



*Alberta Energy Inventory:
Status, Challenges and Opportunities*

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Turning Resources to Reserves

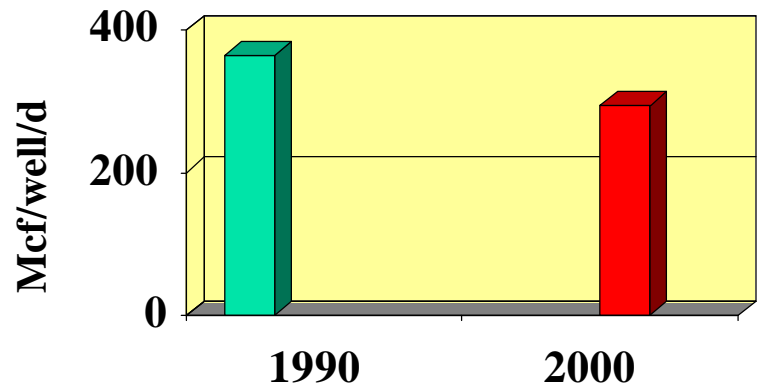
- “Resource” is the total energy source
 - requires major investments in technology, infrastructure and intellectual capacity
- “Reserves” are the recoverable fraction of the “Resource”
 - based on technical and economic feasibility
- Using current technologies, recovery is:
 - Conventional Oil: 30 %
 - Oil Sands: < 15 %
 - Natural Gas: only conventional

Alberta's Natural Gas: Status

■ Maturing (< 9 years)

- Reserves – 44.8 trillion cubic feet (TCF)
- Production – 5 TCF/y
 - 73% exported
- Wells drilled – 7,353 (2000)

■ Declining well productivity



- **Technologies:** Well established; need new technologies for coal bed methane, deep and tight gas
- **Infrastructure:** 600 Gas plants & pipelines
- **Intellectual Capacity:** Top-of-the-Class but aging

Natural Gas: Future

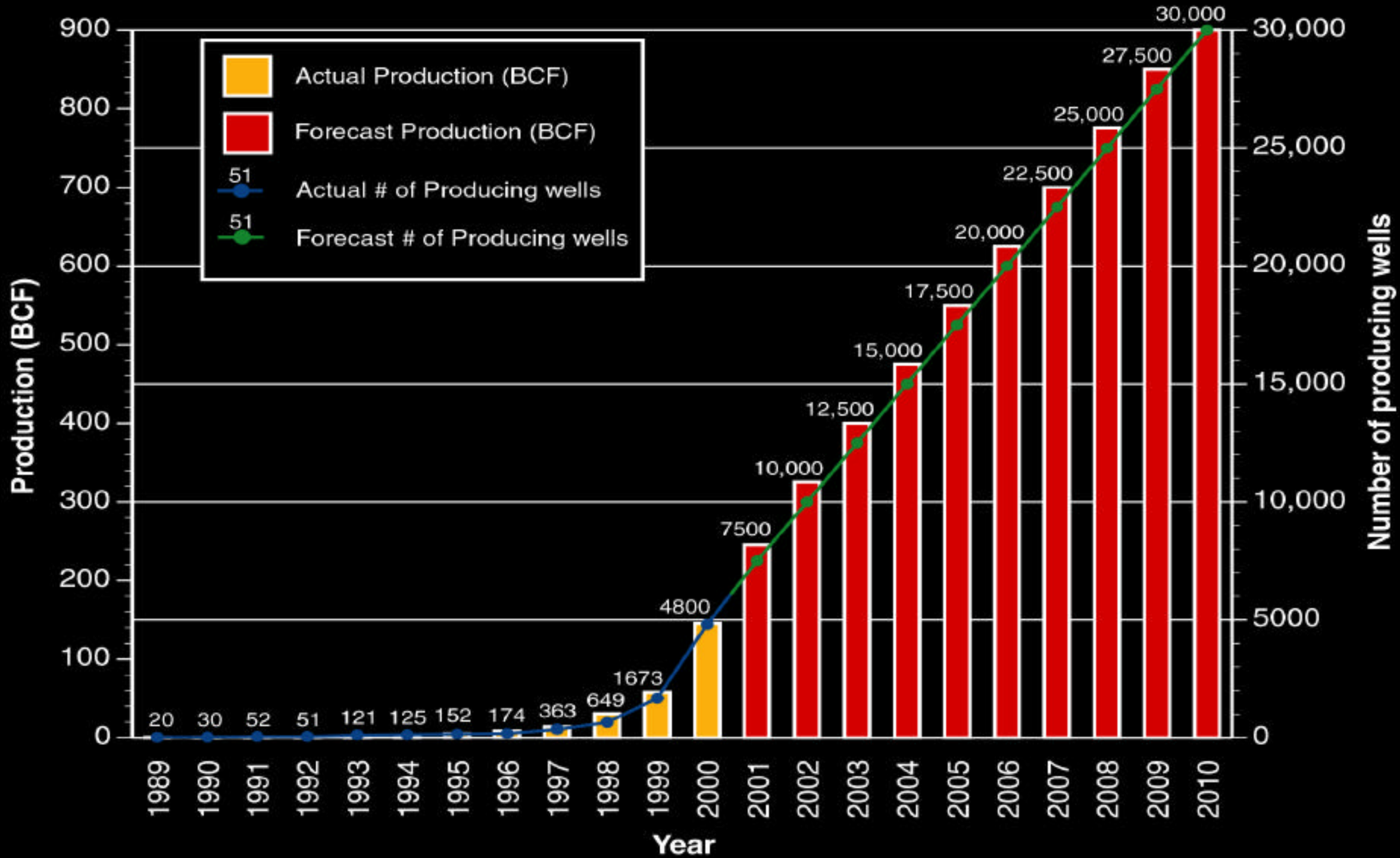
- Cradle to grave emissions will increase
 - Leaner, sourer gas, gas high in CO₂
- Costs will increase
 - More difficult extraction
 - Higher costs of gas processing
- Emissions similar to coal in the long-term
 - Federal “clean energy exports” jeopardy
- Long-term coal bed methane – 3 x more gas in CBM but potential unproven

