ptrc

Petroleum Technology
Research Centre

Carbon Capture Utilization and Storage: Meeting global GHG targets with a Saskatchewan-made solution

Erik Nickel, Director of Operations
Petroleum Technology Research Centre

Outline

1. What is CCUS?
2. Why is it important?
3. Why Saskatchewan?
4. Weyburn CO_2- EOR - the early days
5. Aquistore – taking it to the next level
    a) Measurement, Monitoring and Verification Program
    b) Public Assurance Monitoring

What is CCUS?

ptrc
Petroleum Technology Research Centre

- CCUS is a suite of technologies applied to reduction of CO_2 emissions from a specific point source
- Capture is often a chemical process dependent upon the specific source conditions
- Storage is the measured, monitored and verified injection of CO_2, usually in a supercritical state, deep underground.
- The ‘U’ is utilization. Currently that mostly means EOR work, but can mean creation of new products (i.e. cement additive)

One Tonne of CO_2 …

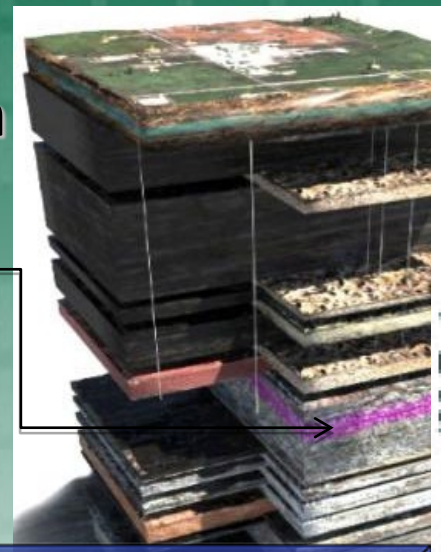
ptrc
Petroleum Technology Research Centre

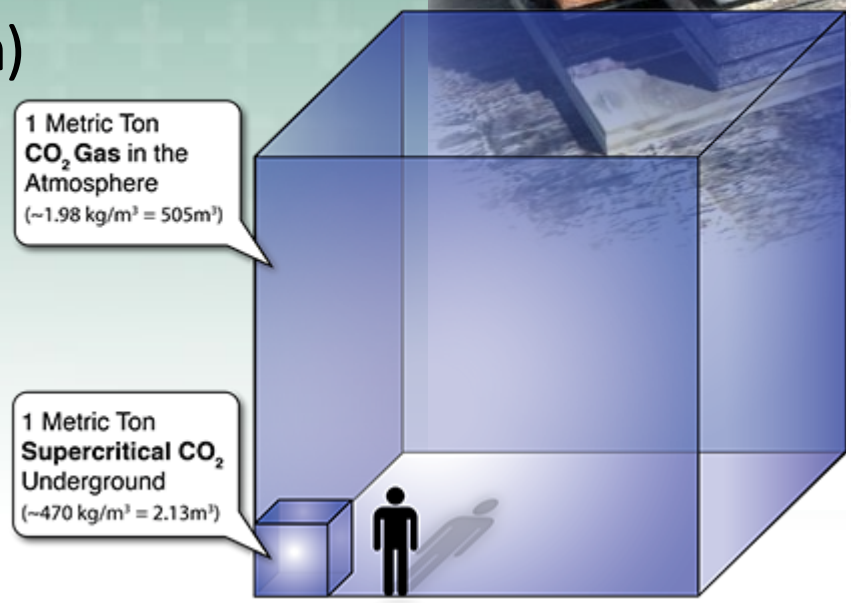
We each contribute about 16 of these a year.

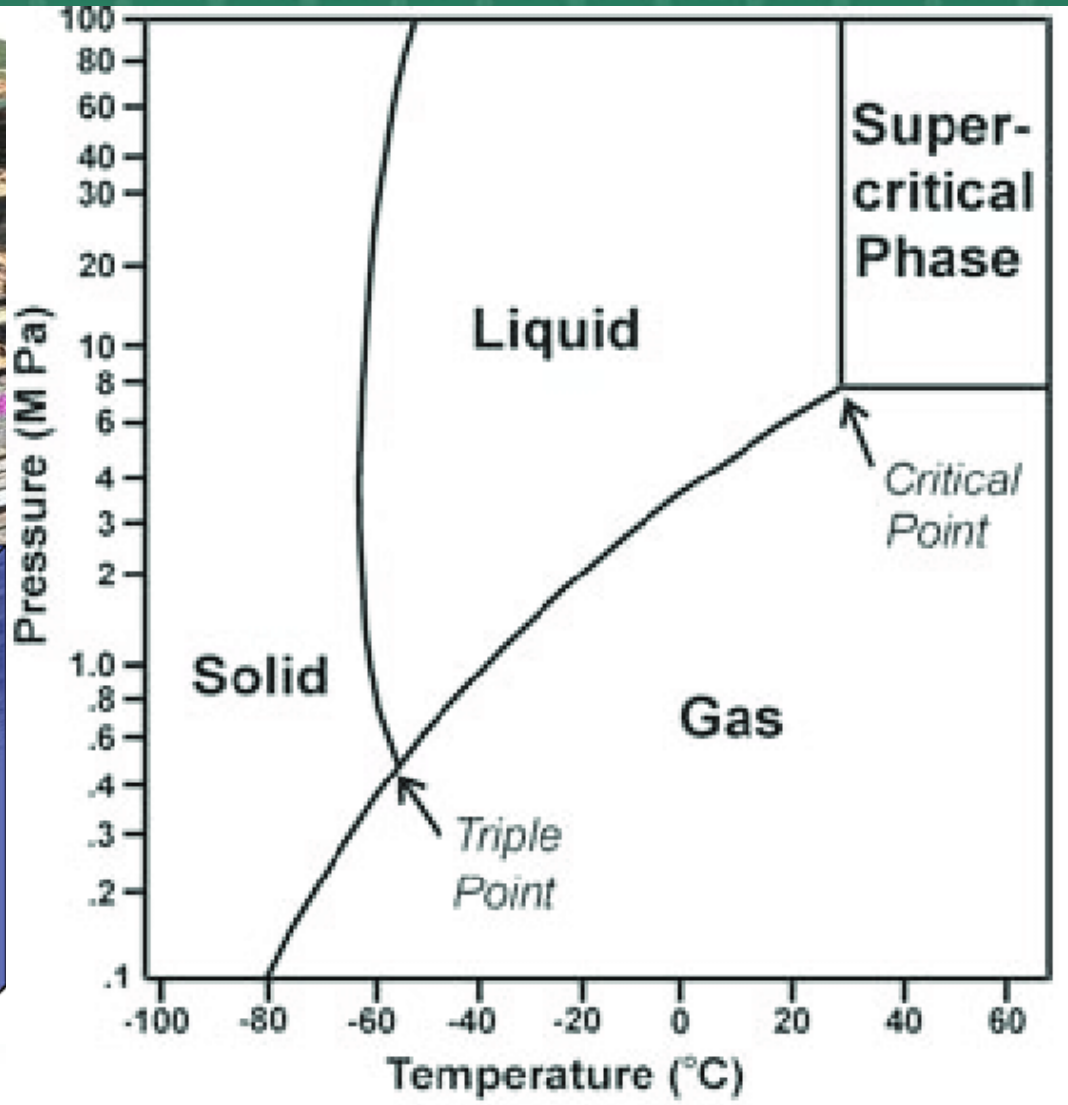
CO2 Storage and EOR

ptrc
Petroleum Technology Research Centre

- EOR in shallower zones (1500m for Weyburn, 400m in Lloydminster)
- Aquifer storage much deeper (Aquistore 3000m)
- "Supercritical" zone becomes important



