CARBON MANAGEMENT

ATTAINING REGIONAL SOLUTIONS

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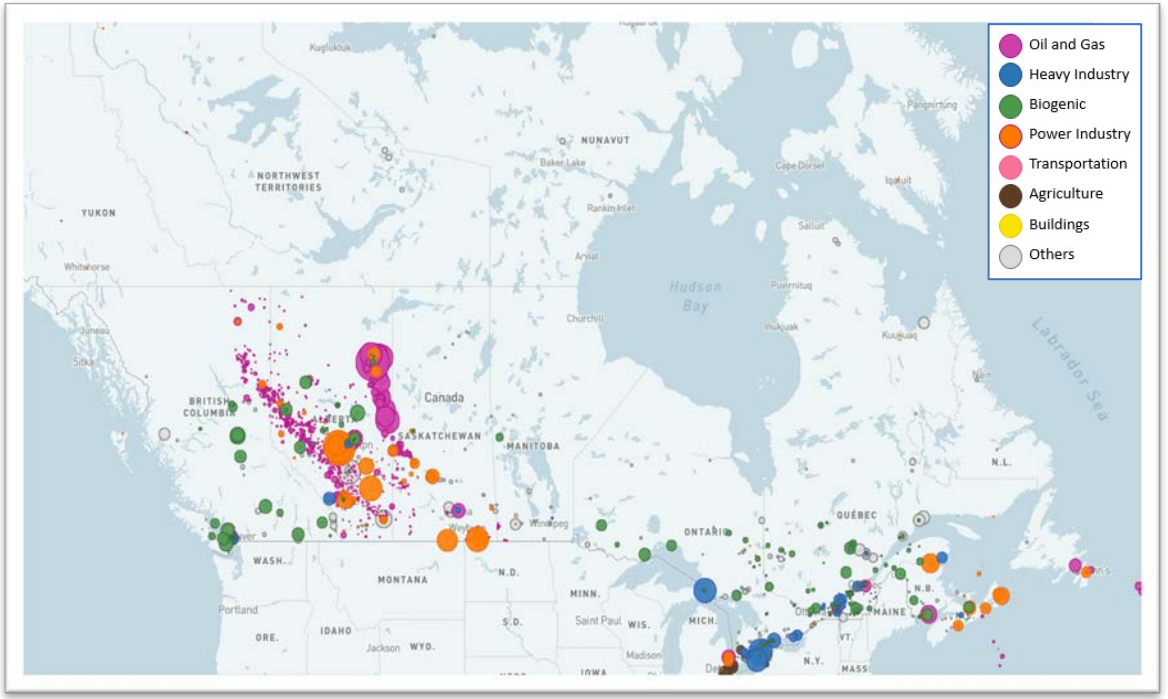
How do we achieve net zero CO_2 emissions?

- Researchers at Natural Resources Canada are creating tools that we can all use to solve the CCUS part of the puzzle
- Extensive external collaboration with industry and universities
- CO_2 capture from fossil, process and biogenic sources
- CO_2 storage prospectivity
  - Geological reservoirs
  - Mineralization (e.g. tailings)
- CO_2 transportation
- CCUS hubs and clusters

