



# Carbon Capture and **“Saskatchewan”**

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Regina, Saskatchewan , Canada

# Long History of joint CCS activity



- IEAGHG has a long association with Canada and Saskatchewan in particular
  - Canada founder member of programme in 1991
    - Saskatchewan Energy and Mines one of the early associate members
  - IEAGHG Weyburn – Midale CO<sub>2</sub> monitoring and storage project, started in 2002 and ran to 2012.
    - Broad communication and international co-operation
    - Peer reviews of project outcomes goals and objectives
    - Special seminar at GHGT-11 in Kyoto and Special issue of IJGGC
  - 2000 Regina hosted the seminar that led to the IPCC Special report on CCS being approved, published in 2005
  - 2006 GHGT-6 in Vancouver Canada
    - Partners: National Resources Canada, and University of Regina
  - Post combustion capture Network, hosted by University of Regina in 2001, 2004 and 2009.

# The first Boundary Dam CO2 Capture Pilot plant



- Originally built in 1987, upgraded with bag house in 2000
- 4 tonnes/day CO2
- Major Equipment
  - Absorber-**18"-64' high**
  - **Stripper 16"-59' high**
  - Anderson 2000 SO2 removal Unit
  - 2 million Btu/hr boiler



# International Capture Test Centre opened in 1999/2001



- Centre of excellence on post combustion capture based at University of Regina
- Laboratory and pilot facilities – Boundary Dam
- Extensive list of publications
  - Amine based capture; degradation, cost reduction, etc
  - Capture plant flexibility studies
  - Etc., etc.,
- Commercial development with HTC Pure Energy

# IEAGHG Weyburn-Midale Project

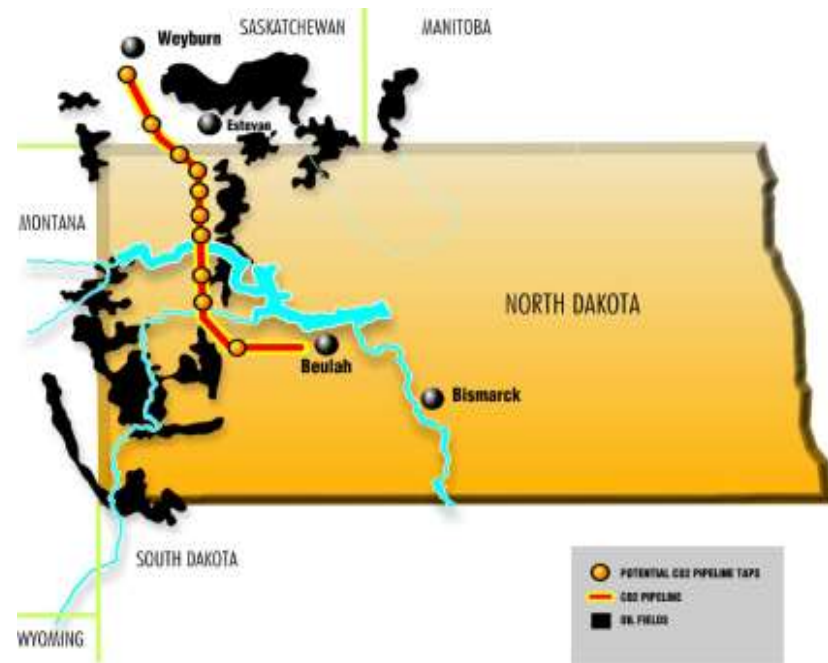


- First fully monitored CO<sub>2</sub>-EOR project
- Second major international collaborative storage research project
- Established best practise for monitoring
- Demonstrated fate of CO<sub>2</sub> using seismic monitoring
- Demonstrated importance of baseline monitoring
  - Supposed leak from site was disproved based on baseline monitoring
  - New technique by University of Texas based on C isotope analysis showed baseline data not critical

# Lets not forget!



- 1<sup>st</sup> cross border CO<sub>2</sub> pipeline
- Impurities present H<sub>2</sub>S and mercaptans
- Permitted and constructed without issue
- No operational issues reported – continuous supply to Cenovus



**350km overland pipeline**

# Boundary Dam – the first commercial scale CCS demonstration Project



# IPCC AR5 WGIII Negativity to CCS



- “Components in use but not applied at large scale!”
  - What about; Sleipner, InSalah, Air products etc etc.,
- **“No commercial scale CCS power plant”**
  - A fair comment would have been;  
**“No commercial scale CCS power plant in operation but several under construction and close to operation”**



