



Geoscience BC

OPEN HOUSE & UPDATE ON NORTHEAST BC GEOLOGICAL CARBON CAPTURE AND STORAGE ATLAS

Presented by:

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CICE

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& CLEAN ENERGY



Ministry of
Energy, Mines and
Low Carbon Innovation

Northern Opportunities. Global Solutions.

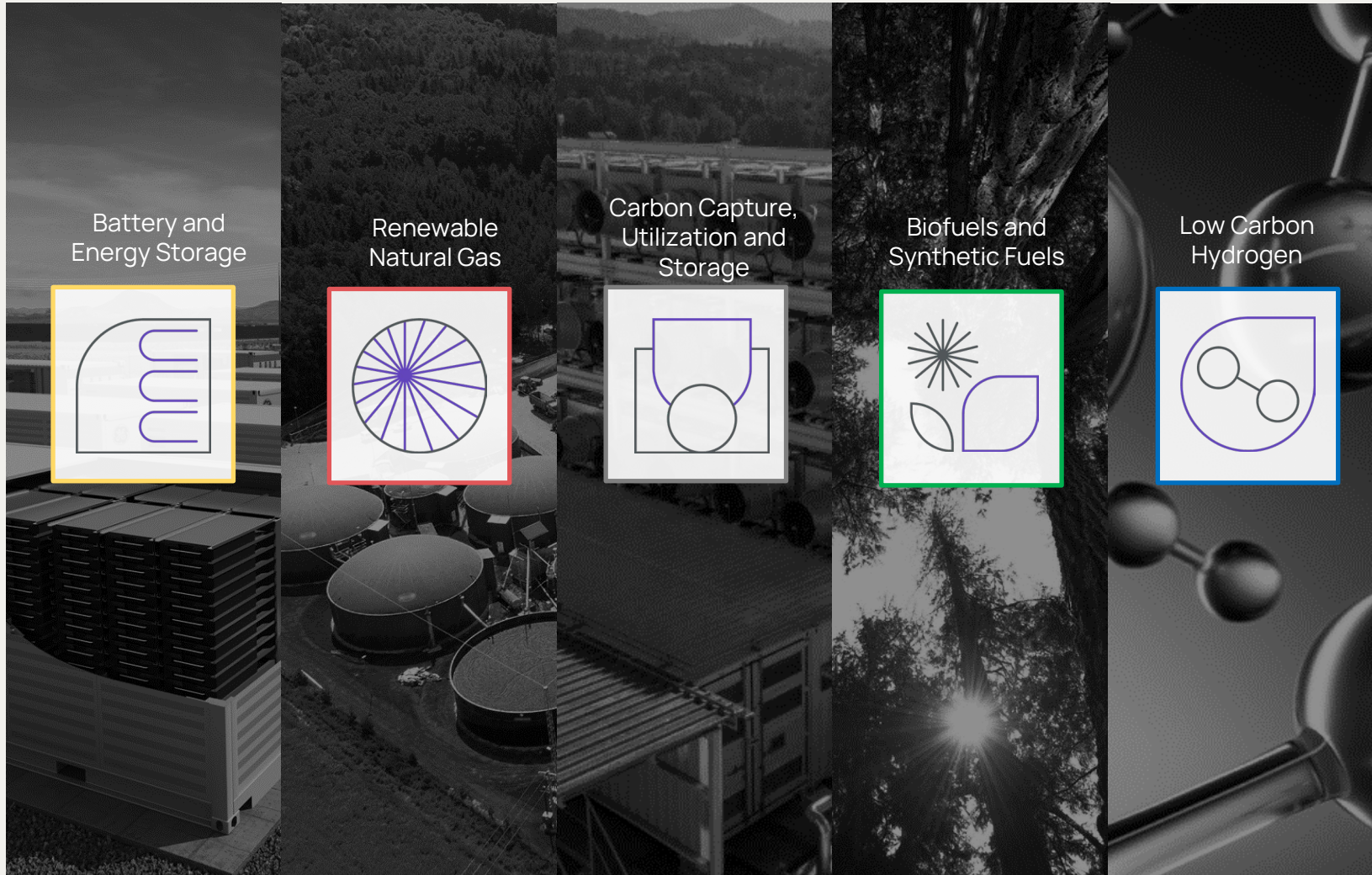
Yemi Adefulu
Deputy Executive Director
The B.C. Centre for Innovation and Clean Energy

Supporting Innovation.

From BC.
To the World.



CICE's 5 Focus Areas to Drive Decarbonization



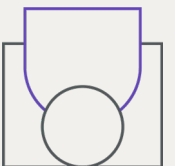
CICE's 5 Focus Areas intersect with Fort St. John



**BATTERY
TECHNOLOGY &
ENERGY STORAGE**



**RENEWABLE
NATURAL GAS**



**CARBON CAPTURE,
UTILIZATION AND
STORAGE**



**BIOFUELS &
SYNTHETIC FUELS**



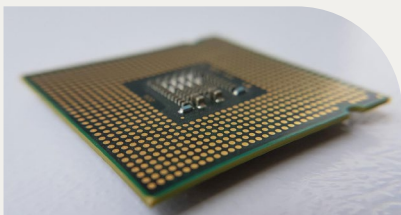
**LOW CARBON
HYDROGEN**



Transportation



Energy



**Tech and
Innovation**



Mining and Mineral Exploration



Agriculture



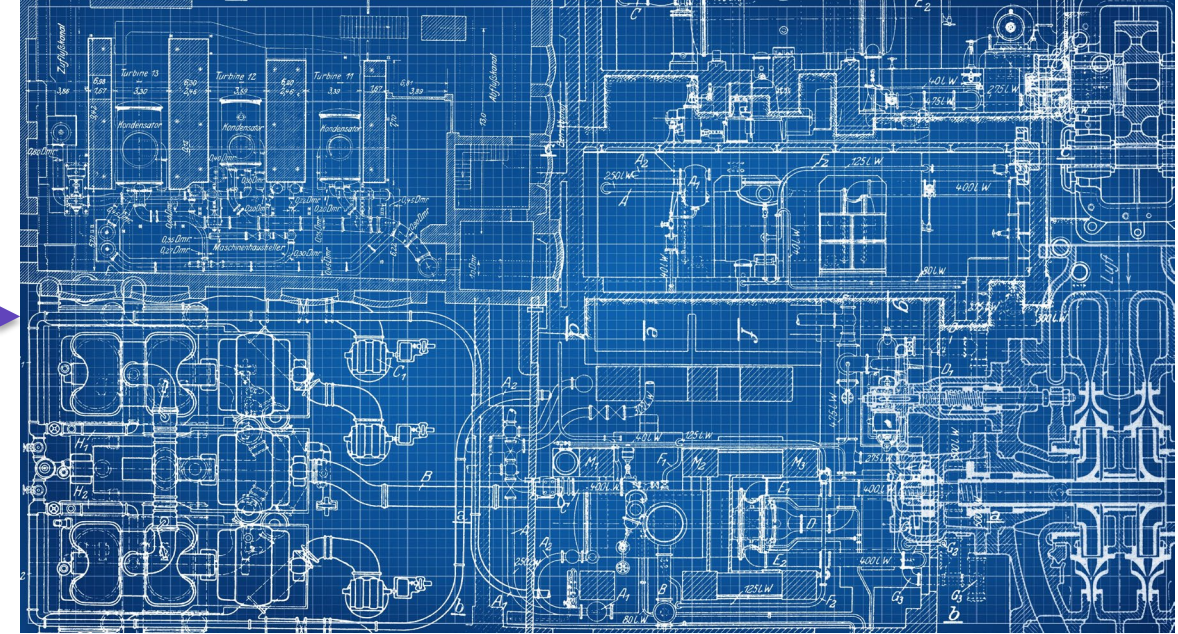
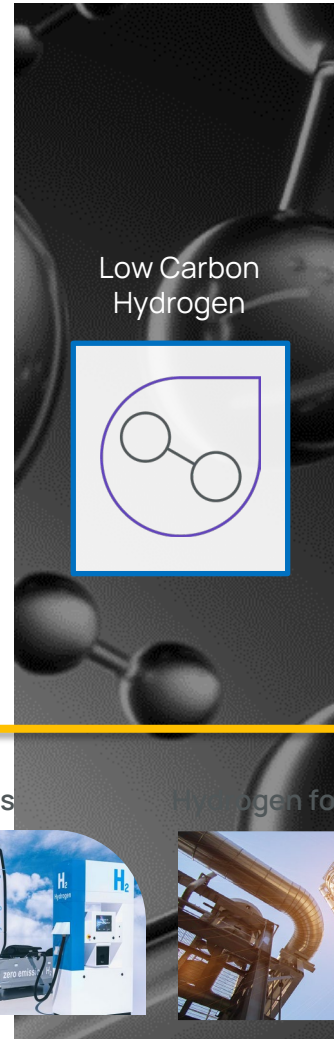
Pulp and Paper



Forestry

CICE Focus Area: Hydrogen

- **Low-carbon Hydrogen** is key to hard-to-abate sectors like heavy-duty trucking
- **CICE** is launching the **Hydrogen Investment Blueprint** to stimulate investment into the Hydrogen value chain
- **Created the Hydrogen Consortium**