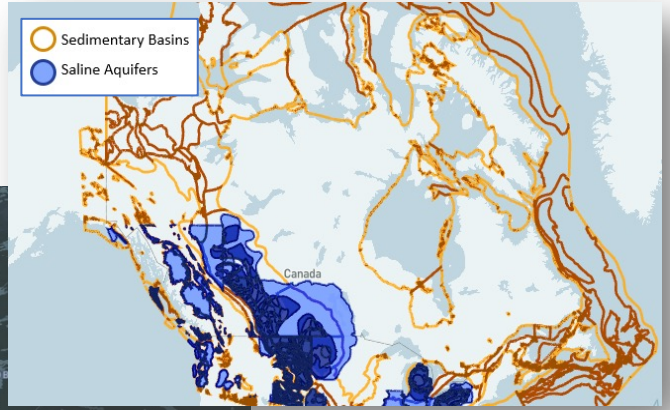


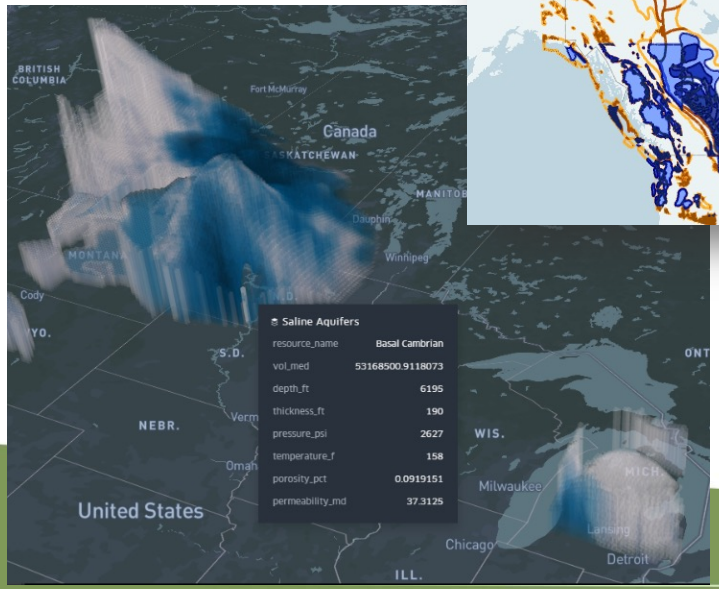
Major CO_2 emitters in Canada by emission rate;
Fossil & process ECCC 2018, biogenic data NRCan 2018 from provincial sources

Emissions in British Columbia

- Many of British Columbia's large emitters are distant from proven CO_2 storage reservoirs
  - Bio-energy CCS opportunities, and hence negative emissions, are not co-located with CO_2 storage
  - Process emission intensive industries are not co-located with CO_2 stroage
- CO_2 transportation costs will be a relatively large fraction of total CCUS costs
  - For many emitters the rule of thumb that 90% of cost of CCS is CO_2 capture is not valid

CO_2 Storage Opportunities



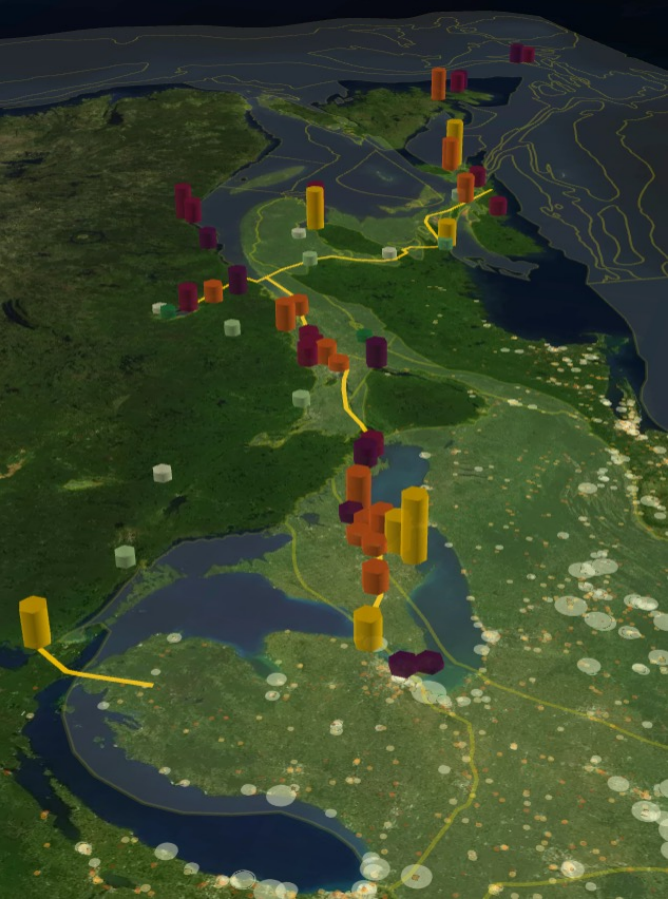


Above: Sedimentary basins and saline aquifers

Left: Saline aquifers coloured by volume, height showing depth

- As CO_2 storage data becomes available it will become available in both our publicly available datasets and in the mapping tools, for example:
  - Reservoir identification
  - Data required for reservoir assessment
- Currently aggregating information and converting to a common data form
- National and regional analyses will provide '**combined chance of success**' type metrics giving clues as to where CO_2 storage projects are most likely to be successful
- Data can be easily filtered in order to identify opportunities with the 'right stuff'

Canada



Transportation Planning

- National scale
- Snap shot & time varying optimization algorithms
- Operational and strategic approaches
- Cost minimization considering:
  - Potential impact on First Nations lands
  - Protected areas
  - Existing rights-of-way
  - Socio-economic implications
  - Local construction cost factors (e.g. slope, population density, soil type)
  - OPEX expenses (e.g power, labour)
  - Integration with US potential CCUS networks
  - Robustness and redundancy
- Bottoms up engineering including pressure loss, pipe size and thickness, allowable stresses, re-compression stations

