



# Navigating carbon management & climate mitigation driven by ESG and sustainability Plans

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Senior Chemical Engineer  
Barr Engineering Co.

10:00 am opening remarks, introduce Barr (5 min)

Carbon and climate basics—drivers, definitions, and incentives (15 min)

Introductions leading industries (15-20 min each)

Panel, "Leading industry experience" (15-20 min each, 45-60 min total)

12-1pm Lunch

1:00pm Golf – 9 holes

# How do you see the path to a Net Zero Future?



# Key takeaways

## Overall

Help you  
prepare for  
net zero  
carbon  
future

## Intro

Learn basic  
definitions  
and a high-  
level view of  
what the  
industry is  
doing

## Panel

Bring people  
together,  
learn from,  
and build a  
foundation  
towards  
sustainability

Opening remarks, introduce Barr

Carbon and climate basics—drivers, definitions, and incentives

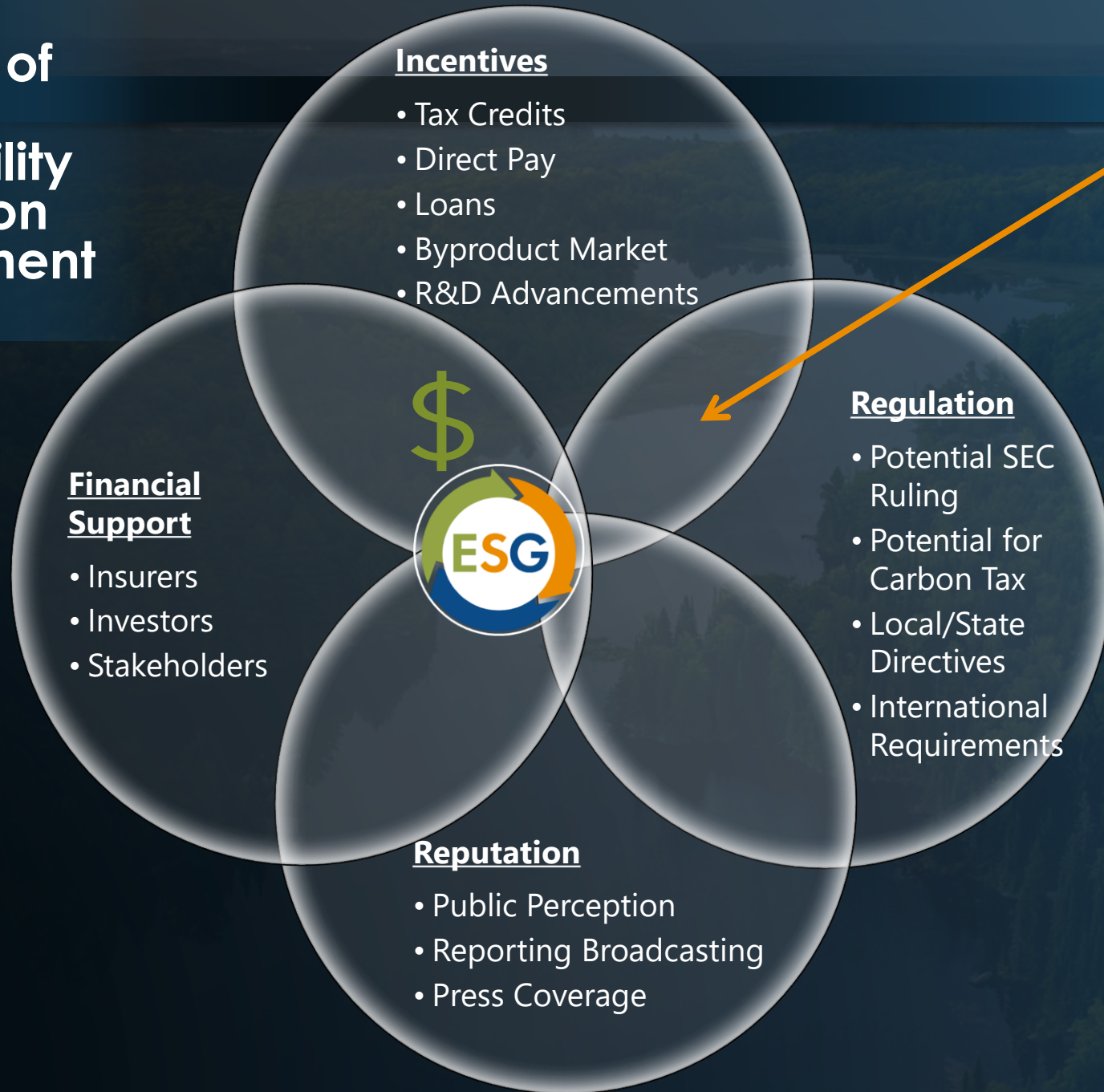
Introductions leading industries

Panel, “Leading industry experience”

