

# CCUS in Alberta - A proud history and bright future

**InnoTech Alberta**

A Subsidiary of Alberta Innovates

**November 6, 2025**



# OVERVIEW

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- CCUS in Alberta
- Advancements in CCUS in Alberta
- InnoTech Alberta
  - Carbon Capture, Utilization and Decarbonization
  - Carbon Storage



CCUS in  
ALBERTA

# CARBON CAPTURE, UTILIZATION, AND STORAGE

## Carbon Capture

Separation of CO<sub>2</sub> from gas streams at facilities, such as fossil fuel power plants, ethanol plants, fertilizer plants, refineries, cement, and steel plants, or directly from the atmosphere.

## Carbon Utilization

CO<sub>2</sub> captured is used to create products (e.g., curing cement and low-carbon synthetic fuels).

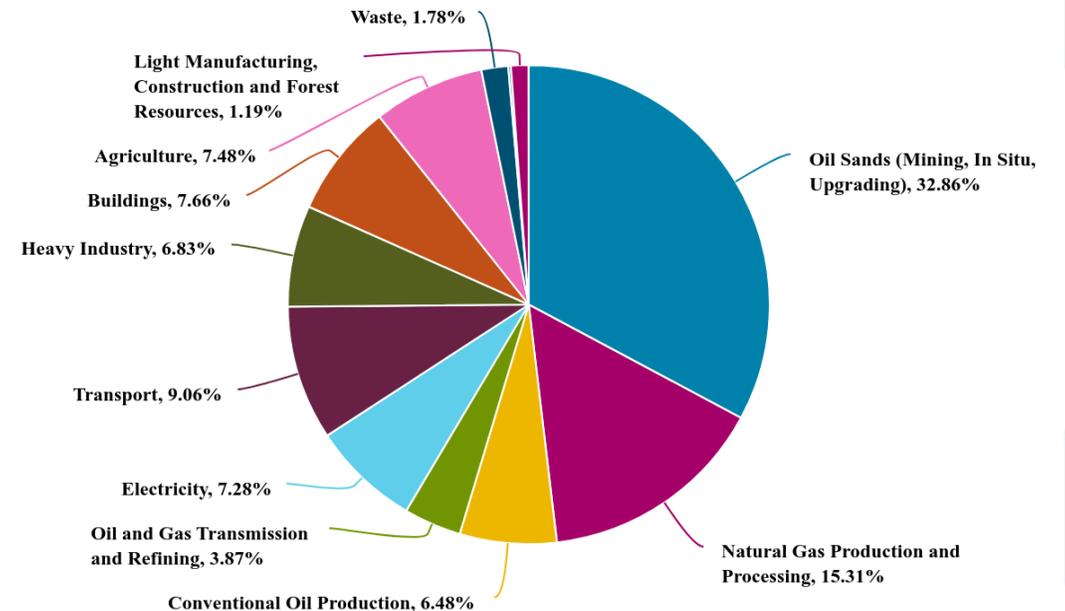
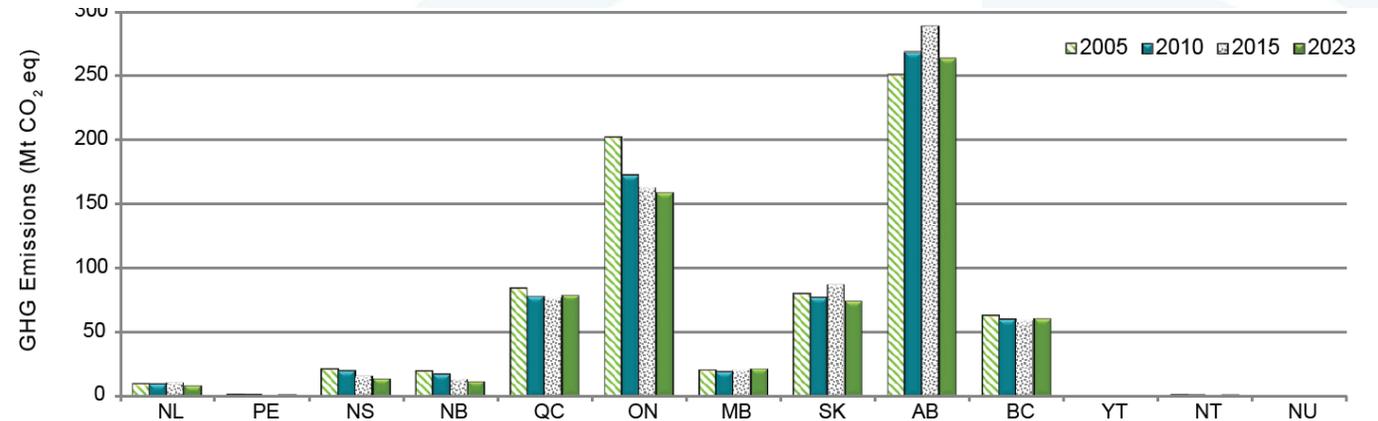
## Carbon Storage

CO<sub>2</sub> captured is compressed and transported to be permanently stored in geological formations underground (e.g., saline aquifers, oil reservoirs).

# INDUSTRY GHG EMISSIONS IN ALBERTA

Source: Environment and Climate Change Canada - National Inventory Report

- In 2020, total industrial GHG emissions were **256 megatonnes** of carbon dioxide equivalent (MT CO<sub>2</sub>e).
- Alberta's emissions per capita are the **second highest** in Canada at 58 tonnes CO<sub>2</sub>e—**three times the national average** of 17 tonnes per capita.
- Largest emitting sectors in Alberta are **oil and gas production, electricity generation and transportation.**



Breakdown of Alberta's 2023 emissions by sector.

# MITIGATING CLIMATE CHANGE



## International Energy Agency

IEA's 1.5°C scenario model shows **~45%** of total global emission reductions between 2015 and 2050 are from industrial sector use of CCUS in applications that cannot be replaced by renewable or other non-emitting energy technologies.



## Intergovernmental Panel on Climate Change

Concluded that without CCUS, costs of climate change mitigation could increase by **138%**, and further, realizing a 1.5°C scenario may not even be possible without CCUS technologies.



