



INDUSTRIAL DECARBONIZATION

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ENERGY & CLIMATE

UH Hydrogen Symposium

THIS IS DOW

Every answer starts with asking the right question.

At Dow, these questions and the pursuit of solutions for the world's toughest challenges inspire us to collaborate and use our materials science expertise to create innovative solutions that transform our world and deliver a sustainable future.



2022 NET SALES

\$57B



EMPLOYEES

~37,800



MANUFACTURING SITES

104



GLOBAL REACH

31 countries

in which Dow manufactures products

Note: All data as of December 31, 2022



ENERGY AND FEEDSTOCKS REQUIRED TO MANUFACTURE OUR PRODUCTS

>10GW

of energy from fuel to produce heat, power and steam imported and used

>1GW

of power and steam purchased from utilities

>80

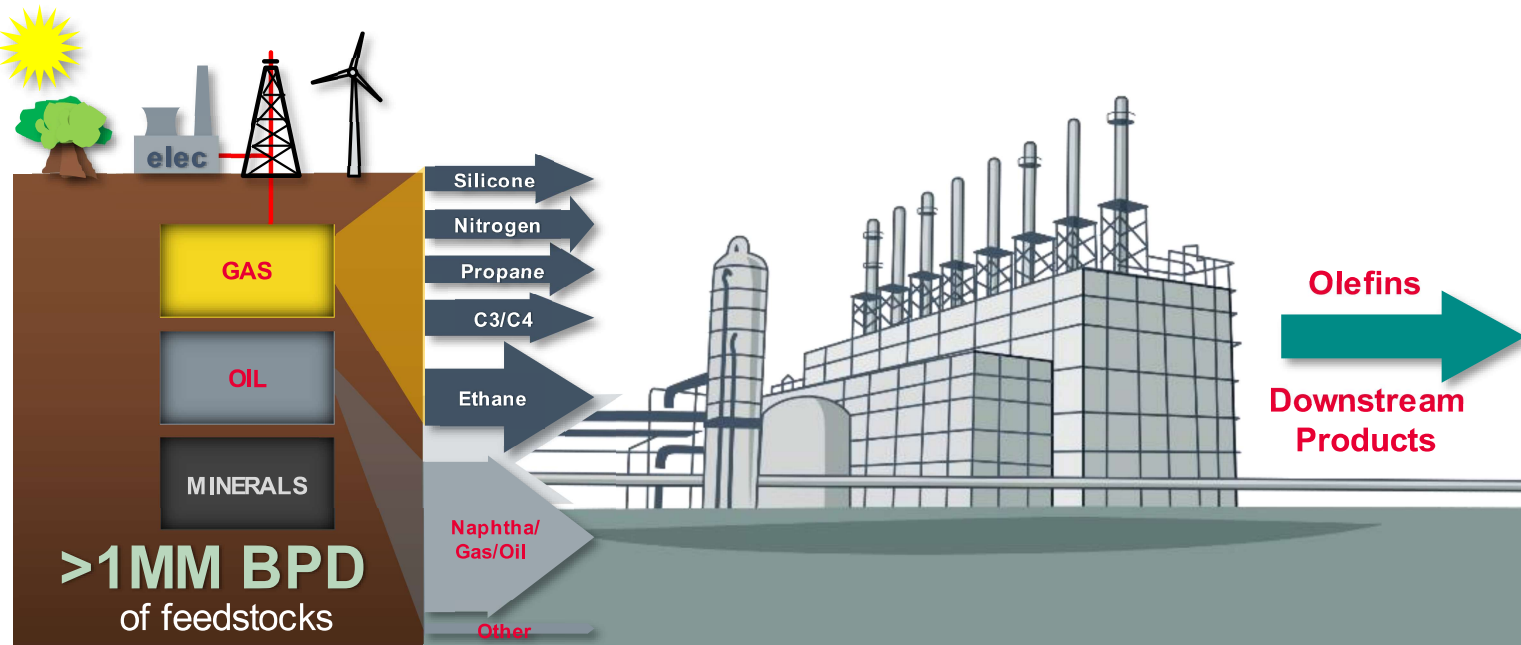
gas & steam turbines & boilers

>200

furnaces

25

major sites



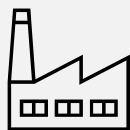
SOLUTIONS FOR DIVERSE MARKETS

The collage shows various applications of Dow products. The top section is labeled **PACKAGING & SPECIALTY PLASTICS** and includes images of a grocery store, a person in a white protective suit, and power lines. The middle section is labeled **INDUSTRIAL INTERMEDIATES & INFRASTRUCTURE** and includes images of industrial equipment and colorful clothing. The bottom section is labeled **PERFORMANCE MATERIALS & COATINGS** and includes images of a woman's face, a car, and a building.