# ESG, sustainability and carbon management definitions

<b>Carbon Management</b>	A systematic, organization-wide approach to controlling carbon or carbon equivalent emissions and carbon combustion residuals
<b>Carbon dioxide equivalent (CO<sub>2</sub>e)</b>	A quantity of Greenhouse Gases or GHG can be expressed as CO <sub>2</sub> e by multiplying the amount by its Global Warming Potential or GWP
<b>Decarbonization</b>	A broad term that generally refers to efforts to reduce carbon or carbon equivalent emissions
<b>Carbon Neutral</b>	Carbon emitted is being captured or stored—for carbon only and paired with carbon offsets like planting trees
<b>Net Zero</b>	GHG emitted is removed or stored—Typically refers to all GHG

# Overview of drivers for sustainability and carbon management



**September 2022**  
EPA announces formation of office of Environmental Justice

**Net-Zero Emissions Operations by 2050, including a 65% reduction by 2030**

- ESG and sustainability strategy
- Stakeholder interests
- Customer and investor pressures
- SEC rule making

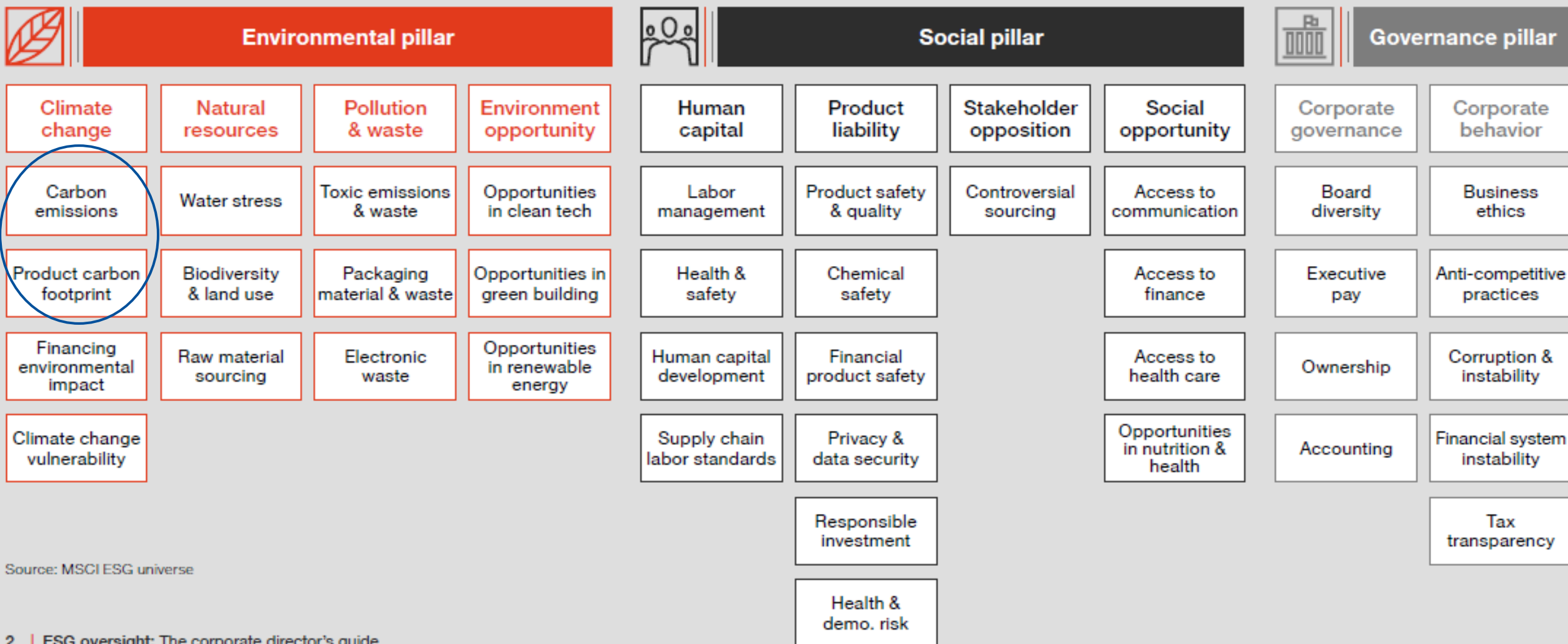


*ESG is a term representing the three central factors in measuring the sustainability and societal or ethical impact of an **investment** in a company or business.*