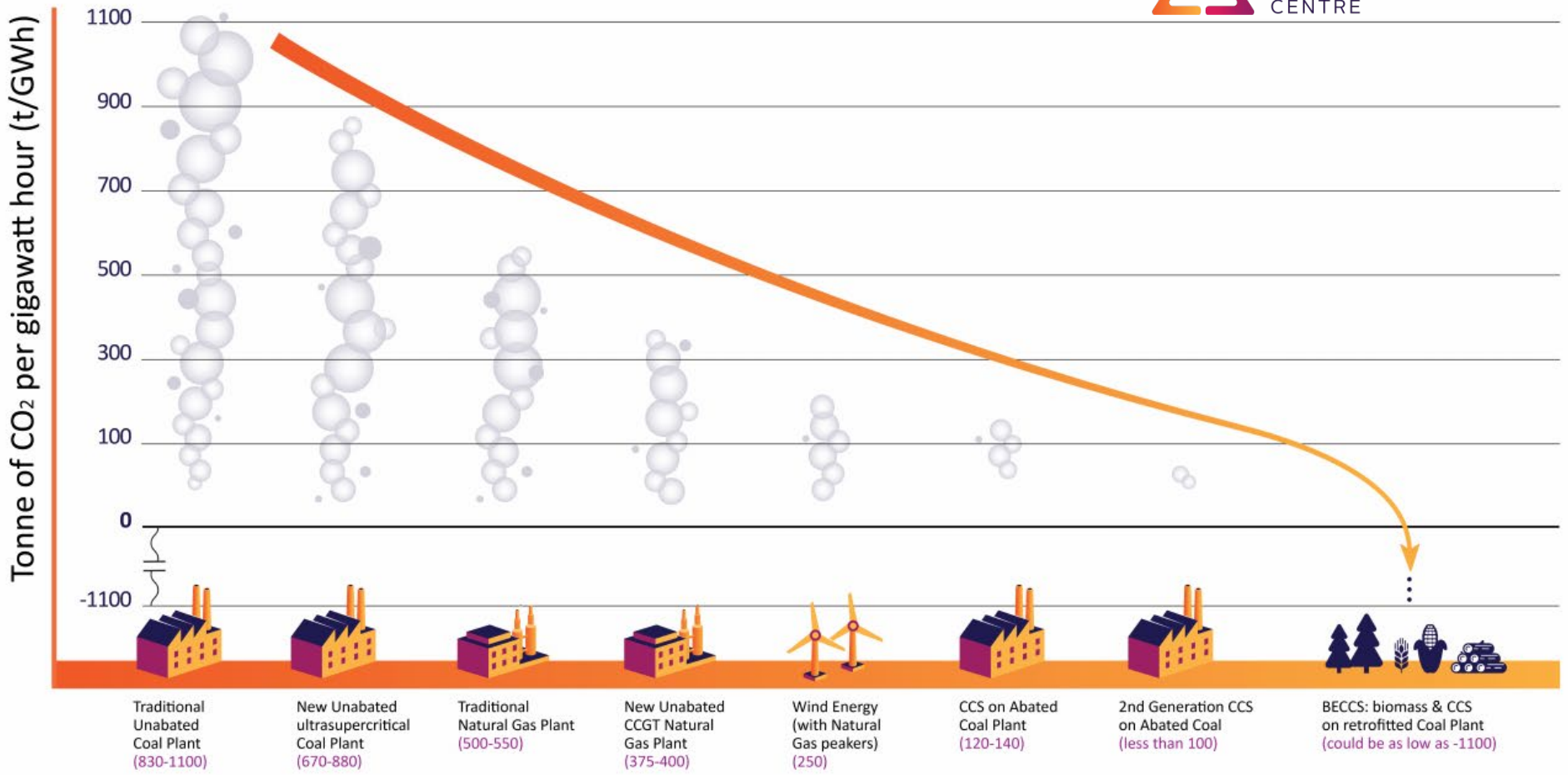




CO_2 Emissions - Significantly Reduced with Carbon Capture & Storage (CCS)

CO_2 emissions are significantly reduced with large-scale CCS – which is further reduced with 2nd generation CCS and shows negative emissions with BECCS.

