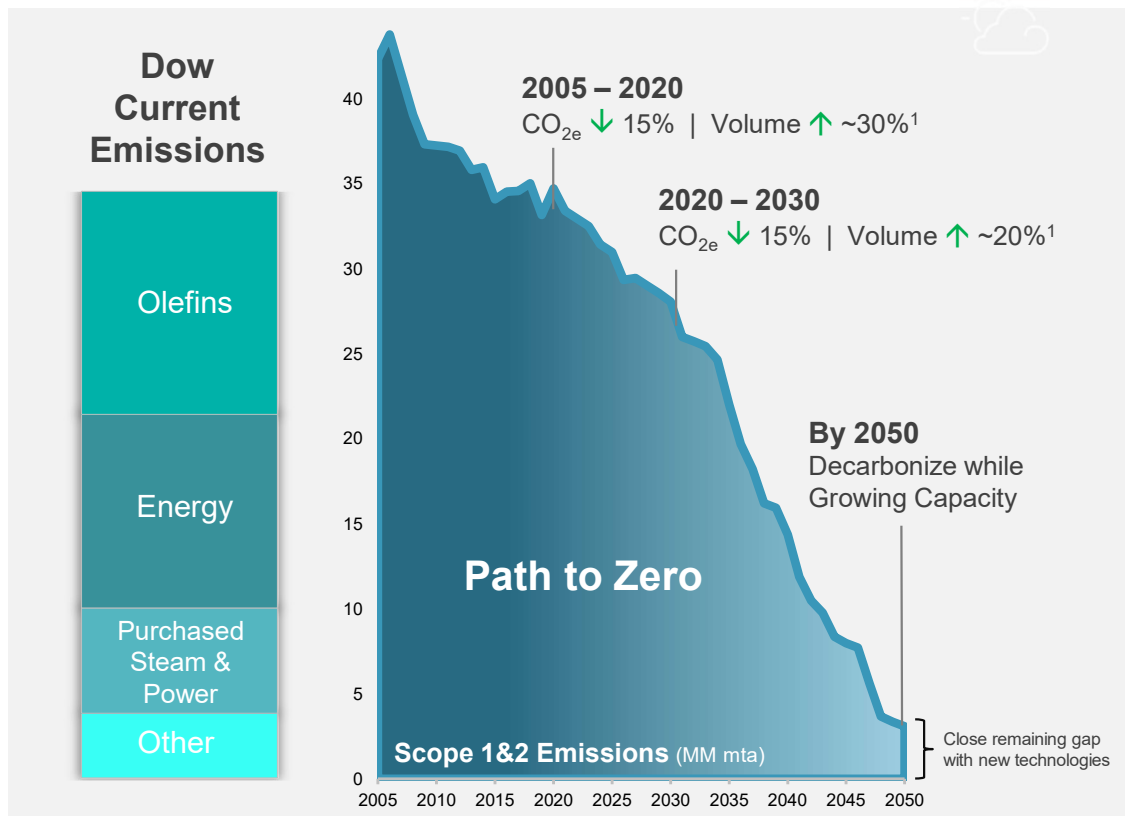
CO₂ Reduction: 15,450 MT/yr

Power: 1 MW from off-gas shift to HRSG duct burners.

2023 recipient of ACC Responsible Care Energy Efficiency Award

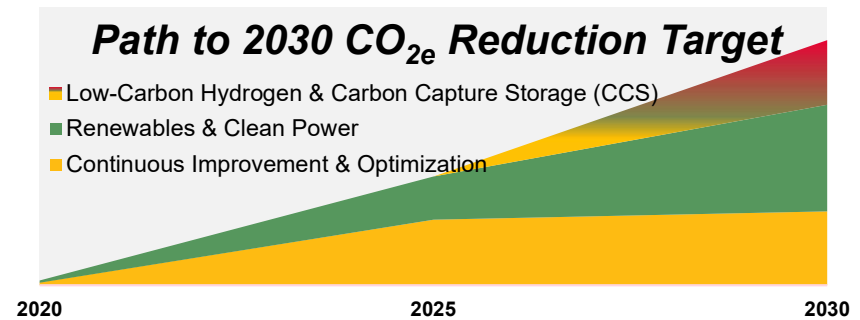
Project Team: John Brandon, Fred Fendt, Michael McCrackin, and Derek Rabalais

Dow's Path to Zero-Carbon Emissions While Driving Growth



Focus Areas to Drive CO_{2e} Reduction

- Optimizing our facilities & processes
- Increasing use of clean energy and steam
- Building a value generating scope 3 pathway
- Investing in next generation manufacturing technology
- Developing low carbon products and technology for our customers



Affordable and achievable path to zero-carbon emissions while supporting growth

Thank you

