

Shaping an Integrated Energy Innovation Strategy for Alberta's Heavy Oil and Bitumen

Slugging It Out XII

"The Future is Heavy"

Petroleum Society of CIM & CHOA

March 29th, 2004

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Alberta Energy Research Institute***

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Alberta's Energy Resources



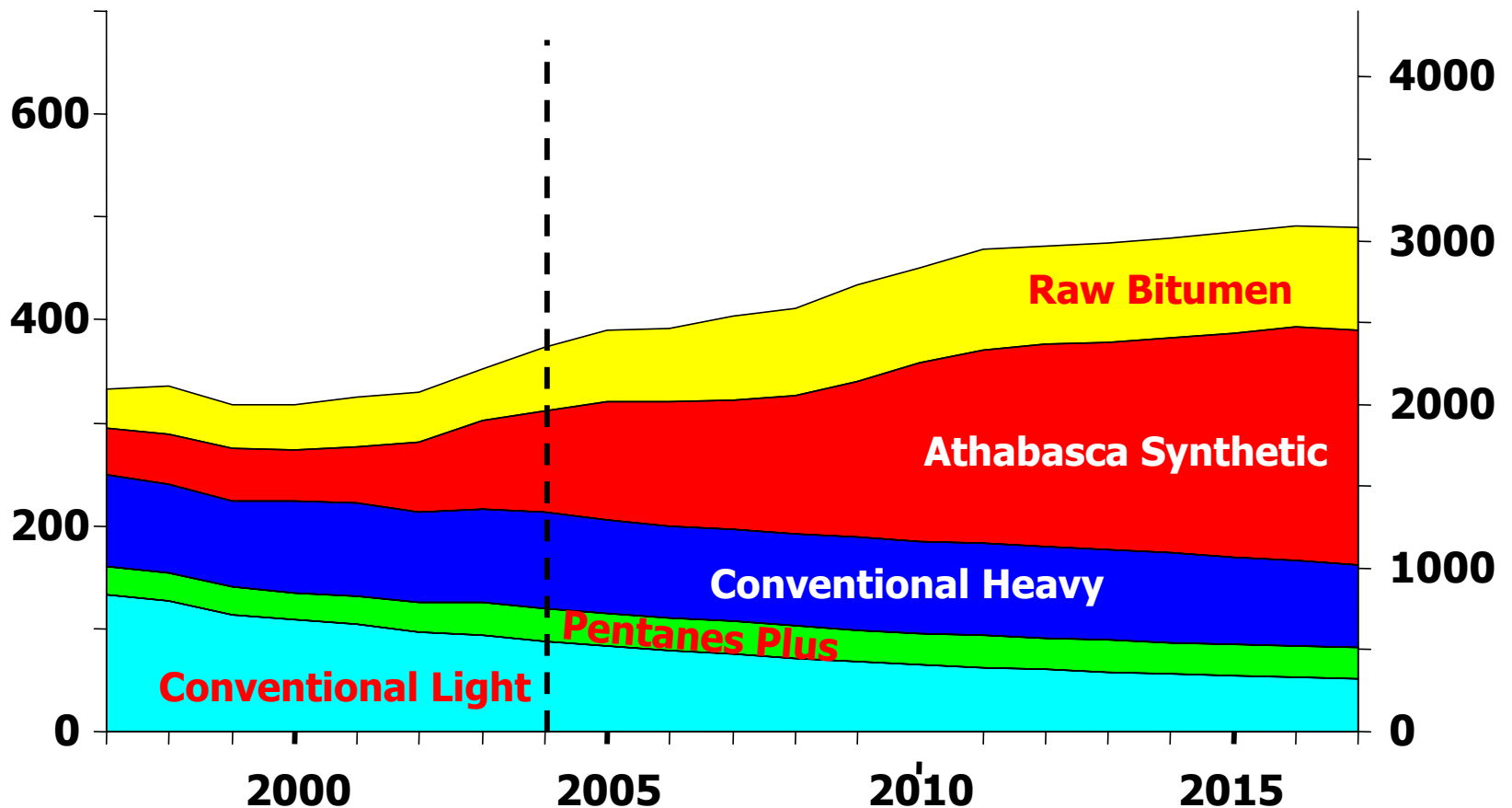
Resources	Oil	Gas	Bitumen	Coal
	Million m3	Million m3	Million m3	Mill tonnes
Remaining Reserve	291	1211	27,810	34,000
Annual Production	43.5	140.7	100.23*	34
Remaining Life	7	9	580	1000

Coal Bed Methane
 >3,600 Million m³

Western Canada Sedimentary Basin Crude Oil Production Potential

(000 M3/D)

(000 B/D)



Alberta Oil Sands Risks

- Production costs affected by rising cost of natural gas
 - ❑ Steam generation
 - ❑ Hydrogen for upgrading
 - ❑ Natural gas liquids for petrochemicals
- CO₂ emissions add additional risks
- Value of bitumen derived products
- “Permission to practice” – air emissions, land access and water management
- Investor confidence – labor shortages, cost over-runs.

