

Energy Innovation to Suit Tomorrow's Market

Presentation to

Combustion Canada Conference

September 21 –24, 2003

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Alberta Energy Research Institute**

WWW.AERI.AB.CA



Alberta Energy Research Institute (AERI)

Bill 7 (ASRA Amendment Act 2000) dissolved AOSTRA and established AERI

From:

**Oil sands technology
and research**



To:

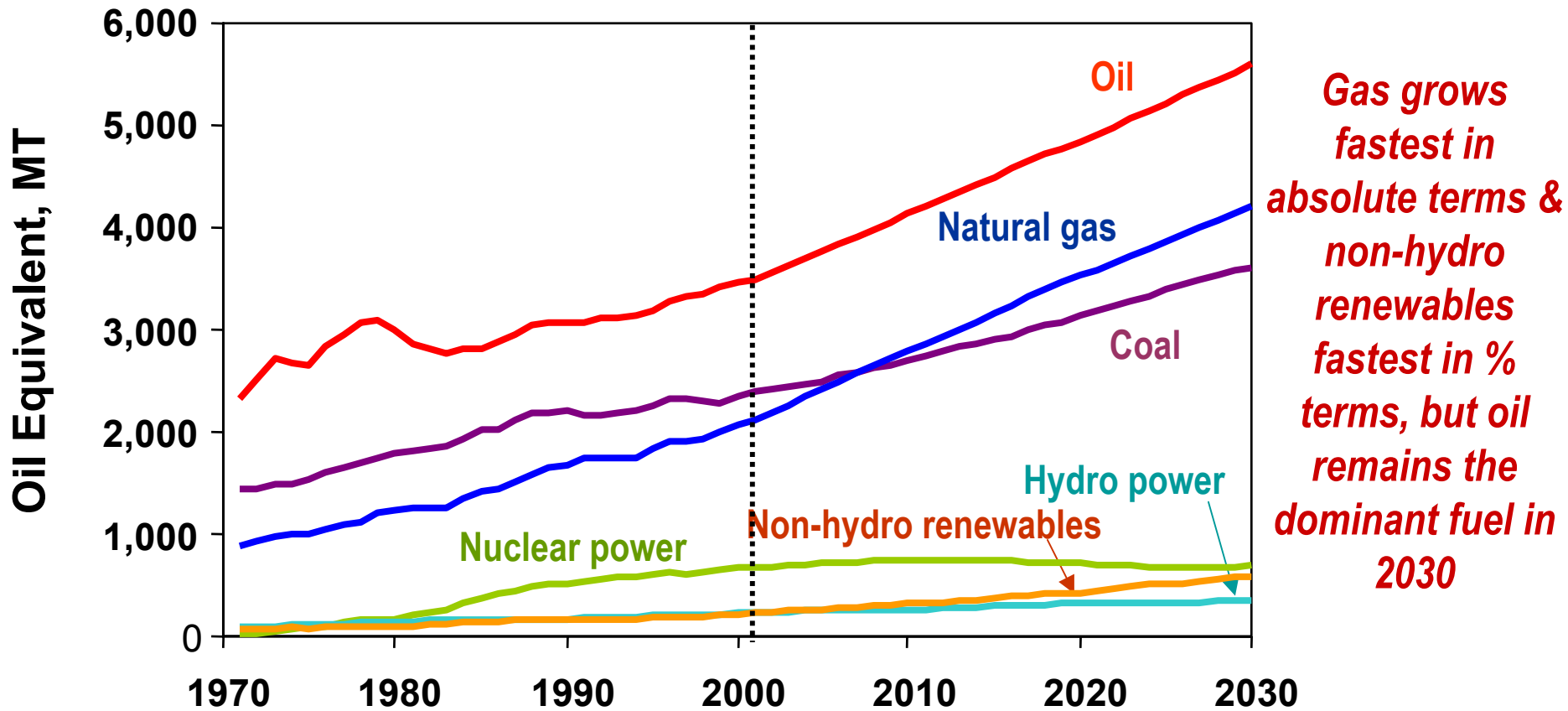
**Research on all forms
of energy**

Mission: Enhance the development of energy resources in the Province through technology and innovation