## GoA Climate Change Strategy

Estimates that by 2050 the rate of CO<sub>2</sub> sequestration will have to be **139 megatonnes** of CO<sub>2</sub> per year to meet 2050 targets.

CCUS contributes to **one-fifth** of the emissions reductions needed across the industry sector.

# CCUS IMPORTANCE IN ALBERTA



## Economic Growth

Contributes to clean and inclusive economic growth.



## International Market

Expands international market and trade opportunities.



## Hard-to-Abate Sectors

Addresses emissions from hard-to-abate but crucial sectors of Alberta's economy.

## Pathways to Decarbonization

Enables other pathways essential to decarbonization (e.g., electrification, hydrogen).



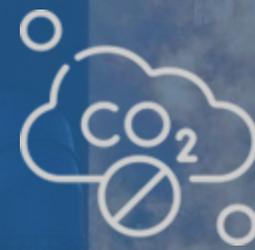
## Ideal Geology for Storage

Alberta Sedimentary Basins provide many suitable sites for CO<sub>2</sub> sequestration in several types of geological formations.



## Negative Emissions Technologies

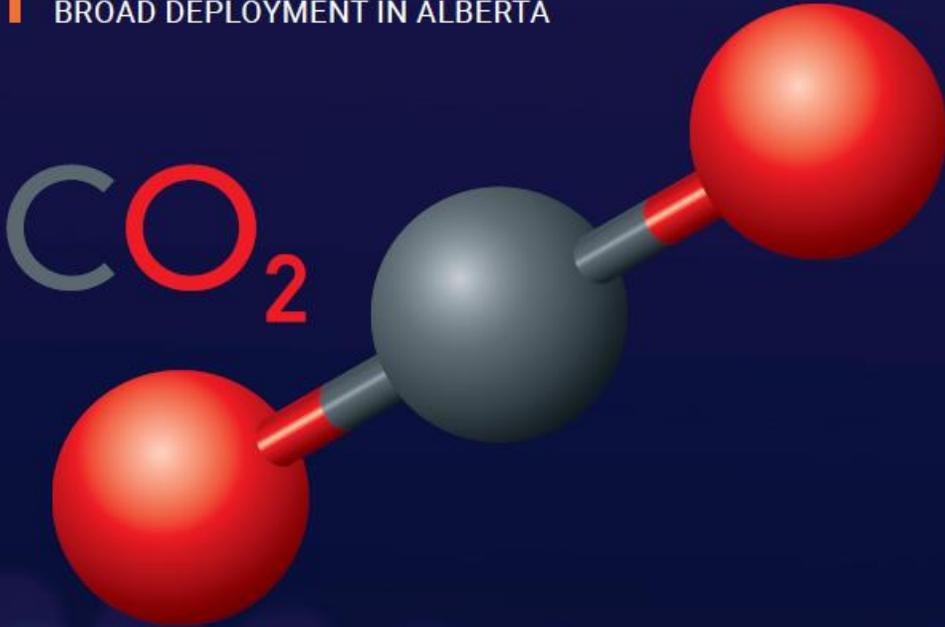
Delivers carbon dioxide removal via CCUS negative emissions technologies.



CCUS  
ADVANCEMENTS

# CARBON CAPTURE, UTILIZATION, AND STORAGE (CCUS)

TECHNOLOGY INNOVATION TO ACCELERATE  
BROAD DEPLOYMENT IN ALBERTA



APRIL 2022

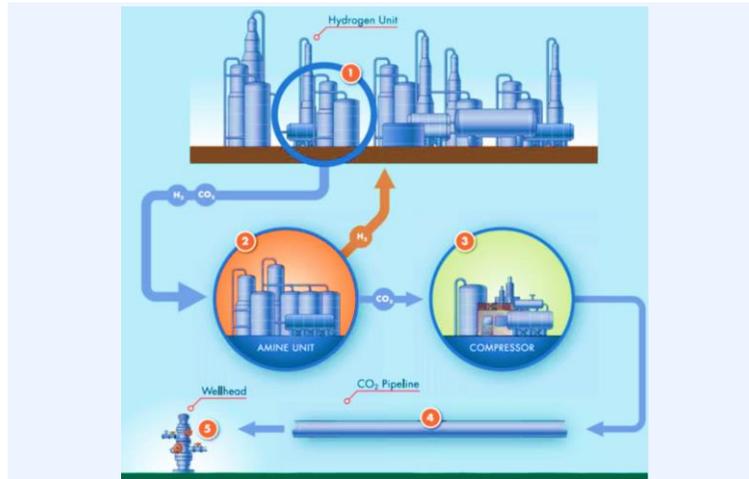
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“Governments and corporations around the world have been making pledges to reduce greenhouse gas (GHG) emissions to net zero. One of the most important pathways to achieve net zero emissions (NZE) is carbon capture, utilization and storage (CCUS)”.

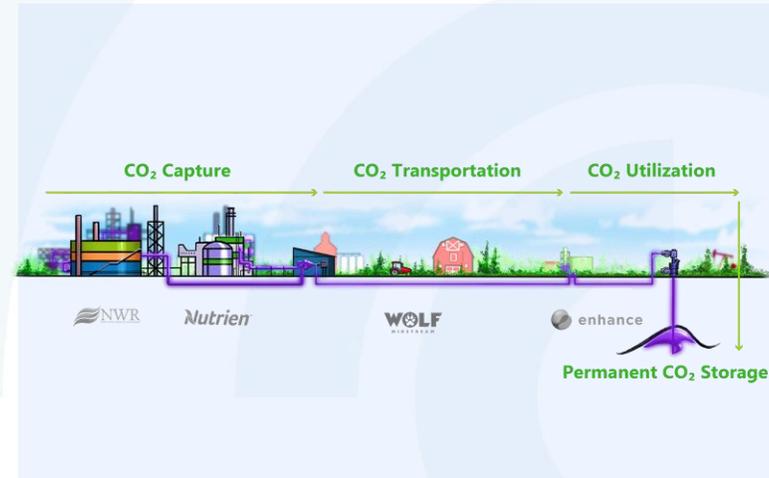
# CCUS ADVANCEMENTS IN ALBERTA

- Government of Alberta committed \$1.24 Billion through 2025 to two commercial-scale CCUS projects in oil sands and fertilizer sectors.