SAGD Production Risk

- Cost of bitumen production proportional to cost of natural gas

Natural Gas Costs, \$/mcf	SAGD Operating Costs, \$/bbl
3.50	6.70
6.00	9.00
9.00	11.50

Hydrogen Risk

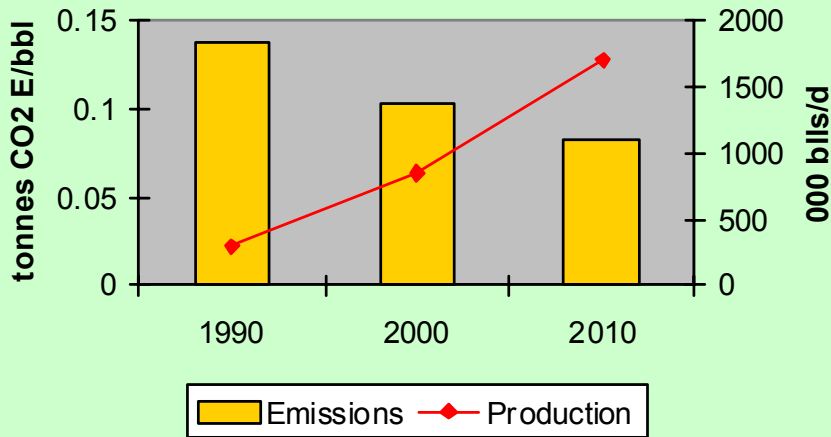
- Cost of hydrogen proportional to cost of natural gas

Natural Gas Costs, \$/mcf	Hydrogen Costs, \$/bbl	Production Costs of SCO, \$/bbl
3.5	3.6	12.0
6.0	5.8	14.0
9.0	8.1	16.4

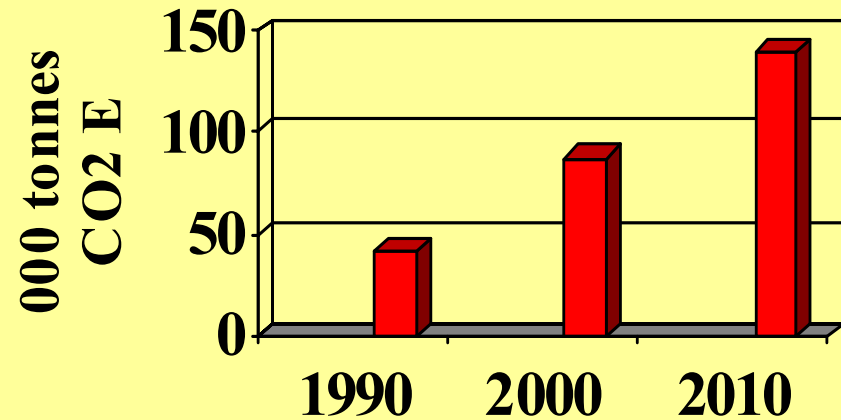
CO₂ Emission Risks

- Sources of upgrader GHG emissions
 - ❑ The furnaces ~40%
 - ❑ Hydrogen production by SMR ~40%
 - ❑ Sulphur recovery and other units and utilities ~10%

Oil sands energy efficiency gains



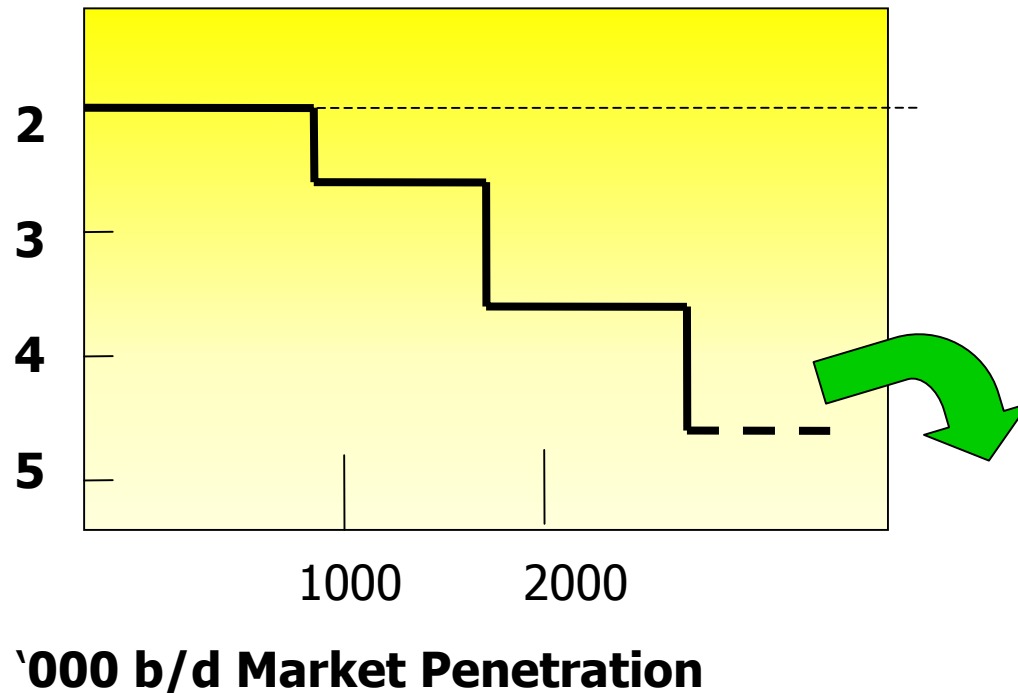
Total emissions increase



- CO₂ Emissions could add \$1.00 to \$3.00 CDN to the production costs of SCO
(CO₂ emission credits of \$15 to \$45/ton)