NET ZERO IS POSSIBLE BY 2050

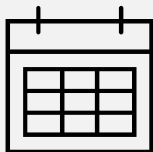
What we need to do:



Over the next 30 years...

- Phase out inefficient assets
- Decarbonize what remains
- Build best in class, carbon neutral assets for growth

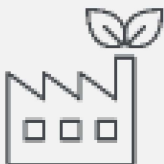
When & where:



Timeline and location driven by...

- Affordability
- Regulatory regimes (tax, subsidies, emission cost)
- Product demand

How:



Deploy known tech near-term and innovate to lower cost...

- Blue/circular hydrogen, nuclear & CCS
- Reliable renewables
- Low-carbon cracking



THE PATH AND TIMING MATTER

Protect the Climate

Near Term:

By 2025, we intend to reduce our Scope 1 & 2 carbon emissions¹ by 2MM metric tons (mta) vs. our 2020 baseline².

Mid Term:

By 2030, we intend to reduce our net annual Scope 1 & 2 carbon emissions by 5MM mta vs. our 2020 baseline¹.

Long Term:

By 2050, Dow intends to be carbon neutral (Scope 1 + 2 + 3 plus product benefits).

Our Approach to Climate Protection



Optimizing Our Manufacturing Facilities & Processes for Sustainability



Increasing Use of Clean Energy & Steam



Investing in Transformative Next-Gen Manufacturing Technology



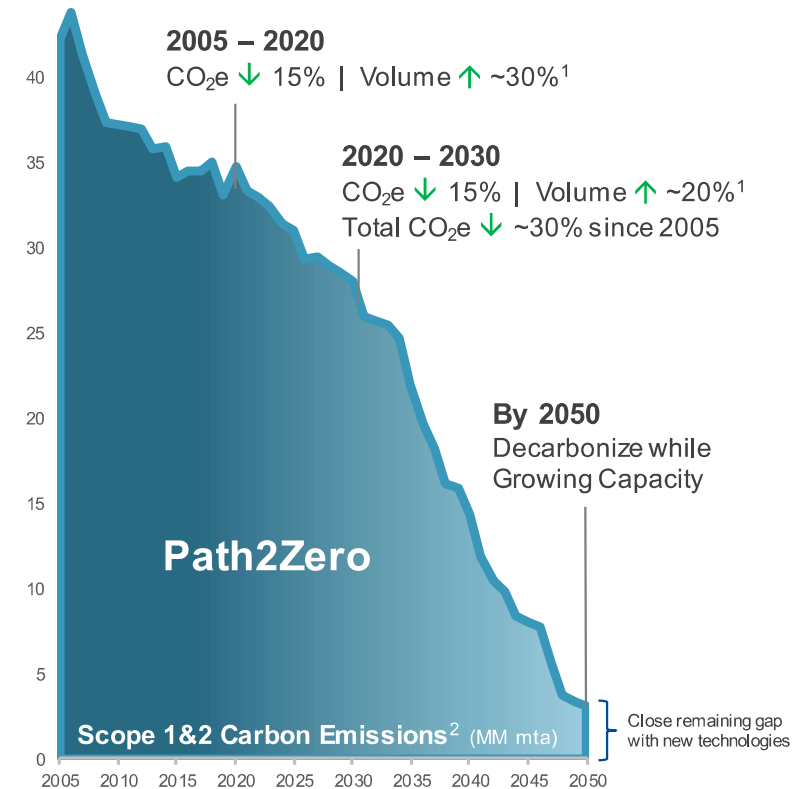
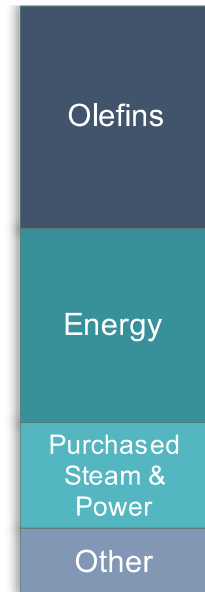
Developing Low-Carbon Products & Services



Building a Value-Generating Scope 3 Decarbonization Pathway

Aligning Timing with Growth and Asset Renewals

Dow Current S1/2 Emissions



1. Volume growth represents ethylene capacity, excludes JVs
2. All references to carbon are specific to GHG emissions in carbon dioxide equivalent (CO₂e).