INTERNATIONAL CCS KNOWLEDGE CENTRE

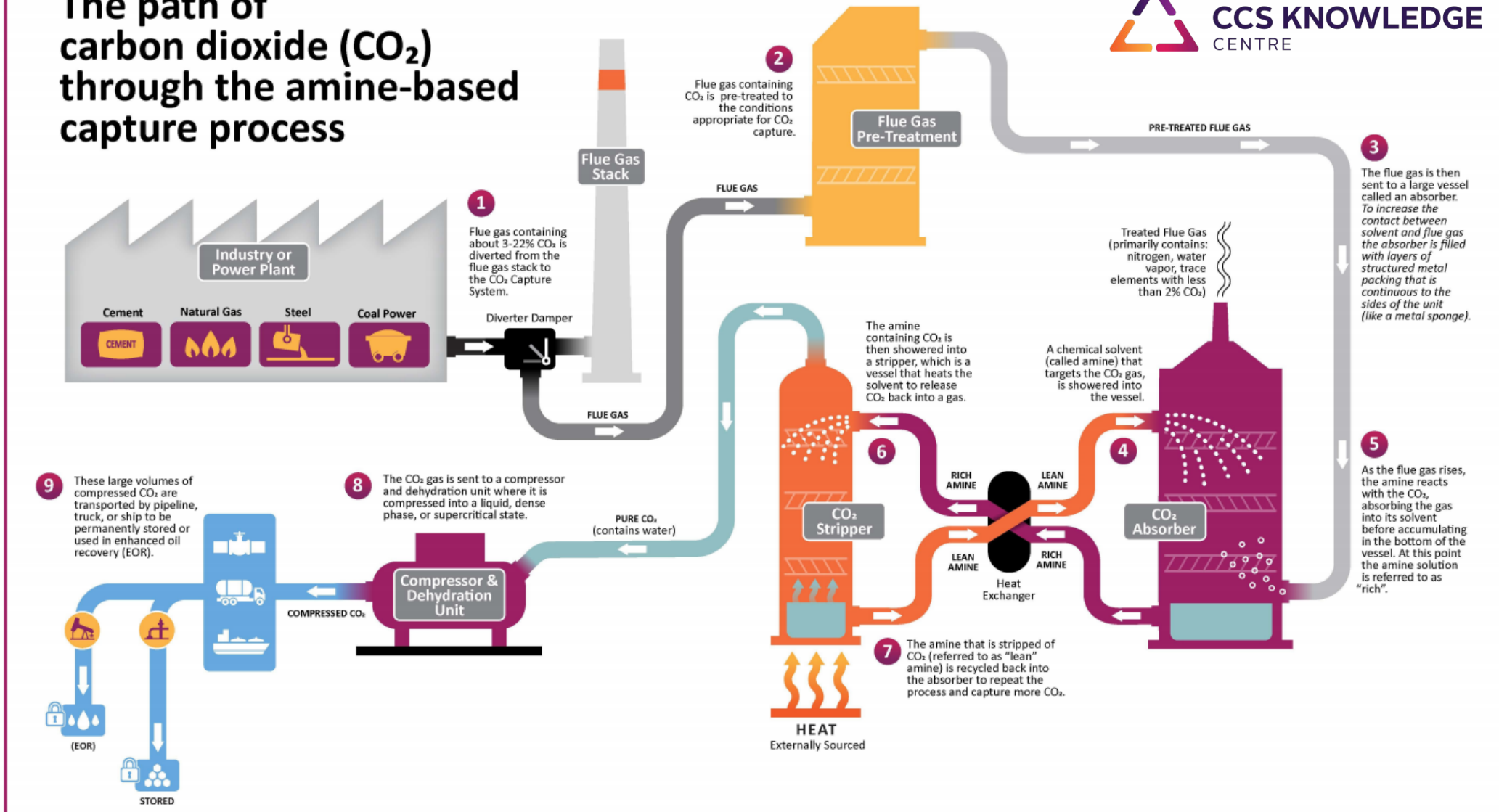


ptrc
Petroleum Technology Research Centre

The path of carbon dioxide (CO_2) through the amine-based capture process

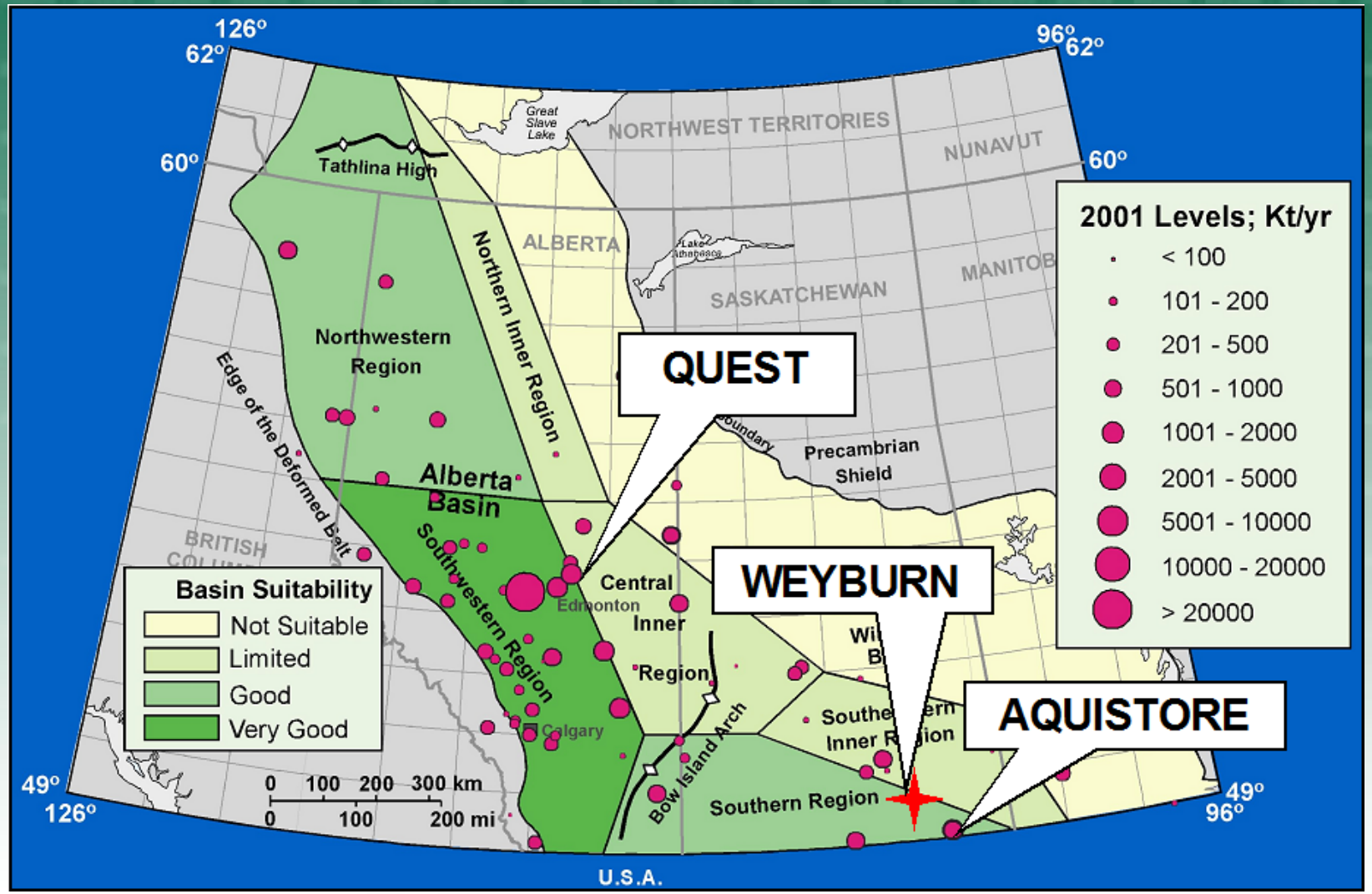
INTERNATIONAL CCS KNOWLEDGE CENTRE

ptrc Petroleum Technology Research Centre



Why Saskatchewan?

ptrc
Petroleum Technology Research Centre



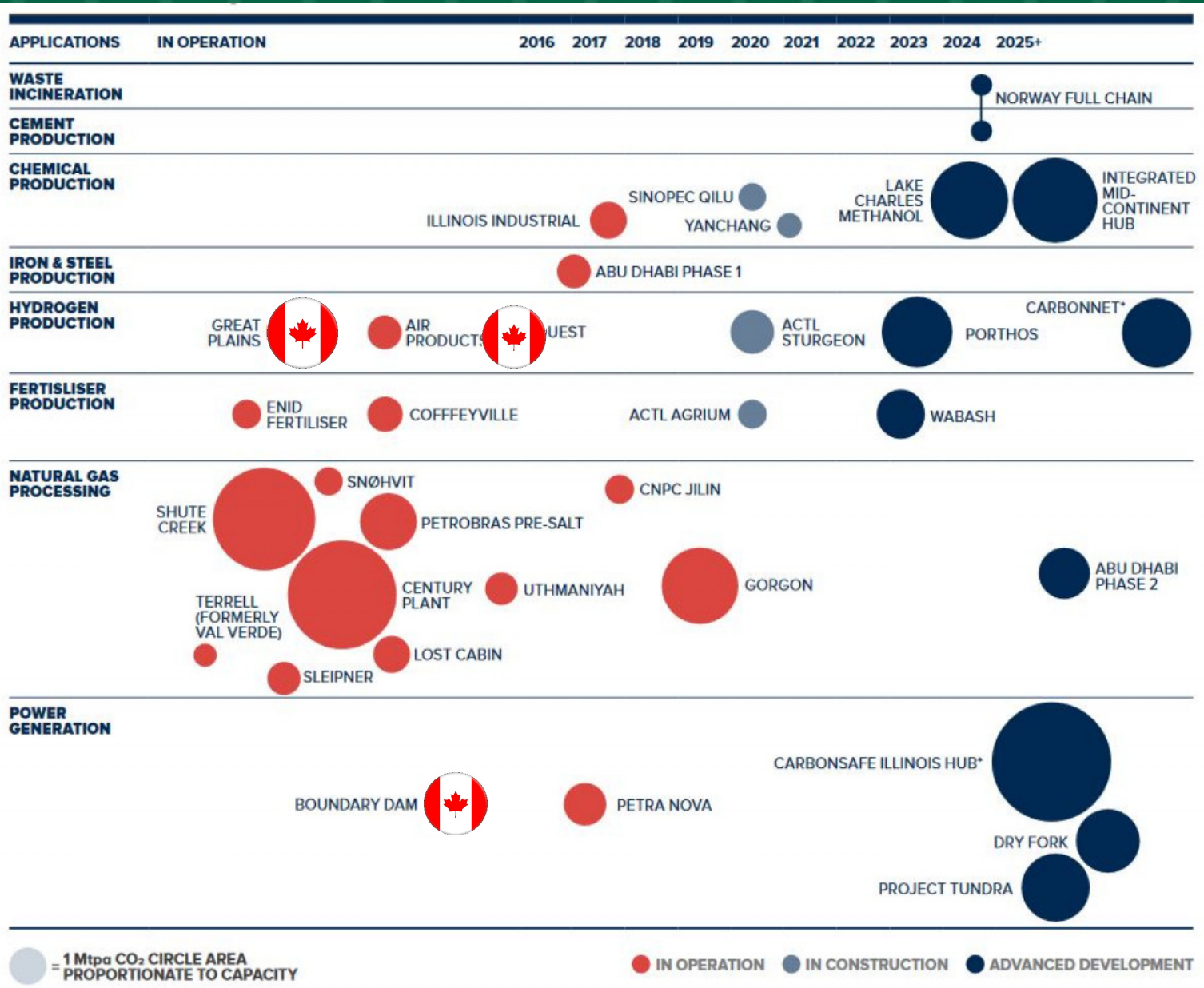


FIGURE 3 POWER AND INDUSTRIAL APPLICATIONS OF LARGE-SCALE CCS FACILITIES IN OPERATION, UNDER CONSTRUCTION AND IN ADVANCED DEVELOPMENT

*Size of the circle is proportional to the capture capacity of the facility.
Indicates the primary industry type of the facility among various options.