# Driver – ESG Landscape

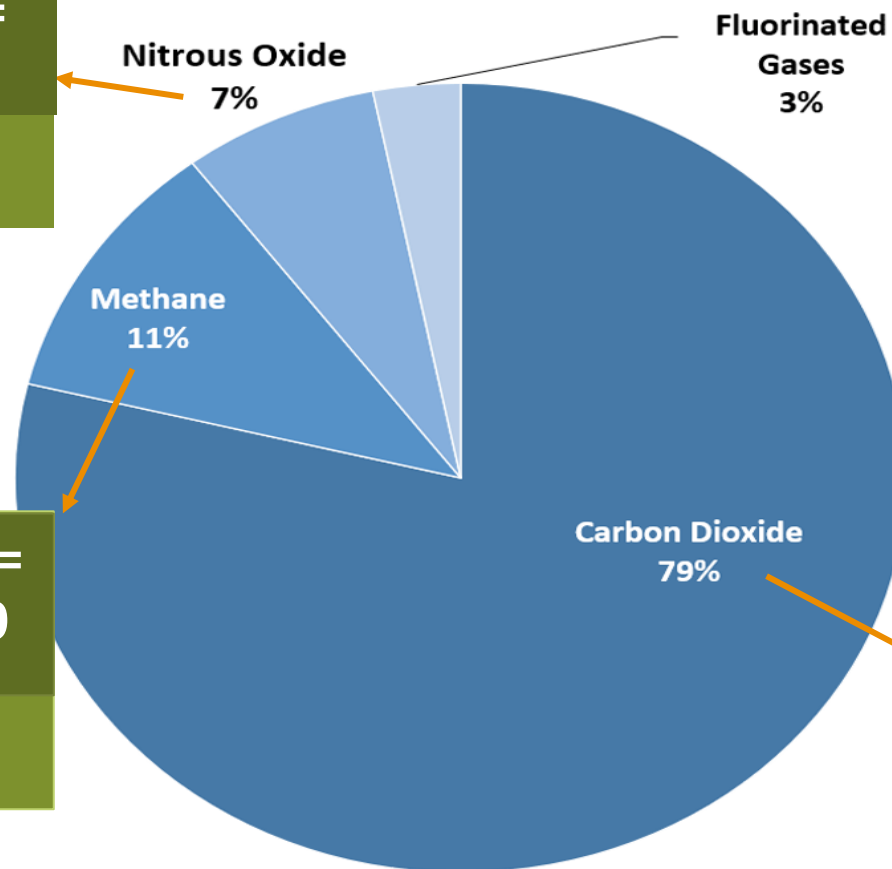
Figure 1: A view of the ESG landscape



Source: MSCI ESG universe

# Driver-climate change

## Overview of U.S. Greenhouse Gas Emissions in 2020



**GWP= 273**

Agricultural  
Wastewater  
Stationary Combustion  
Chemical Production  
Transportation

**GWP= 25-30**

Natural Gas / Petrol  
Agricultural  
Landfills  
Coal Mining

**GWP= > up to 22,000**

Refrigerants  
Aerosols  
Foam  
Fire Repellent  
Solvents  
Transmission & Distribution