INDUSTRIAL ENERGY DECARBONIZATION OPTIONS



Advanced Nuclear

- Co-located designs opportunity to decarb sites with high demand and reliability
- Gen IV capable of providing high temp/ pressure industrial steam



Hydrogen

- High temp applications
- Large sites needing reliable energy
- H₂ from cracker methane off-gas decarb treatment
- Fuel for cracker furnaces, boilers, & GTs



CCS

- Essential to reforming H₂ plant at cracker sites
- Sites that produces CO₂ as part of chem production process
- Economically difficult for small sites; would need access to hub



Renewables

- Relies on decarb of public power grids
- Most sites will continue to draw power from the grid
- Grid power sites will convert NG boilers to H₂ or apply Power to Heat methods



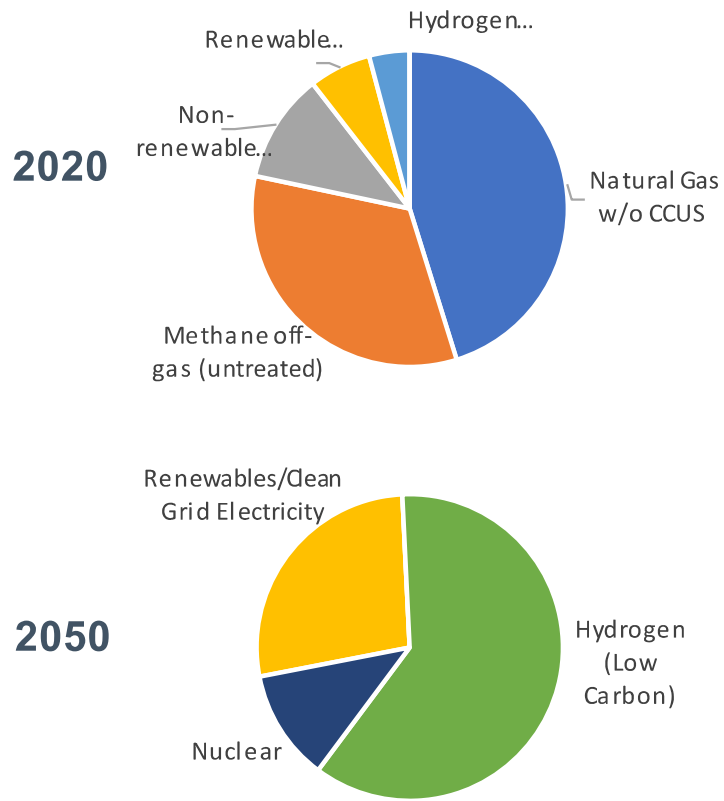
Power to Heat

- Sites on grid power and some with cogen
- Steam demand varies from site to site
- Tech selection dependent on steam conditions: e.g., heat pumps vs. thermal batteries



ENERGY DECARBONIZATION STRATEGY

Energy Generation by Dow



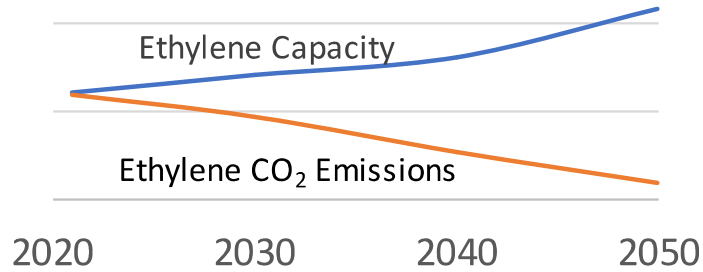
Includes cracker off gas feedstock

Hydrogen Combustion	Renewables	Nuclear
<ul style="list-style-type: none"> ▪ Circular H₂ for hydrocarbons furnaces ▪ Develop CCS alternatives to support H₂ production and downstream decarbonization ▪ Advance dry low NO_x capabilities for H₂ fired cogeneration 	<ul style="list-style-type: none"> ▪ Renewables currently 41% of purchased power vs 25% in 2020; maximum of ~50% ▪ Significant contributor to Dow's 2030 CO₂ reduction target ▪ Regional strategies to ensure reduced emissions at the lowest cost 	<ul style="list-style-type: none"> ▪ Advance Seadrift, TX nuclear project with US DOE to replace gas turbines and decarbonize site ▪ Evaluate additional Dow sites and alternative advanced nuclear technologies for alternative use cases