The Potential Value Gap

US\$ below equivalent
conventional crude with similar
°API and S



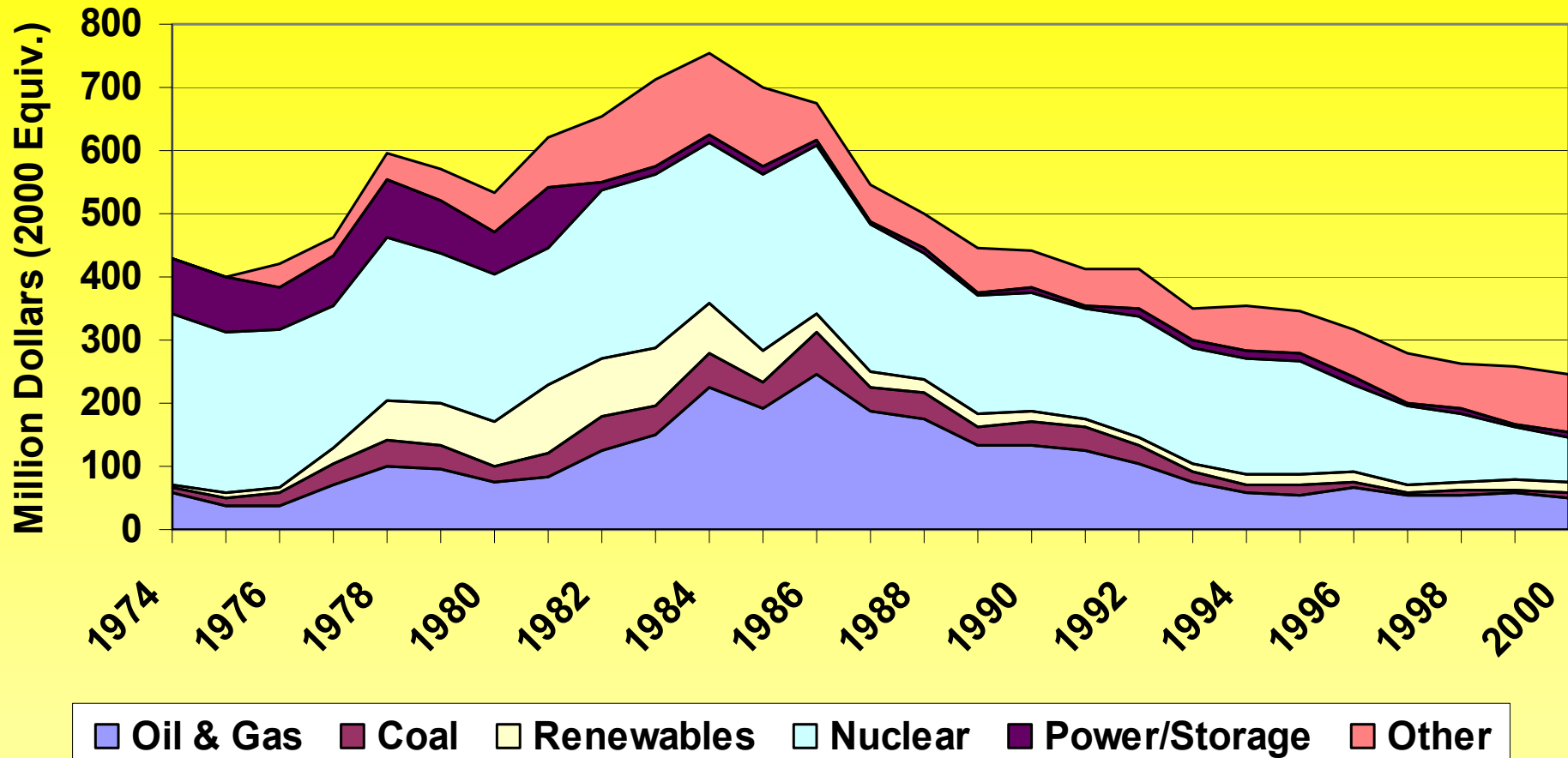
After Bill Dawson, NCUT

Need for Technological Innovation

- Natural gas substitution
- Improved recovery processes
 - ❑ enhancements to SAGD
 - ❑ Vapour extraction (VAPEX)
 - ❑ thermal solvent
 - ❑ Gravity stable combustion
 - ❑ Artificial lifts, pumps
- Improved refinery conversion technologies
- Significant portion of resource is not currently economic → requires technological advances

R&D investments in energy has fallen dramatically over the past decade

Canadian Energy R&D Funding (IEA Statistics, 2000)



Alberta Energy Research Institute (AERI)

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

From:

**Oil sands research
and technology**



To:

**Research and technology
on all forms of energy**

Alberta Energy Research Institute (AERI)

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

Mandate:

- Position Alberta for the future in energy
- Add value to Alberta's energy resources
- Encourage and invest in technology and innovation
- Coordinate R&D across agencies

Strategy:

- Partnerships & International collaboration

Strategic Goals to 2020 (Draft)

Framework for Innovation Programs

Bitumen-derived Production	Support the development of key technologies and innovation networks that will contribute significantly to the growth of production levels to 3.0 million barrels per day of heavy oil and bitumen by 2020.
Value of Bitumen-derived Products	Support the development of the key technologies and innovation networks that will contribute significantly to the diversity, value and competitiveness of bitumen-derived products including fuels, chemicals and petrochemicals.
Greenhouse Gas Emissions	Support the development of a number of key technologies and innovation networks that in total will achieve a 50% reduction (over the base year) in greenhouse gas emissions per unit of GDP in Alberta by 2020.
Clean Coal/Carbon Technologies	Support the adaptation and development of the key technologies that will be incorporated in a clean coal/carbon demonstration plant in Alberta by 2010 and fully commercial plants by the year 2020.
Gas Recovery	Support the development of a number of key technologies that will result in 15% of Alberta gas production coming from non-conventional sources by 2020.
Conventional Oil Recovery	Support the development of a number of key technologies that will lead to a 20% increase in oil recovery through carbon dioxide-based and other enhanced recovery processes by 2020.
Water Use in Energy Industry	Support the development of a number of key technologies that will result in a 50% reduction in fresh water usage by the energy industry in Alberta by 2020.
Alternative and Renewable Energy Production	Support the demonstration and commercial application of a number of alternative energy production technologies in Alberta that will provide 20% of energy production in Alberta by 2020.