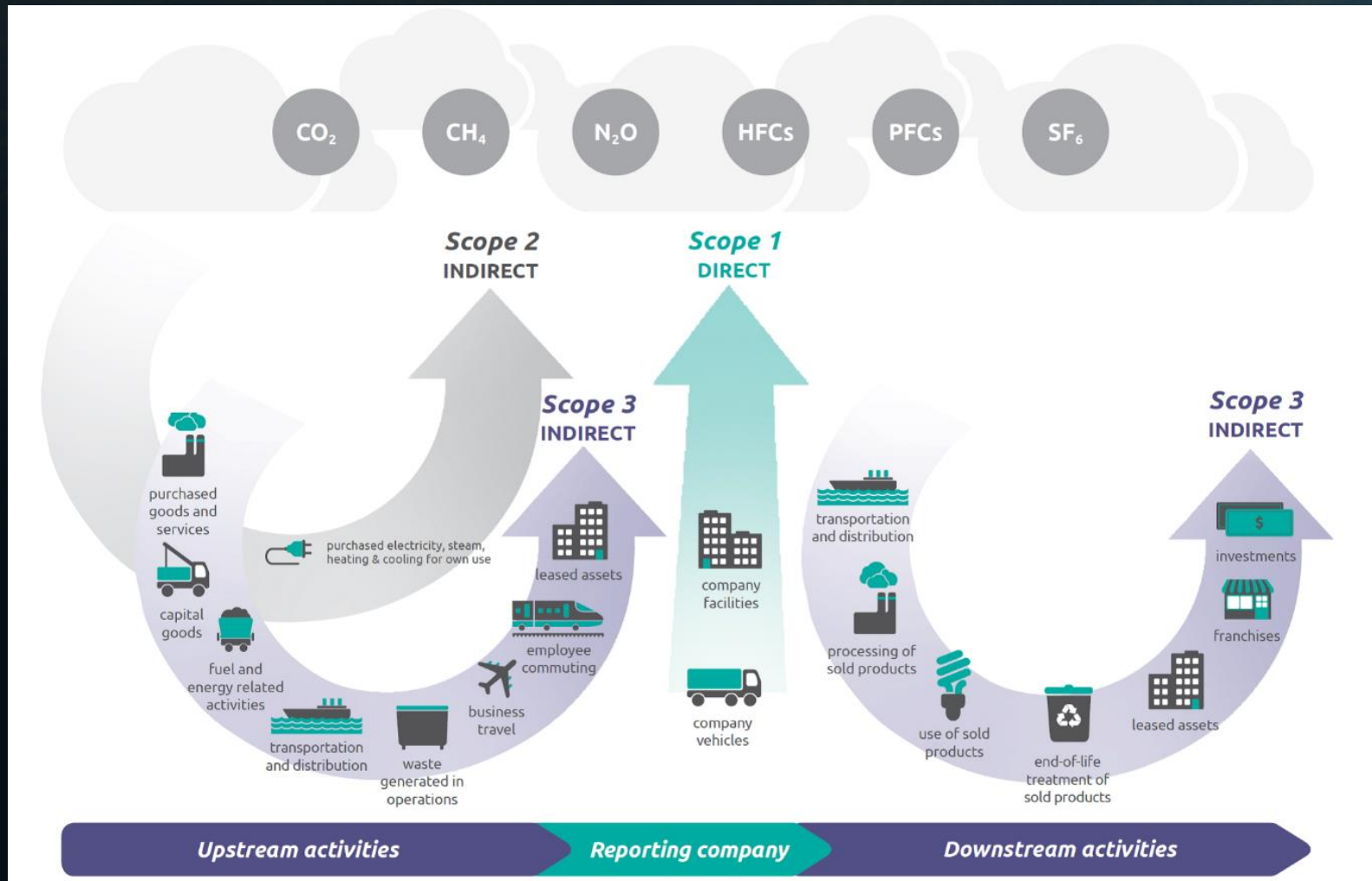
Global Warming Potential (GWP) = a measure of how much energy the emissions will absorb over a given period of time (20 yr. example). The larger the GWP, the more that a given gas warms the Earth compared to CO<sub>2</sub> over that time period.