Image courtesy GCCSI

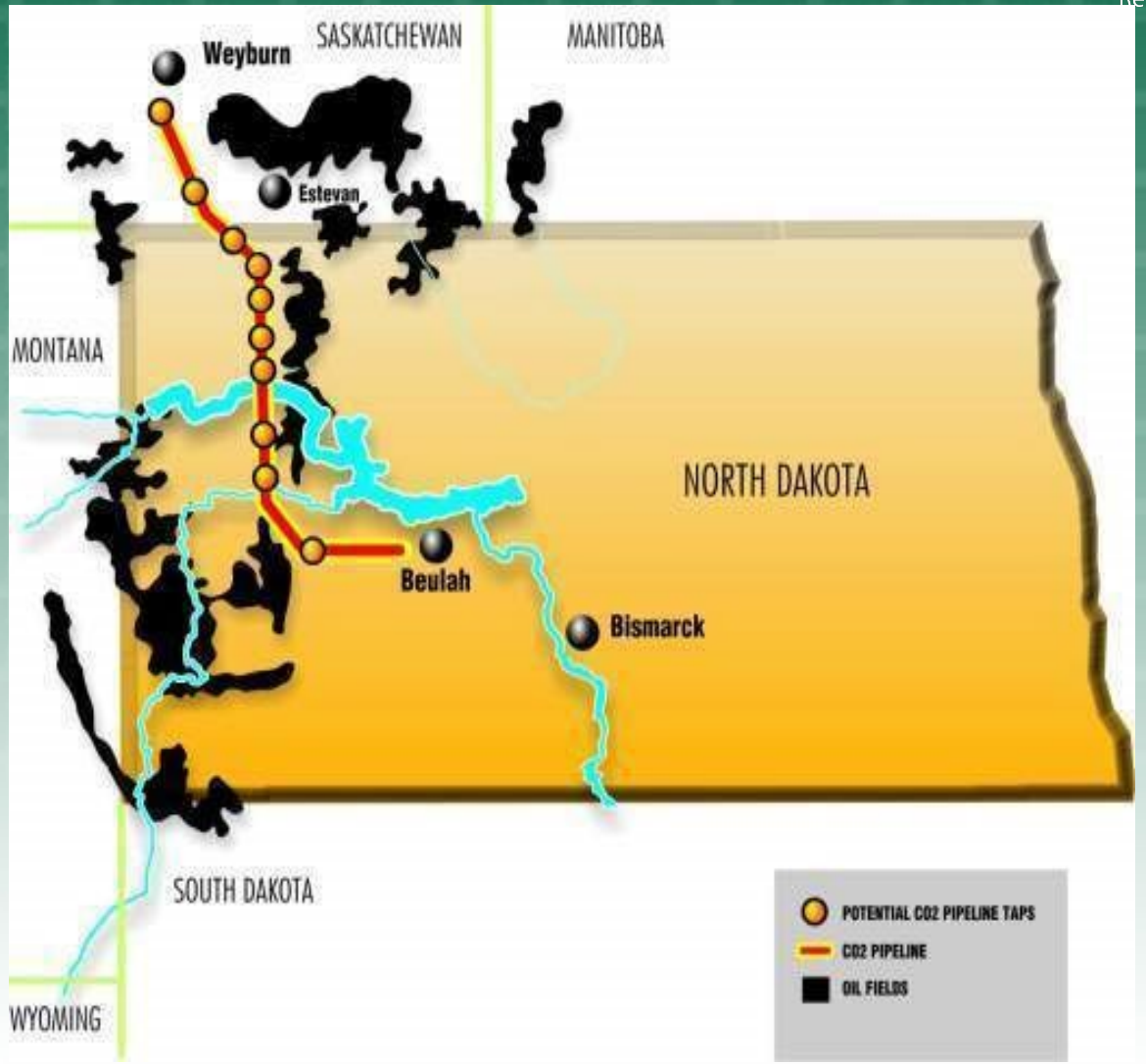
Petroleum Technology Research Centre

- Industrial CCUS projects in the world
- Canada was an early adopter
- We are quickly being outpaced by US megaprojects
- Tax incentives (45Q) in the US amount to $50/Tonne tax break for storage ($35 for EOR)

WEYBURN: THE FIRST CCS/EOR PROJECT

ptrc
Petroleum Technology Research Centre

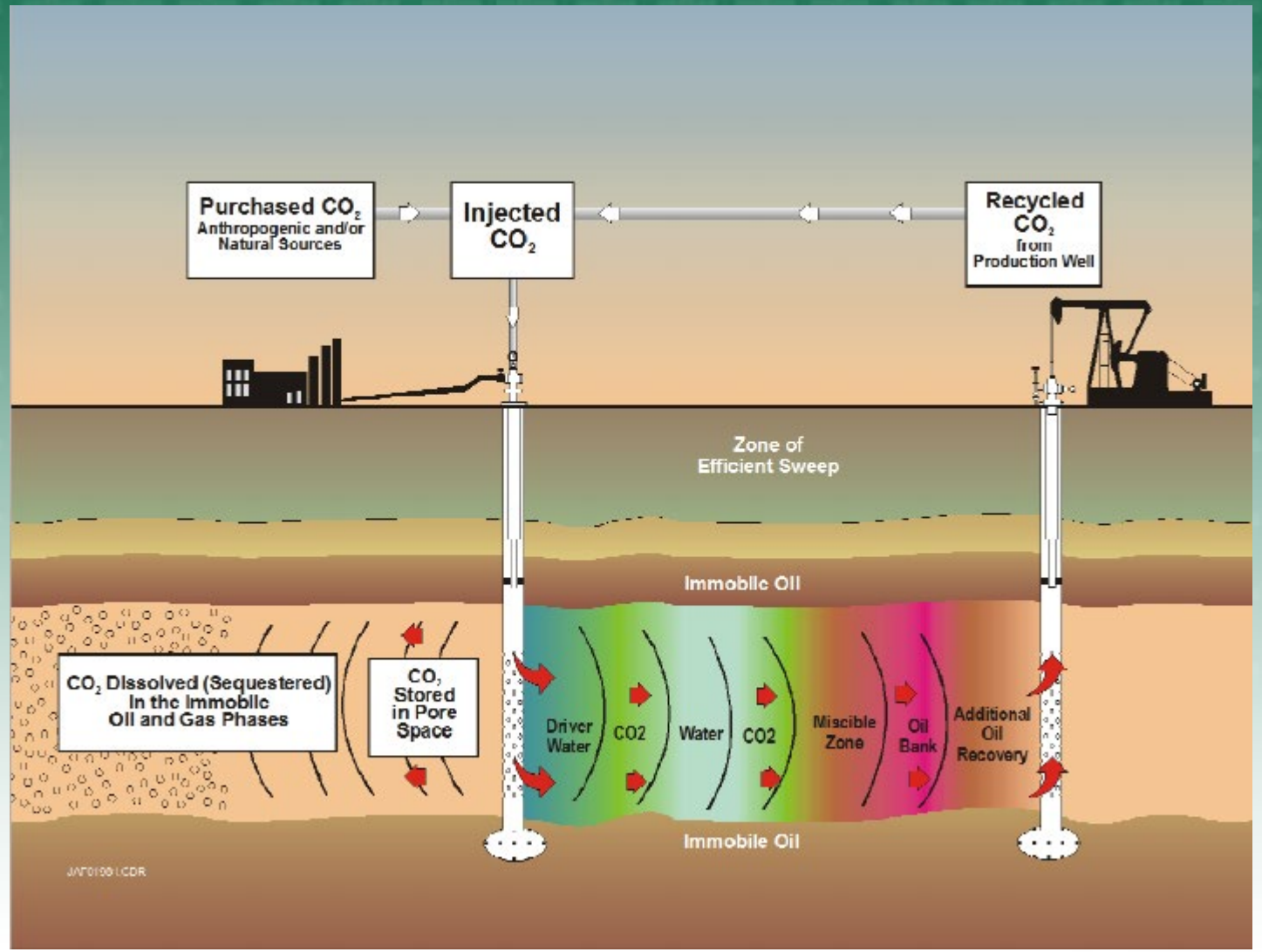
- *Started in 1998*
- *approx. 6000 tonnes/day suitable for EOR*
- CO_2 purity 95% (less than 2% H_2S)
- 180 mi pipeline (14 in & 12 in) built & operated by Great Plains
- 39 Million Tonnes Stored in Weyburn/Midale