Coordinating **action** between stakeholders across the Hydrogen Economy

Hydrogen OEMs



Hydrogen for Industries



Hydrogen for Utilities



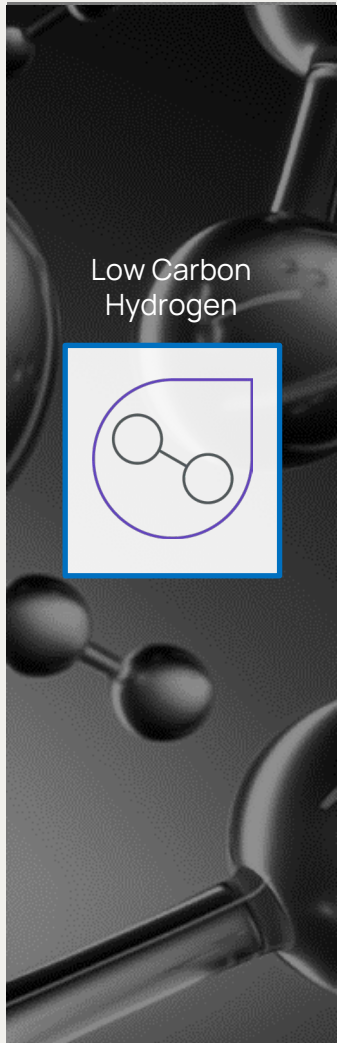
Hydrogen for Transportation



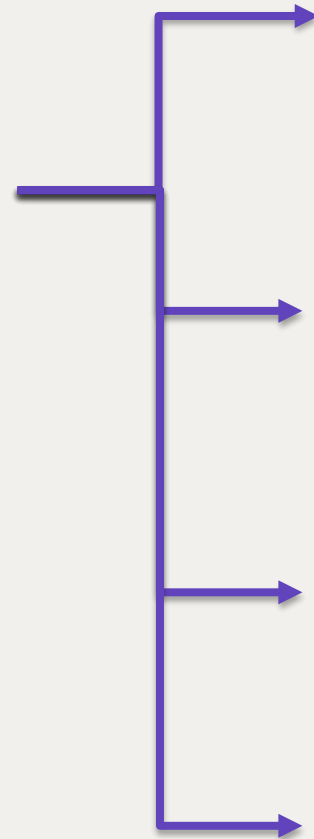
Funders



CICE Focus Area: Carbon Management



- Development of the **Carbon Management Investment Blueprint**



- **Global Scan:** What is the global context of Carbon Management?
- **Carbon Management Framework:** In-depth research on potential solutions for BC
- **Multi-year actionable roadmap:** Recommendations to scale the Carbon Management Industry
- Underpinned by a **Carbon Capture and Storage Atlas** with a focus first on Northeastern BC

Carbon Management

How do we get there together?

1 Validate storage potential in **Northeastern BC**



2 Establish a **Blue Hydrogen Hub** in Northern B.C.

3 Advocate for policy that supports the development of a **Carbon Hub**

4 Identify **projects** and **strategic partnerships** to get started





Want to get involved in Carbon Management?

Let's Talk.

ABOUT GEOSCIENCE BC

Not-for-profit society established in 2005: independent, public earth science research and data about minerals, energy and water resources that:

- Improves our collective level of geoscience knowledge
- Informs responsible natural resource development and investment decisions
- Catalyzes socio-economic opportunities
- Stimulates innovation and geoscience technologies



ABOUT GEOSCIENCE BC

- Identifying critical minerals and metals deposits
- Measuring and reducing emissions, catalyzing low- and zero-emission energy
- Understanding and protecting water resources
- Building capacity, understanding and partnerships
- Indigenous involvement and advancing reconciliation



Critical Minerals & Metals



Carbon Capture & Storage (CCS)



Cleaner Energy



Monitoring & Geohazards

COLLABORATION

Bringing together resource sectors, governments and regulators; community and business leaders; Indigenous groups; and academia.

Diverse range of collaboration agreements, partners and members:

- **BC Geological Survey**
- **Geological Survey of Canada - NRCan**
- **Mining Association of Canada; Prospectors & Developers Association of Canada**
- **Canadian Hydrogen & Fuel Cell Association**
- **Tahltan Nation; Fort Nelson First Nation**



GEOSCIENCE BC MEMBERSHIP

- New membership classes launched Jan 31, 2022 – now more than 100 members!
- Support, provide input, network and stay up to date on Geoscience BC's public minerals, energy and water research.
- Membership opportunities to suit industry, academia, communities, Indigenous groups and governments working towards shared goals.



12 CORPORATE



61 INDIVIDUAL



4 STUDENT



33 ASSOCIATE



JOIN TODAY

NEBC GEOLOGICAL CCS ATLAS PROJECT & BENEFITS

- Desktop study to identify, assess, and rank geological CO₂ sequestration sites in Northeast BC – includes depleted oil & gas pools and deep saline aquifers
- Assessing carbon capture and storage (CCS) potential in British Columbia's Northeast Region that will help guide the rapidly growing low-carbon energy, hydrogen and CCS sectors
- Project funded by BC Centre for Innovation and Clean Energy, and supported by BC Hydrogen Office



"For British Columbia to meet its CleanBC goals, we must shift how we produce and consume energy. Renewable and low-carbon hydrogen will play a critical role in our sustainable energy future. With our clean hydroelectricity, abundant natural resources and innovative companies, B.C. can be a world leader in the growing hydrogen economy – creating new cleantech jobs and opportunities for people across the province. The B.C. Hydrogen Strategy lays out the actions we will take together to realize this vision on the path to net-zero emissions by 2050."

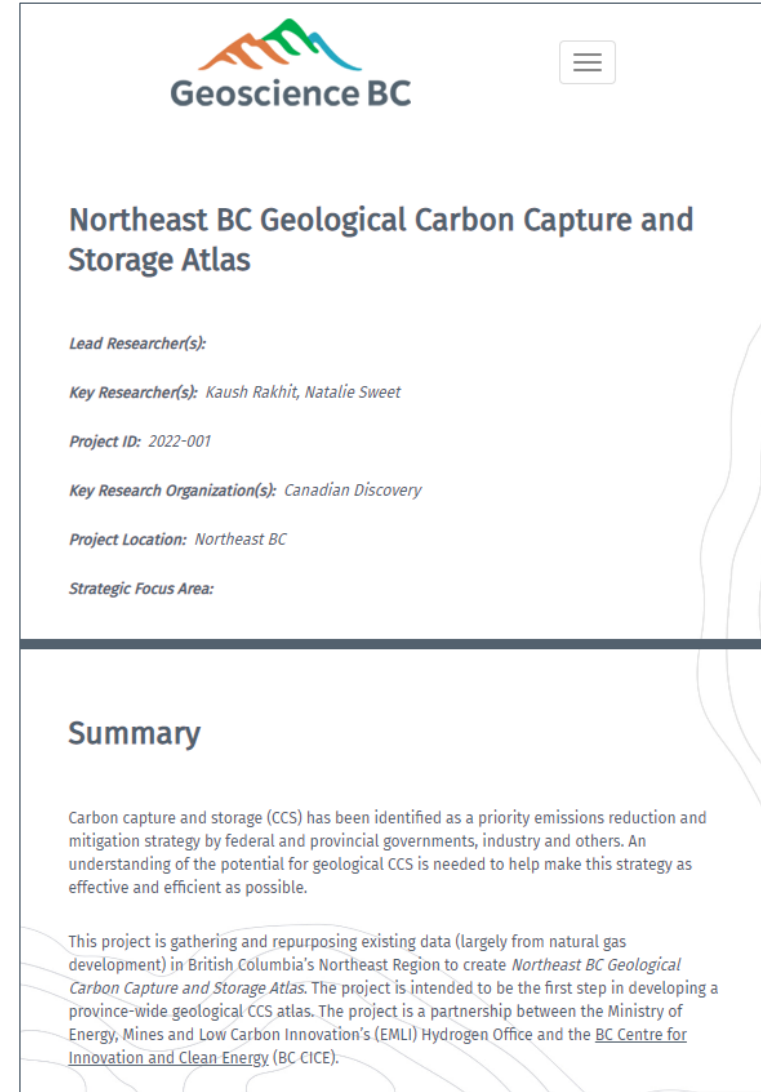


Honourable Bruce Ralston
Minister of Energy, Mines
and Low Carbon Innovation

H₂

PROJECT UPDATE

- **Early 2022:** Scoping discussion and planning with partners; creation of Project Advisory and Steering committees
- **June 1:** Joint announcement about project
- **June - July:** RFP review, contractor selection and technical assessment initiated; engagement program started
- **August 30:** Fort St John project open house - thank you for joining us!



The screenshot shows the homepage of the 'Northeast BC Geological Carbon Capture and Storage Atlas'. At the top is the Geoscience BC logo and a hamburger menu icon. The title 'Northeast BC Geological Carbon Capture and Storage Atlas' is prominently displayed. Below the title, several key details are listed: Lead Researcher(s), Key Researcher(s) (Kaush Rakhit, Natalie Sweet), Project ID (2022-001), Key Research Organization(s) (Canadian Discovery), Project Location (Northeast BC), and Strategic Focus Area. A horizontal line separates this header from the 'Summary' section. The summary text explains that Carbon capture and storage (CCS) has been identified as a priority emissions reduction and mitigation strategy by federal and provincial governments, industry and others. An understanding of the potential for geological CCS is needed to help make this strategy as effective and efficient as possible. The bottom paragraph states that this project is gathering and repurposing existing data (largely from natural gas development) in British Columbia's Northeast Region to create the 'Northeast BC Geological Carbon Capture and Storage Atlas'. The project is intended to be the first step in developing a province-wide geological CCS atlas. The project is a partnership between the Ministry of Energy, Mines and Low Carbon Innovation's (EMLI) Hydrogen Office and the BC Centre for Innovation and Clean Energy (BC CICE).