<https://www.epa.gov/ghgemissions/understanding-global-warming-potentials>

**GWP= 1**

Transportation  
Power  
All Industries  
Commercial & Residential

# Definition – scope 1,2, & 3 emissions



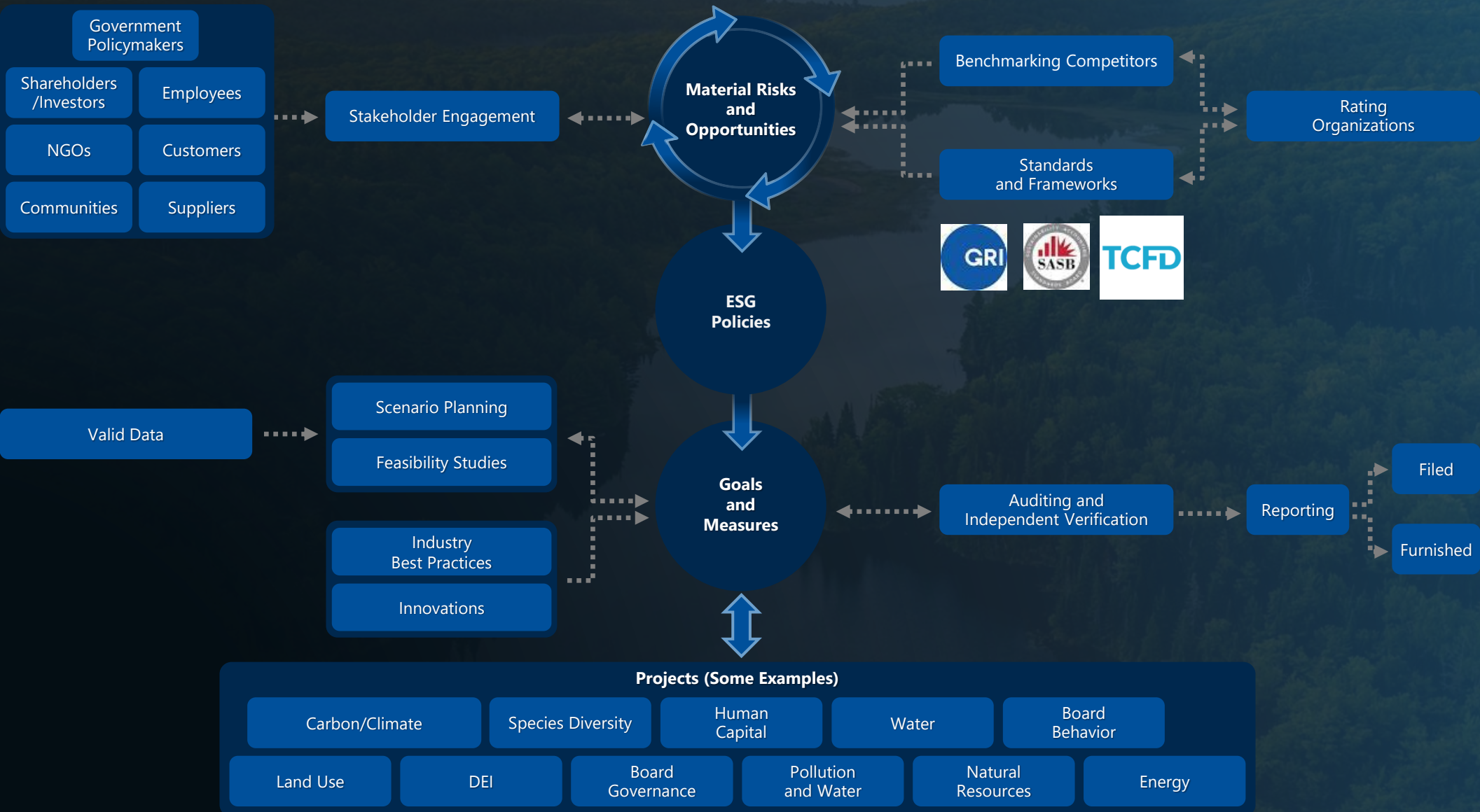
## Direct Versus Indirect Emissions

**Scope 1:** direct emissions from operations

**Scope 2:** indirect emissions from energy use (electricity, steam, cooling, heating)

**Scope 3:** indirect emissions associated with operation's upstream and downstream value chain

# Projects driven by ESG reporting and ranking



# Driver – ESG / regulatory reporting framework example

As the U.S. strives to achieve net-zero emissions from the power sector, here's a look at how the country's 30 largest\* investor-owned utilities are faring in terms of decarbonization.

Companies are scored on a scale of 1 (lowest) to 5 (highest) for each metric, indicating whether they are trailing or leading, respectively. The overall decarbonization score is an average of the six metrics.