# PCC Scale up

- China building 1GW ultrasupercritical pf boilers in 2010
  - Yuhuan plant at 45% efficiency
- Belchatow, Poland largest lignite fired ultrasupercritical pf boilers at 858MW
  - 42% efficiency

BD WA Parish



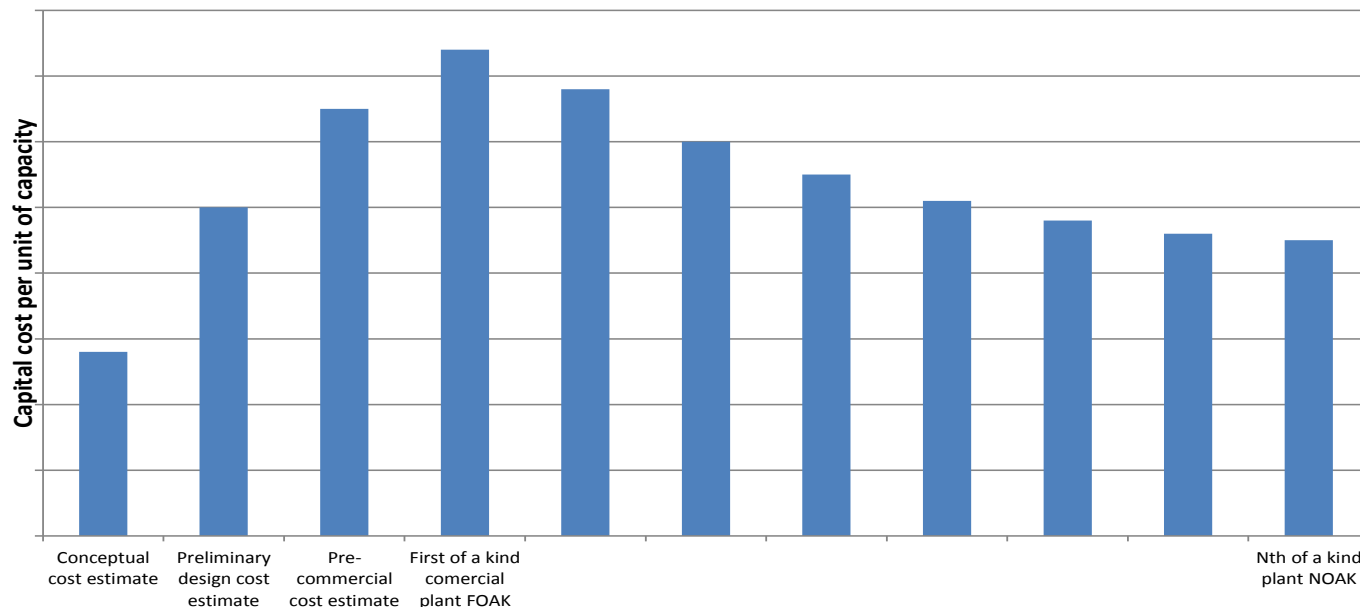
- At appropriate scale for partial capture market in USA
- Need another scale up operation in due course for EU/Asian markets
- Scale up well within chemical engineering norms





# Reducing cost is key

- Reducing cost via technology learning/replication
  - Experience from other technologies could reduce costs by up to 20%