ROADMAP: CRACKERS

Decarbonize & Grow

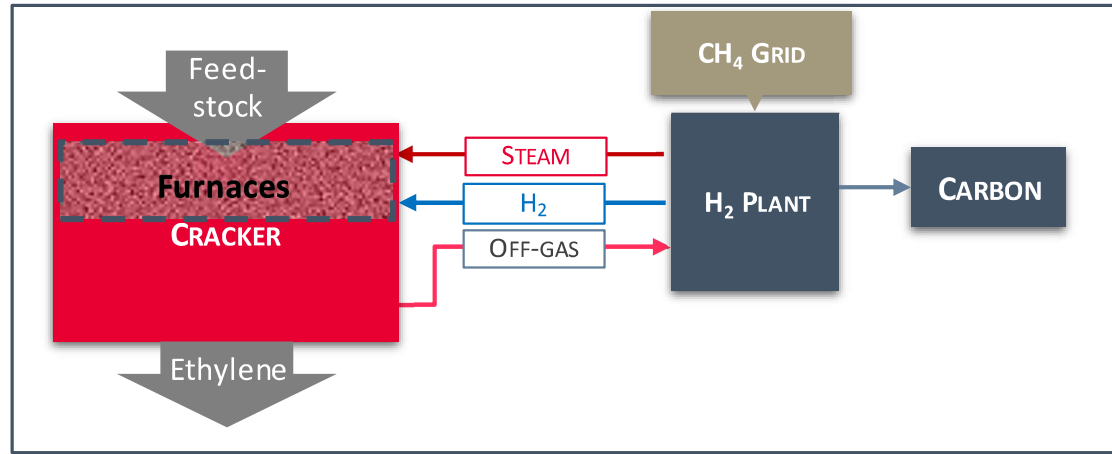


GHG Sources

- CO₂ from flue
 - Methane off-gas from feedstock

Options

- Methane off-gas treatment to yield H₂
- Low-carbon/renewable feedstock
 - Availability
 - Negative CO₂ w/ off-gas treatment & CC
- E-cracking
 - Off-gas not addressed; can create H₂ options