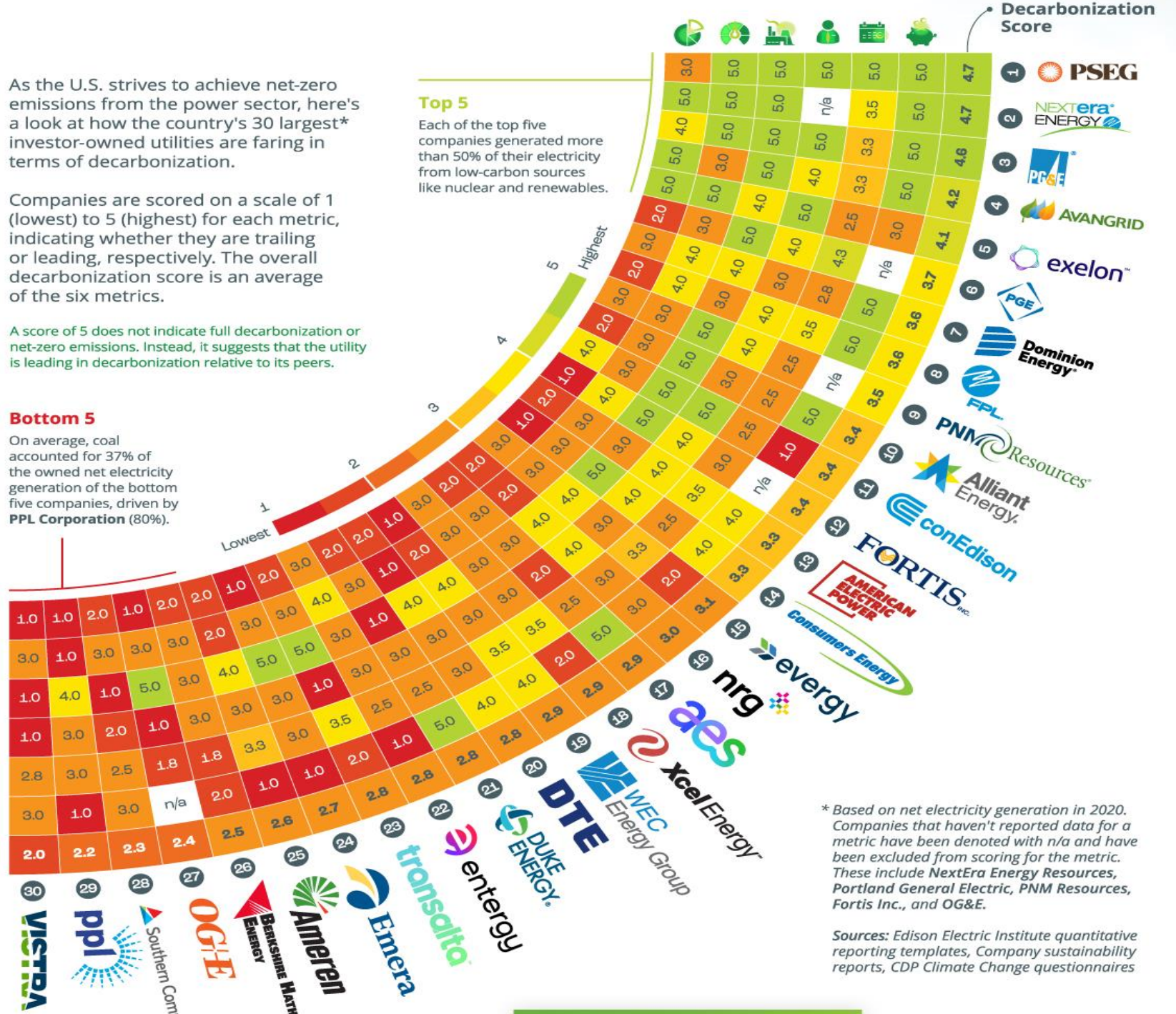
A score of 5 does not indicate full decarbonization or net-zero emissions. Instead, it suggests that the utility is leading in decarbonization relative to its peers.

### Bottom 5

On average, coal accounted for 37% of the owned net electricity generation of the bottom five companies, driven by PPL Corporation (80%).

### Top 5

Each of the top five companies generated more than 50% of their electricity from low-carbon sources like nuclear and renewables.



\* Based on net electricity generation in 2020. Companies that haven't reported data for a metric have been denoted with n/a and have been excluded from scoring for the metric. These include NextEra Energy Resources, Portland General Electric, PNM Resources, Fortis Inc., and OG&E.