A Tool to Support Industry

Regional industrial hubs and clusters

- Minimize costs by working together
- For example, replicate the Alberta Carbon Trunk Line many times over

Data identifying and characterizing CO_2 storage opportunities

- Onshore
- Offshore
- Mineralization from tailings

Transportation infrastructure

- Support multi-player buy and public-private partnerships
- Cost and feasibility
- Repurposing of existing

Policy & regulatory requirements

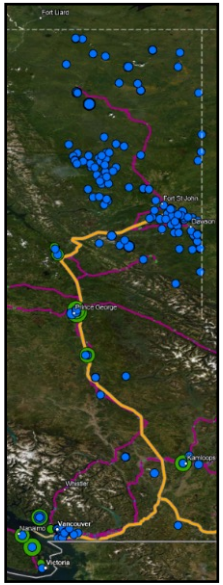
- Identify and link to existing policies and regulations
- Identify applicable codes and standards
- Cross-boundary

Cost characterization

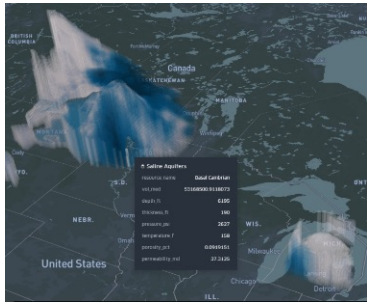
- Nation-wide at industry level
- Facility based as updated information becomes available

**led by Robin Hughes, NRCan's CanmetENERGY Research Group*

Milestones for 2021-22



- Potential hubs / clusters across Canada identified and characterized
- Data for CO_2 storage reservoirs aggregated
- CO_2 capture costs for facilities with high CO_2 emissions predicted:
- CO_2 transportation corridors characterized with optimization started
- Interactive graphics for sharing modeling results with the public to enhance overall knowledge of CCUS in our communities generated and shared
- Open-source code released to the public for use and improvement of the CCUS models



OPPORTUNITIES

1. Leverage what is already being done
    - e.g. Lafarge concentrating 1t/d CO_2
    - Behaviour change in businesses resulting from carbon tax
2. Lateral integration
    - Industrial ecology, circular economy, etc.
    - Test out innovation
3. Regional leadership
    - Leverage regional relationships
    - Be seen nationally