CO2 Storage and EOR

ptrc
Petroleum Technology Research Centre

- Most EOR is running miscible CO_2 from one well to another, often in complicated patterns
- "Supercritical" CO_2 becomes important to achieve miscibility with the oil
- "WAG" is alternating water with the CO_2 to build up an "oil bank"



Weyburn Findings

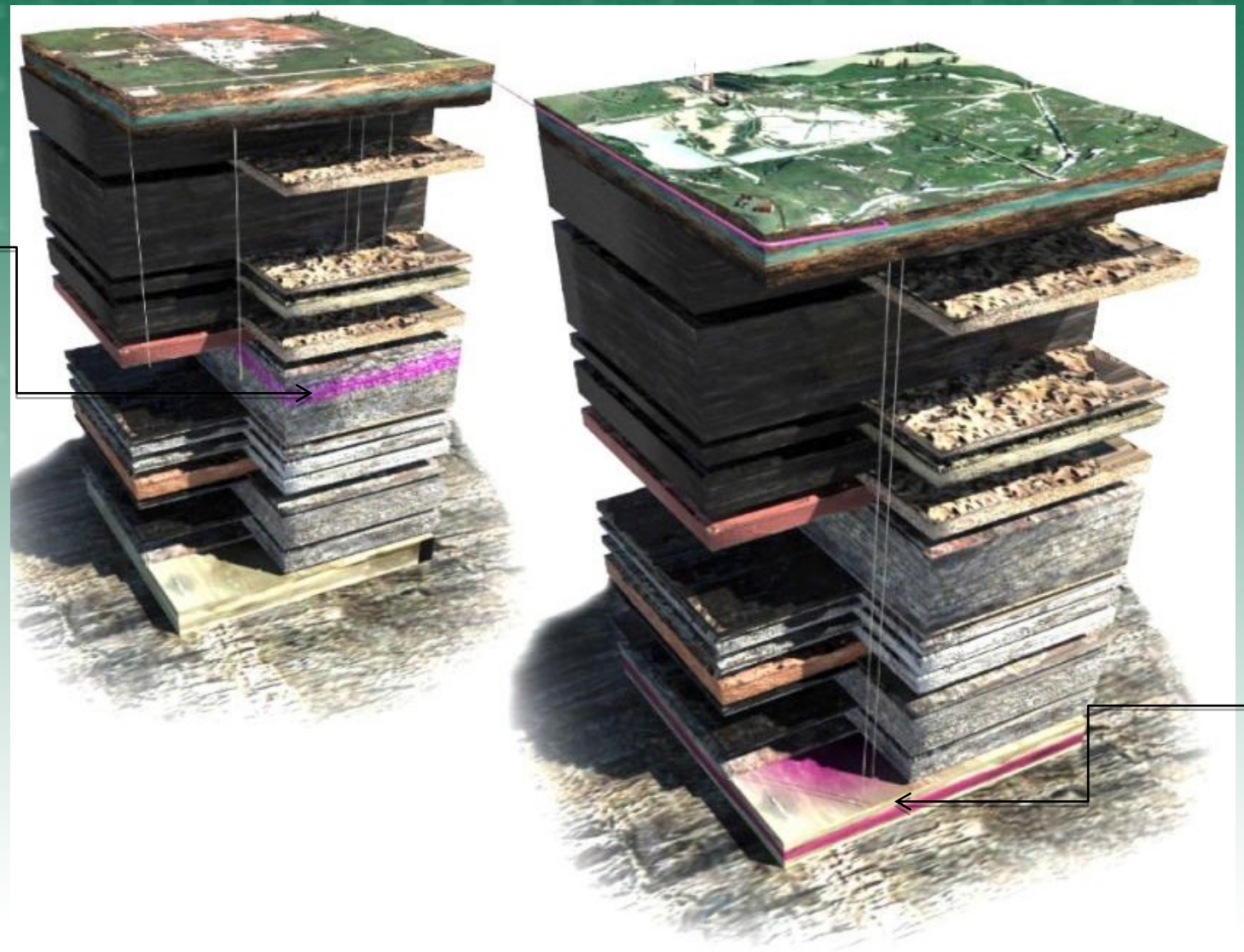
ptrc
Petroleum Technology Research Centre

PTRC's CCS Research – Dissemination and Capacity Building

ptrc
Petroleum Technology Research Centre

Aquistore Background

ptrc
Petroleum Technology Research Centre



Aquistore/Boundary Dam Background

ptrc
Petroleum Technology Research Centre

- CCS plant in lower right
- Each stack represents a “unit” at the plant
- Line from Unit 3 seen running to CCS plant

SaskPower CCS facility achieves 4 million tonnes of CO2 captured

Estevan Mercury
MARCH 31, 2021 01:38 PM

SaskPower’s Carbon Capture and Storage (CCS) facility at Boundary Dam Power Station near Estevan has captured more than four million tonnes of carbon dioxide (CO2) since operations began in 2014.

Pipeline Route

ptrc
Petroleum Technology Research Centre

Wells Drilled!

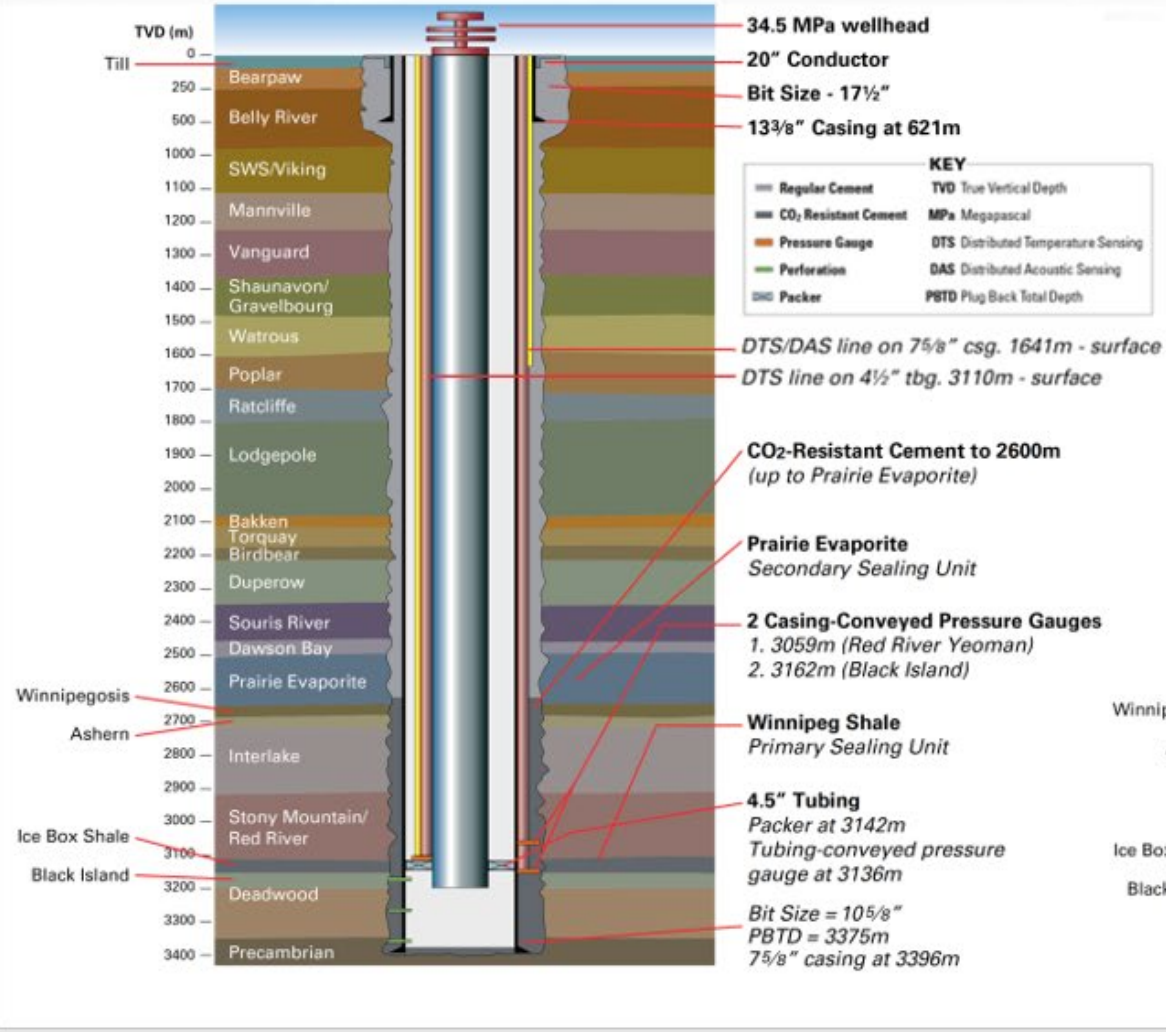
ptrc
Petroleum Technology Research Centre