Mandate: Position Alberta for the future in energy

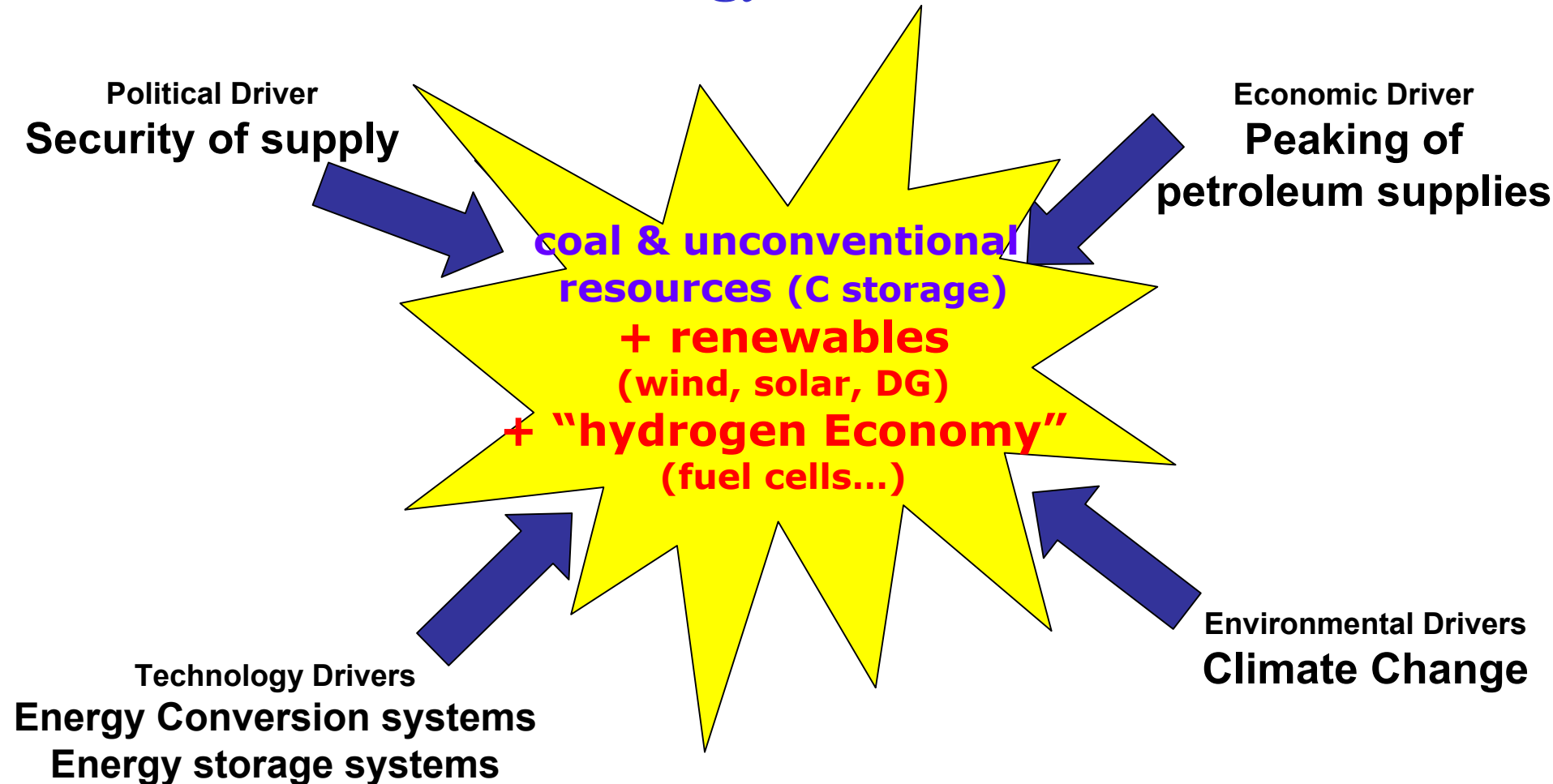


Scenario of World Energy to 2030



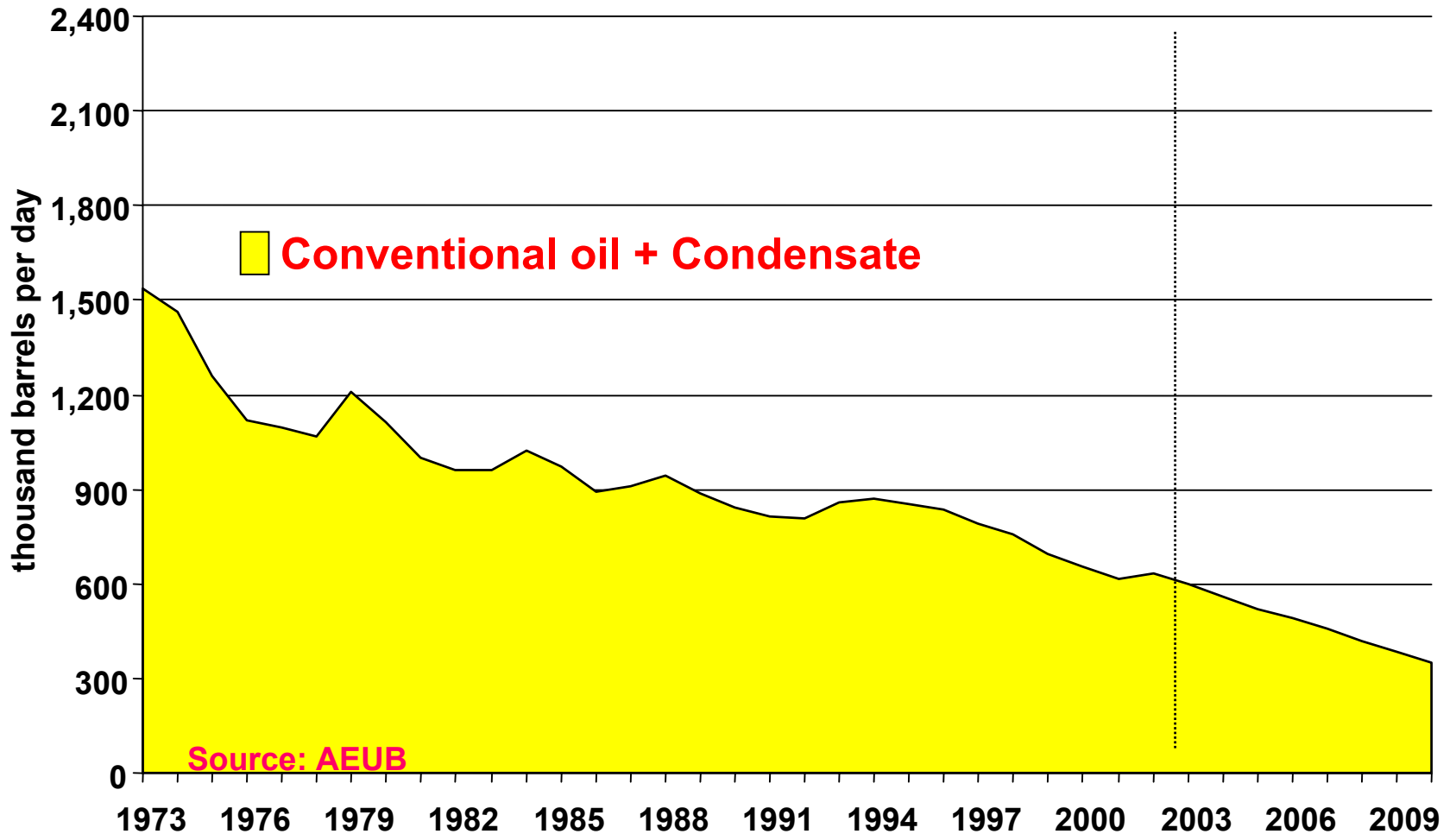


Major Drivers Leading to Energy Technology Discontinuities



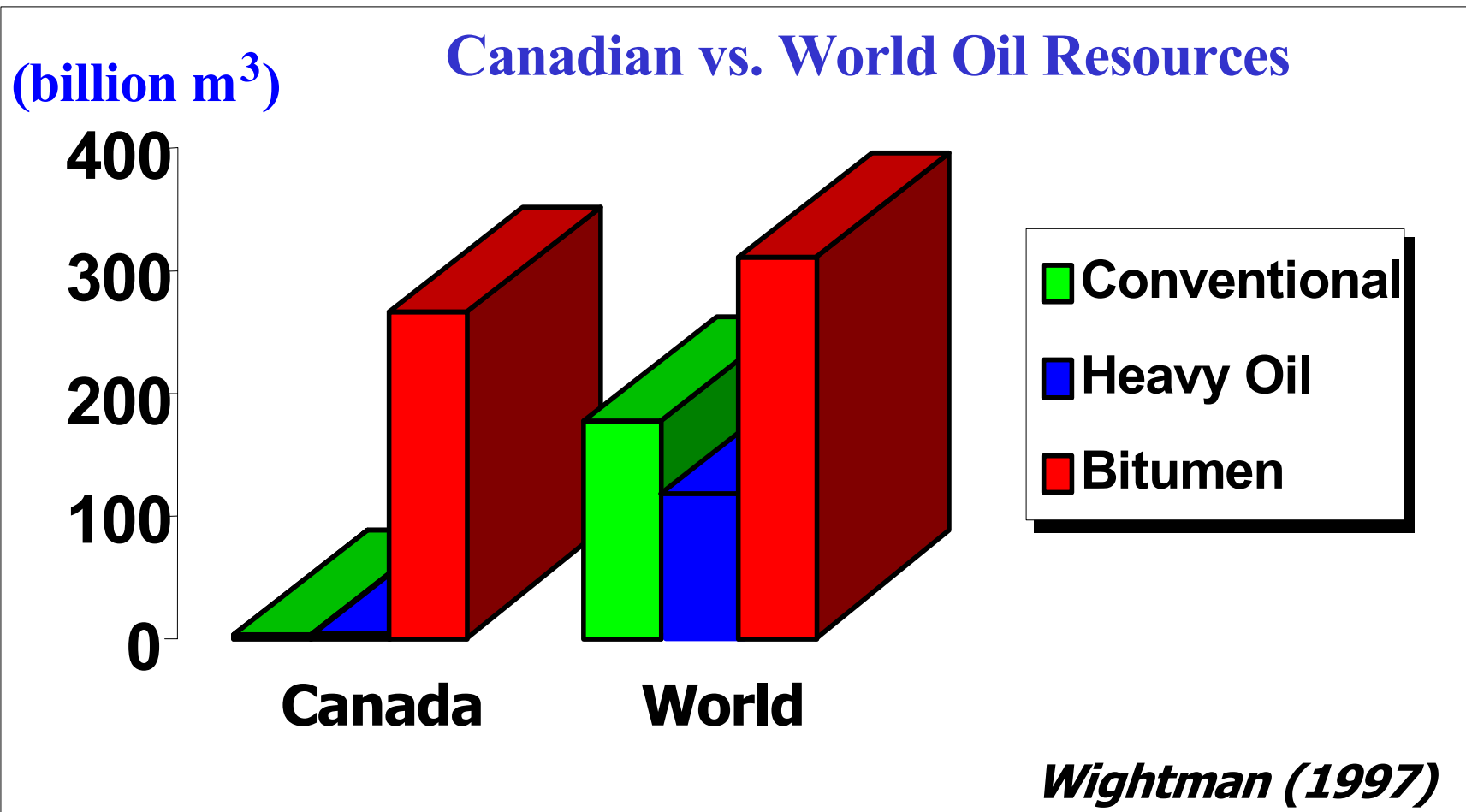


Alberta Conventional Liquid Petroleum Production (1973 - 2010)