Geoscience BC

Northeast BC Geological Carbon Capture and Storage Atlas

Lead Researcher(s):

Key Researcher(s): Kaush Rakhit, Natalie Sweet

Project ID: 2022-001

Key Research Organization(s): Canadian Discovery

Project Location: Northeast BC

Strategic Focus Area:

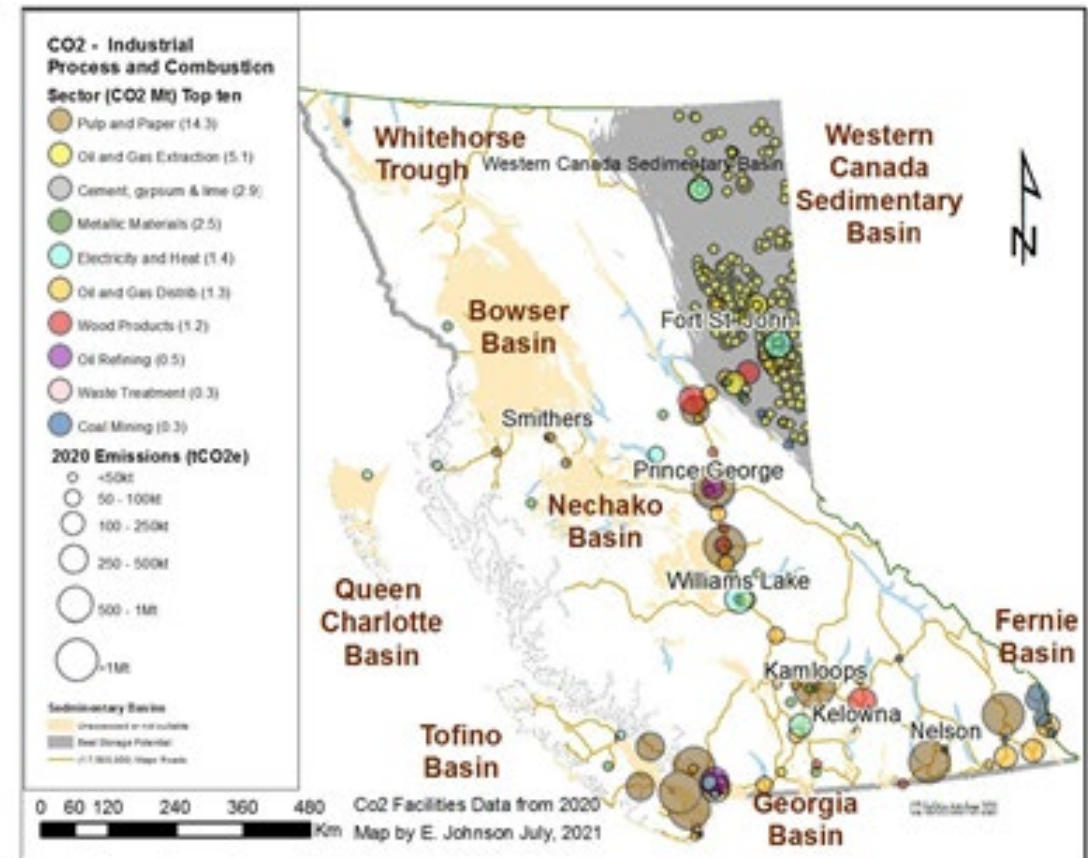
Summary

Carbon capture and storage (CCS) has been identified as a priority emissions reduction and mitigation strategy by federal and provincial governments, industry and others. An understanding of the potential for geological CCS is needed to help make this strategy as effective and efficient as possible.

This project is gathering and repurposing existing data (largely from natural gas development) in British Columbia's Northeast Region to create *Northeast BC Geological Carbon Capture and Storage Atlas*. The project is intended to be the first step in developing a province-wide geological CCS atlas. The project is a partnership between the Ministry of Energy, Mines and Low Carbon Innovation's (EMLI) Hydrogen Office and the [BC Centre for Innovation and Clean Energy \(BC CICE\)](#).

PROJECT NEXT STEPS

- **November 2022:** Independent peer review of project findings and report
- **December 2022:** Project report, maps and supporting data to be made public
- **December 2022 – January 2023:**
 - Remaining engagement
 - Open house
 - Technical talks



GEOSCIENCE BC – OTHER CCS PROJECTS

Carbon Mineralization Project (P2018-038)

- The current Carbon Mineralization Potential Project for British Columbia (CaMP-BC), led by Dr. Gregory Dipple at UBC, assessed the abundance, location, shape, and areal extent of serpentinized ultramafic rocks in B.C. using existing geological, geochemical, and geophysical data

North Central BC Nechako Basin Geological CCS Atlas (P2022-008)

PROJECT CONCEPT

- Compilation of existing data and identification of data gaps
- Preliminary assessment of CO₂ sequestration capacity and locations
- Assess areas proximal to larger CO₂ emission sites

Southwest BC Geological CCS Atlas (P2022-009)

PROJECT CONCEPT

- Assess CO₂ sequestration viability in deep saline aquifers
- Update and interpretation of existing data
- Proximal to large CO₂ emission sites





THANK YOU



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Ministry of
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Northeast BC Geological Carbon Capture and Storage Atlas

Presented by Natalie Sweet, Project Manager and Allison Gibbs, Senior Hydrodynamicist

Canadian  Discovery Ltd.

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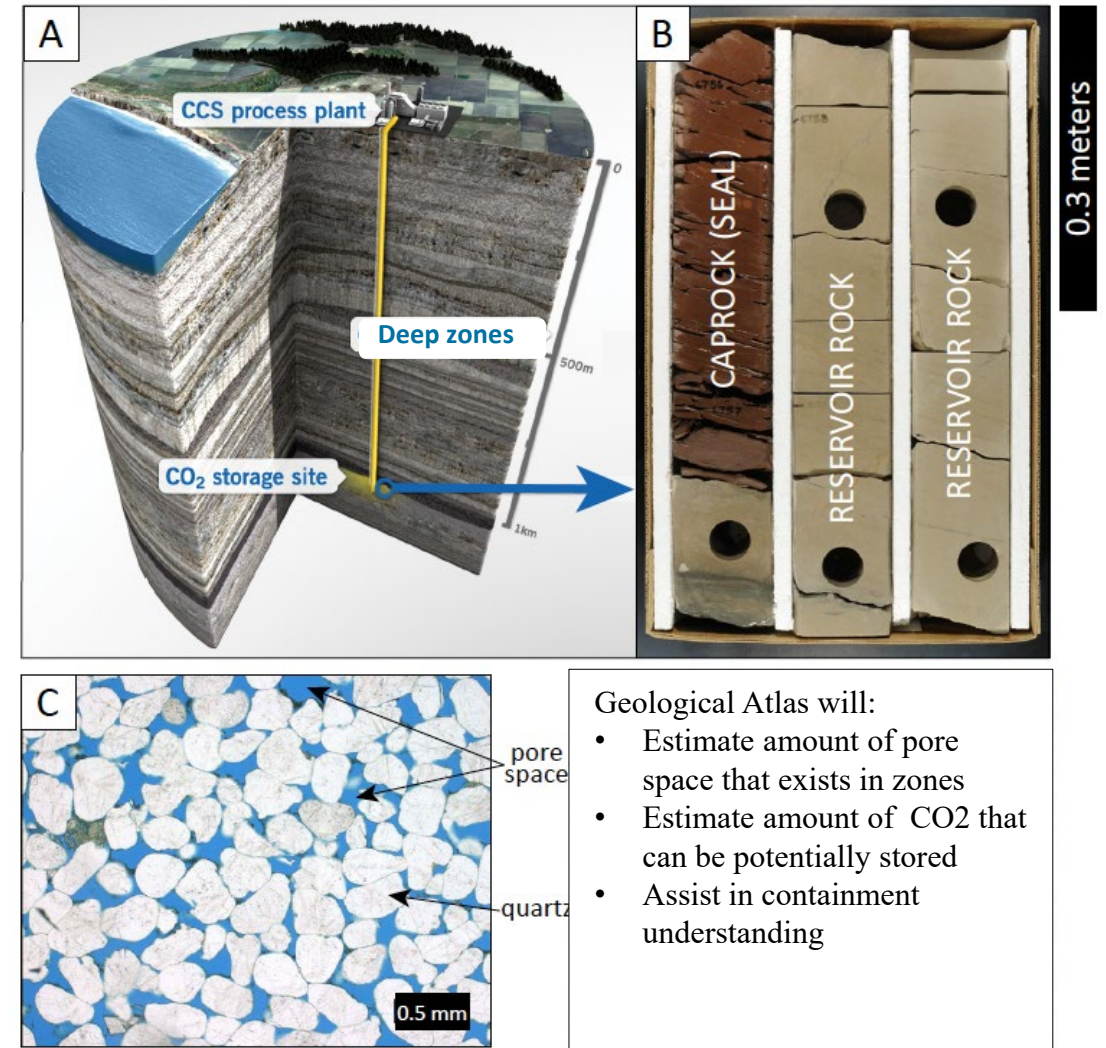
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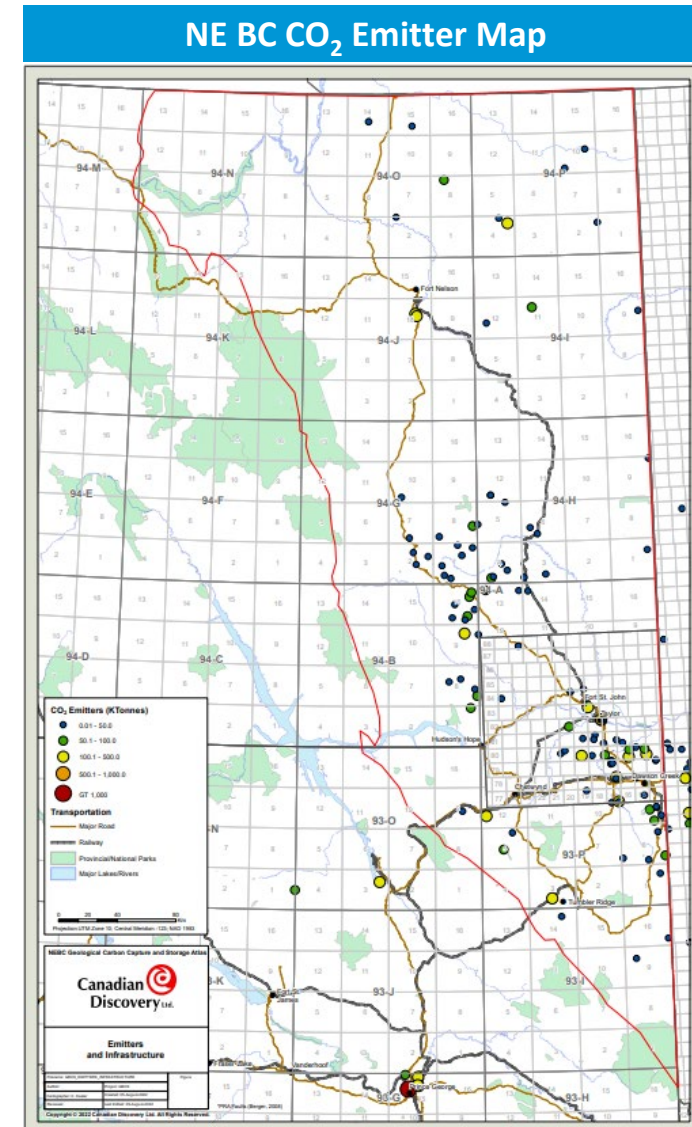
Outline