Summer, 2012

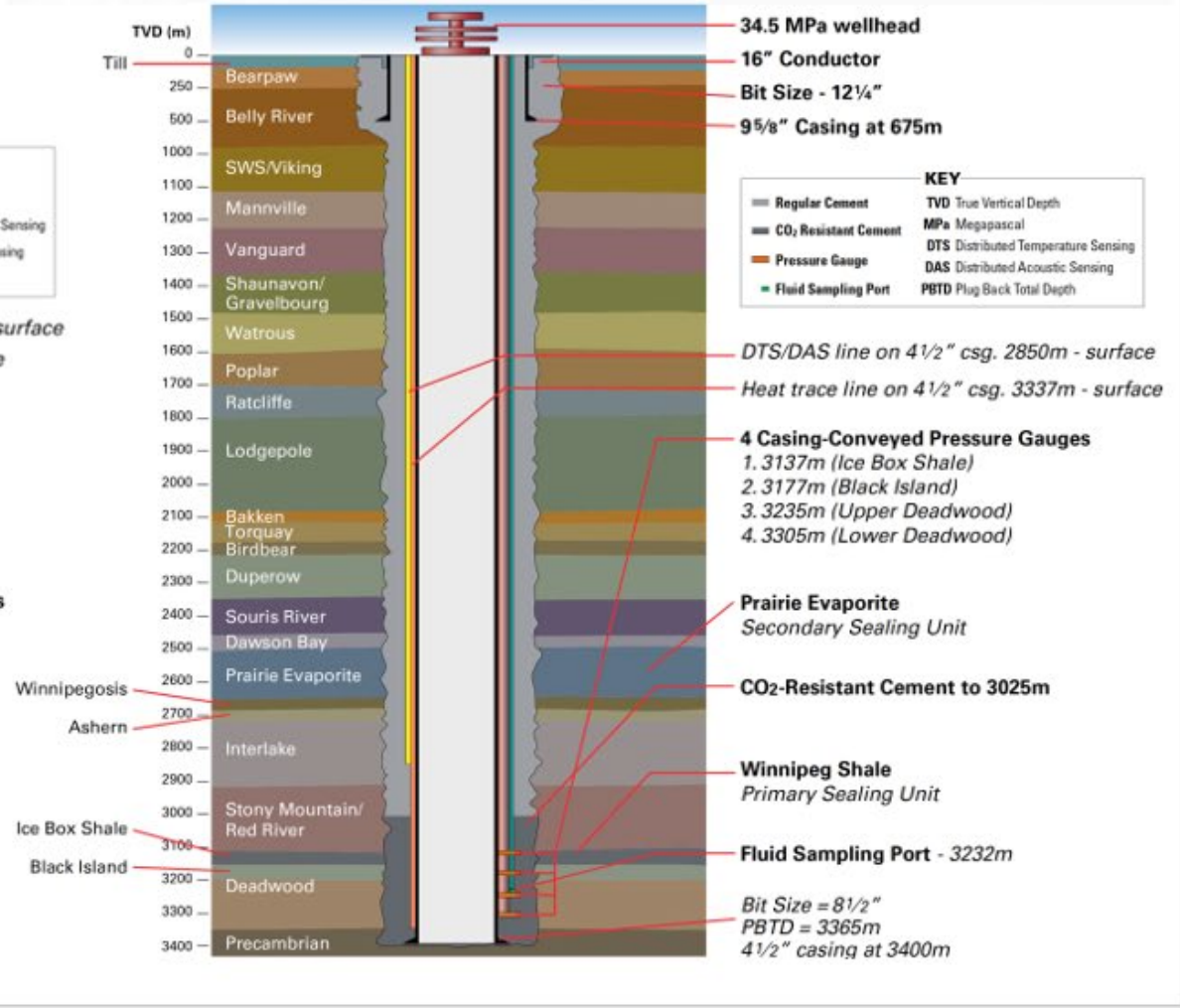
Well Schematics

Petroleum Technology Research Centre

PTRC INJ
5-6-2-8W2M



PTRC OBS
D5-6-2-8W2M



MMV Field Laboratory

ptrc
Petroleum Technology Research Centre

Surface-based:

- Regional 3D seismic survey
  - Geological characterization
  - Baseline & time-lapse
- Permanent seismic array
  - Time-lapse imaging
- Electrical/electromagnetic
- Gravity