Huge Oil Sands Resources

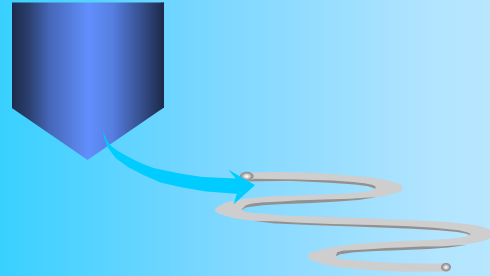




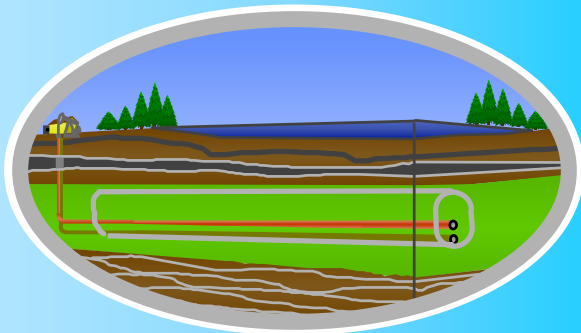
Reductions in Production Cost is Driven by Technology (Oil Sands Example)



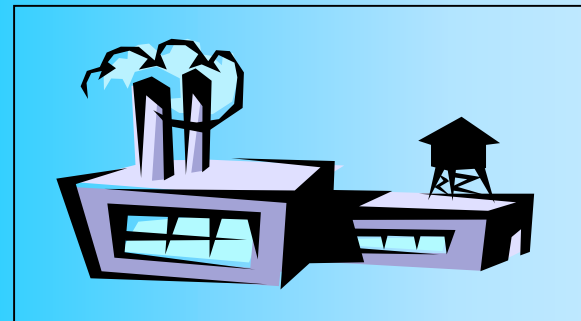
Truck & Shovel



Low Energy Extraction and Hydrotransport



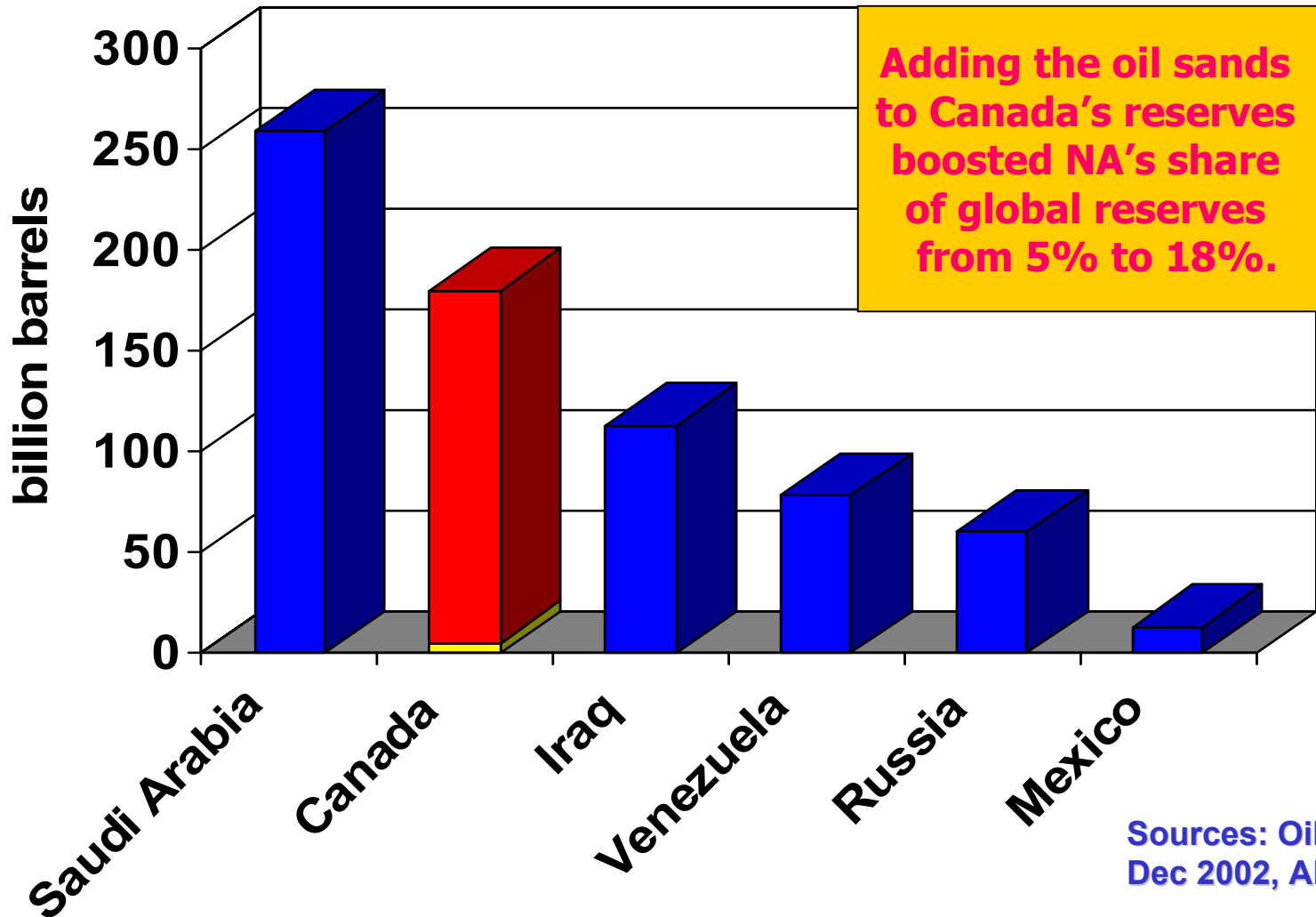
**SAGD
Horizontal Wells**



Co-Gen Power Plants



Proven World Reserves





Oil Sands Projects in 3 Deposits



- | | |
|---|--|
| <p>Syncrude ✕
 Albian (Shell) ✕
 True North (Koch) ✕
 Japan Canada Oil Sands
 Exxon Mobil ✕
 Pan Canadian
 Deer Creek</p> | <p>Suncor ✕
 Gulf
 PetroCan.
 Northstar
 CNRL ✕
 Opti
 SynEnCo ✕</p> |
| <p>Alberta Energy
 Cdn Natural Resources (CNRL)</p> | |

- | |
|-------|
| Shell |
|-------|

- | | |
|---|---|
| <p>Imperial Oil
 Alberta Energy
 Cdn Natural Resources
 Petrovera
 Black Rock</p> | <p>Koch
 Murphy
 Suncor
 Husky
 Numac</p> |
|---|---|

✕ Mining; Others "InSitu"