- Geoscience BC NEBC Atlas
 - » Why is this project needed?
 - » BC CO₂ Emissions
- Carbon Global Cycle
 - » Why does excess CO₂ need to be stored?
- What is Geological CCS?
 - » Focus of Atlas is on the 'S' for Storage
 - » Potential global impact of CCS
- Storage FAQ's
 - » Types of storage
 - » Science of CO₂
 - » Ensuring Containment
 - » Has CO₂ storage been done before in BC?
- Outputs and Benefits of the Atlas

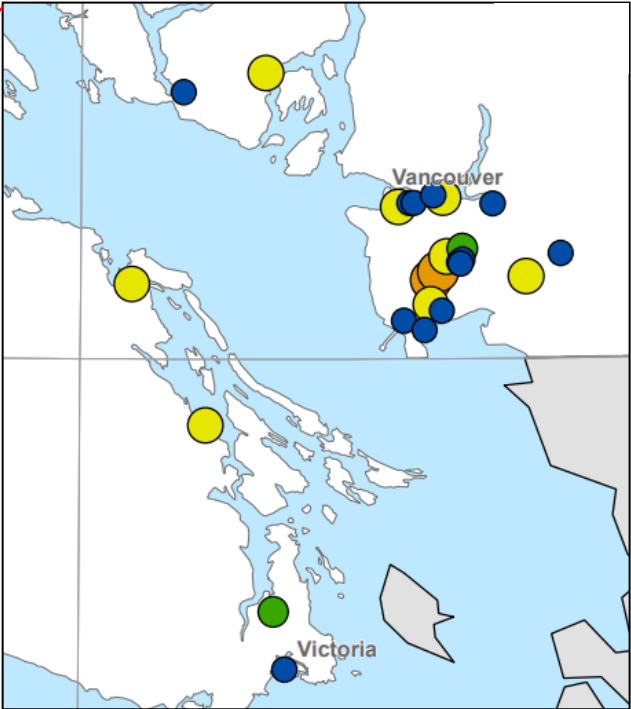
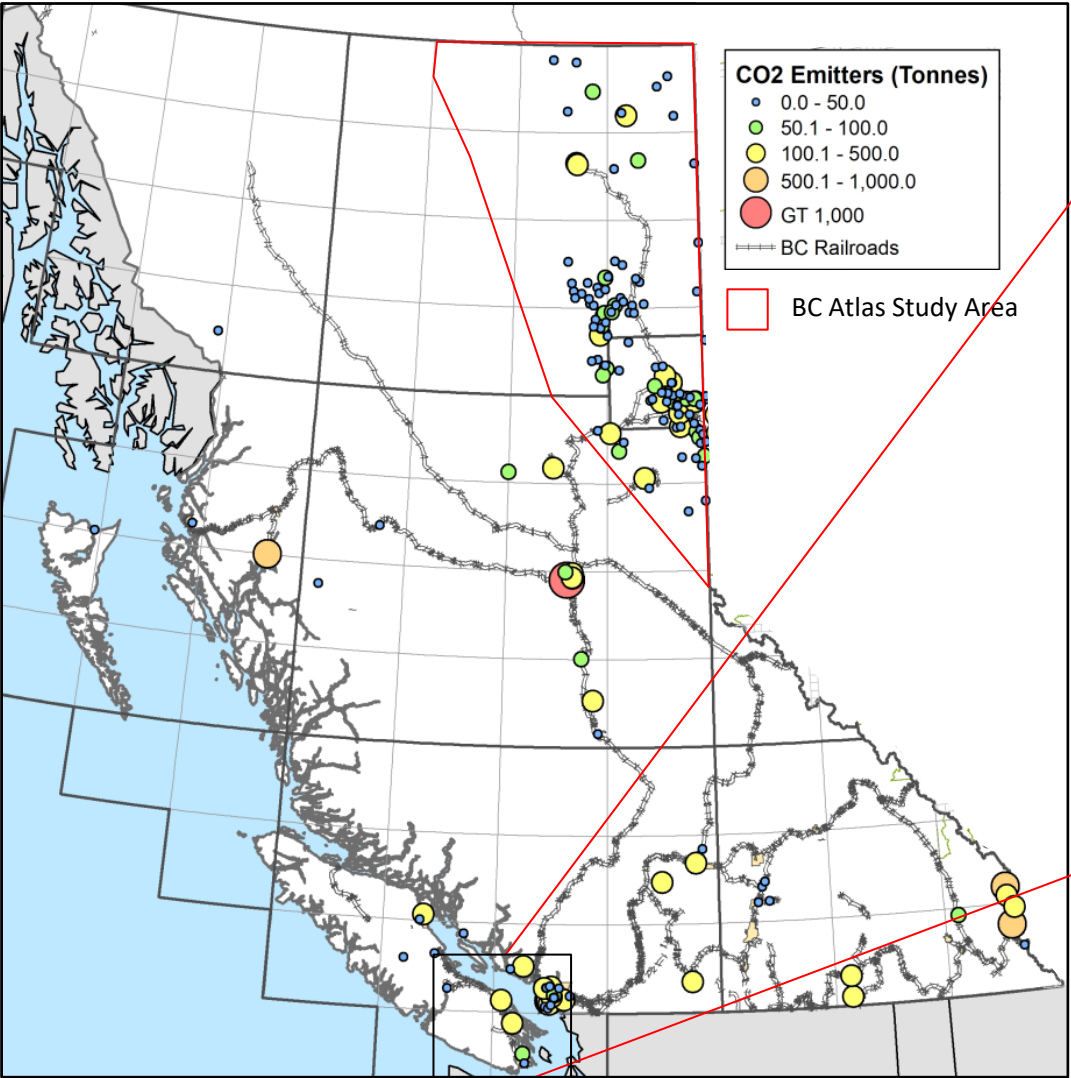


Why NEBC Geological Carbon Storage Atlas?