Sources: Edison Electric Institute quantitative reporting templates, Company sustainability reports, CDP Climate Change questionnaires

# Driver – federal incentives U.S. & Canada (Similar)

Federal tax credits and R&D: a tool to drive carbon management

## Infrastructure Investment and Jobs Act

Billions in CCUS Demonstration  
Funding for hubs and pilot plants

## 45Q Tax Credit Updated with Inflation Reduction Act

Construction Start January 2033  
12 yr. payout with Direct pay option first 5 years (longer for tax exempt)  
\$85/tonne CO<sub>2</sub> Stored  
\$60/tonne EOR  
\$180/tonne DAC with saline storage  
\$130/ton DAC EOR

## Other Inflation Reduction Act

RNG, Biofuels 2024  
Nuclear – 2032  
Advanced Manufacturing 2032  
Clean Hydrogen 2033  
Sustainable Aviation 2026  
Clean Energy / Energy Storage  
Grants, Loans, Other Incentives

## GHGRP/GHG MMR

- Reporting Program Required for Select Facilities since 2009
- Emit more than 25,000 tonne CO<sub>2</sub>e/year
- Supply of certain products resulting in over 25,000 tonne CO<sub>2</sub>e/year
- 25,000 tonne CO<sub>2</sub>e/year for underground injection.

## GHG BACT

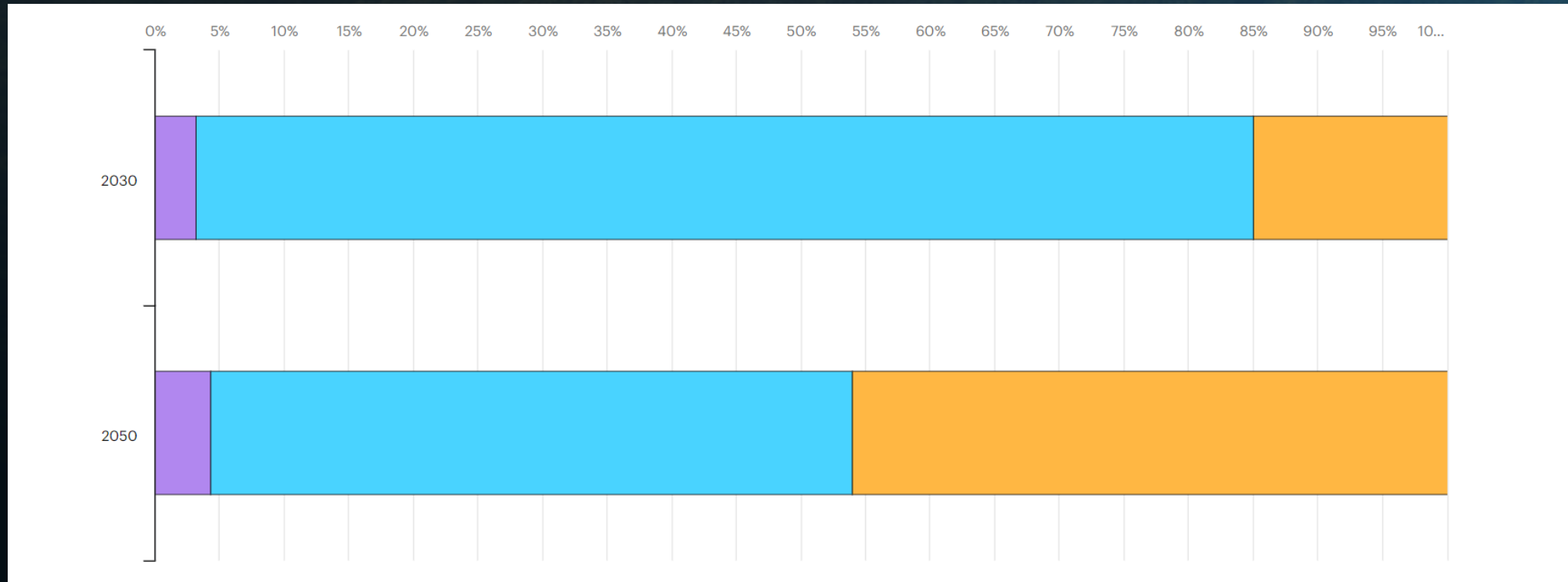
- Major Source Emitting GHG
- Common for Combustion (est. >80% GHG Emissions from Combustion)

## State Mandated

- Varies widely, Cap and Trade, State Plans, Incentives

# Net zero and emerging technologies

emerging technologies



● Behaviour changes    ● Technologies on the market    ● Technologies under development