Current production

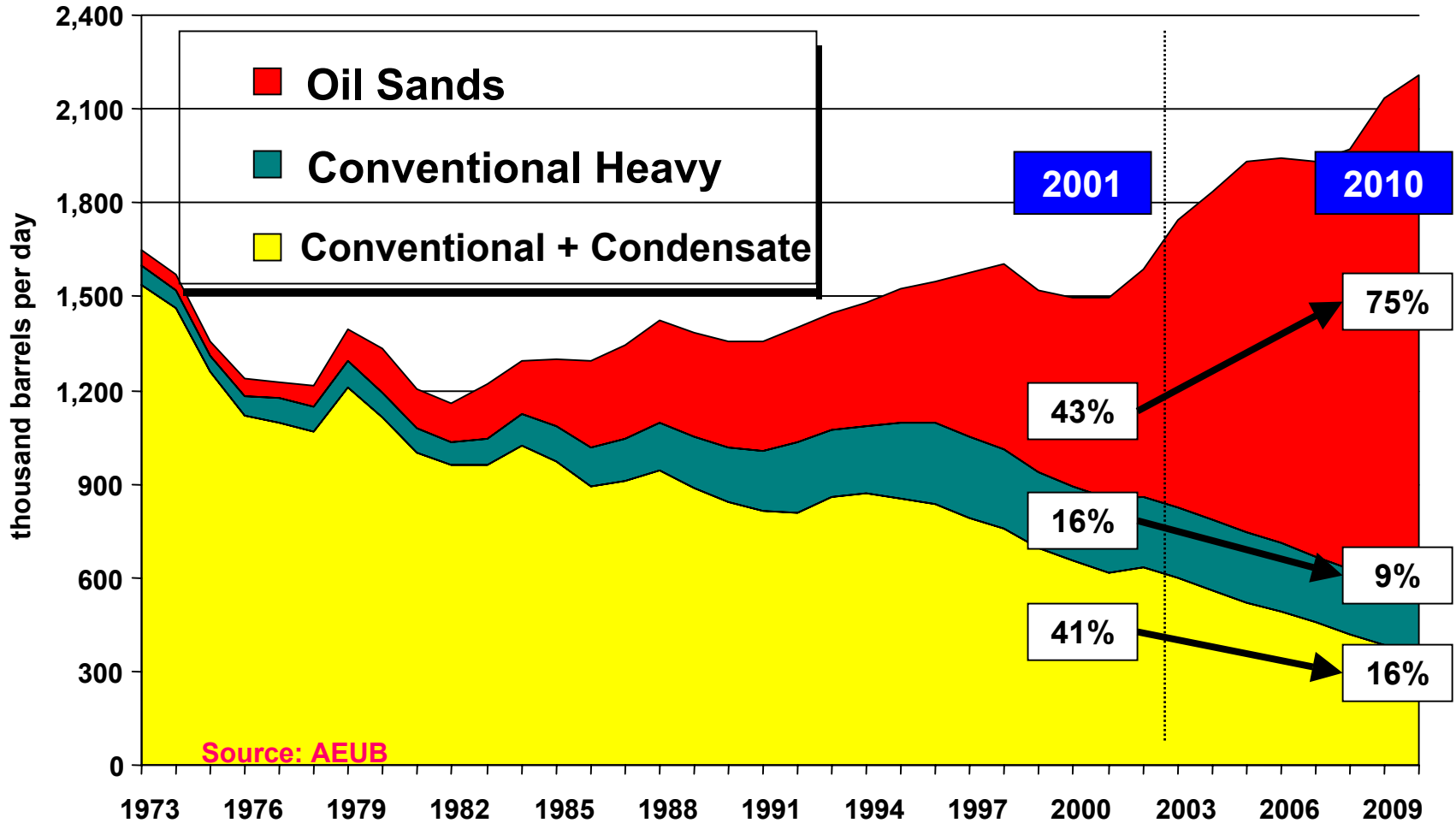
- 830,000 bbls/day

Projects

- Announced \$86 Billion
- Planned \$54 Billion
- Completed \$17 Billion



Alberta Liquid Petroleum Production (1973 - 2010)





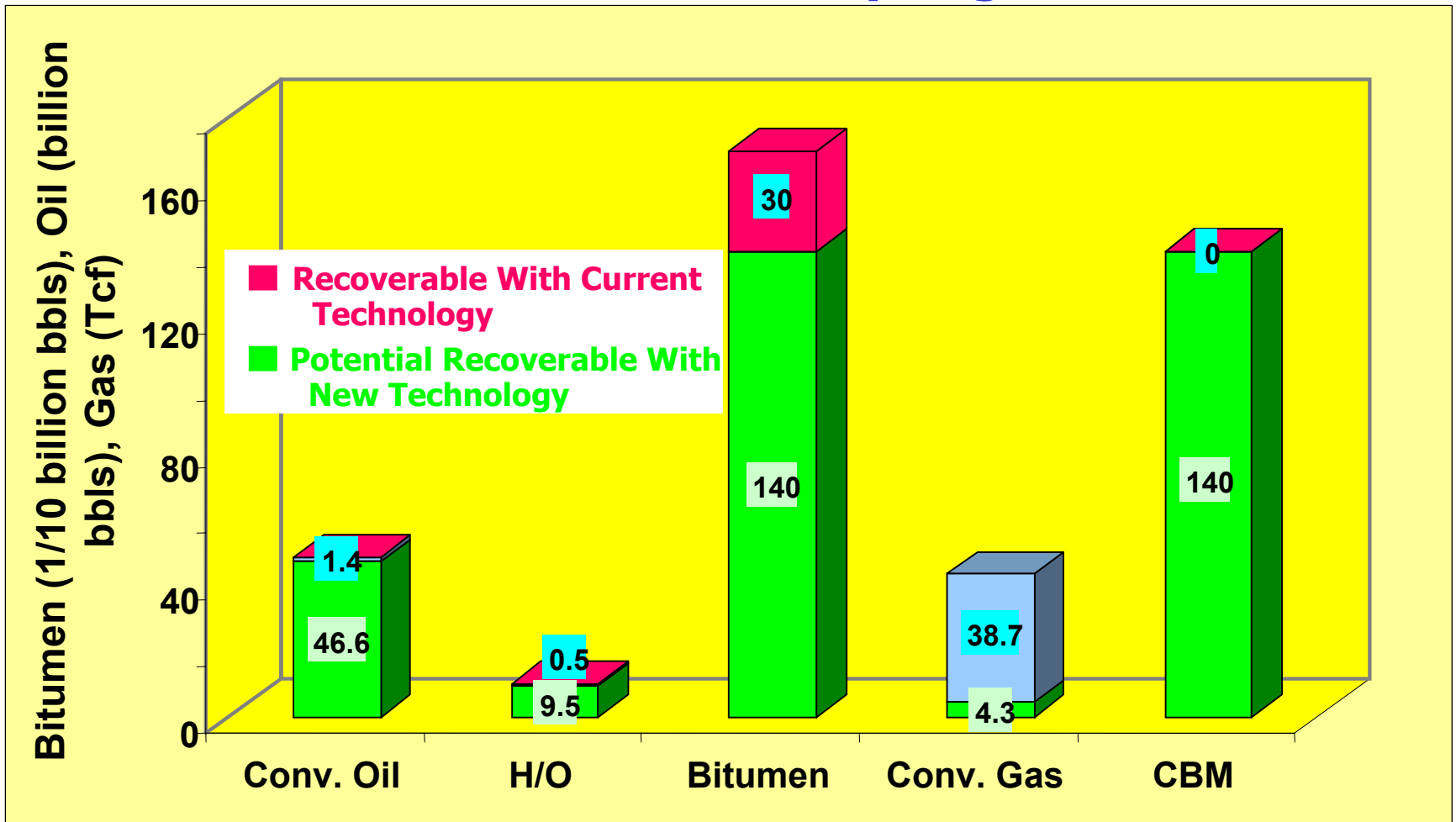
Today's Serious Challenges

- Maturing WCS Basin
 - ❑ Conventional crude production decline
 - ❑ Conventional natural gas near peak
- High gas prices and tight supplies threaten
 - ❑ Oil sands upgrading (huge H₂ demand)
 - ❑ Thermal recovery
 - ❑ Petrochemical manufacturing
- Bitumen and synthetic crude market limitations
- Emission control costs high
 - ❑ SO_x, NO_x , PM, Hg, CO₂
- GHG emissions – additional business risks