Background - Energy Innovation Network (EnergyINet)

- Developed the Alberta Energy Innovation Strategy
 - ❑ Transformative – integration across energy sector boundaries → “integrated energy economy”
 - ❑ Well defined and focused priority areas
- Endorsed by the Alberta Government (September 2002)
- Strategy becomes the technology & innovation component of Alberta’s Climate Change Plan (Oct. 2002)
 - ❑ Additional investments in technology and innovation
 - ❑ “Credits” for investments in research and technology
- Recognition that the status quo (“fragmentation”) would not achieve our ambitious energy vision

Energy Innovation Network (EnergyINet)

- Launched process for building transformative partnerships
 - ❑ Engaged 150 participants from across the country (Start March, 03)
 - ❑ Confirmed analysis on strategy
 - ❑ Need for initiating integrated innovation networks in energy
- Shared Vision:
 - “*An abundant supply of environmentally responsible energy, creating economic prosperity and social well-being for Canadians*”
- Key Operating Principles
 - ❑ Critical concepts: *Integration, Innovation and Collaboration*
 - ❑ Global perspective,
 - ❑ Focus on strengths
 - ❑ Build on existing initiatives to add value and achieve shared goals

EnergyINet Programs

Major Theme – Industry Involvement and Guidance

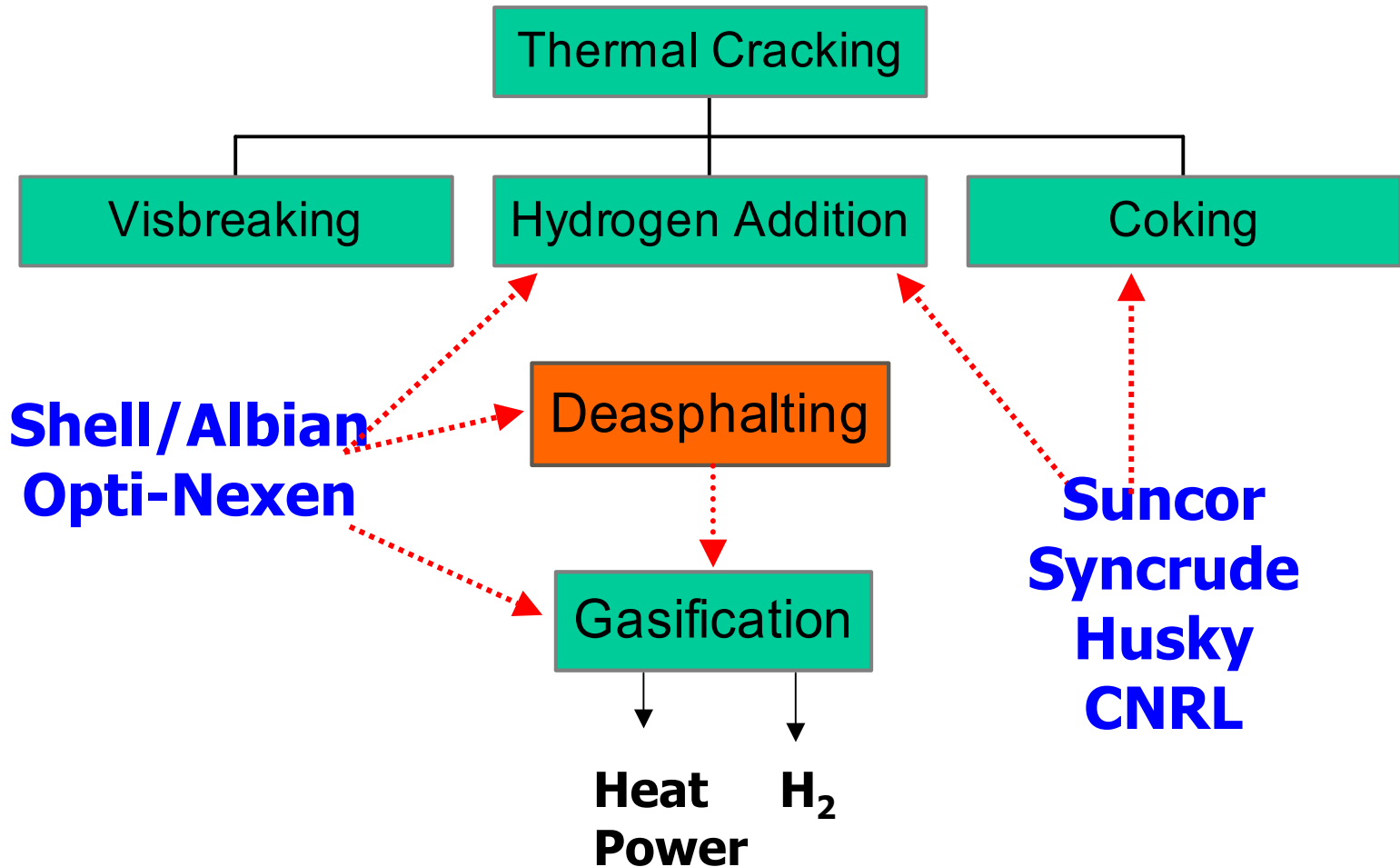
- Launching the first four priority programs
 - ❑ Oil Sands Upgrading
 - ❑ Clean Carbon/Coal
 - ❑ CO₂ Management
 - ❑ Natural Gas and Conventional Oil
- In Parallel - Identified gaps and established priorities
 - ❑ “An Integrated Approach to Energy Research and Technology Development” (Feb 2003)
 - ❖ Impact (economic & environmental) vs. Achievability (market and technical)
 - ❖ Portfolio based on “platform technologies”
 - ❑ Feasibility/gap analysis studies (2003-04)
 - ❑ ACR Roadmap
 - ❑ Oil Sands R&D Inventory