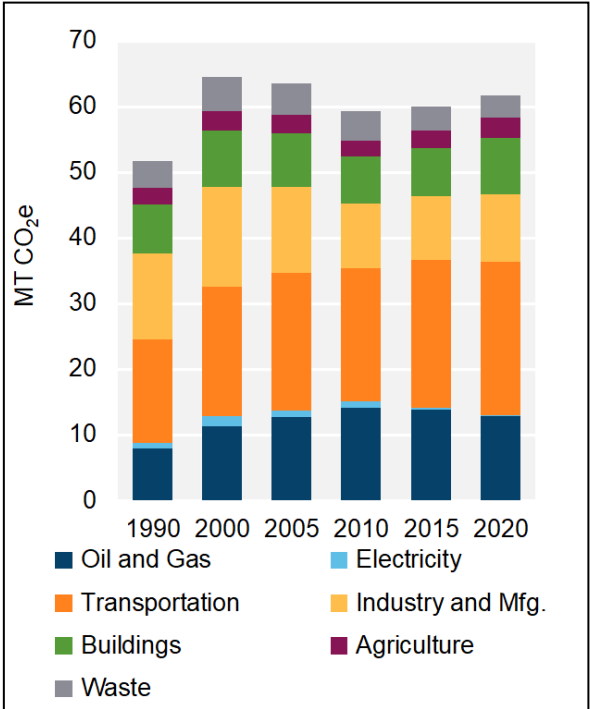
- Identify and assess underground permanent storage potential of carbon dioxide (CO₂)
- Identify most favourable storage sites
- Provide key information to enable improved decision making by policy and regulatory makers, industry, First Nations, Communities and others:
 - » CCS – Carbon Hub model to capture and store large volumes of CO₂ from multiple emitters
 - » Industry Use – solutions for modest scale emitters; local decisions
 - » Green Economy - assist in ‘low carbon intensity Hydrogen’ opportunity assessment and decisions



Annual BC Emissions



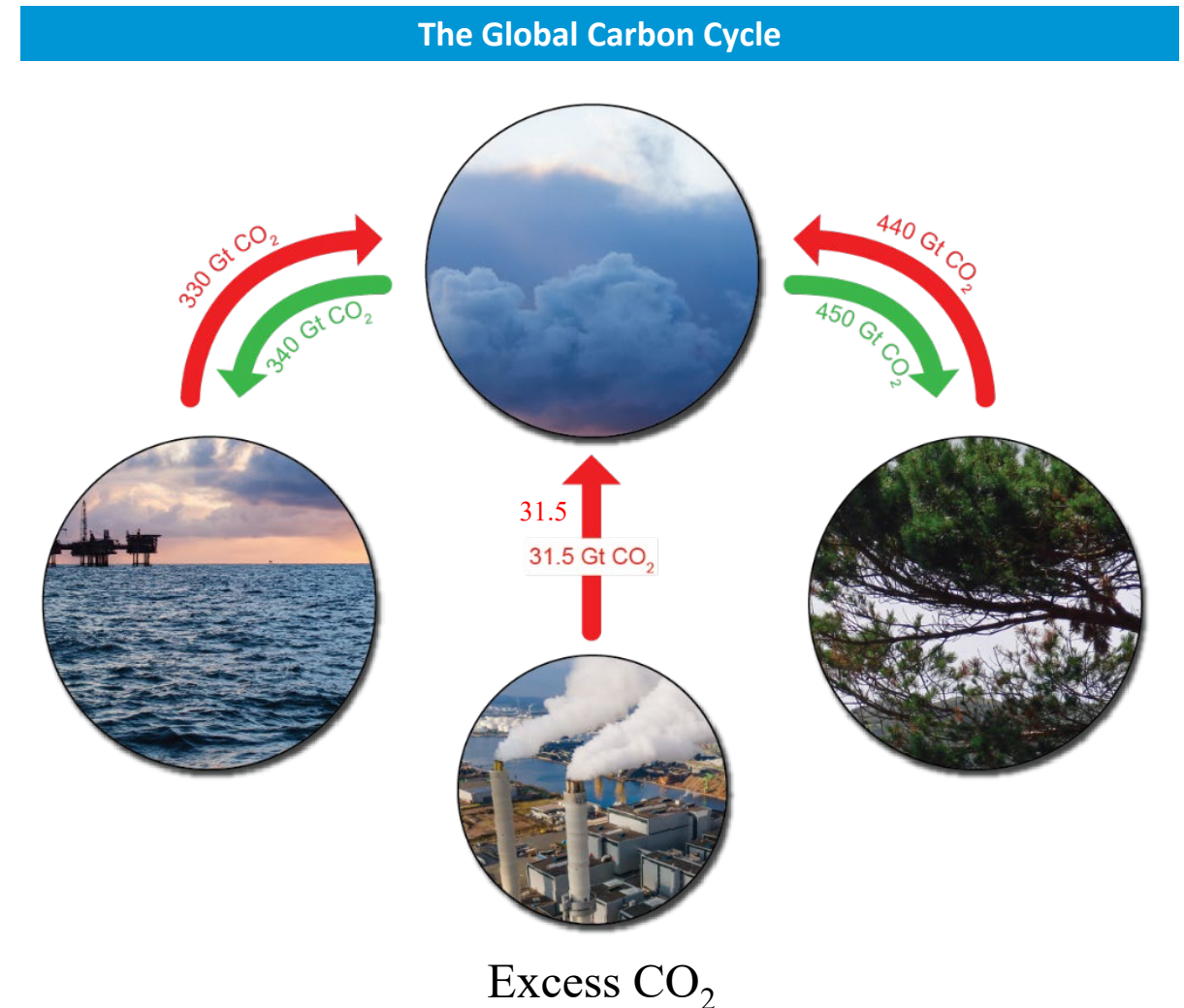
Vancouver Area



Annual Emissions Breakdown

The Global Carbon Cycle and Anthropogenic (Human Influenced) Excess CO₂

- CO₂ is a necessary and naturally occurring gas
- Carbon Cycle is a complex system
- Oceans and forests naturally release and capture CO₂ and act to balance CO₂
- BUT:
 - » Too much CO₂ disrupts the natural carbon cycle and acts as a heat trap
 - » Carbon Capture and Storage will permanently remove excess CO₂ from the atmosphere
- 2021 Data
 - » 31.5 Gigatonnes (Gt) of excess CO₂



Modified from NASA 2018

How much is a Gigatonne?

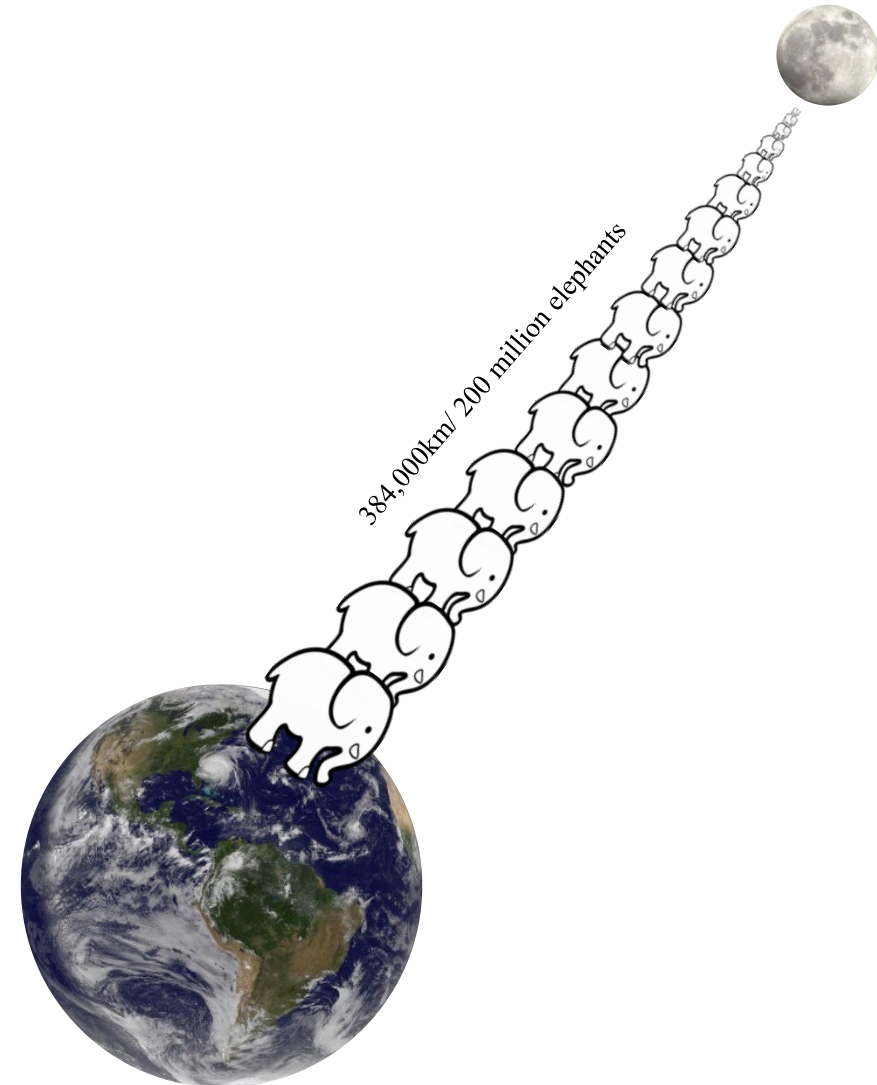
Zeros matter:

- Kt = Kilo tonne = 1,000 tonnes
- Mt = Mega tonne = 1,000,000 tonnes
- Gt = Giga tonne = 1,000,000,000 tonnes

So, how big is a gigatonne?