	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: FORT SASKATCHEWAN

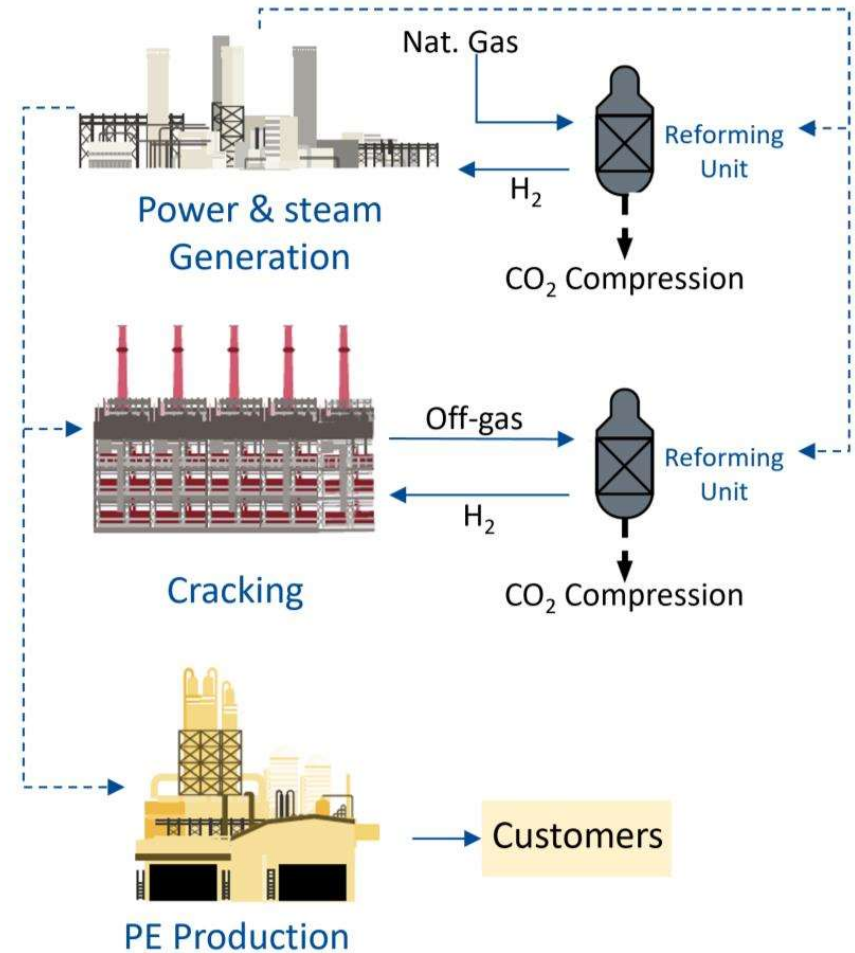
Two Phase Project – Complete by 2029

- Hydrogen-fueled ethylene cracker
- Low carbon power and steam
- Add ~1.8 million metric tonnes of ethylene capacity
- Expanded polyethylene production
- Produce and supply approximately 3.2 million metric tonnes of certified low- to zero-carbon emissions polyethylene and ethylene derivatives
- Decarbonize ~20% of Dow's global ethylene capacity while growing polyethylene supply ~15%



Site Expansion

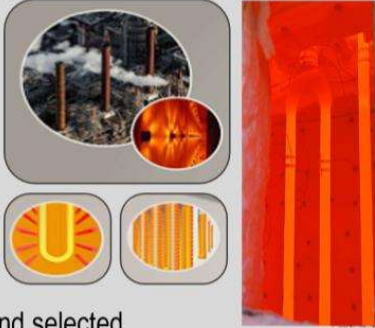
Site Perimeter



ROADMAP: E-FURNACE DEVELOPMENT FOR STEAM CRACKING

e-Furnace: Laboratory Concept Validated

- Directly uses clean energy, eliminating CO₂ emissions from heating
- Up to 30% energy savings
- Modeling confirms feasibility
- e-Heating technology evaluated and selected



e-Cracker Pilot Plant → Strengths & Opportunities



- Sustainable decarbonization and NO_x emission elimination
- Deployable across industries, and increased process safety

Commercial Deployment

- Leverage Pilot learnings to commercial scale
- Dependent on clean electricity infrastructure

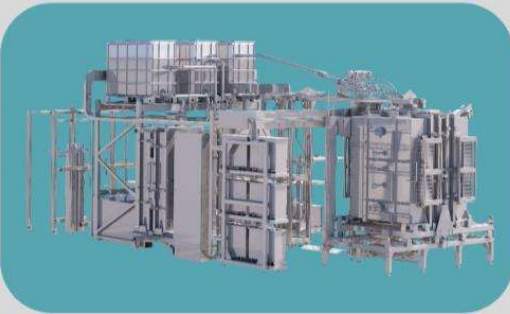
2023

2024

2025 - 2026

2027+

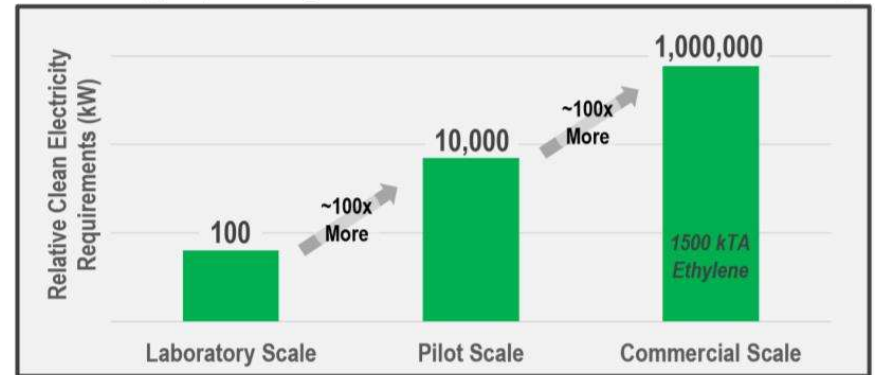
From Laboratory Concept to Scalable Pilot Plant Design