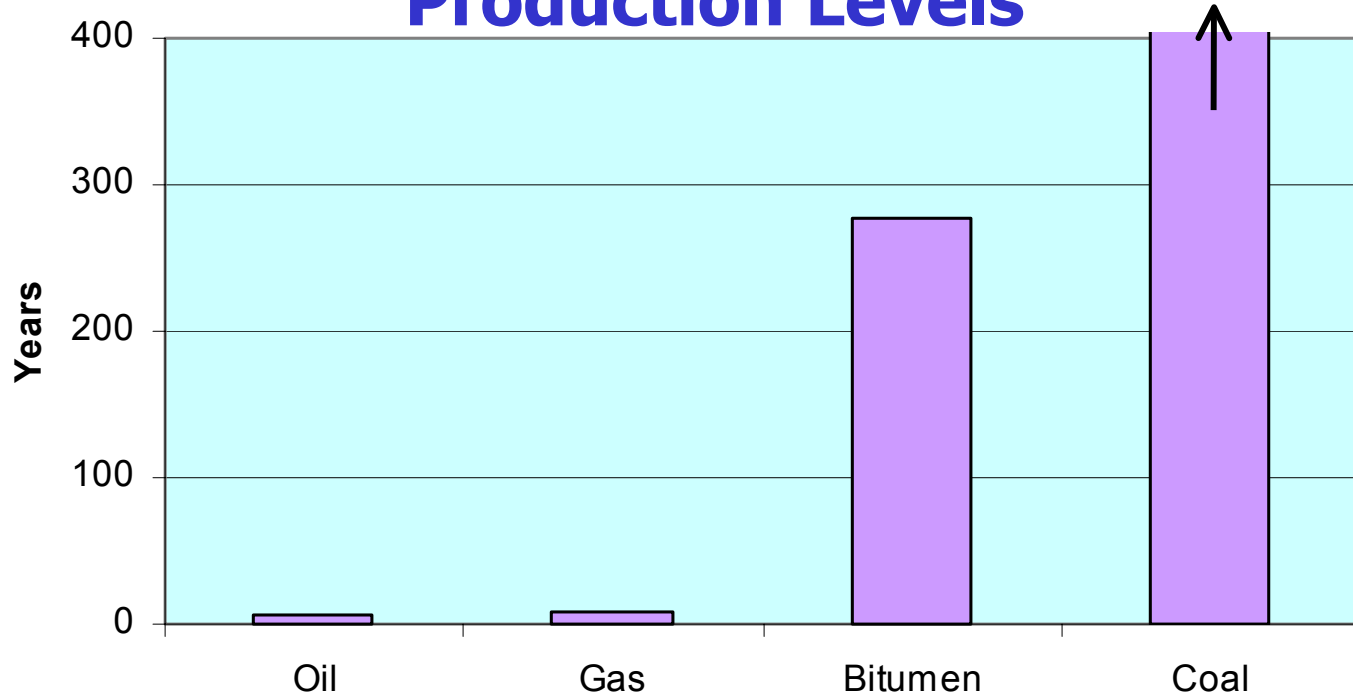
The Opportunities

The potential recoverable energy with new technology is extremely large





Alberta: Remaining Resource Life at Current Production Levels



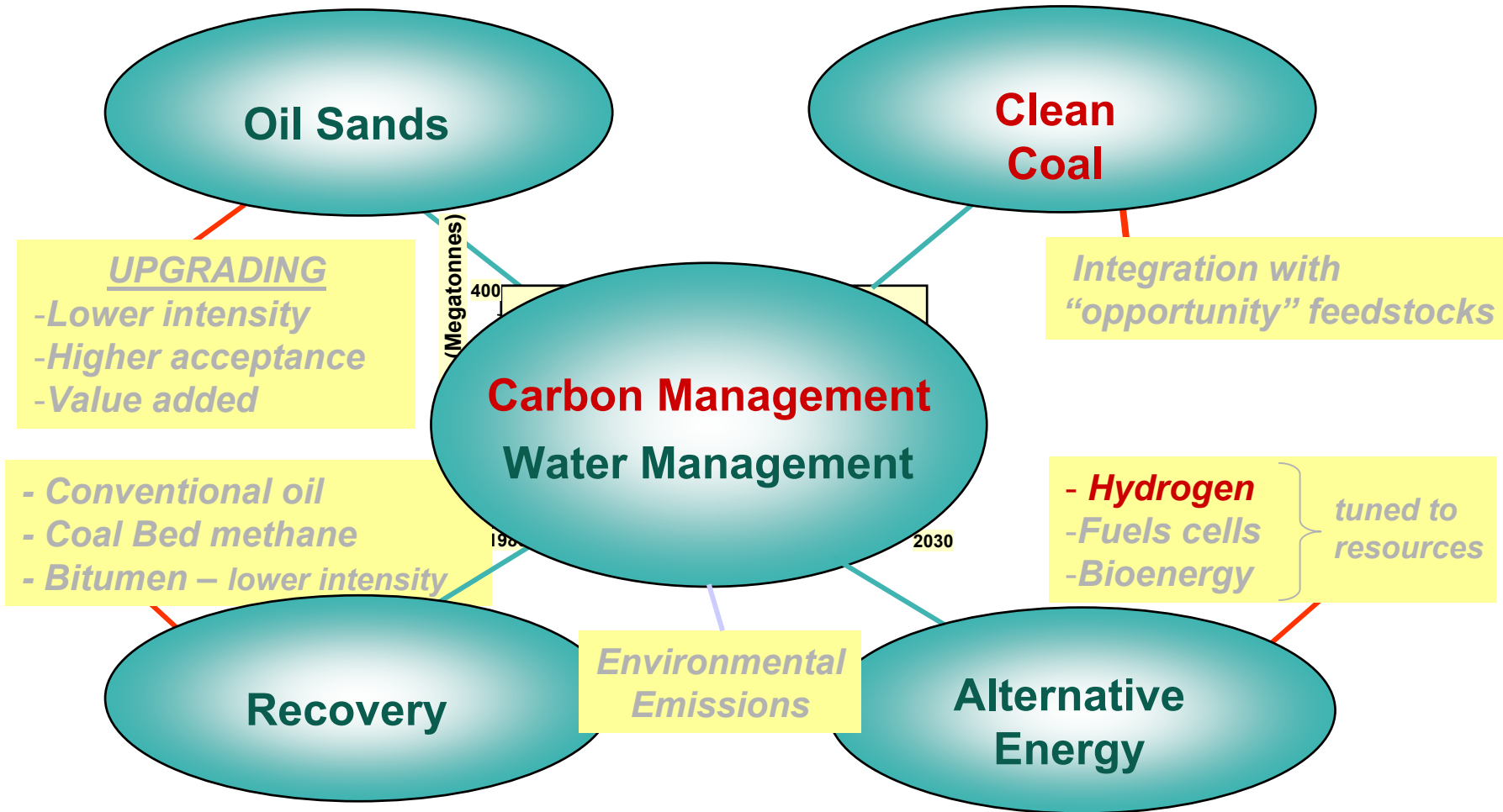
	Oil	Gas	Bitumen	Coal
	Million m3	Million m3	Million m3	Mill tonnes
Remaining Reserve	291	1211	27,810	34,000
Annual Production	43.5	140.7	100.23*	34
Years	6.7	8.6	277	1000

•Based on projected oil sands production of 1.8 million barrels per day by 2012

Source: Alberta Energy Utilities Board Statistical Series 2002- 98



Technology and Innovation Strategy Priority Areas





H₂ Use in Alberta

- On a per capita basis Canada is one of the largest producers and consumers of hydrogen in the world - about 1.75 million tonnes per year
- Over 70% of this production is in Alberta
 - ❑ About 750,000 tonnes of the Alberta production is used in for Upgrading & Refining of oil
 - ❑ Made from SMR of Natural Gas