- One gigatonne is roughly 200 million elephants; this is enough elephants to stretch from the Earth to the moon (which would admittedly be bad for the elephant at the bottom).
- A gigatonne is also equivalent to the mass of each of the following:
 - » 5.5 million blue whales
 - » 3 million Boeing 747 jets

One Gigatonne in Elephants

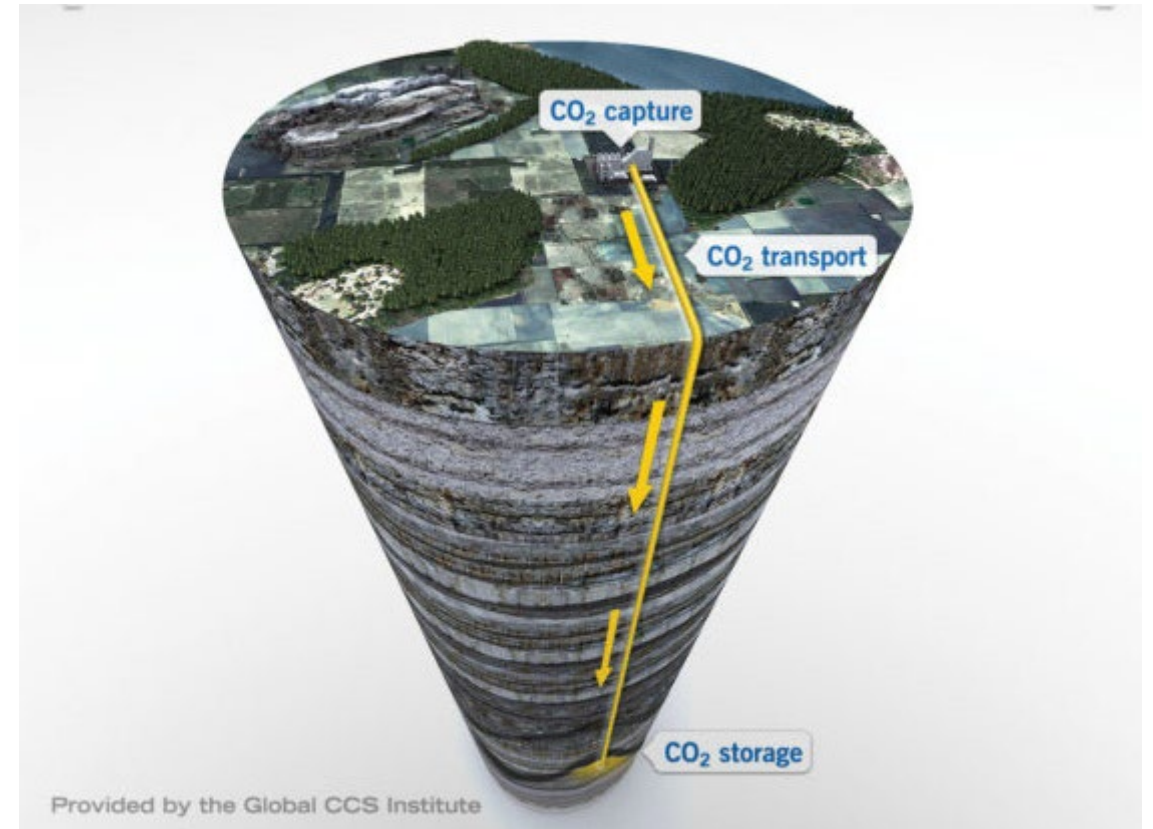


What is Geological CCS?

CCS – Carbon Capture and Storage

- Carbon Capture – separation of CO₂ from other gases at industrial facilities such as coal and natural gas-fired power plants, steel mills and cement plants
- Transport – compressed CO₂ transported via pipelines, trucks and rail to a suitable geological storage site
- Storage – CO₂ is injected deep into the subsurface

Carbon Capture and Storage



CCS in Canada and around the World

- Estimated subsurface storage potential globally is 8,000 – 55, 000 Gt
- However, viable, accessible and effective storage is much less.
- Storage sites need to have:
 - » Sufficient cap rock (seal) to keep the CO₂ contained
 - » Sufficient geological pore space characteristics
 - » Areas of low seismic/faulting risk
 - » Close to emitters (economic)
 - » No conflicting land use constraints

CCS to date:

- Shell Quest CCS in Alberta stored 6,000,000 tonnes (6 Mt) in less than 5 years and is currently storing >1Mt/year
- Globally 40 Mt were captured and stored in 2020



CO₂ Geological Storage in Canada and around the World

- CCS is safe and well tested. CCS worldwide working safely and effectively for over 45 years
- No evidence to indicate that CCS causes earthquakes
- Good assessment of CO₂ storage sites is important
- Canada has 2 major and successful CCS projects – Quest (Alberta) and Aquistore (Saskatchewan)
- BC has already stored over 2.6Mt of CO₂ through acid gas disposal projects



Carbon Storage: Frequently Asked Questions

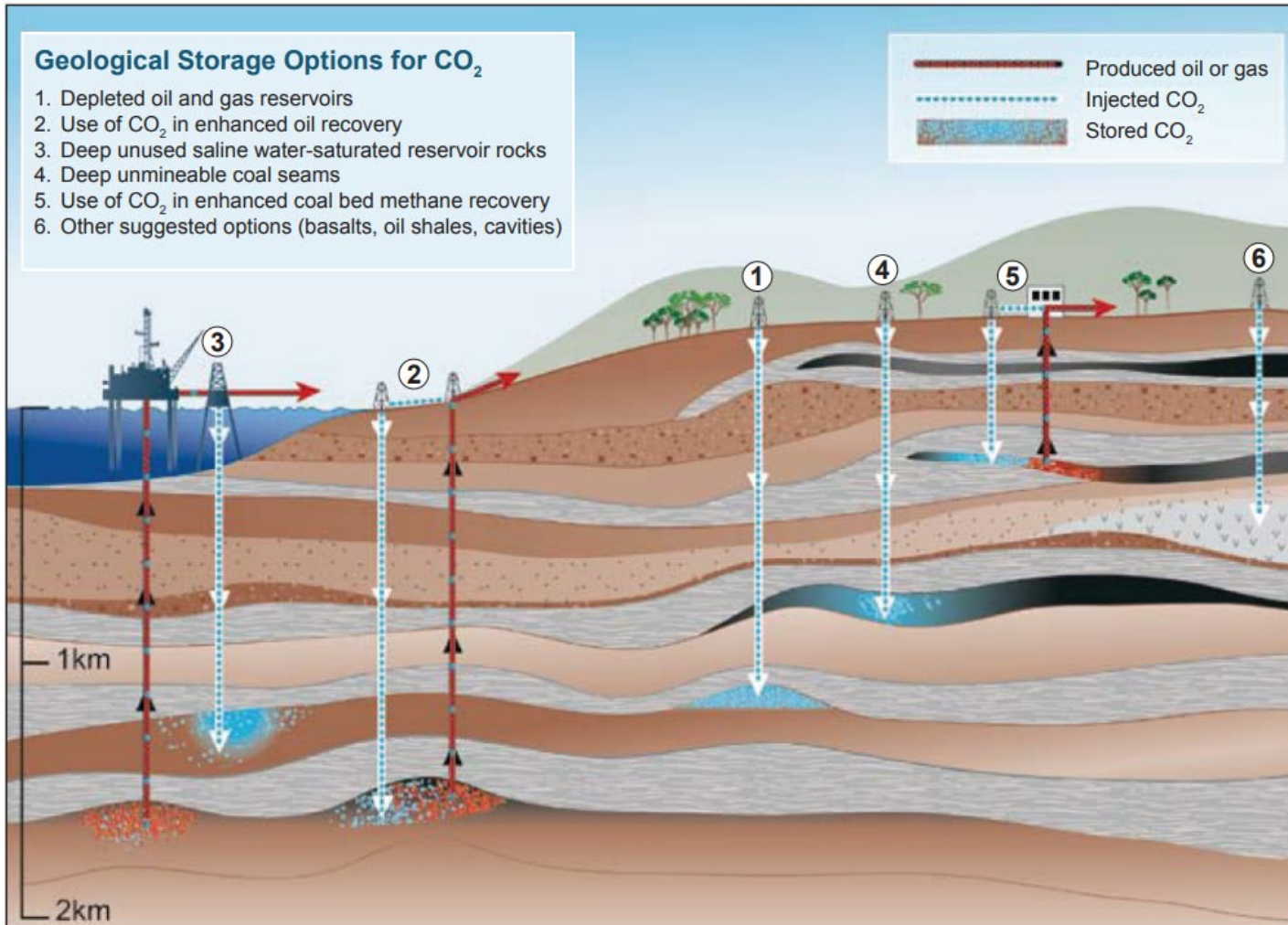
- What Types of Geologic Storage Options Exist?
- What Makes a Reservoir Good for Carbon Storage?
- How is Containment Ensured?
- Has CCS been done before in British Columbia?

And finally...

- How will the NEBC Carbon Storage Atlas Help?



What Types of Geological Storage Options Exist?