Platform Technologies

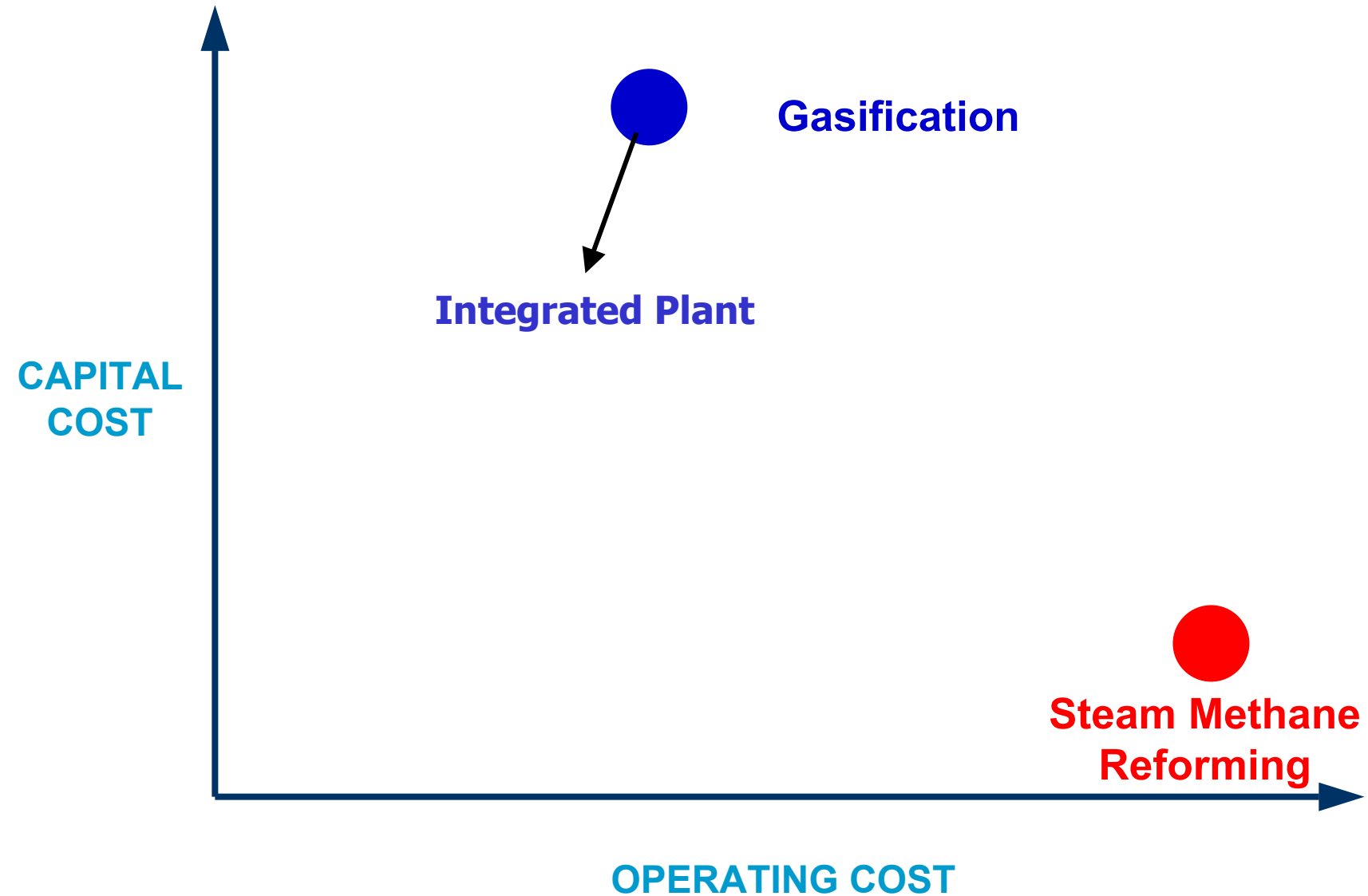
Platform Technologies	Strategic Areas					
	Clean Coal/Carbon	Upgrading Technology	CO2 Management	Improved Recovery	Water Management	Alternative Energy
Geological Storage of CO ₂						
Gasification						
Catalysis						
Hydrogen Technol						
Separatbn Technol & Solv Deash						
In Situ Technol						
Water Treatment Technol						

	Indicates Major Impact		Indicates Secondary Impact		Minor Impact
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Upgrading Technology – 1940 - Today