Plume

- Passive seismic (broadband & short period array)
- InSAR
- GPS
- Tiltmeters

Deformation

- Groundwater & soil gas monitoring
- Carbon isotope profile

Leakage

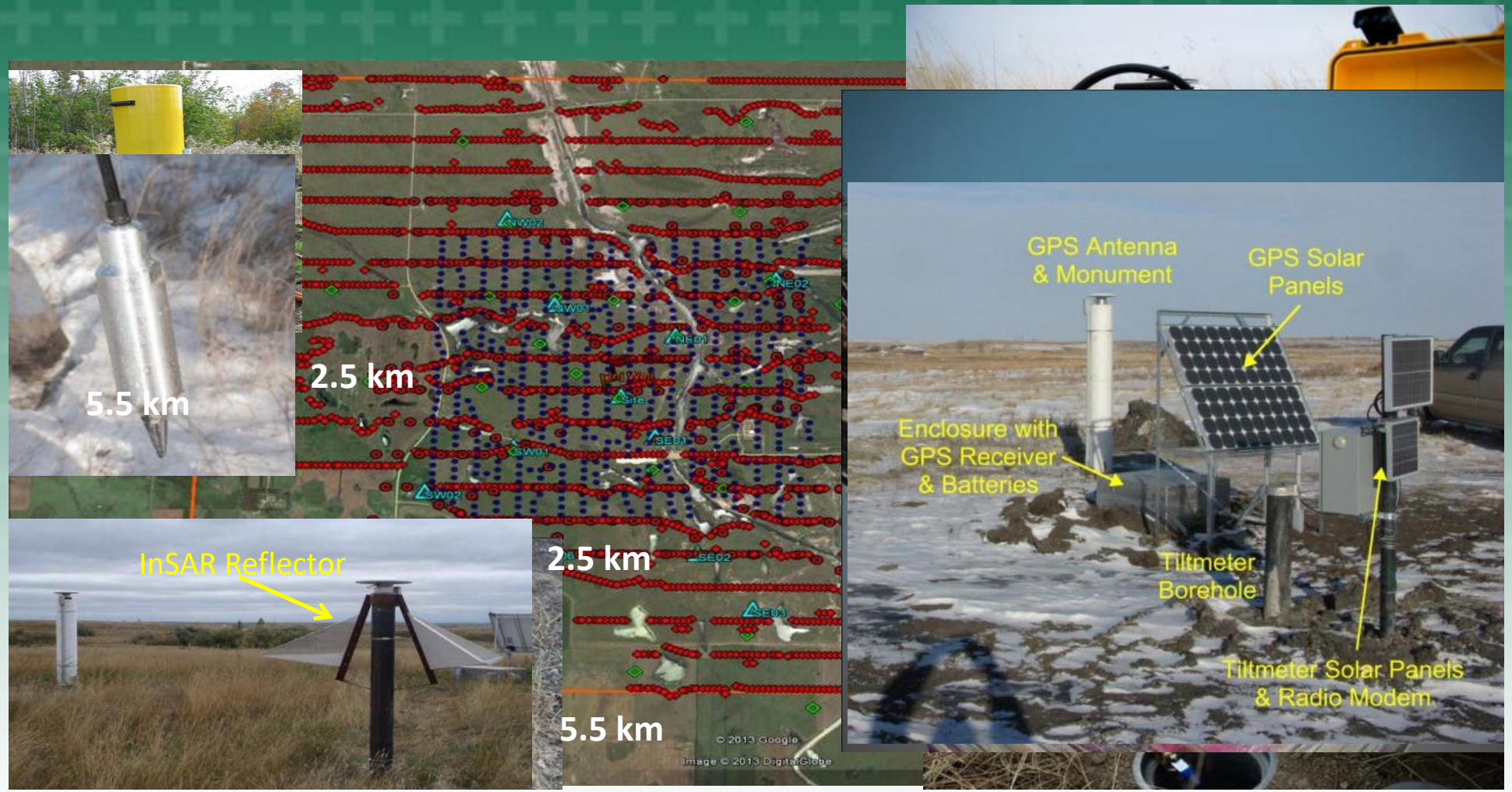
Down-hole

- Cross-well seismic & VSP
- Cross-well & surface-to-downhole electrical monitoring
- Real-time P & T
- Passive seismic
- Fluid sampling
- Time-lapse logging
- Distributed Acoustic/ Temperature Sensors (DAS/ DTS)
- Heater cable
- Gravity

In Situ

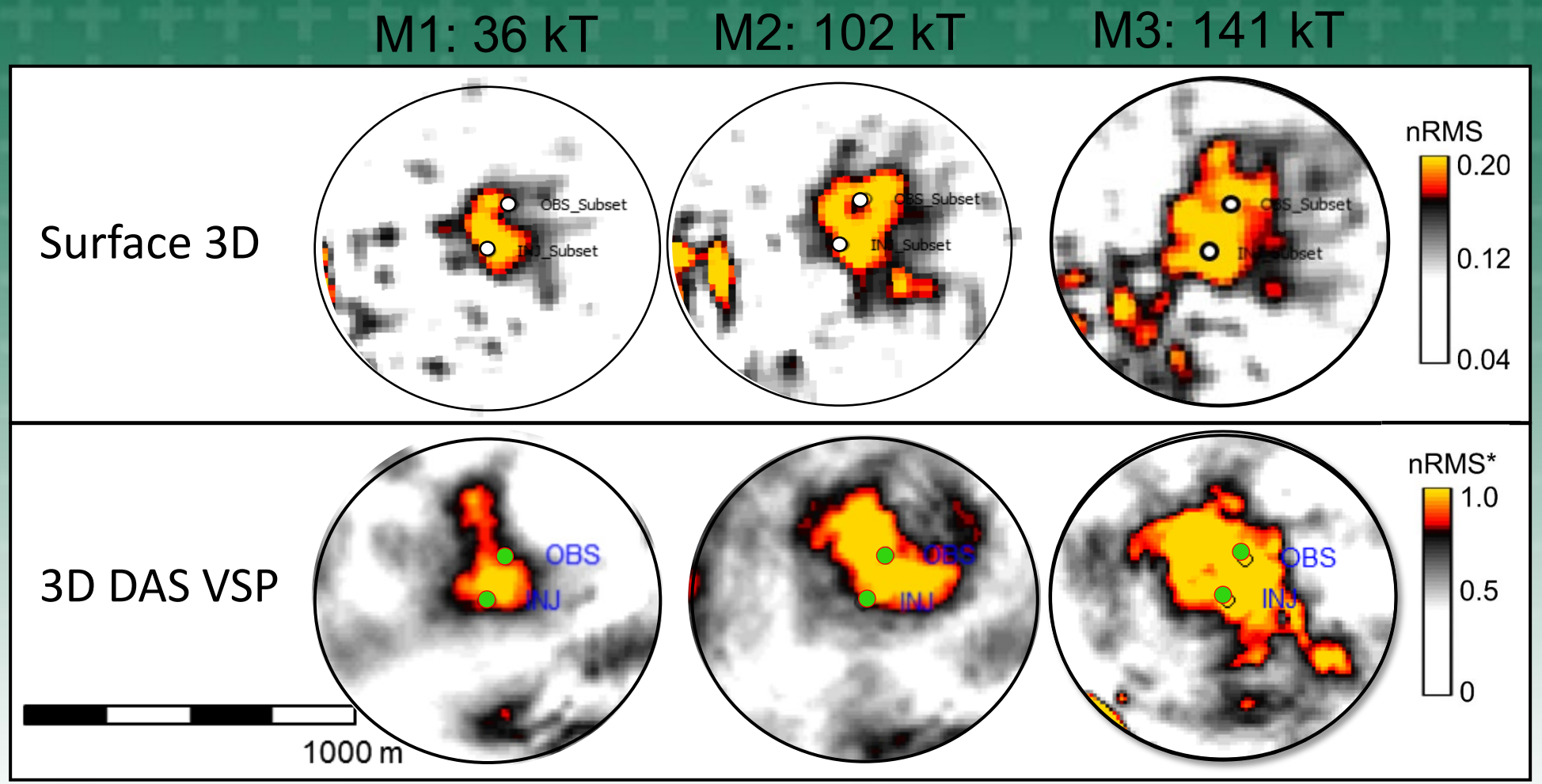
Aquistore Monitoring Program

ptrc
Petroleum Technology Research Centre



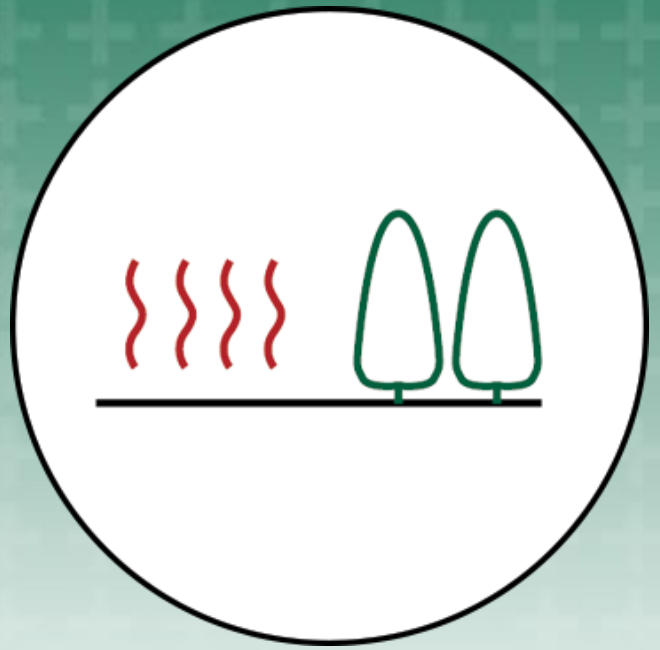
Seismic Studies Surface Geophones vs. DAS