## Shell Quest

Integrated CCS project that captures CO<sub>2</sub> from an existing oil sands upgrader and transports it by pipeline for sequestration underground in deep saline formations.



## Alberta Carbon Trunk Line

240 km pipeline that transports CO<sub>2</sub> from an existing fertilizer plant and an oil sands refinery to CO<sub>2</sub>-EOR in central Alberta.

# CCS FEED STUDY PROJECTS IN ALBERTA



Lafarge Canada



CNRL



Capital Power



Strathcona Resources



Enmax Energy



Agrium Canada (Nutrien)



Entropy



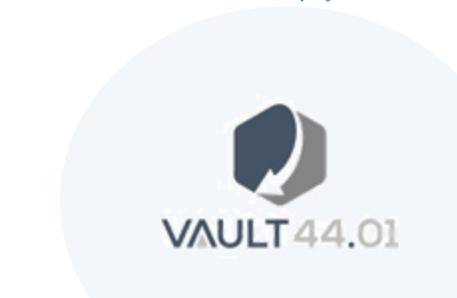
Heartland Generation



Suncor Energy



City of Medicine Hat



Vault 44.01



# NRG COSIA CARBON XPRIZE



**TURNING CO<sub>2</sub> INTO PRODUCTS**

# \$20 MILLION

Prize Purse

The \$20M NRG COSIA Carbon XPRIZE develops breakthrough technologies to convert CO<sub>2</sub> emissions into usable products.

**Five NRG COSIA Carbon XPRIZE finalists competed at ACCTC from 2019 – 2020**

 AIR COMPANY.	 Carbon Corp.	 CARBON CURE.
Air Company	Carbon Corp.	CarbonCure
 United States	 United States	 Canada

 Carbon Upcycling-NLT	 cert
Carbon Upcycling-NLT	CERT
 Canada	 Canada

# KEY RECOMMENDATIONS FROM CCUS PROJECTS

## 1 Leverage Expertise

Leverage Alberta's experience in commercial-scale CCUS projects to develop more commercial projects in high CO<sub>2</sub> concentration facilities.

## 2 FEED Studies

Conduct CCUS FEED studies and build commercial-scale projects at both an oil sands facility and a NGCC power plant using commercial aqueous amines and improve learning curve for future projects.

## 3 Storage Hubs

Use analysis tools developed in Alberta to assess potential storage hubs for CO<sub>2</sub> and develop a regional large-scale model to assess potential interactions between hubs.

## 4 Advance Technologies

Advance the most attractive second generation technologies to commercial demonstration.

## 5 Carbon Utilization Development

Focus on carbon utilization development on large-scale CO<sub>2</sub>-EOR projects, mineralization, and conversion to materials that can replace or displace high GHG incumbent materials.

## 6 Cleantech

Identify ways to develop more clean tech talent and entrepreneurs in the province and help existing clean tech companies to grow.

# InnoTech Alberta

A Subsidiary of Alberta Innovates



# DRIVING INNOVATION SINCE 1921

We have a long and proud history transforming the energy, agriculture, environment, forestry and manufacturing sectors.

1921

**Science and Industrial Research Council of Alberta (SIRCA)**

Recognizing the importance of natural resources in Alberta and their potential commercial and industrial uses, Alberta establishes the first provincial research organization in Canada.

1981



**Alberta Research Council (ARC)**

Evolved into one of Canada's leading innovation organizations focused on technology development, converting early stage ideas into marketable products and services.

2016



We have evolved to become a wholly owned subsidiary of Alberta Innovates. With over 325 scientists, engineers, and professional staff; more than 100,000 square metres of laboratory space; and 600 acres of experimental farm land, we accelerate technology development.

1930

**Research Council of Alberta (RCA)**

An extraction process patent issued to RCA chemist Dr. Karl A. Clark was integral in laying the foundation for investment in oil sands development.

2010

**Alberta Innovates — Technology Futures (AITF)**

One of four provincial corporations, AITF focused on helping enhance the capacity within Alberta's high-tech companies.



# InnoTech - a Subsidiary of Alberta Innovates

- InnoTech Alberta is a public R&D service provider
- InnoTech Alberta offers technology development services on a fee-for-service basis focused on

- » Technology R&D and commercial deployment
- » Technology de-risking, scale-up, and piloting
- » Specialized analytical test methods
- » Innovation and advanced technologies



*The work InnoTech does is specialized and capital-intensive. It is customized, project-based and often unique.*