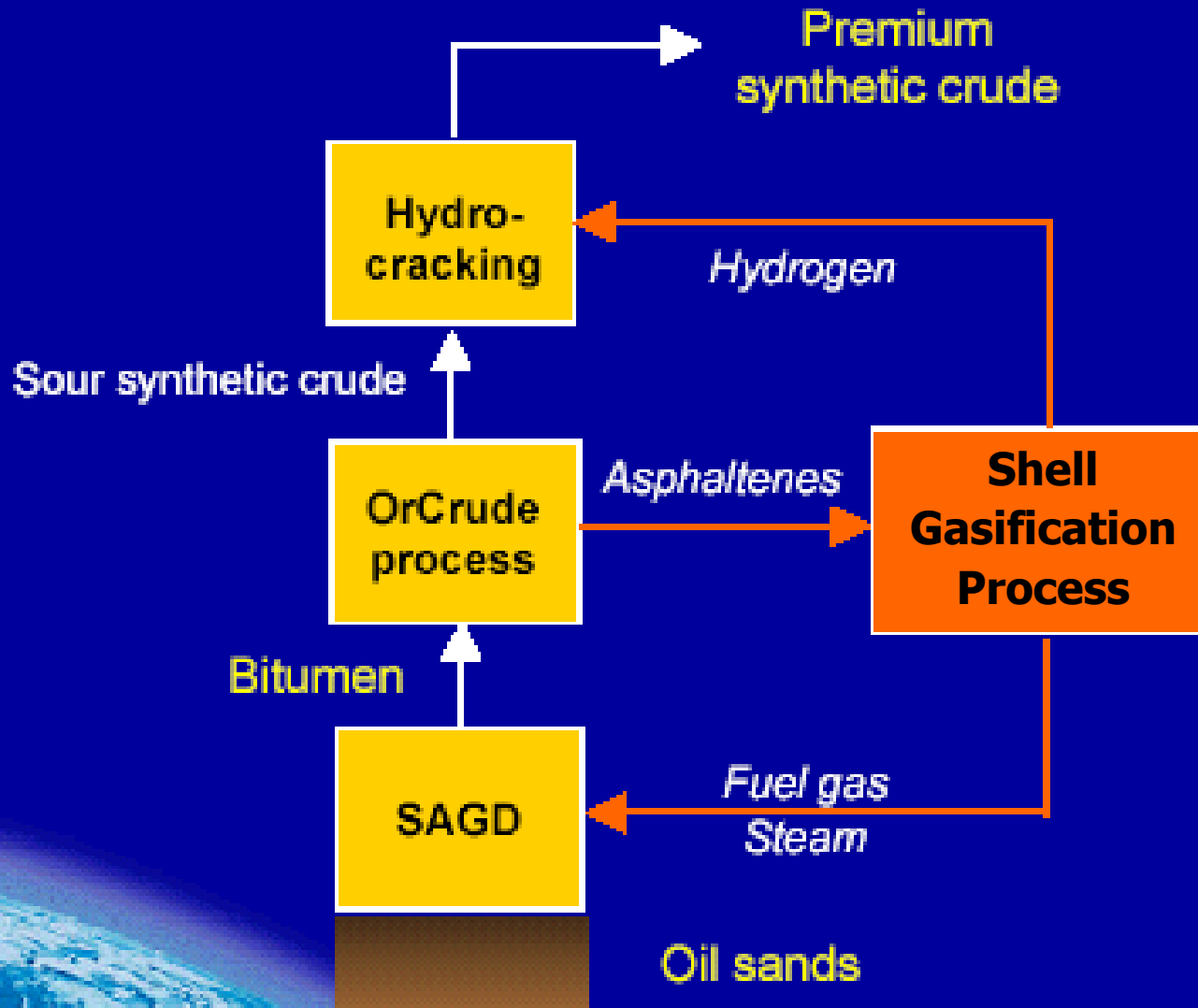


Hydrogen Production Costs



Integrating In-Situ Oil Sands Production and Upgrading to Reduce Cost and Increase Product Value