- Completed finalization of unit design:
 - e-Furnace pilot scale unit enables testing and evaluation of commercial furnace structure and tube heating
 - Modular design for rapid deployment & scale up
- Pilot plant design completed; awaiting FID



e-Cracking requires significant low-cost & reliable clean electricity



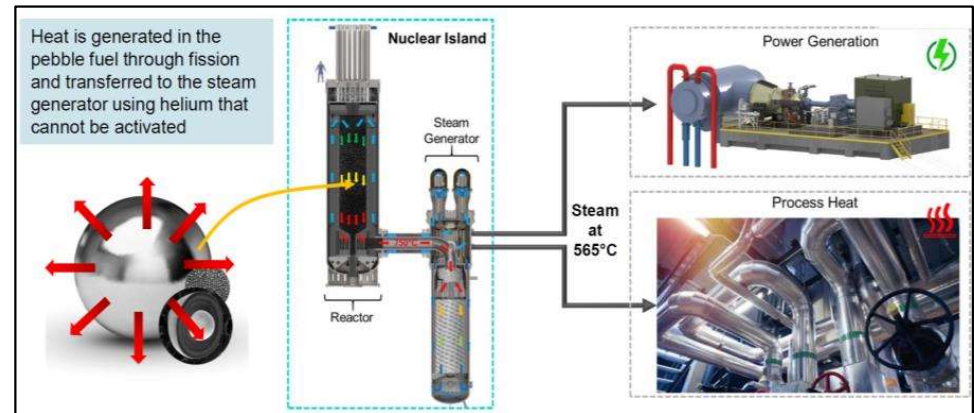
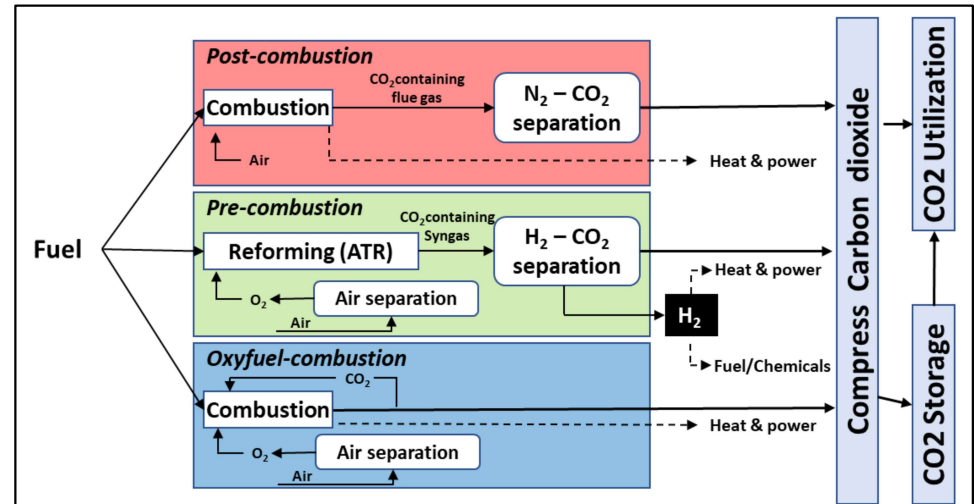
ROADMAP: ENERGY PRODUCTION

Source

- CO₂ from natural gas combustion

Options

- Post-combustion CCS
- Pre-combustion (H₂) CCS
- Oxy-combustion CCS
- Methane pyrolysis (H₂) solid carbon
- Hydrogen grid (low-carbon)
- Renewable power to heat (steam)
- Advanced nuclear
- Biofuels (limited)



DOW'S SEADRIFT, TX ADVANCED SMALL MODULAR NUCLEAR PROJECT

Safe, Reliable, Zero Emissions Power and Steam Production

- Replacing site's existing energy and steam assets with 4 of X-energy's Xe-100 HTGR reactors
- Safe design, compact footprint, competitive cost, and enhanced power and steam reliability
- Supported from U.S. DOE's Advanced Reactor Demonstration Program ("ARDP") Cooperative Agreement
- Emissions reduction of ~440,000 MT CO₂e/year
- Preparing to submit Construction Permit applications to the U.S. Nuclear Regulatory Commission in 2024
- Expected to be operational by ~2030

Dow's Strengths to Support Advanced Nuclear Development

- Dow's process drives for low capex, meeting financial targets, and driving investments with an acceptable return while maintaining a competitive cost profile.
- We are experts at delivering mega projects – engineering, construction, project management
- We have the desire and business incentive to decarbonize

Dow Seadrift, TX site, future home of SMR



GOOD PROGRESS BUT MUCH STILL TO DO



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Duke Energy announces plans to build and operate the nation's first system capable of producing, storing and combusting 100% green hydrogen in a combustion turbine in Florida

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October 27, 2023





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