ptrc
Petroleum Technology Research Centre

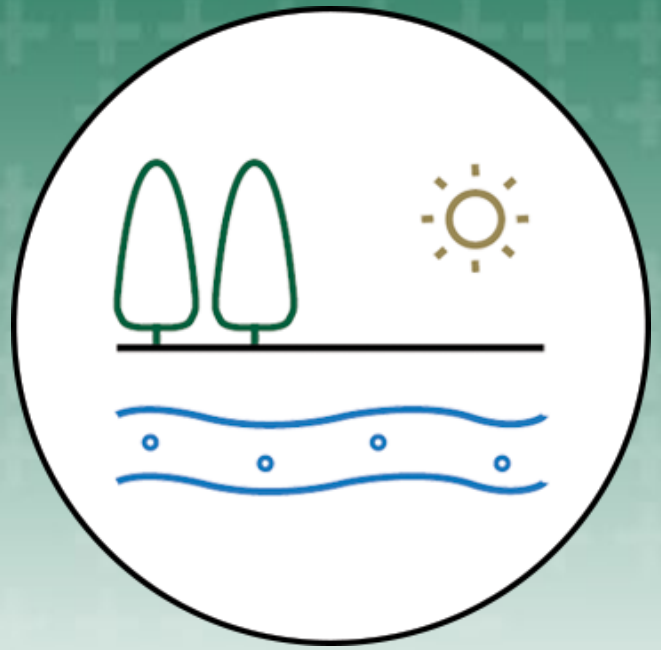


Public Assurance

ptrc
Petroleum Technology Research Centre



Zero Impact on Soil Gas

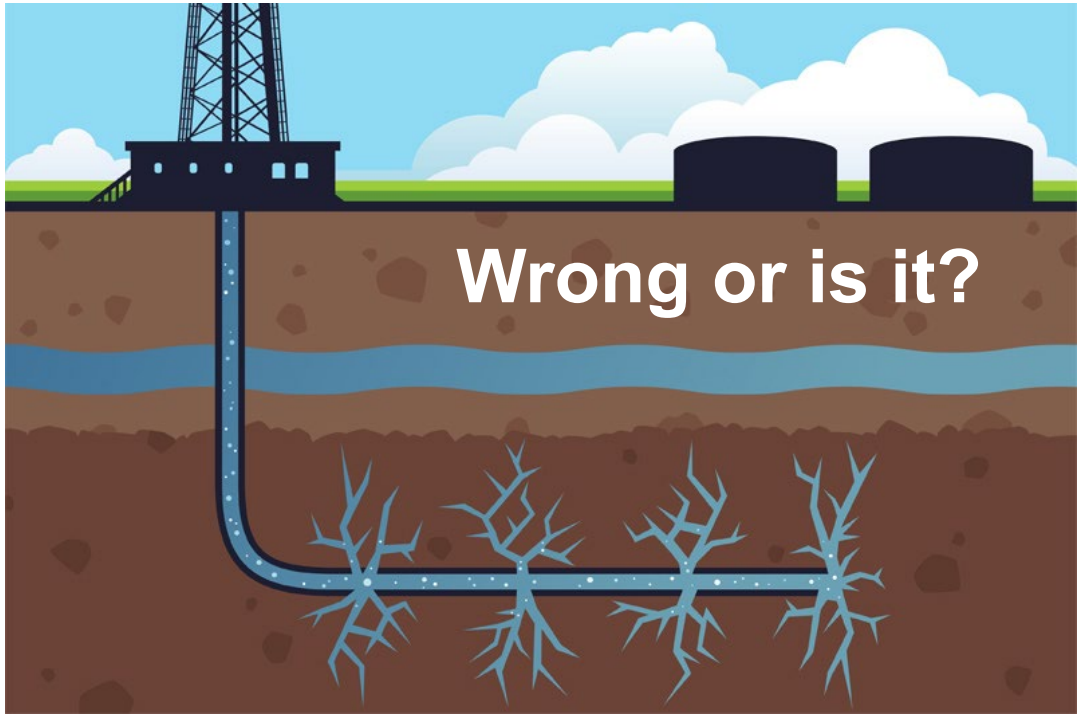


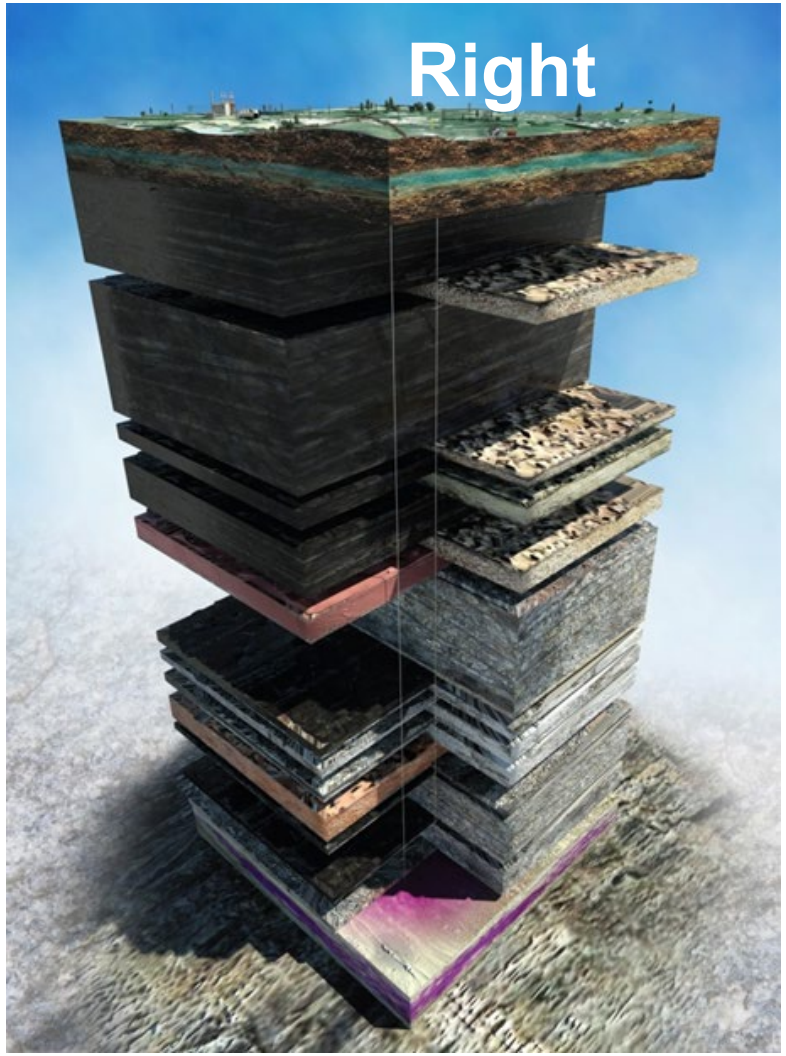
Zero Impact on Ground Water

No Measurable Seismic Activity

Public Engagement

One of the purposes of effective CCS communications is to provide clear, scientific detail where needed. This means, for example, the storage images should be to scale.





Language and Image:
The Effect of a Good Story

Open Houses, Estevan Saskatchewan

The future of CCS in Saskatchewan

ptrc
Petroleum Technology Research Centre

"Enhanced oil recovery, carbon capture utilization and storage position Saskatchewan as the best place in North America to test, commercialize and scale new oil and gas technologies."

CONTACT:

Erik Nickel

Director of Operations

erik.nickel@ptrc.ca

Norm Sacuta

Director of Communications

norm.sacuta@ptrc.ca

ptrc

Petroleum Technology Research Centre

https://ptrc.ca

Twitter: @ptrc_sk