# CARBON CAPTURE, UTILIZATION & DECARBONIZATION

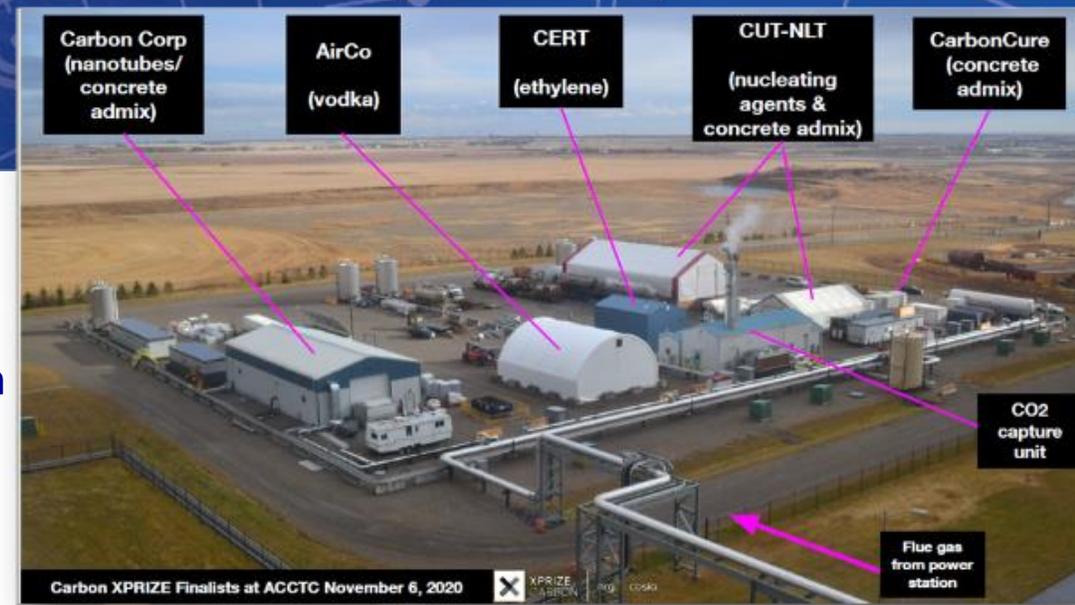
# CCU & Decarbonization

## Capture, Utilization and Decarbonization R&D -

- Develop and/or de-risk solutions and technologies to address client challenges related to CO<sub>2</sub> capture, CO<sub>2</sub> conversion/utilization and methane decarbonatization

## Technology Demonstration and Scale Up – ACCTC (Alberta Carbon Conversion Technology Center)

- Demonstrate and validate CO<sub>2</sub> capture, conversion/utilization and methane decarbonatization technologies in real-life conditions within a semi-commercial scale environment to support future commercialization



Synthetic Fuels



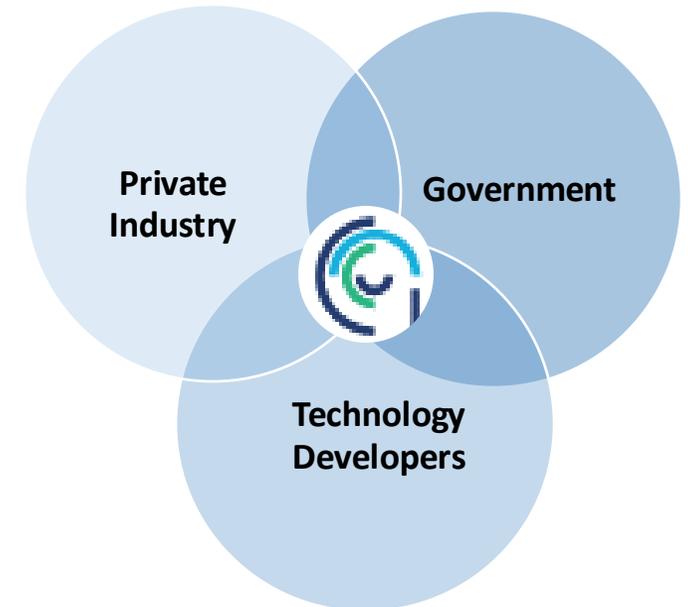
Carbon Additives



Building Materials



Chemicals



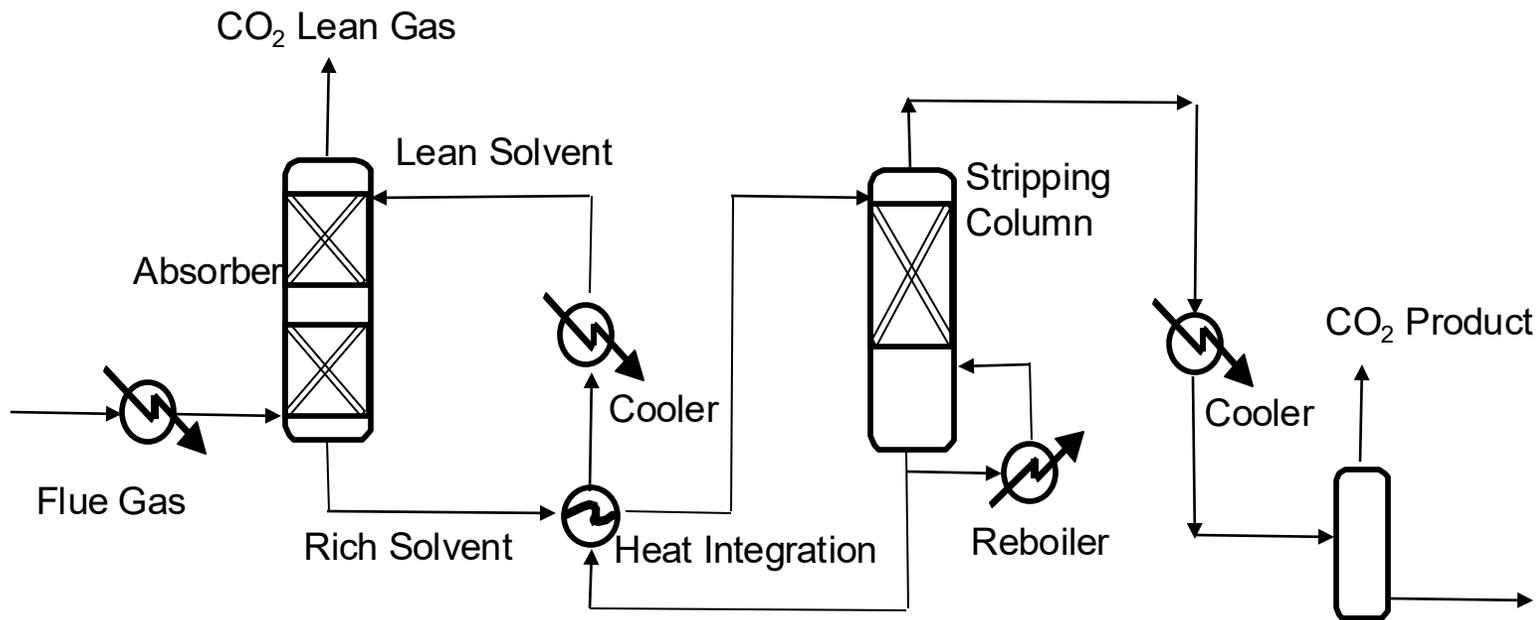
# ACCTC Overview

- **5 outdoor Test Bays** with total area of 125,000 ft<sup>2</sup>
- **Raw CO<sub>2</sub> directly from flue gas** supplied to each Test Bay at a flowrate of **1 – 5 tonnes/day**
  - Flue gas: 4 – 6% CO<sub>2</sub>
  - Supply pressure range: 30 – 40 kPa<sub>g</sub>
- **Concentrated CO<sub>2</sub>** from an amine-based capture unit available to each Test bay at a flowrate of **6 tonnes/day**
- Each Test Bay individually metered for natural gas use electrical service, and water use