# Cost reduction



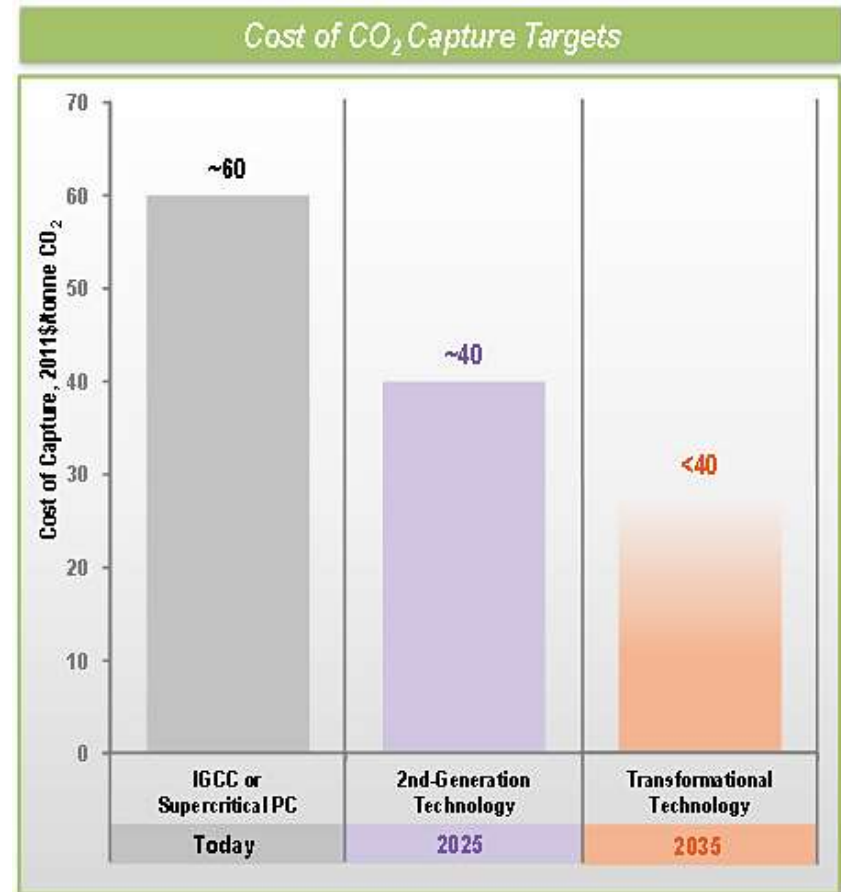
- Competitive market situation
  - Some 20 technology vendors which is a healthy situation
  - Vendor in China – demonstrated capture costs about 50% lower than US/EU costs
- Technology innovation
  - Key to driving down costs significantly
  - Major research activities underway coupled with scale up testing