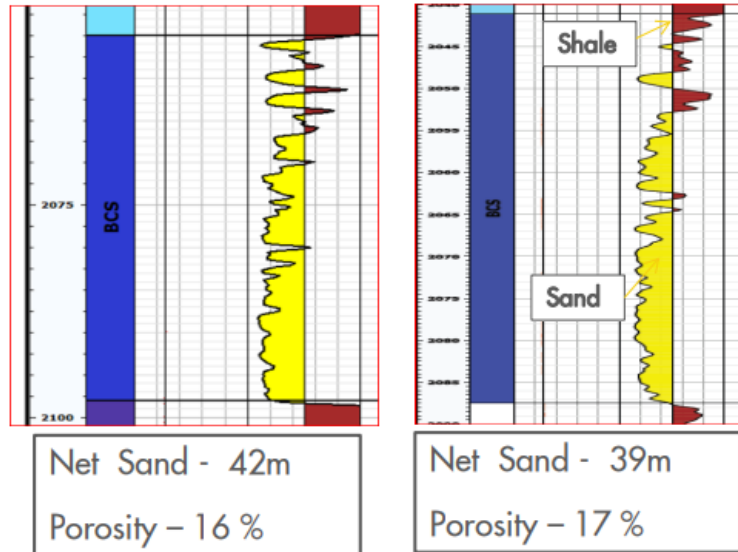
The NEBC Geological Carbon Storage Atlas will address two types of storage:

- CO₂ storage in depleted oil and gas reservoirs (Type 1) is inherently suited to store CO₂ for geological timescales
- CO₂ permanent storage in saline aquifers has the highest capacity potential for long term storage (Type 3)

Modified by CDL from IPCC (2018)

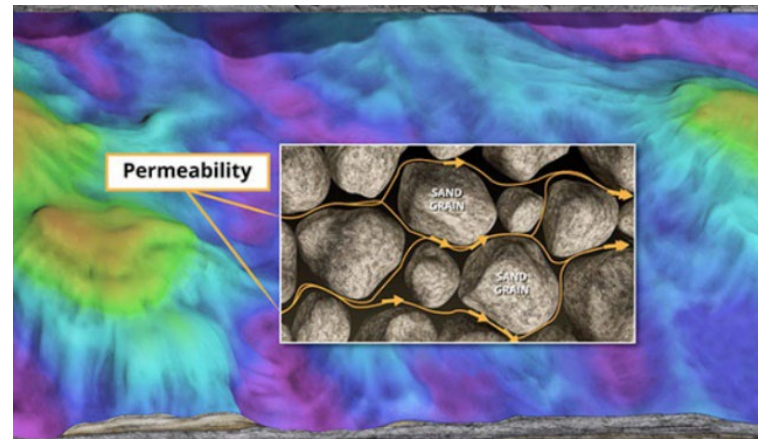
What Makes a Reservoir Good for Carbon Storage?

Porosity/Storage

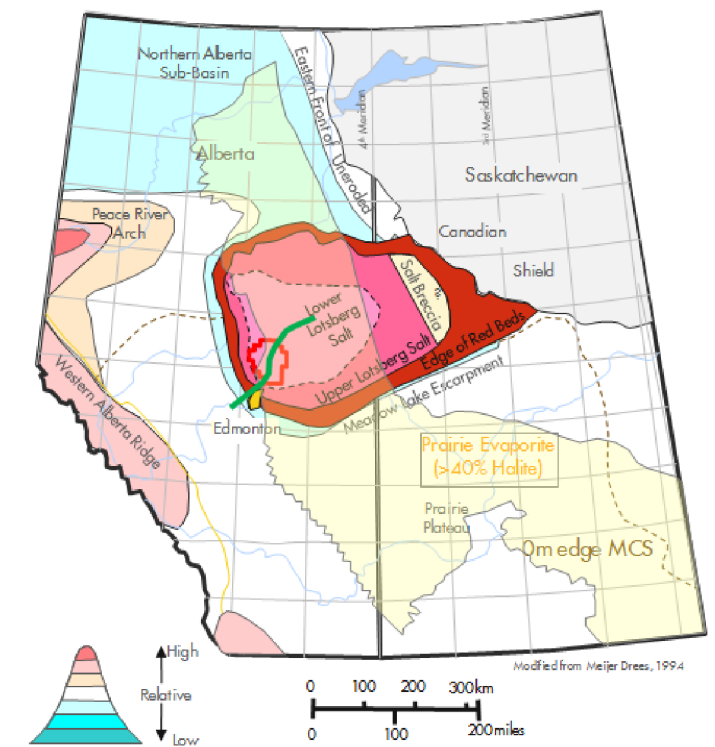


Nb: based on Vsh cut off = 0.35 and Porosity Cut Off = 0.1

Permeability/Injectivity



Seals/Containment

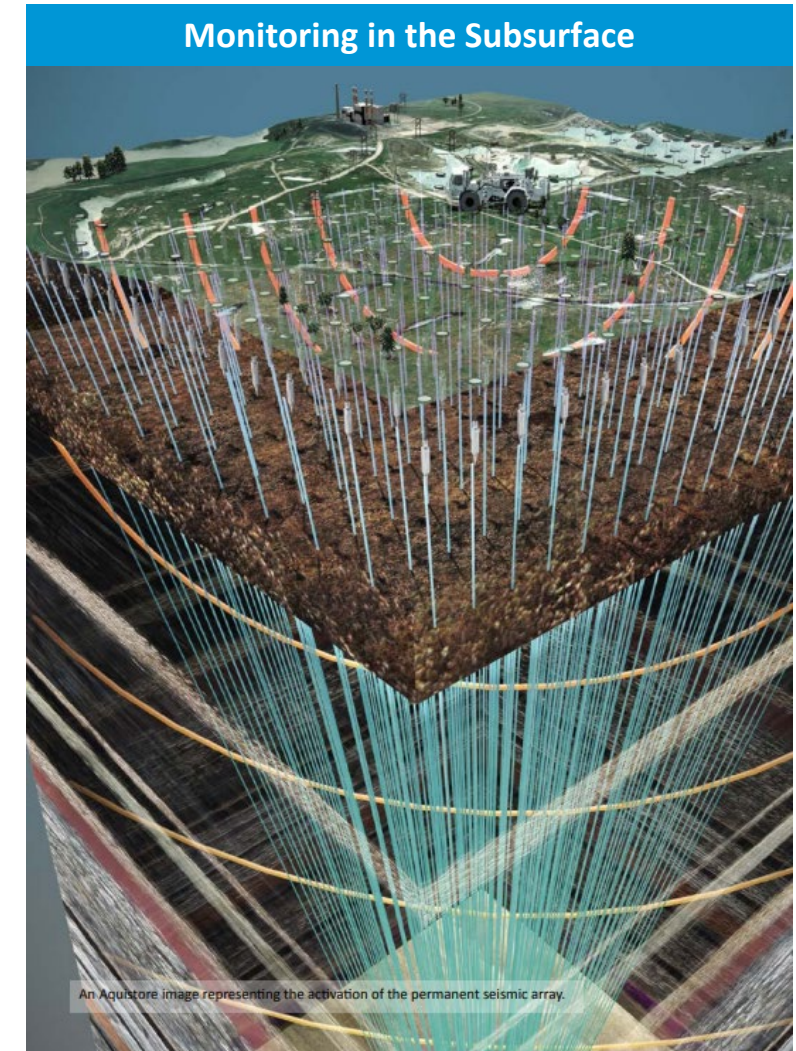
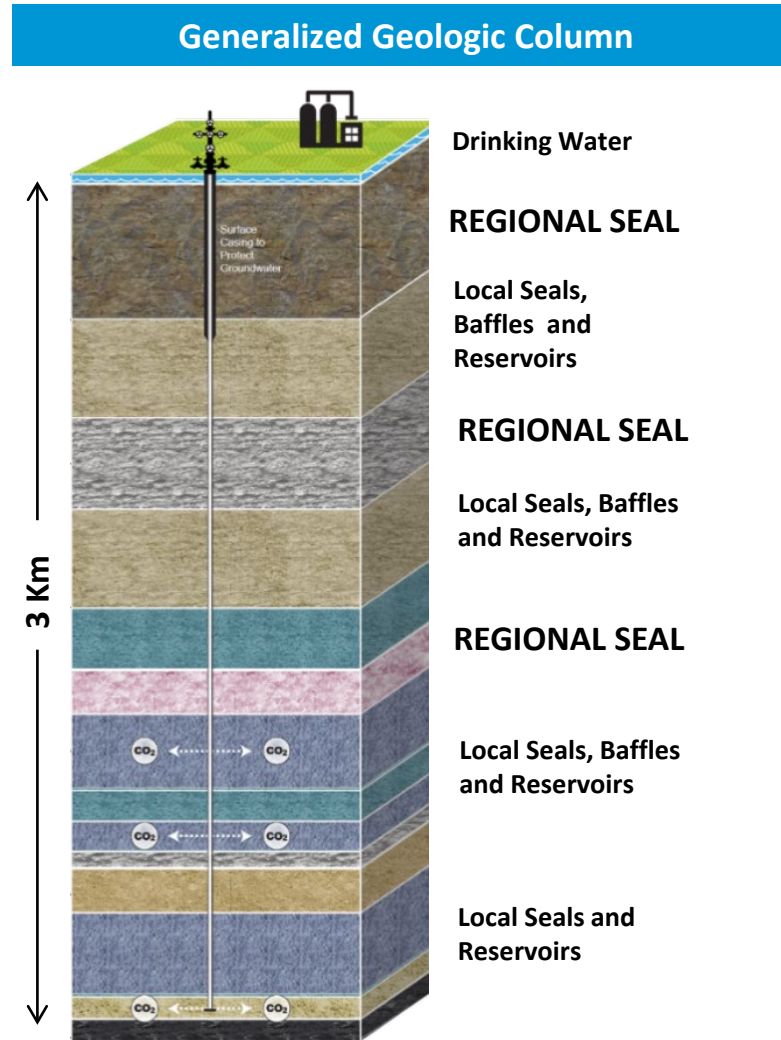


- Regional data informs initial site selection
- Subsequent local simulations will help better quantify
 - » Size of potential storage sites
 - » Uncertainties in the storage system
 - » Potential pathways of CO₂ release

Shell Quest log data and map from Rock and O'Brien (2016); Image from <https://www.geoart.com/what-is-carbon-capture-and-storage/>

How is Containment Ensured?