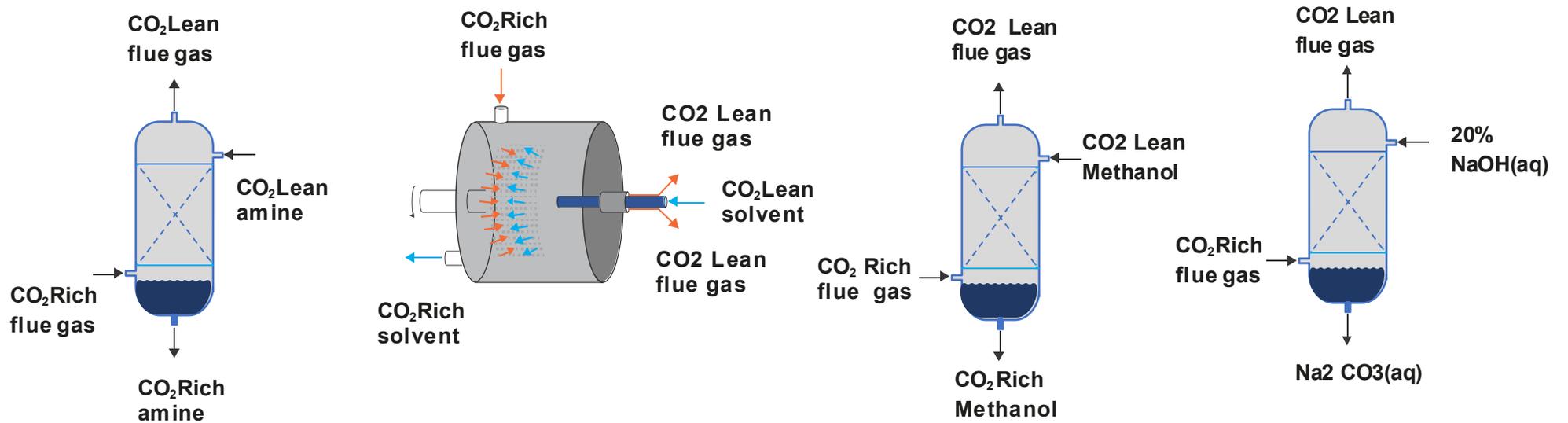


# Amine-Based CO<sub>2</sub> Capture Unit

- The first CO<sub>2</sub> capture unit verified based on ISO 14034
- The plant is fabricated from stainless steel to accommodate testing various novel solvents
- Custom designed unit to absorb CO<sub>2</sub> at low concentration (4 – 6%)

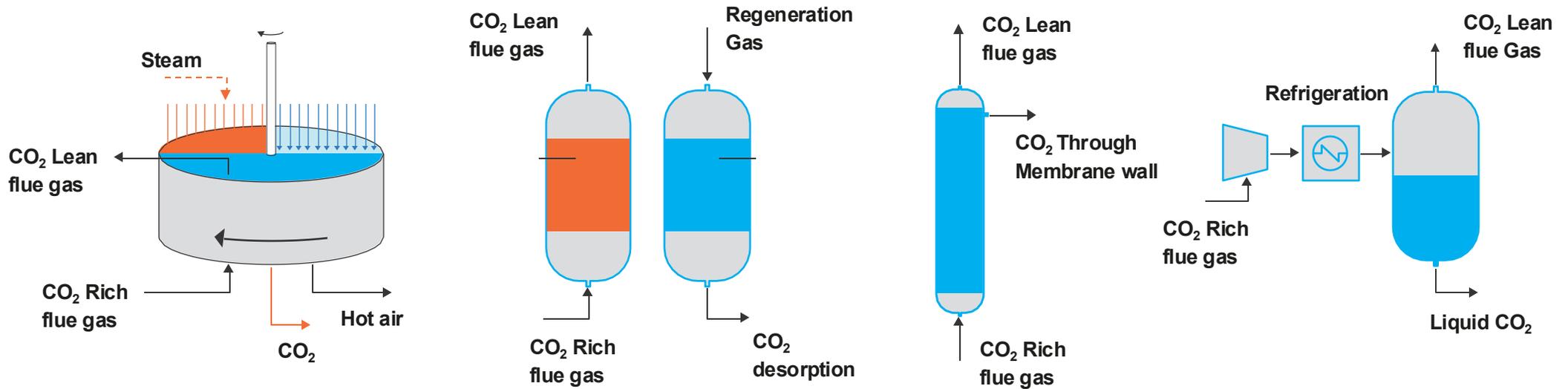


# Absorption



	Conventional Amine Process	Rotating Disk Amine process	Methanol Wash	Mineralization
Separation principle	Absorption	Absorption	Absorption	Absorption
Specific energy demand	3 GJ/tCO <sub>2</sub>	?	1.4 GJ/tCO <sub>2</sub>	8.3 GJ/tCO <sub>2</sub>
Typical temperature	40-60°C	40-60°C	- 40°C	< 35°C
Typical pressure	Ambient	Ambient	25-70 barg	Ambient
Typical CO <sub>2</sub> removal	90%	90% (target)	Up to 100%	90%
Typical CO <sub>2</sub> purity	> 99%	95% (target)	> 98.5%	CO <sub>2</sub> mineralisation to Na <sub>2</sub> CO <sub>3</sub>
Typical plant size (TPY)	40,000 – 400,000	1,000 – 500,000	> 100,000,000	1,000 – 75,000
Technology maturity level	Commercial	Pilot Demo	Commercial	Demonstration