# Reducing PCC energy penalty and costs



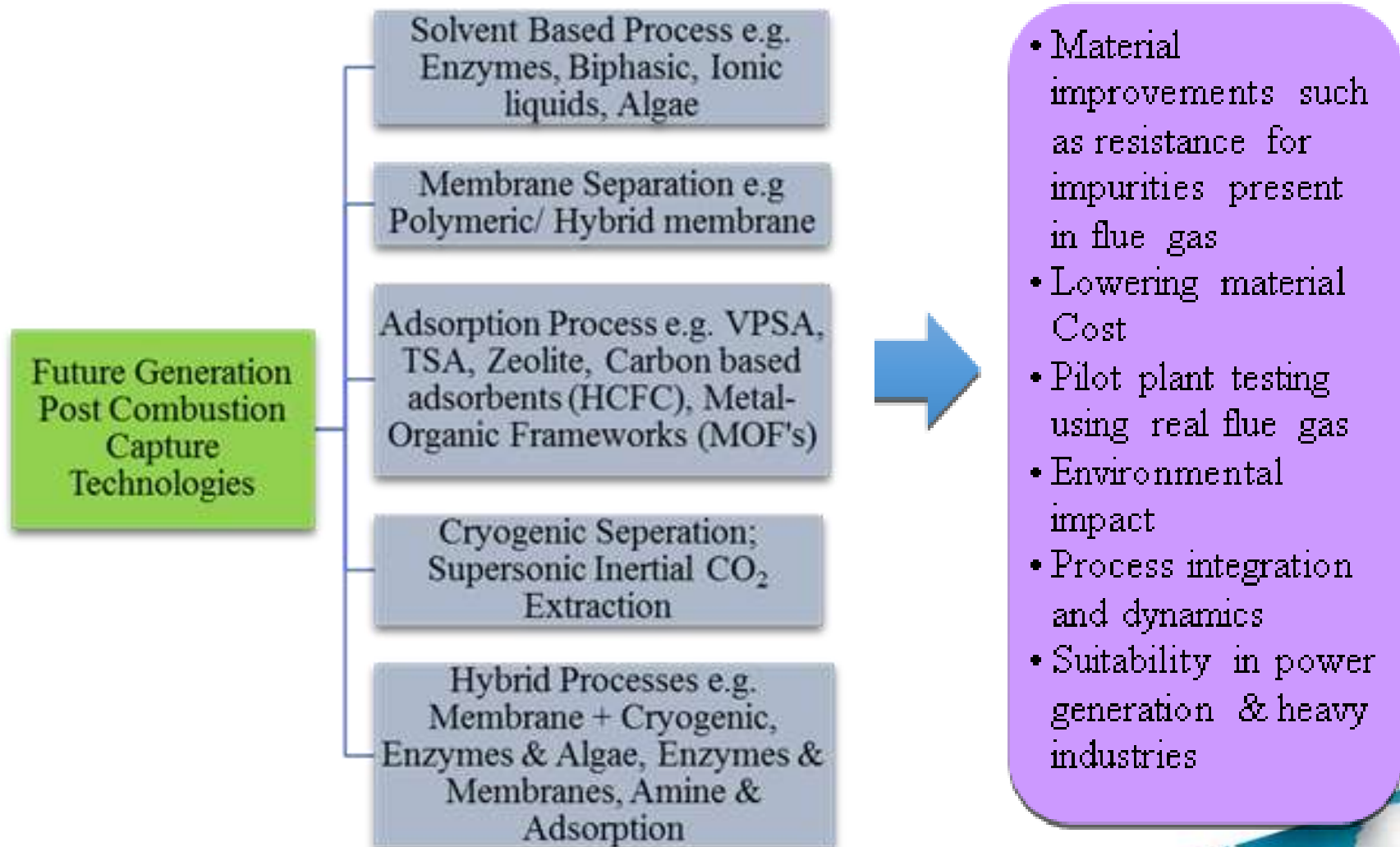
## USDOE Carbon Capture Programme

- Develop 2nd-Generation technologies that:
  - Ready for demonstration in the 2020–2025 timeframe
  - Achieve capture costs of approximately \$40/tonne of CO<sub>2</sub> captured
- Develop Transformational technologies that:
  - Are ready for demonstration in the 2030–2035 timeframe
  - Achieve capture costs of less than \$40/tonne of CO<sub>2</sub> captured