- Identifying Reservoirs and Seals
- Protecting Groundwater
 - » Proper Monitoring, Measurement and Verification Plan
 - » Mitigating risk of legacy wellbores



<https://www.globalccsinstitute.com/archive/hub/publications/192038/aquistore-co2-storage-worlds-first-integrated-ccs-project.pdf>; PCOR Partnership Atlas, 6th Edition

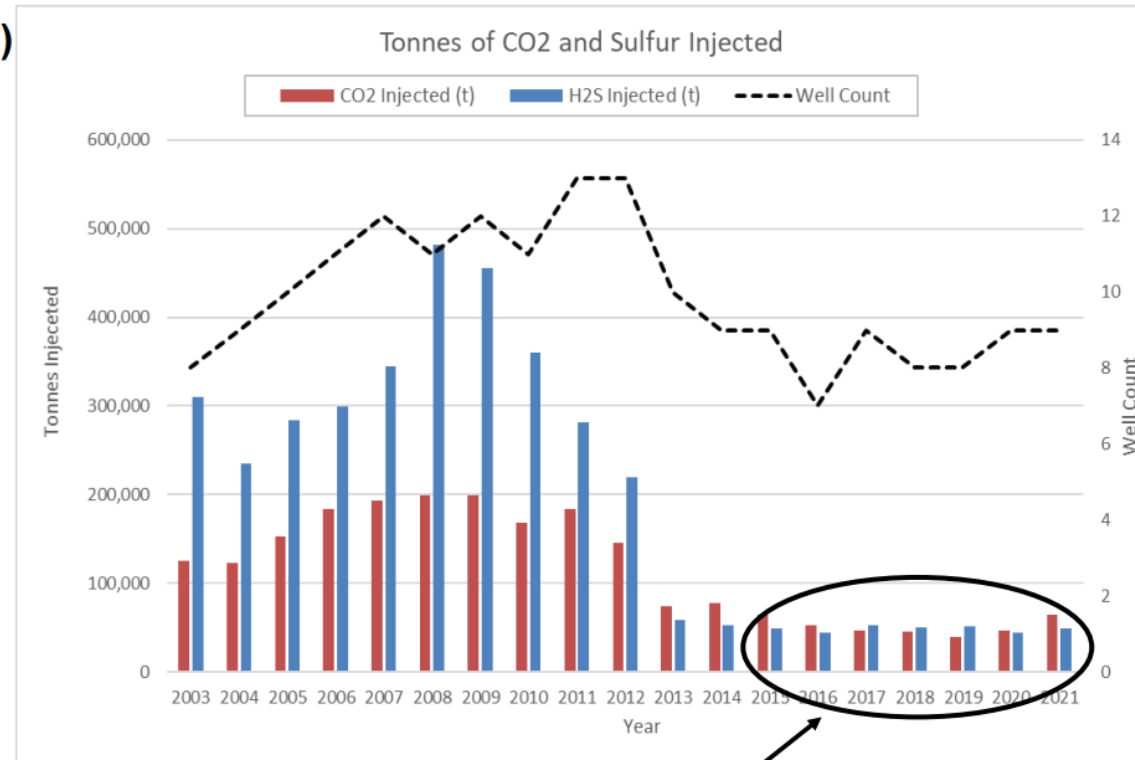
Has CCS been done before in British Columbia?

- Since 1996 2.6Mt of CO₂ have already been safely stored in 13 acid gas (H₂S and CO₂) disposal wells in NE BC
 - » Extensive regulatory oversight experience with long-term integrity of wells and containment in formations
- Case studies of existing carbon storage projects in Canada and current disposal schemes in operations in British Columbia will be provided

Acid Gas (H₂S & CO₂) Disposal Wells

Total of **2.63 megatonnes of CO₂ have been sequestered**, as of December 2021.

Additionally, 8.6 megatons of SO₂ diverted from atmospheric release, if had been flared.



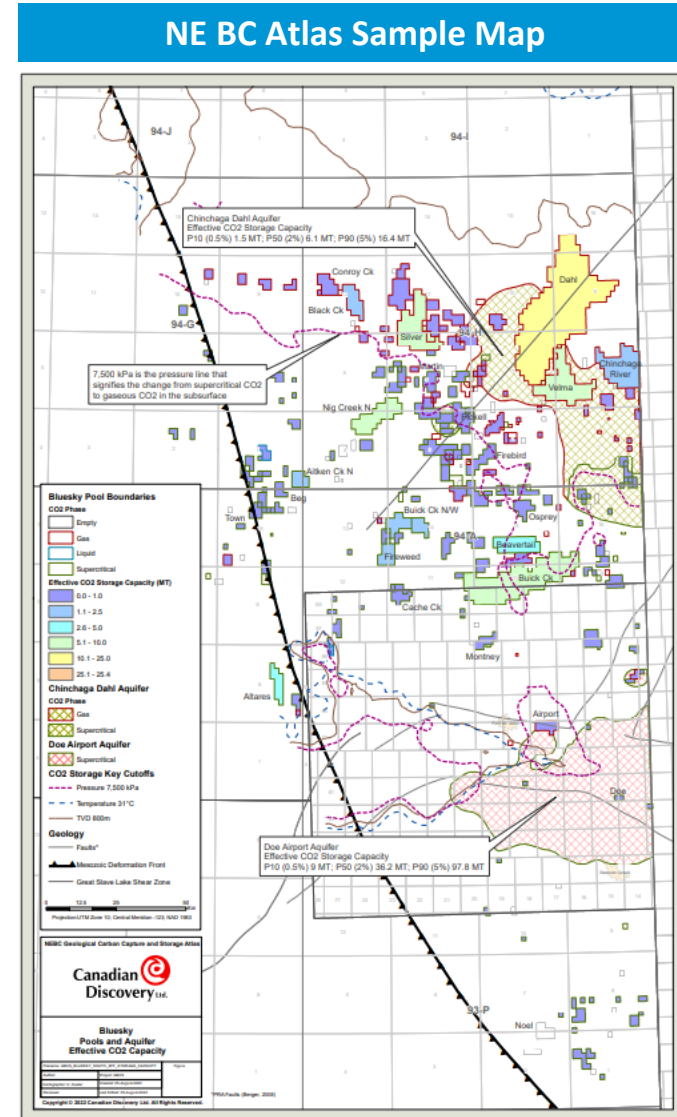
Largest individual well sequestered 0.55 Mt CO₂.

Total ~50% CO₂, individual wells range 30 – 90% CO₂

BC Reserves and Production Report 2021

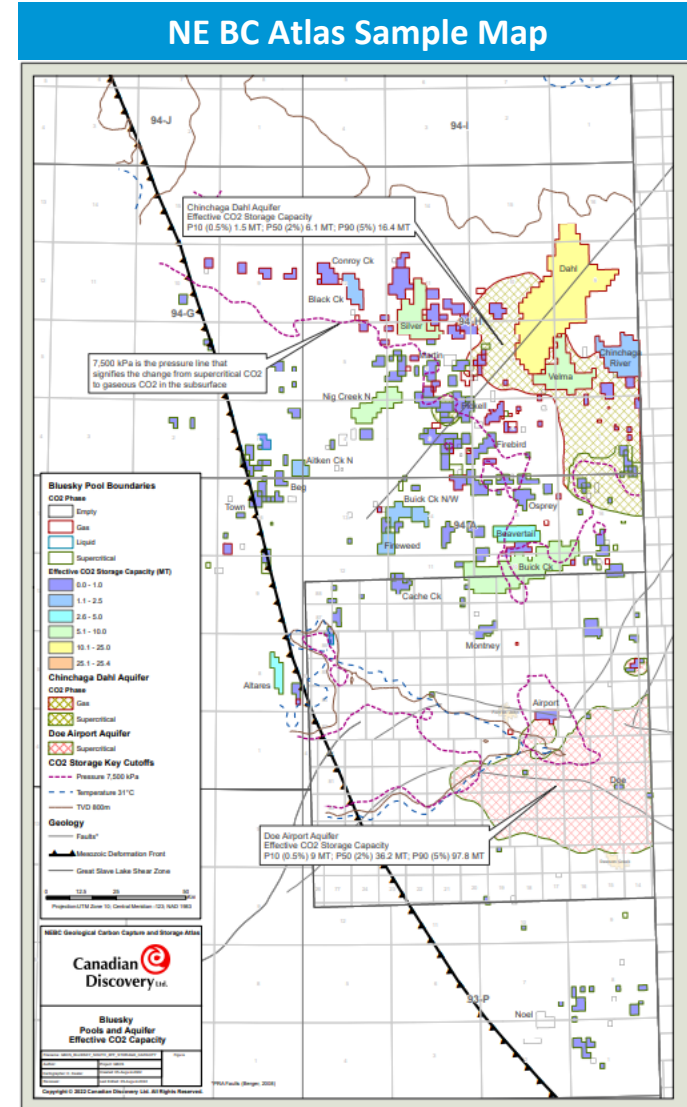
How will the NEBC Geological Carbon Storage Atlas Help?

- Provides easy-to-use Report, Maps and Database
- Identifies, assesses, and ranks the best CCS sites in NEBC (the “low hanging fruit”)
- CCS Favourability Map for each disposal zone
- Allows important re-use of depleted oil & gas pools
- Provides key information to allow informed decision making for development, including Hydrogen projects
- Supports decision making for large to small scale CCS projects, i.e. Hub to local sites
- Identifies knowledge gaps and areas for further research
- Will be a template for research elsewhere in BC



Atlas Highlights

- Project outputs support Net Zero initiative
- Good Science to best inform policy and regulations
- Boosting Clean Economy – lower emissions while transitioning to green energy options





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Thank You

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Q&A

Thank you for your participation



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