# Adsorption/ Physical Separation

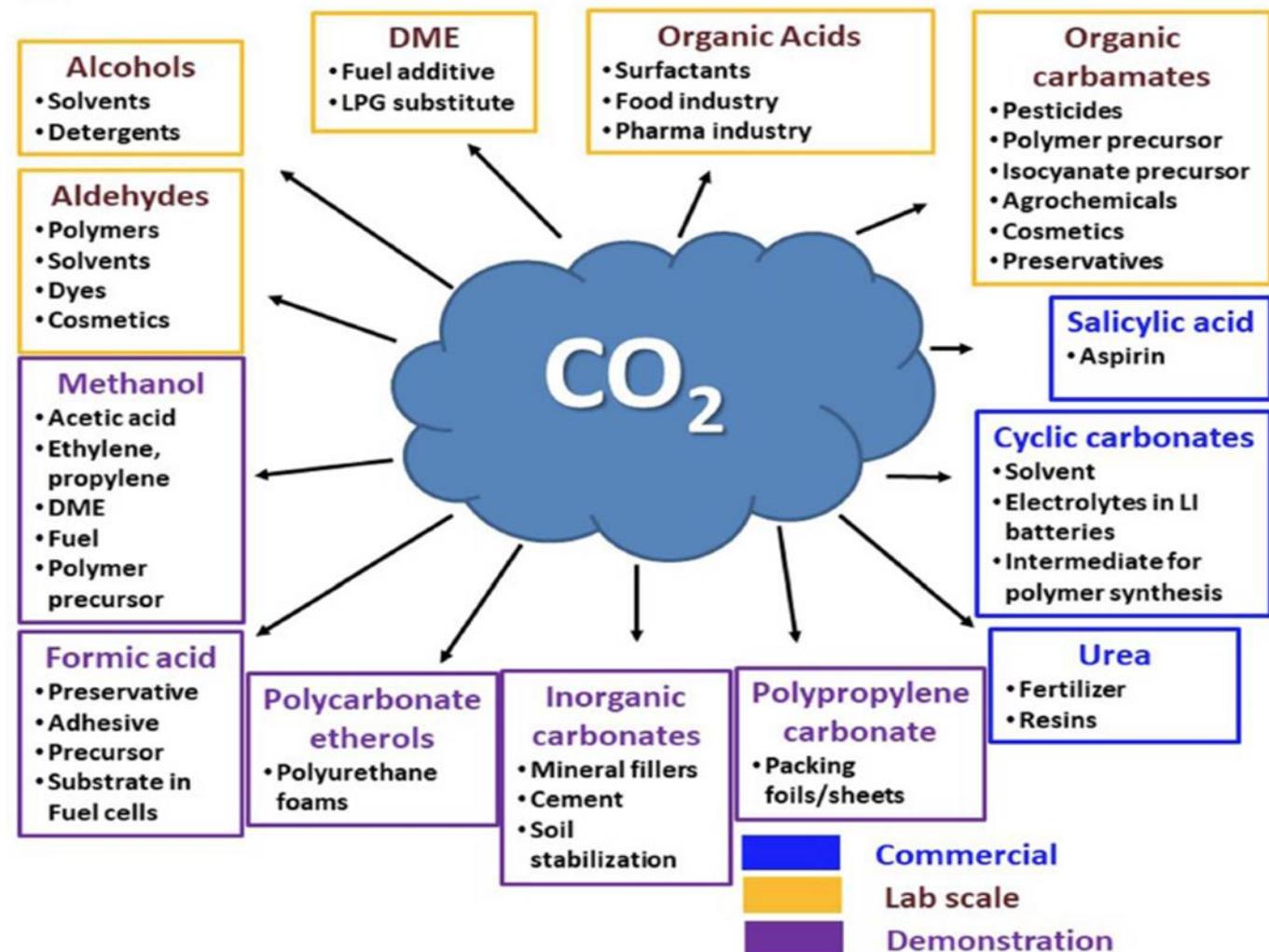
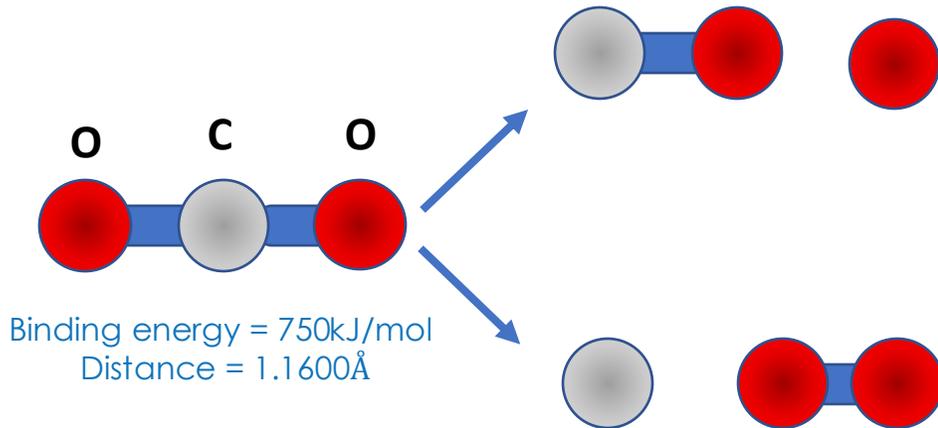


	Temperature Swing	Vacuum Swing Adsorption	Selective Membrane	Cryogenic
Separation principle	Adsorption	Adsorption	Membrane	Cryogenic
Specific energy demand	1.5 GJ/tCO <sub>2</sub>	1.7 GJ/tCO <sub>2</sub>	1.2 GJ/tCO <sub>2</sub>	n.a.
Typical temperature	40-60°C	<40°C	30- 50°C	-50°C
Typical pressure	Ambient	Cycling vacuum and high pressure	Moderate pressure	20-50 barg
Typical CO <sub>2</sub> removal	90% (target)	<90%	<80%	>99% (CO <sub>2</sub> feed >50%)
Typical CO <sub>2</sub> purity	95% (target)	<95%	> 98.5%	>99% (CO <sub>2</sub> feed >50%)
Typical plant size (TPY)	200 – 2,000,000	1,000 – 500,000	1,000 – 1,000,000	>100,000
Technology maturity level	Pilot Demonstration	Demonstration	Commercial	Commercial

# CO<sub>2</sub> Conversion Pathways

For enabling CO<sub>2</sub> Conversion technologies, R&D efforts are focused on:

- 1- CO<sub>2</sub> capture cost reduction
- 2- Developing energy-efficient and cost-effective conversion technology pathways
- 3- Direct conversion of flue gas to products
- 4- Integrating CO<sub>2</sub> conversion and hydrogen production processes



# Innovating

**H<sub>2</sub>  
Production**



**Methane  
Pyrolysis Scale  
Up**

**Carbon  
Characterization**

**Carbon  
Application  
Development**

**CO<sub>2</sub> Capture**



**Solvent Testing**

**Amine  
Process  
Intensification**

**Solid Sorbent  
Testing &  
Characterization**

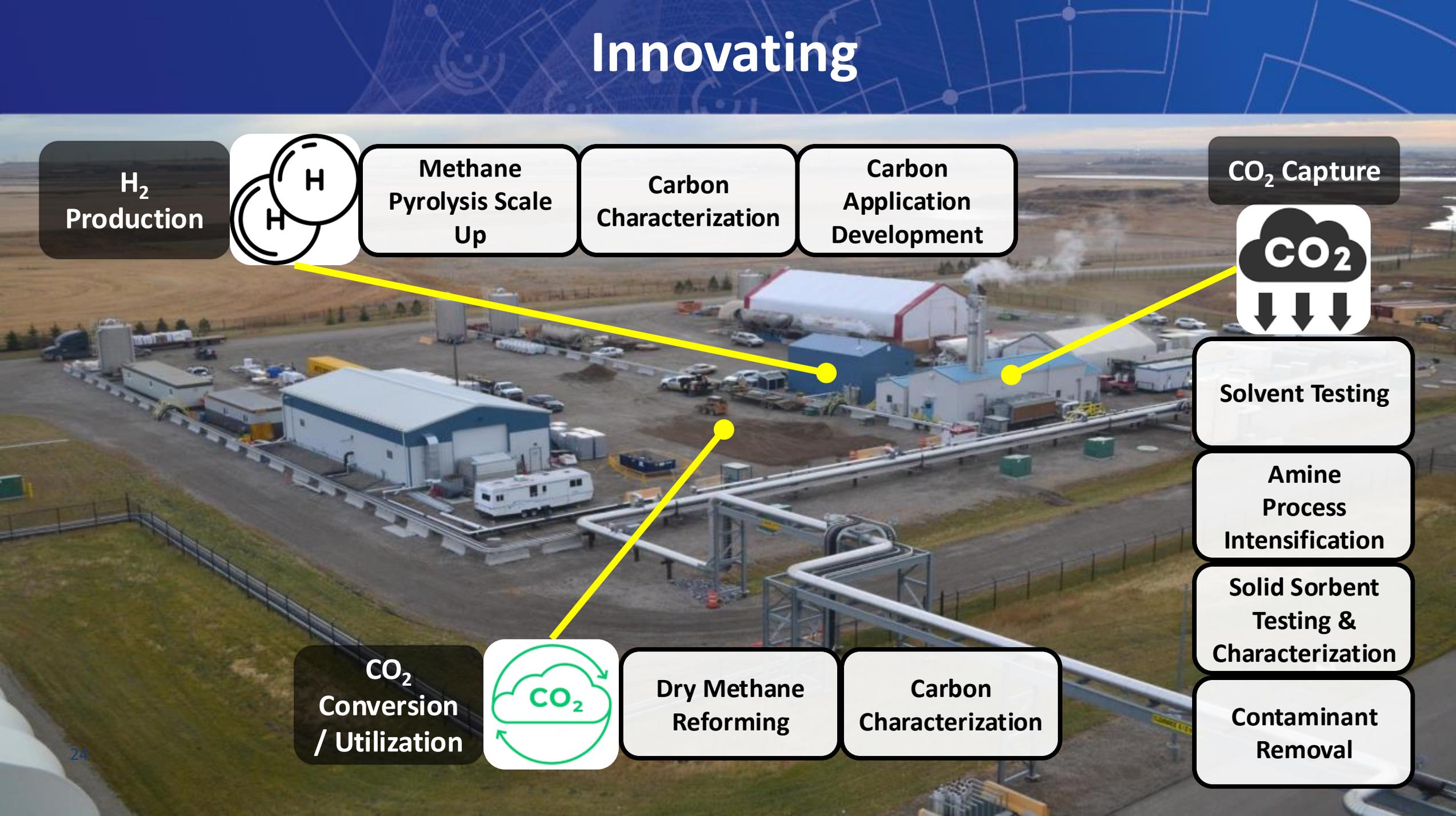
**Contaminant  
Removal**

**CO<sub>2</sub>  
Conversion  
/ Utilization**



**Dry Methane  
Reforming**

**Carbon  
Characterization**



# Decarbonizing Transportation



# CARBON STORAGE

# CO<sub>2</sub> STORAGE LEARNINGS FROM PREVIOUS STUDIES AND PROJECTS

## 1 World Class Expertise and Experience

Decades of experience in both research and hands on project experience

## 2 Vast Storage Resources

Estimated to be over 100 billion tonnes in Alberta's deep saline aquifers and oil and gas reservoirs

## 3 Storage Hubs

Use analysis tools developed in Alberta to assess potential storage hubs for CO<sub>2</sub> and develop a regional large-scale model to assess potential interactions between hubs.