## Carbon byproduct beneficiation

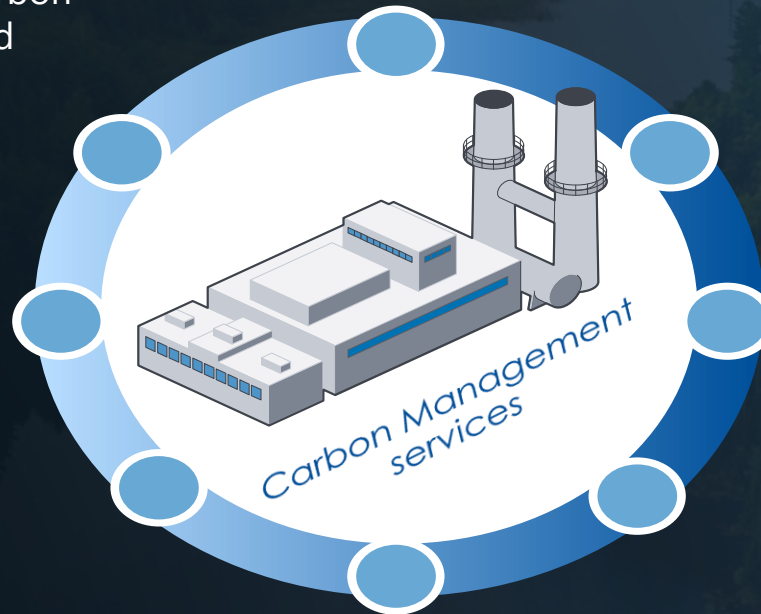
- gypsum conversion
- saleable ash
- carbon / chemical products
- rare earth extraction
- activated carbon
- working fluid

## New processes

- indirect firing
- gasification with chemical looping
- organic Rankine cycle
- ammonia conversion

## Alternative fuel

- biomass
- renewable natural gas
- hydrogen
- biofuels



## Plant betterment

- energy audits
- waste reuse
- boiler efficiency / fouling reduction upgrades

## Energy storage

- batteries
- pumped storage
- compressed air storage
- mine haul trucks
- fuel cells
- hydrogen storage

## Renewables

- solar
- wind
- hydro
- geothermal

## Carbon capture sequestration

- direct air capture
- technology evaluations
- CO<sub>2</sub> pipeline and compression
- carbon capture and sequestration
- biological/greenhouse

# Partnering to Advance Technologies

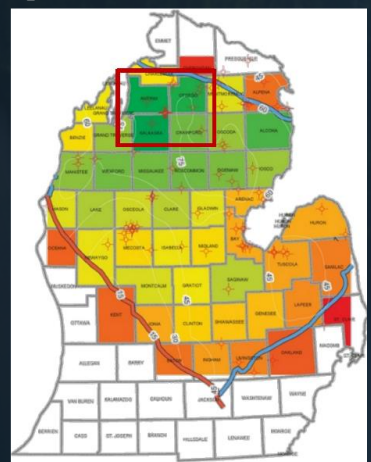
- R&D small business
- Universities
- Vendors
- Research labs
- State and federal agencies
- Industries working together
- Landowners
- Developers



## Local Projects from Matchmaker

- Carbon Solutions LLC
- North Coast Strategies

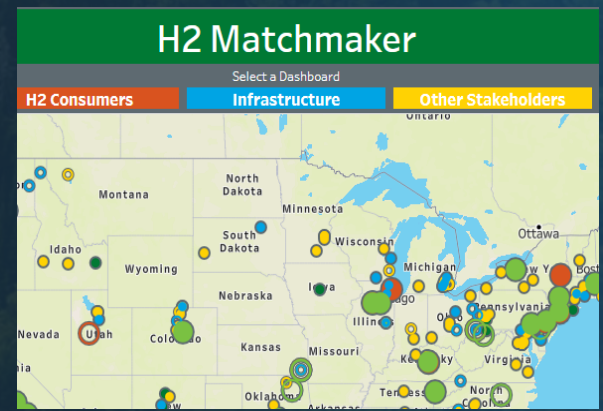
## Carbon Matchmaker | Department of Energy



## Midwest Hydrogen Hub / Michigan Hydrogen Hubs

- H2 demand in Midwest is significant
- Steel Industries
- Transportation
- Paired with Nuclear Power
- **Midwestern Hydrogen Coalition ("M-H<sub>2</sub> Coalition") MOU**

## H2 Matchmaker | Department of Energy



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# Panelist Introductions



- Diana Bach,
  - Co-founder and Owner
  - Positive Scenarios Consulting, LLC.



- Rence Meredith,
  - *Assistant Vice President, Facilities Services*
  - Grand Valley State University



- Linda Hilbert,
  - Executive Director, Environmental Quality & Sustainability
  - Consumers Energy

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# QUESTIONS



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