OPTI – Nexen Long Lake Project

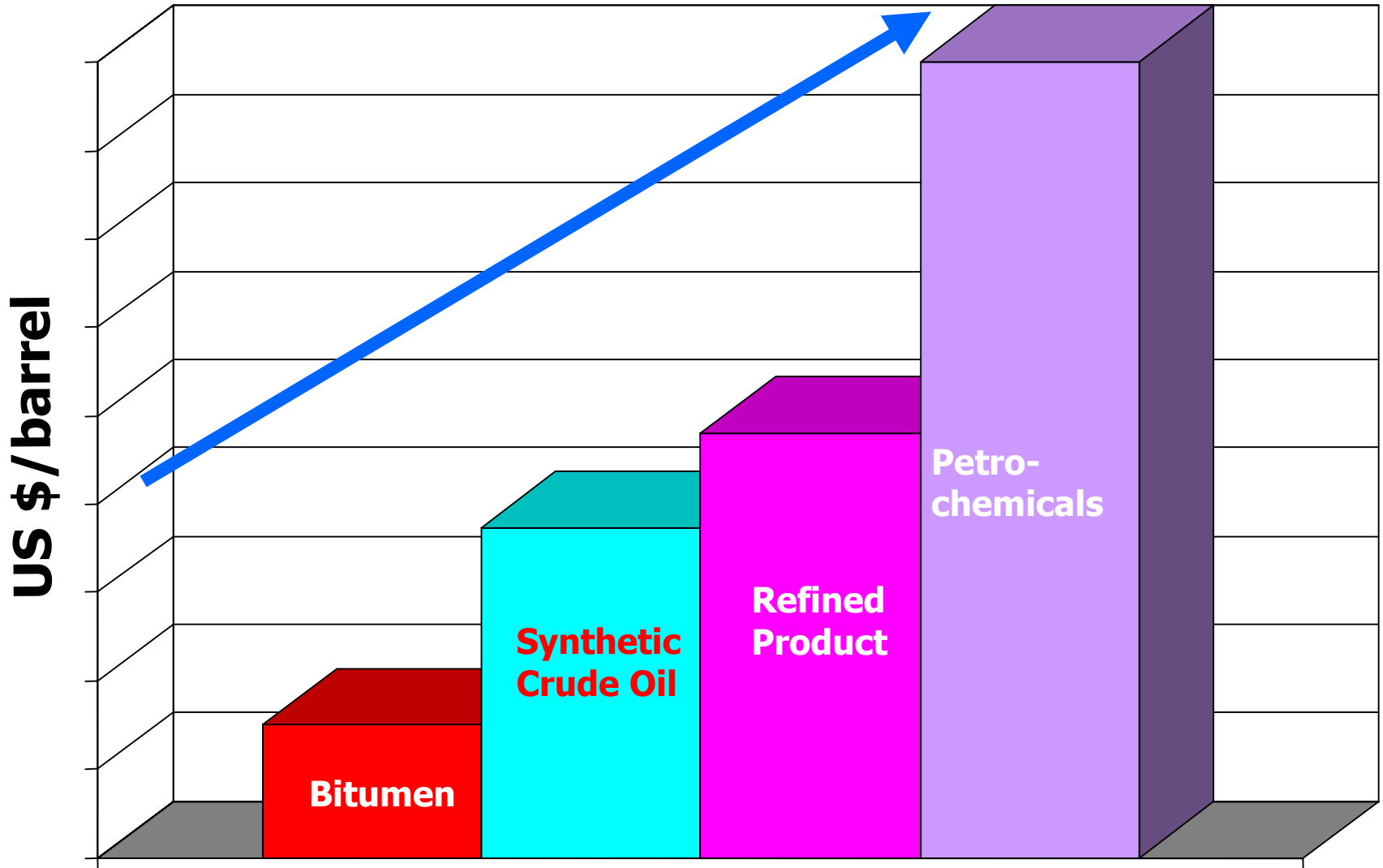


Alberta Oil Sands Products

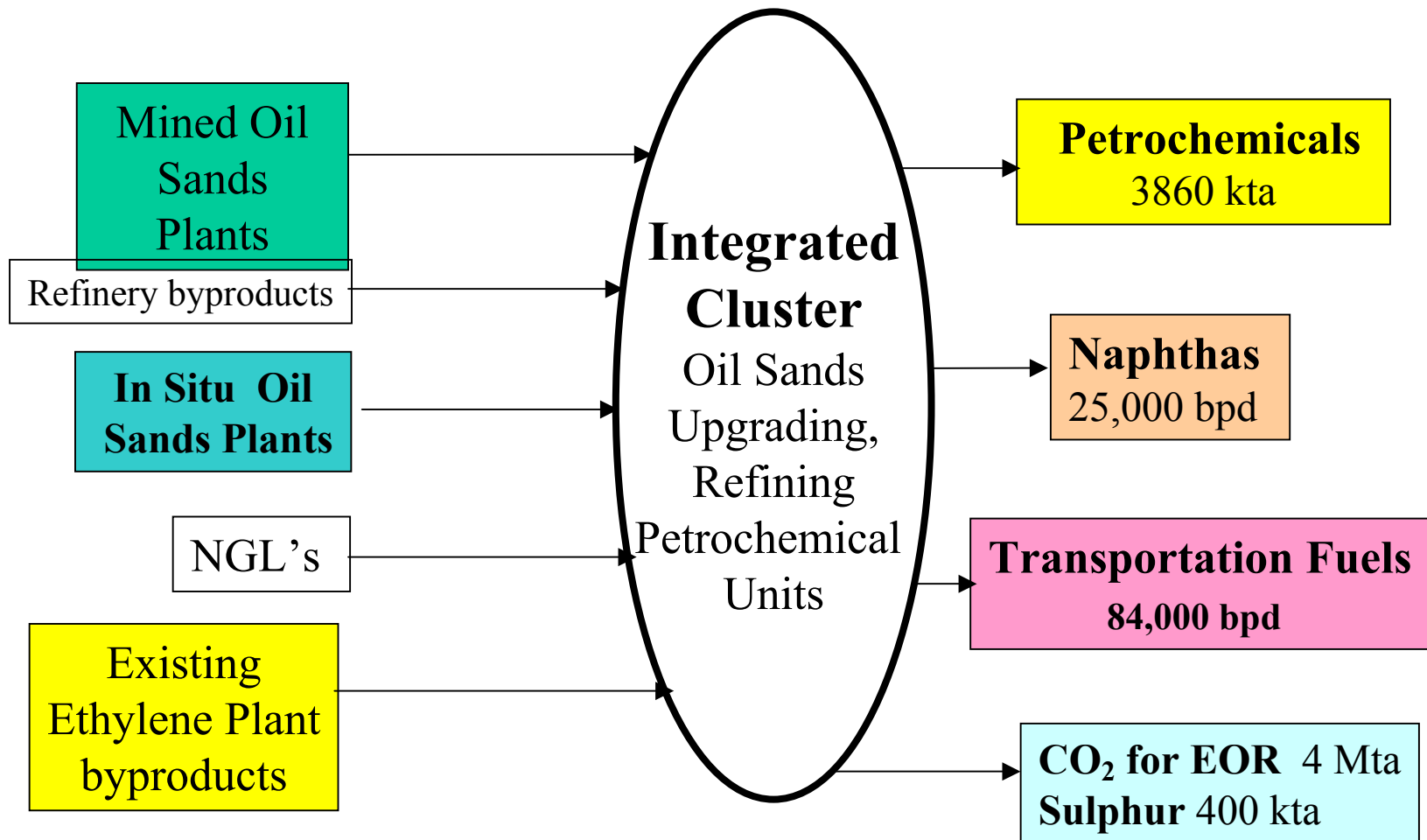
➤ Products:

- ❑ Diluted bitumen
 - ❖ DilBit
 - ❖ SynDilBit
- ❑ Partially upgraded products
- ❑ Sweet syncrude
- ❑ Refined products and petrochemicals