Worldwide Hydrogen Production

<u>Raw Material</u>	<u>H₂ Production</u>
Natural gas	48%
Oil	30%
Coal	18%
Water (electrolysis)*	4%

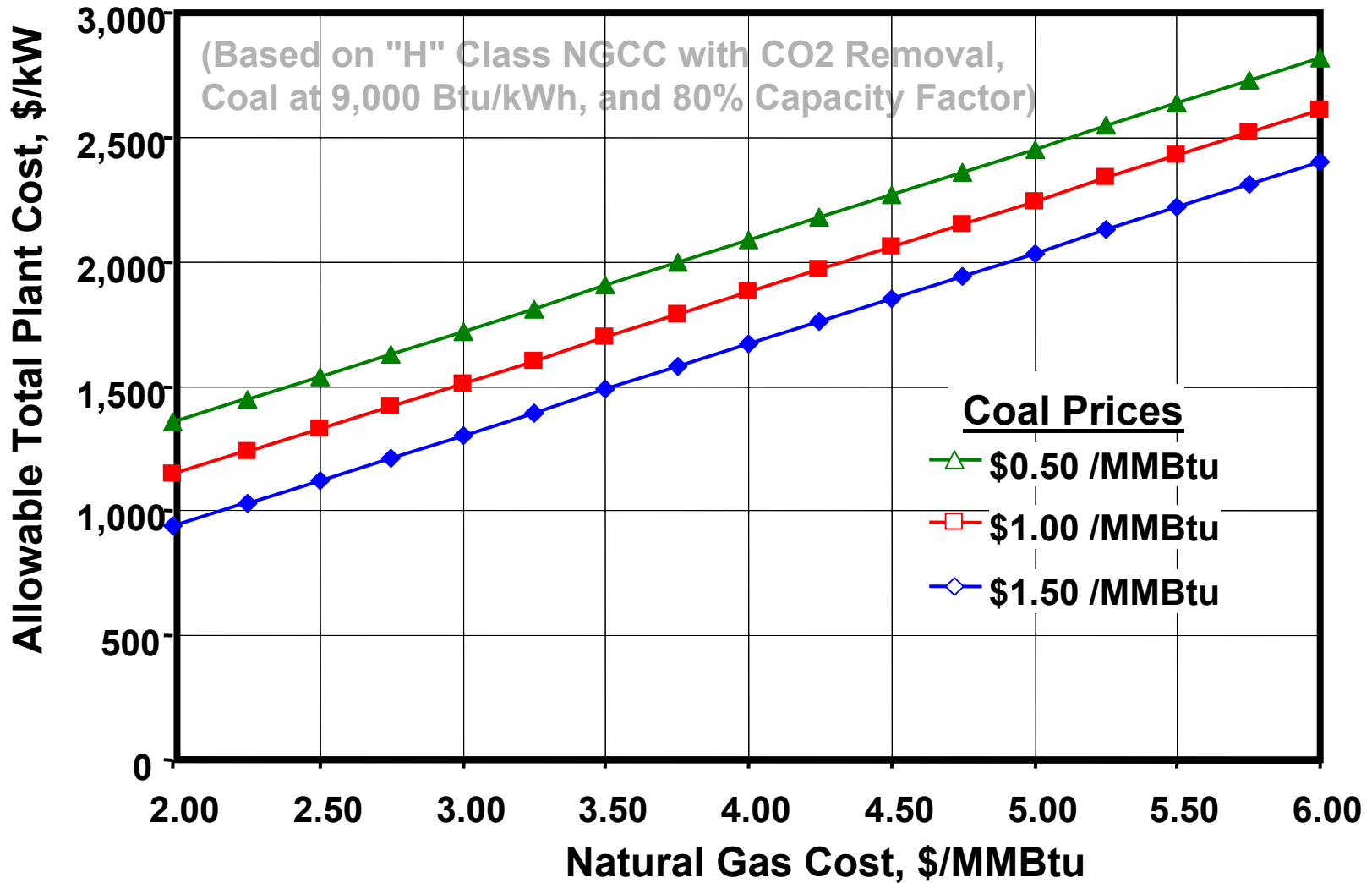
Global Production

- ~400 million m³/y
(equivalent to 10% of world oil production)