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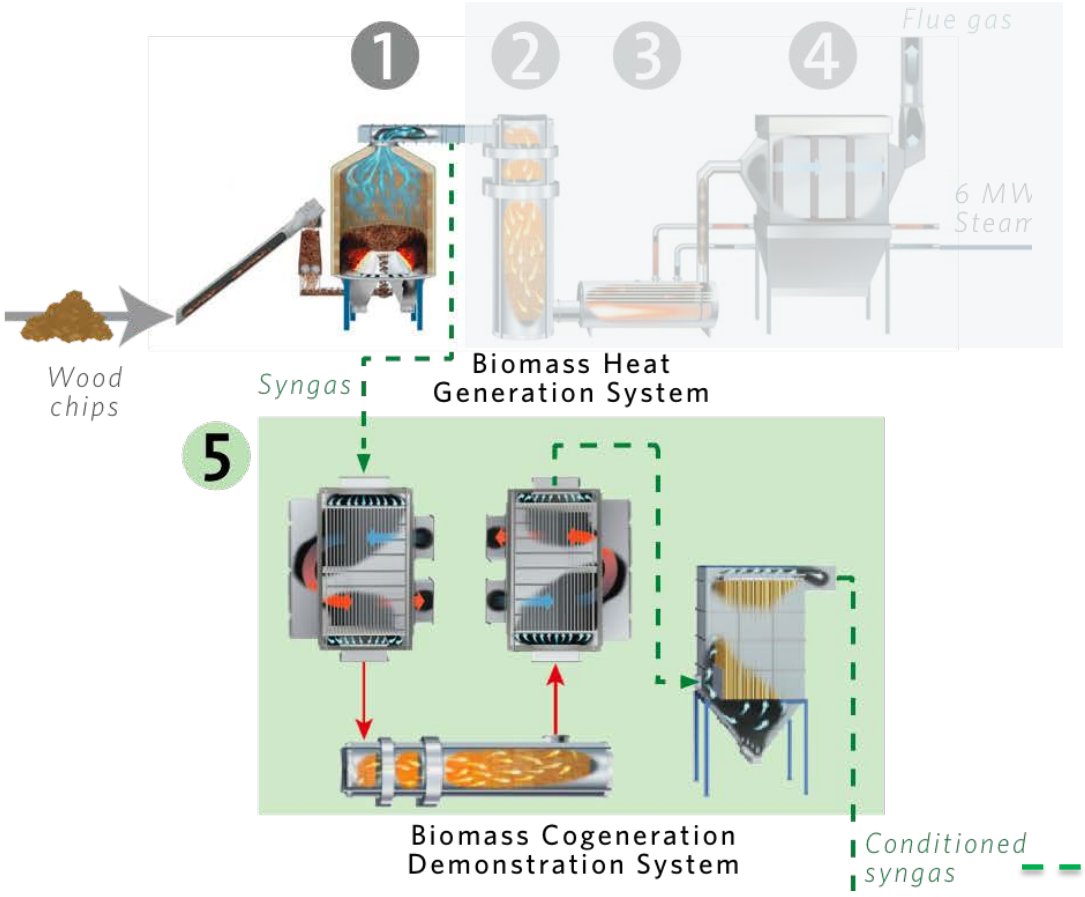
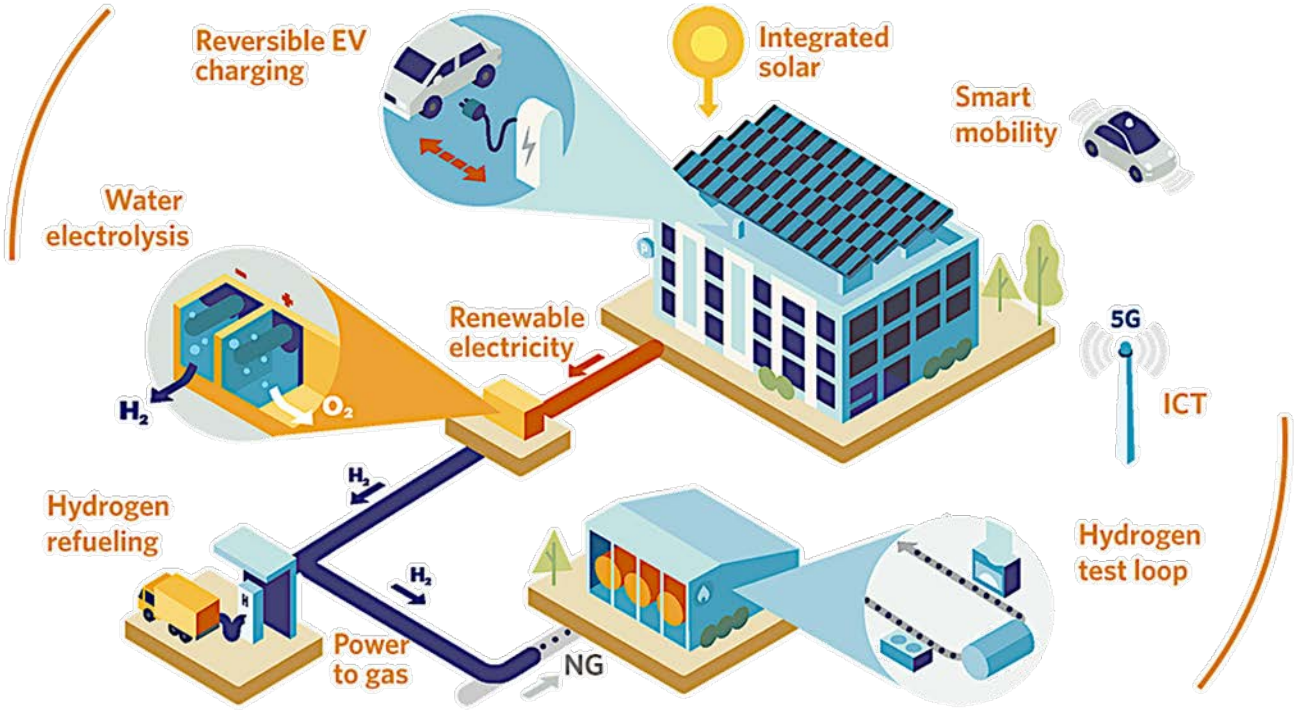
BIOENERGY WITH CARBON CAPTURE AND STORAGE (BECCS)



Clean syngas
- Renewable natural gas

Carbon capture
- Hydrogen production

INTEGRATED RENEWABLE ENERGY HUB



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IN SUMMARY

- **Leveraging**
  - Discover and communicate what is happening in the region
  - Funding opportunities
- **Connecting**
  - UBC
    - Campus as a living laboratory
    - Clean Energy Research Centre – Carbon Cluster
  - Regional connection for building an industrial ecosystem
- **Leading**
  - Tremendous opportunity for this region to lead

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