Increasing Value and Market Options through Upgrading and Petrochemicals

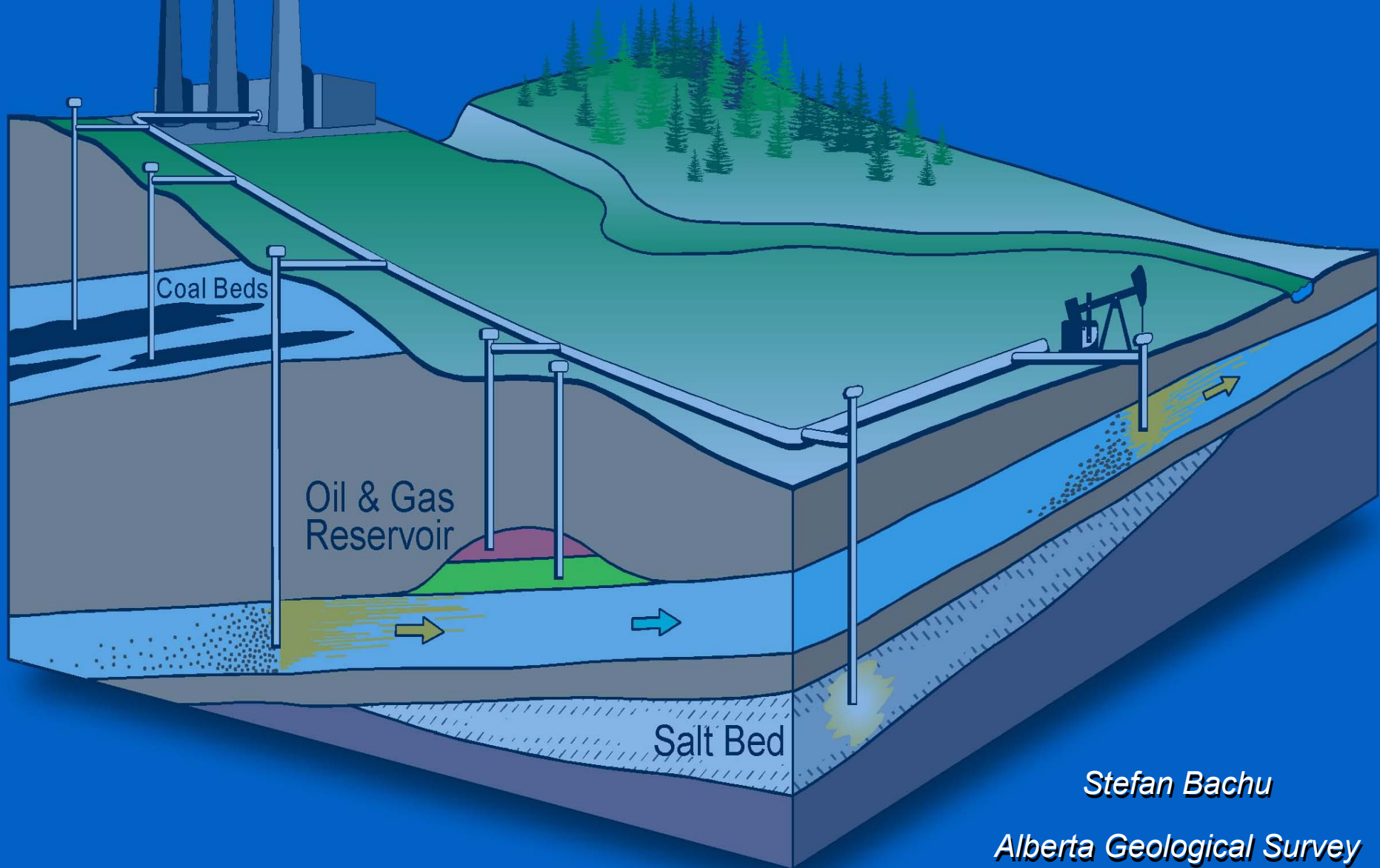


Market Studies – Example of an Integrated Oil Sands Petrochemical Complex



Geological Sequestration of Carbon Dioxide

A Viable Solution for Western Canada



Stefan Bachu

Alberta Geological Survey

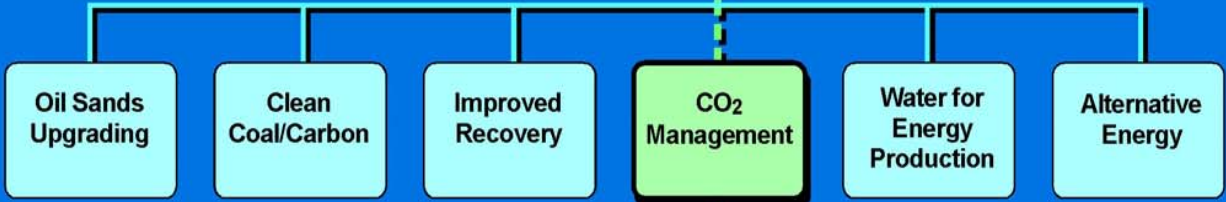
International Activities

International Links

CSLF, IPCC, IEA - GHG, CCP

Energy Innovation Network - EnergyINet

Funding Consortium



Road Mapping

Program Development

CO₂ Capture & Storage Technology Road Map

Networks

Program Management

Canadian CO₂ Capture and Sequestration Technology Network

Capture

Geological Storage

Program Execution

Science, Technology & Innovation

Government Policy



Projects and Activities



Courtesy: Stefan Bachu, AGS

Moving Forward - Energy Innovation Network (EnergyINet)

- Established process for building transformative partnerships –between government and industry that is well adapted to the needs of the heavy oil and oil sands industry
- Key Operating Principles
 - ❑ *Integration – opportunities that emerge when energy sector is viewed as an interconnected whole*
 - ❑ *Collaboration – avoiding fragmentation and achieving shared goals*
- Looking for involvement.

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