*** About 40 kW-h of electricity to produce 1 kg of H₂ which is equivalent to about 4 liters of gasoline**

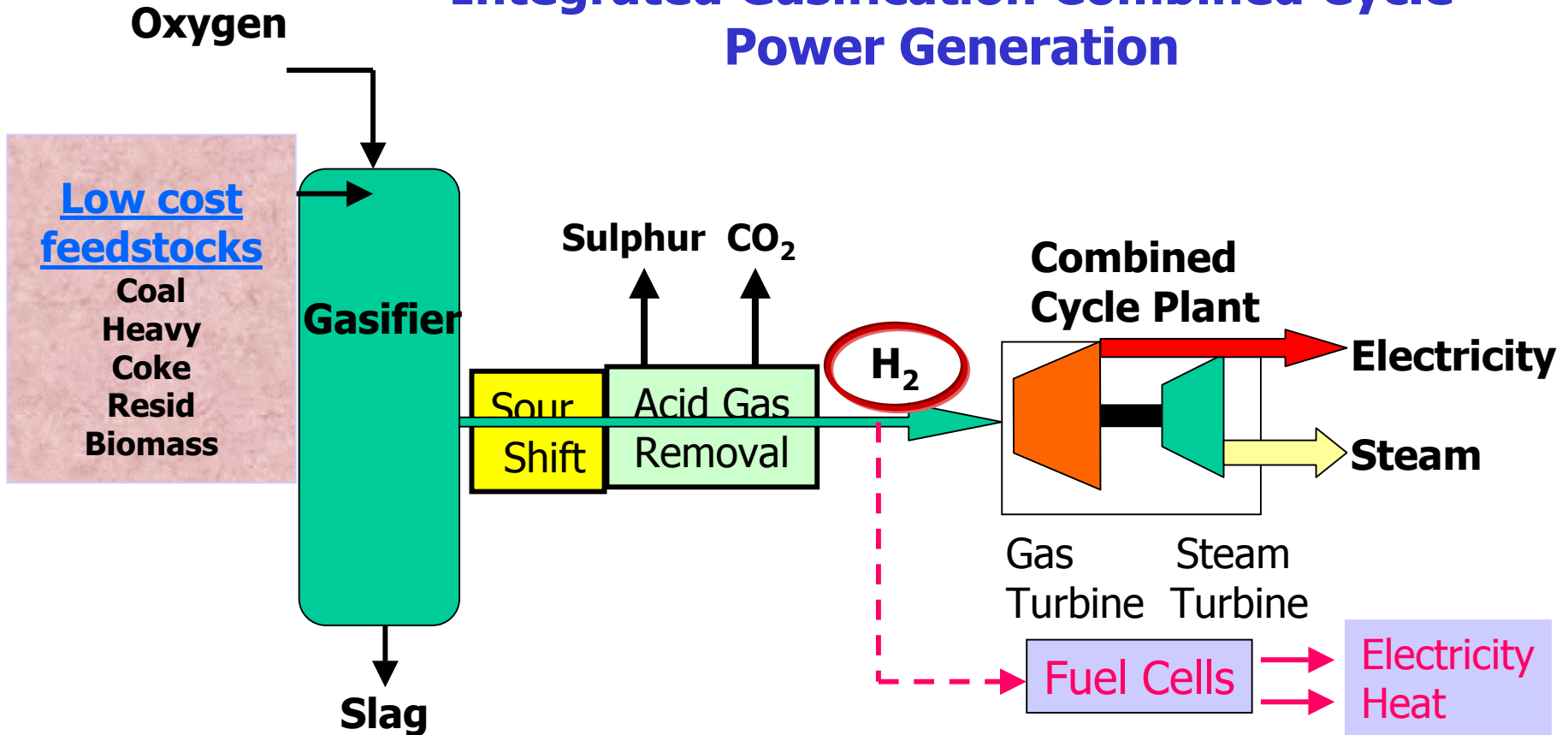


Allowable Coal Plant Capital Costs





Integrated Gasification Combined Cycle Power Generation



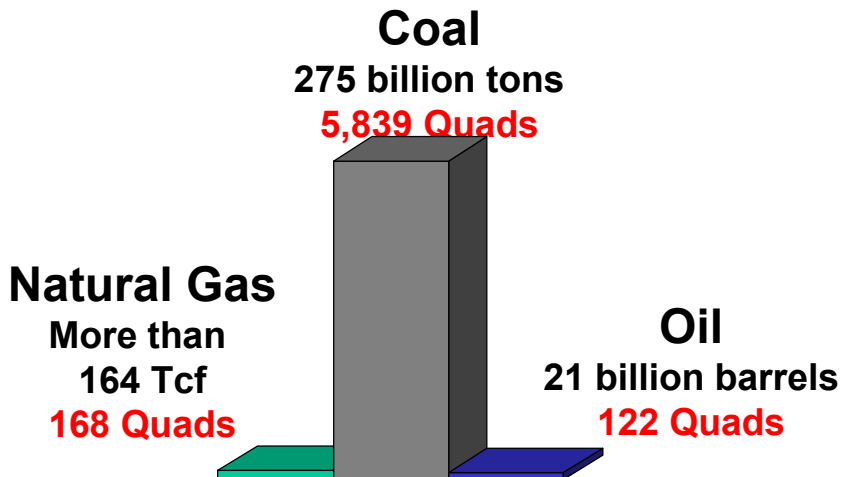
*IGCC has the best potential for commercial production of clean power
With near zero emissions within the next 5 to 10 years*



U.S. Focus on coal (Hydrogen and Carbon Management)

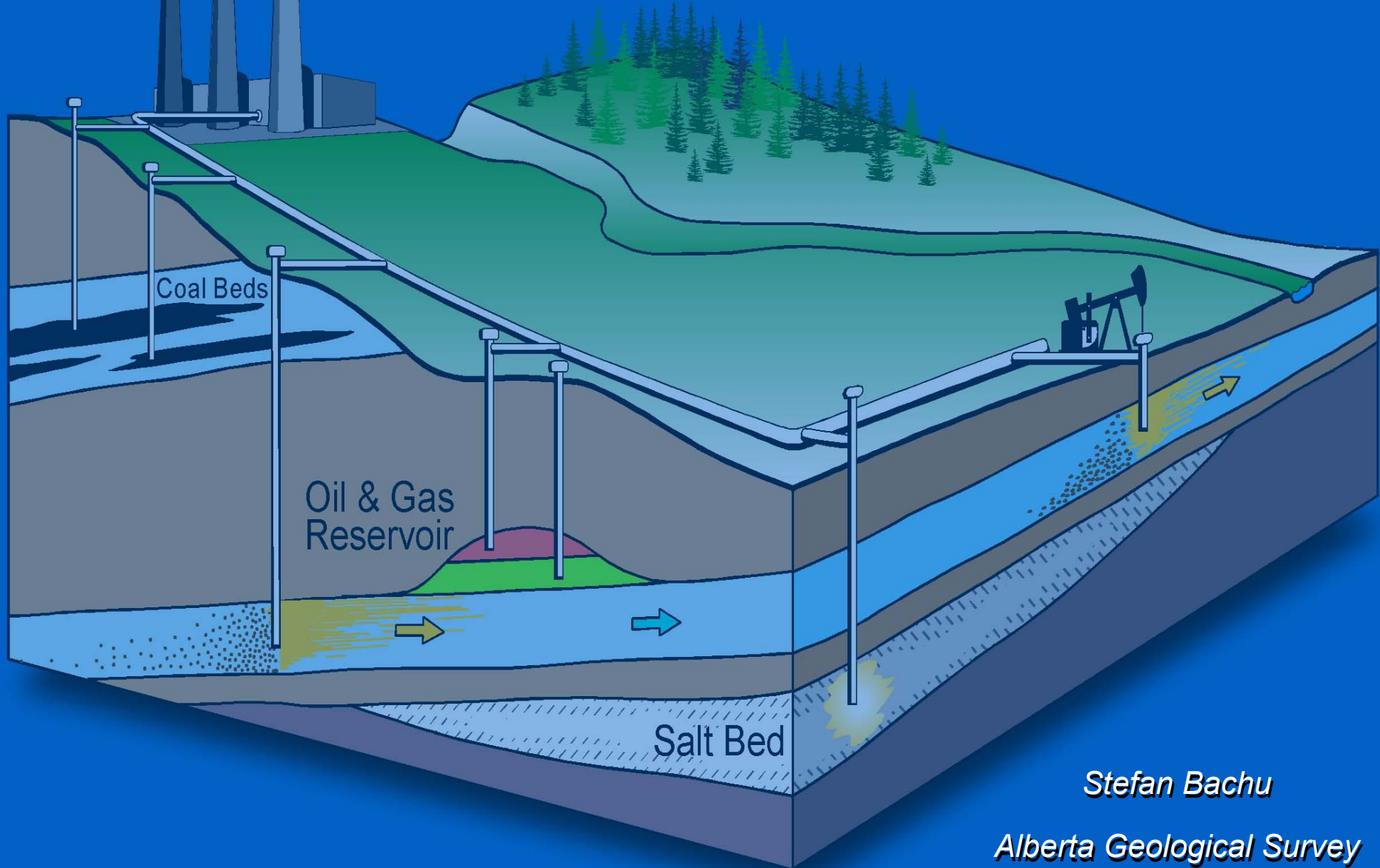


- FutureGen - \$1billion U.S. investment over 10 years
 - ❑ Plant - 275-megawatt (net)
 - ❑ Coal to hydrogen
 - ❖ Building on Solid-state Energy Conversion Alliance (SECA) - \$1 billion program
 - ❑ Reservoir storage (90% of CO₂ stored)
 - ❖ Carbon Sequestration Leadership Forum
 - 14 countries sign charter
 - Commercial-scale demos
 - ❖ Several hundred million funding for research (Stanford, MIT, National Labs)