## 4 Address Gaps

Large scale regional dynamic reservoir pressure model of proposed HUB interactions to assess long-term effective and practical capacity predictions

## 5 Leverage Learnings

Utilize learnings from Quest, WASP, Wayburn, EOR, PTRC, HARP, and more

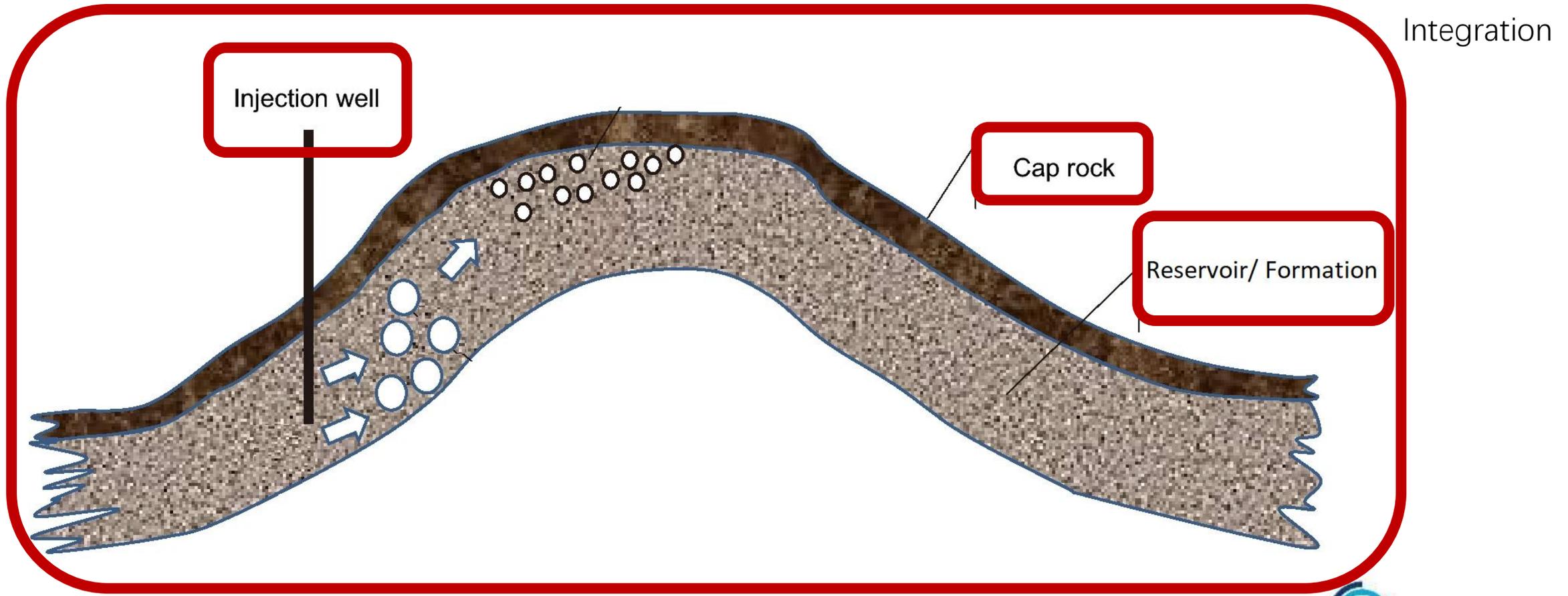
## 6 Continued Innovation

Explore feasibility of shallow aquifer storage

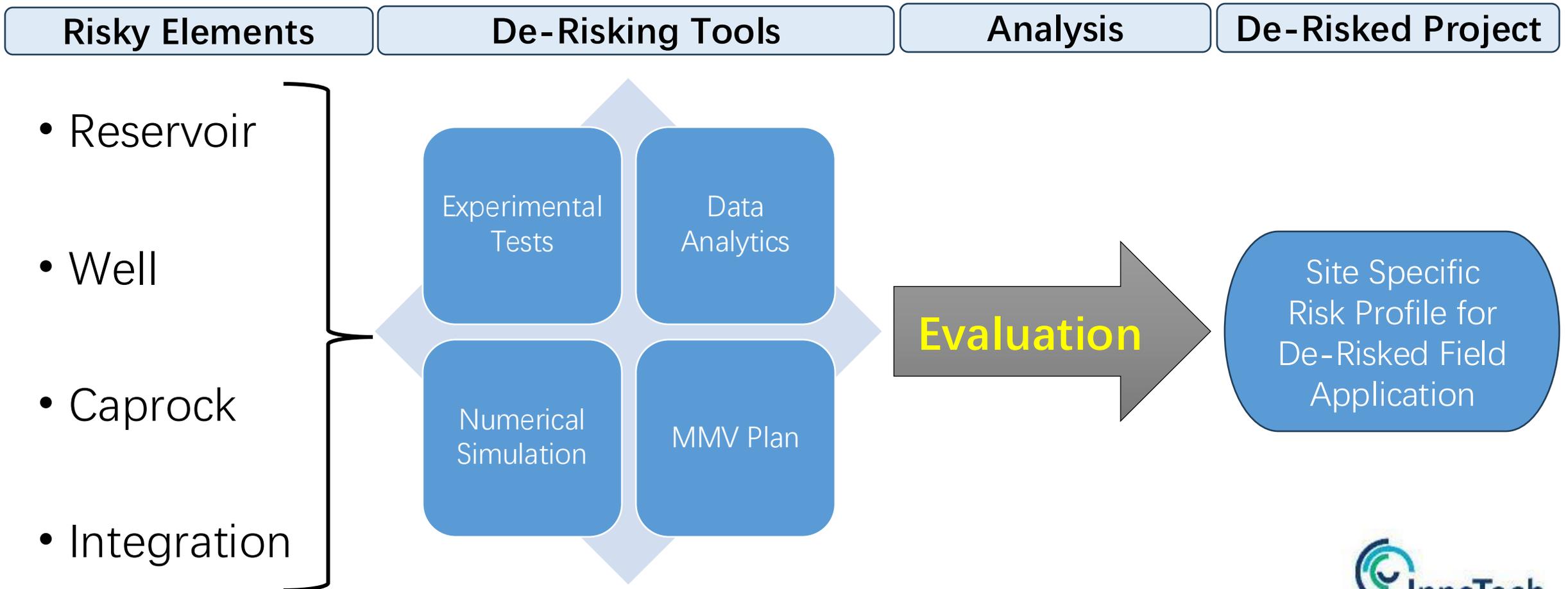


# Risky Territories in CO<sub>2</sub> Storage Projects

- Navigating the Reservoir, Well, Caprock, and Integration Challenges



# De-risking CO<sub>2</sub> Storage Projects



## INNOTECH EXPERIENCE

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- **Geological Characterization**
- **Reservoir Engineering Evaluation**
- ***Geochemical Evaluation***
- **Wellbore Integrity Assessment**
- **Development of Measuring, Monitoring and Verification (MMV) strategy**
- **Assessment of Legal and Regulatory Framework**



# Thank you

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