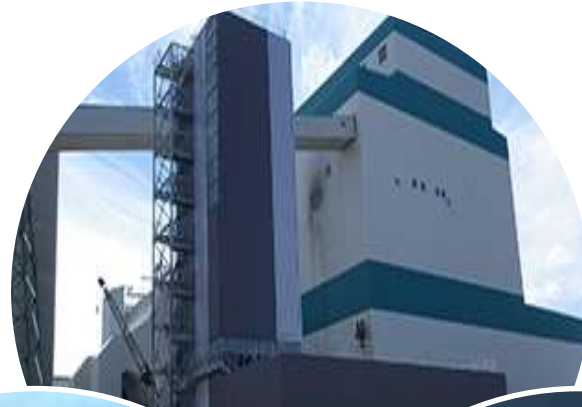


Source: USDOE/NETL

# Next Generation post combustion capture options



# Scale up of new generation capture technology



**Carbon Capture  
Test Facility**

**National Carbon  
Capture Centre**



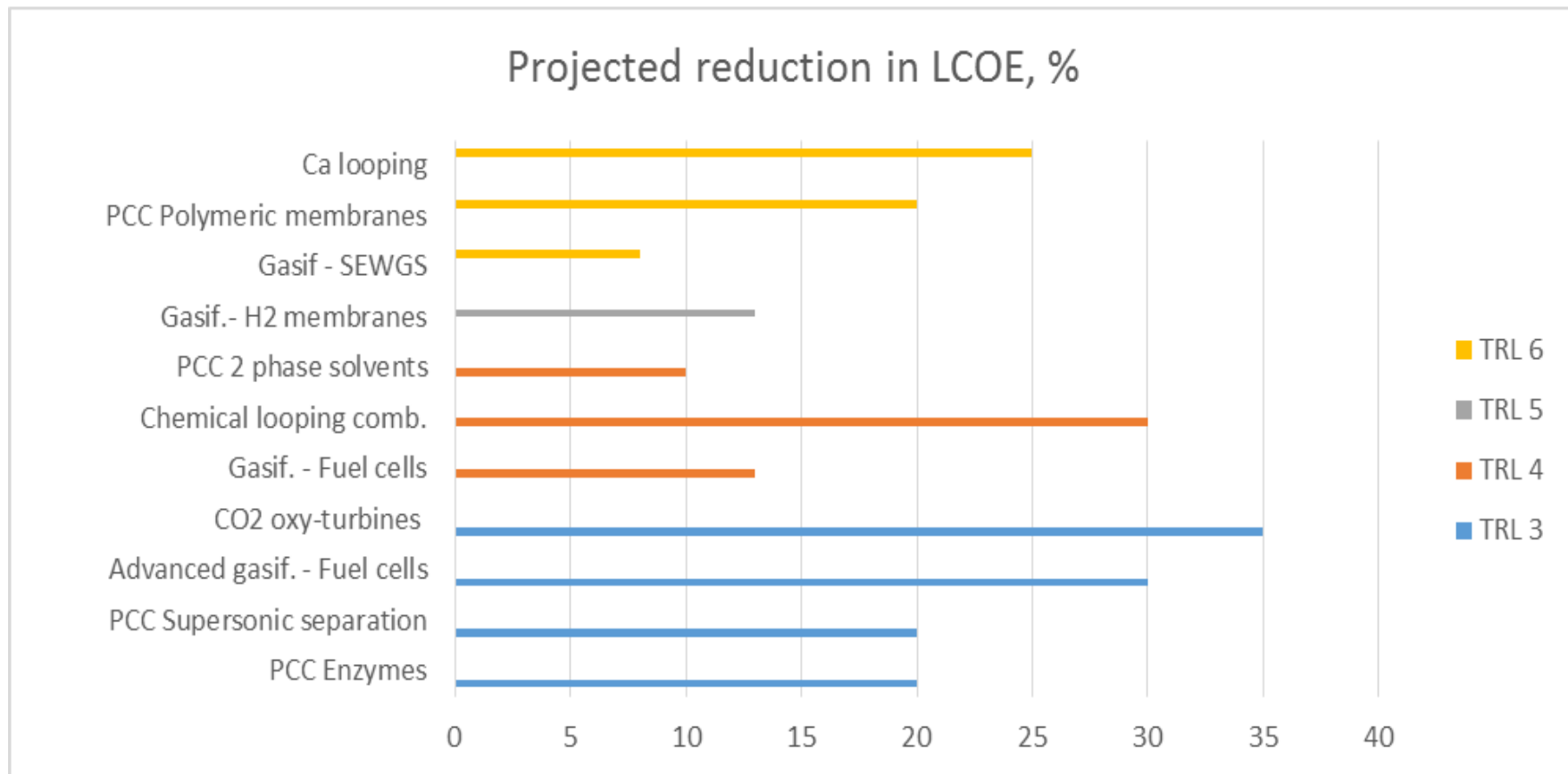
**Test Centre  
Mongstad**



**International Test Centre Network**



# Assessing the potential for cost reduction



Note: The extent of the each bar indicates the projected cost reduction for each technology and not the range of expected cost reductions

# Can we go any faster?



- Scaling up capture technology at a rate consistent with good Chemical Engineering practise
- Solved issues with solvent degradation as we have scaled up
- Pipeline scale up not an issue
- CO2-EOR is good for now but we must move beyond that soon
- Availability of geological storage globally is the rate determining step
- Issues re storage could be present challenges along the way
  - Integrity/environmental impacts
  - Induced seismicity – the new public battleground?





# Summary



- SaskPower/Saskatchewan have been at the forefront of CCS development for ~15 years
- They will continue in that mode in the future
- The eyes of the world will not move from Saskatchewan for months to come.
- What do we need from you:

A SUCCESSFUL START UP AND DEMONSTRATION

**NO PRESSURE MIKE!!!!!!**

# Co-operation continues



## Save the Date: PCCC3

Regina, Canada, 8<sup>th</sup> – 11<sup>th</sup> September 2015



IEAGHG is proud to announce next PCCC3 conference to be hosted by SaskPower, Saskatchewan, Canada. The conference will build on the success of PCCCs1 and 2 and will focus on current PCC issues, developments and future trends in CO<sub>2</sub> post combustion capture technology. PCCC3 will also host a special session to showcase the first year operation experience from CO<sub>2</sub> capture facility at Boundary Dam. Delegates will also have the opportunity to visit the CO<sub>2</sub> capture facilities at Boundary Dam and Shand Power Stations.

### Topics to be covered at PCCC3:

- Amine based solvent development
- Biphasic solvents
- 2<sup>nd</sup>/3<sup>rd</sup> generation capture technology
- Capture process modelling
- Process integration & economics
- Process scale up, operational flexibility and risk analysis
- Pilot plant & demonstration projects
- Demonstration project regulatory issues & lessons learnt
- Environmental impacts
- Equipment corrosion issues
- Industrial application

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Or visit our website: [www.ieaghg.org](http://www.ieaghg.org)

*Boundary Dam, Saskatchewan, Canada*





# Thank you

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