Geological Sequestration of Carbon Dioxide

A Viable Solution for Western Canada

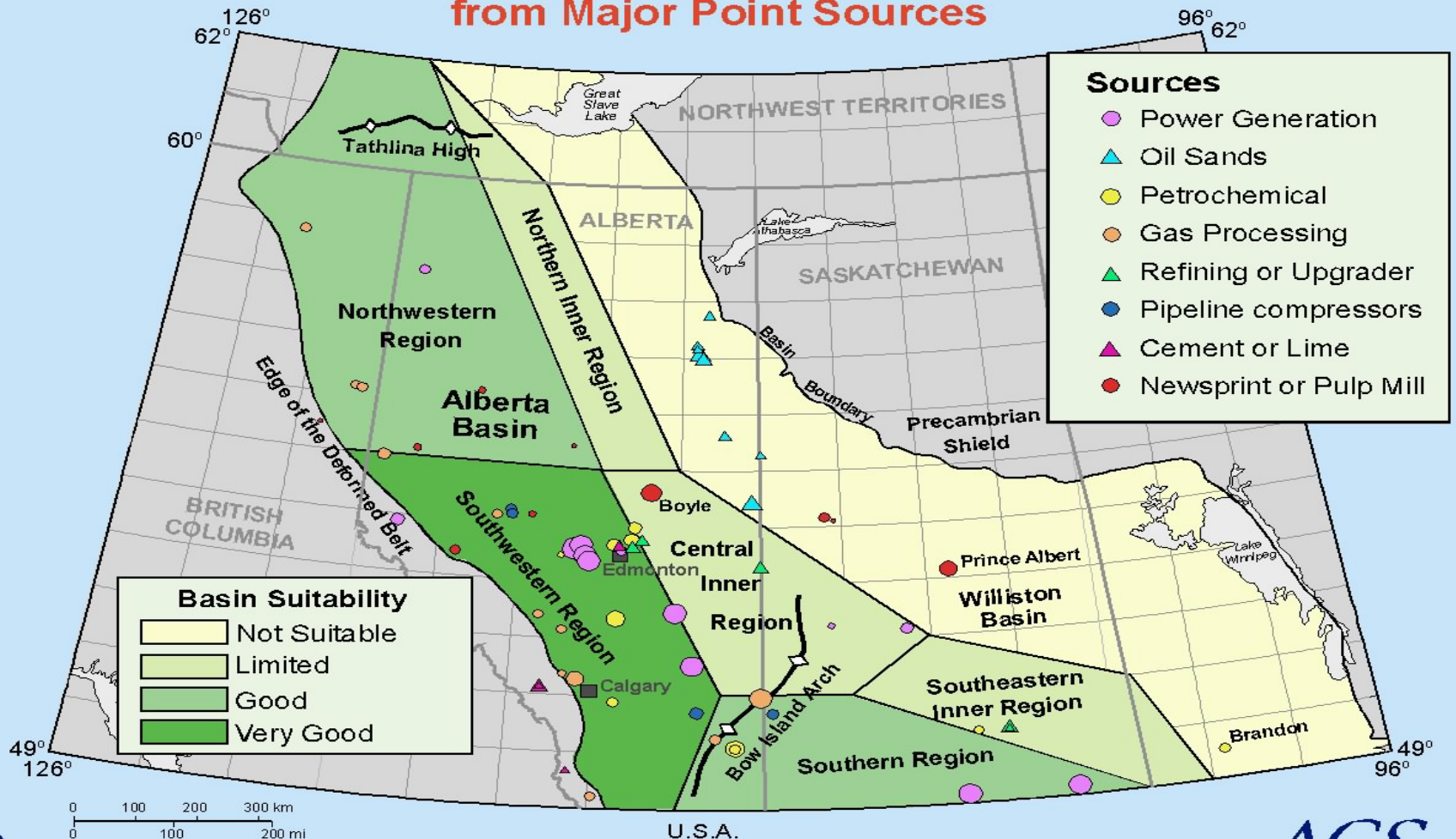


Stefan Bachu

Alberta Geological Survey



Basin Suitability for Geological Storage and Carbon Dioxide Emissions from Major Point Sources





*Workshops held May and September 2003 **

***"Developing the Canadian Network of Innovation
in Carbon Geological Storage"***

NRCan

Alberta Gov.

B.C. Gov

Environment Canada

U of R

ARC

AERI

Sask. Gov.

Nova Scotia

U of C

U of A

EUB:AGS

Industry

** These were the 3rd and 4th in a series of related workshops. The 3 western provinces organized first 2.*



Purpose of the Workshop

- Bring together experts and other diverse stakeholders to address climate change through carbon capture and storage.
- Develop strong commitment to collaborative and coordinated Canadian action to
"significantly accelerate implementation of commercial CO₂ storage projects"
- Lead to a plan for a serious commitment of resources and establishment of a collaborative effort drawing on the best minds available

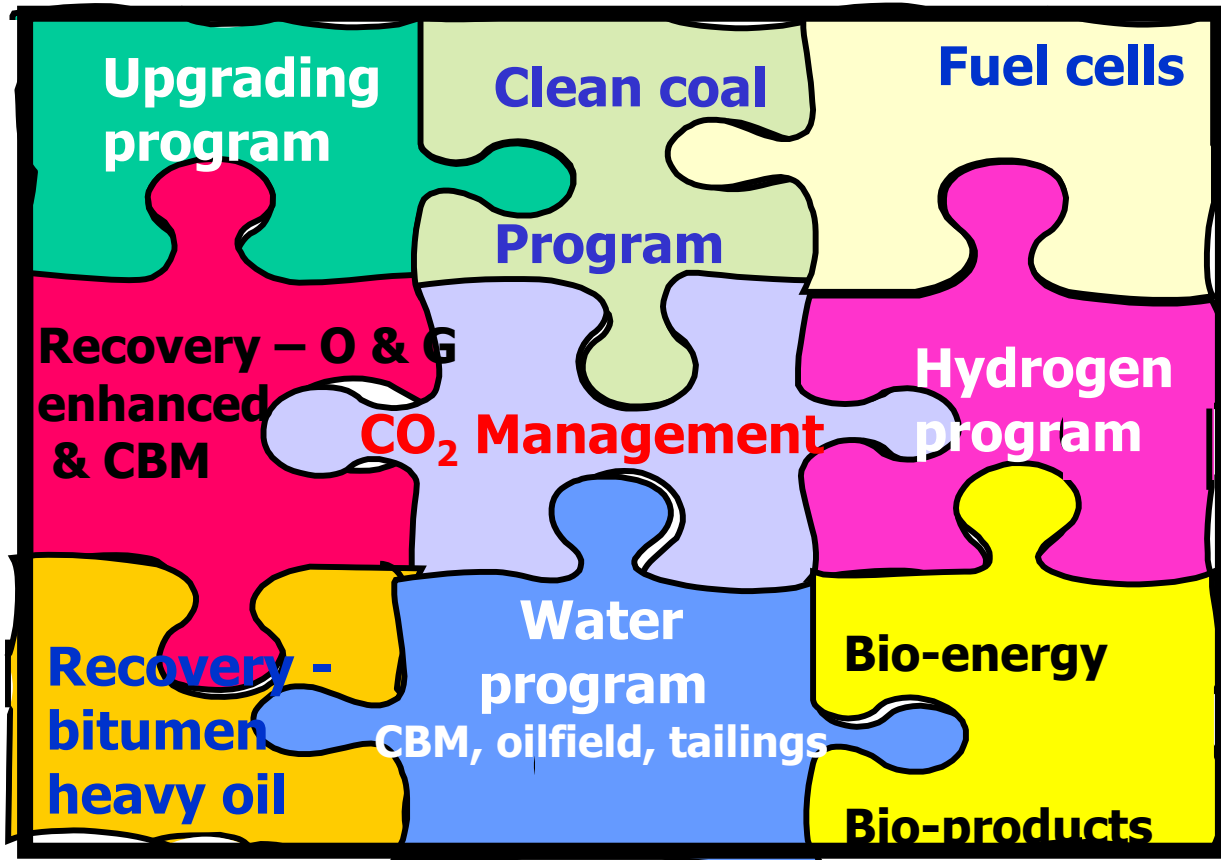


Next Steps for the Carbon Storage Network

- Timing is excellent to develop the Network
 - ❑ Federal climate change announcements
 - ❑ Alberta climate change plan
 - ❑ Other provinces
- Used the workshops to help set directions and enlist commitment
 - ❑ Prospectus
 - ❑ Consortium of Funders
 - ❖ Agreed upon principles
 - ❑ Hiring Program Director/CEO
 - ❑ Flesh out Business Plan
 - ❖ Agreed upon targets
 - ❖ Integrate all current projects, if possible



Conceptual model of Innovation Networks leading to an Integrated Energy Economy





Conceptual Model of Innovation Networks for an Integrated Energy Economy

Integration and Collaboration