Average Energy Intensity, GJ/m³ of production

Sweet Gas – 1.4

Sour Gas – 2.2 (with flaring)

Sour Gas – 3.7 (with sulfur recovery)



Yearly production and number of producing wells for coalbed methane in the Powder River Basin, Wyoming, 1989 through 2000, with forecasts to 2010.

Alberta's Conventional Oil : Status

■ Maturing (< 8 years)

- Reserves – 2,079 million bbls
- Production – 270 million bbls/y
 - 73% exported
- Wells drilled (2000) – 3,198

- **Technologies:** New seismic, horizontal drilling indigenous and adapted
- **Infrastructure:** Refineries & pipelines; capital investment \$12.9 billion/year (incl. Gas)
- **Intellectual Capacity:** Top-of-the-Class but aging

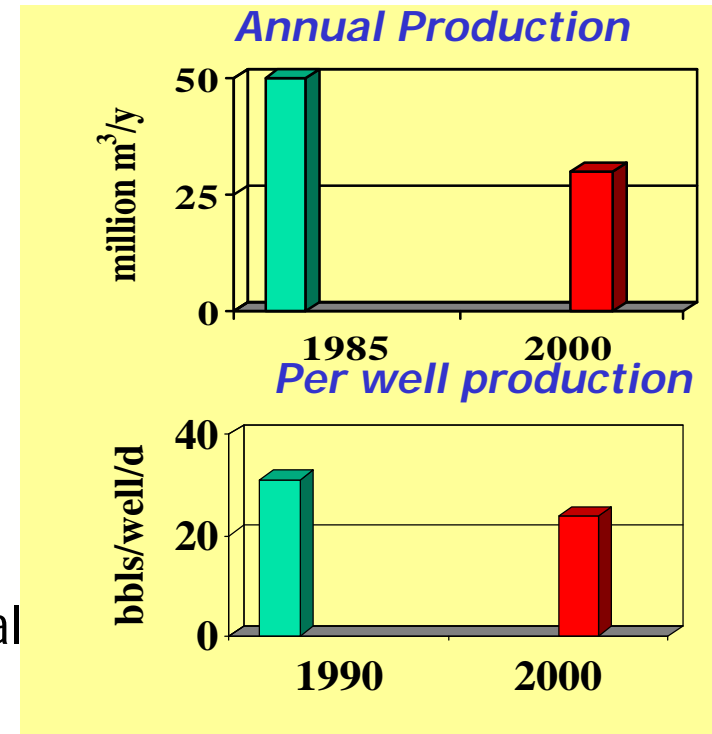
Conventional Oil: Future

Challenge

- Depleting Resource
 - Peak production – 1973
 - Extensive use of horizontal wells and infill drilling
- Investments shifted to oil sands, offshore and international

Opportunity

- 70% still in the ground
- Enhanced oil recovery (EOR) potential is high
- Basin ideally suited for CO₂ storage

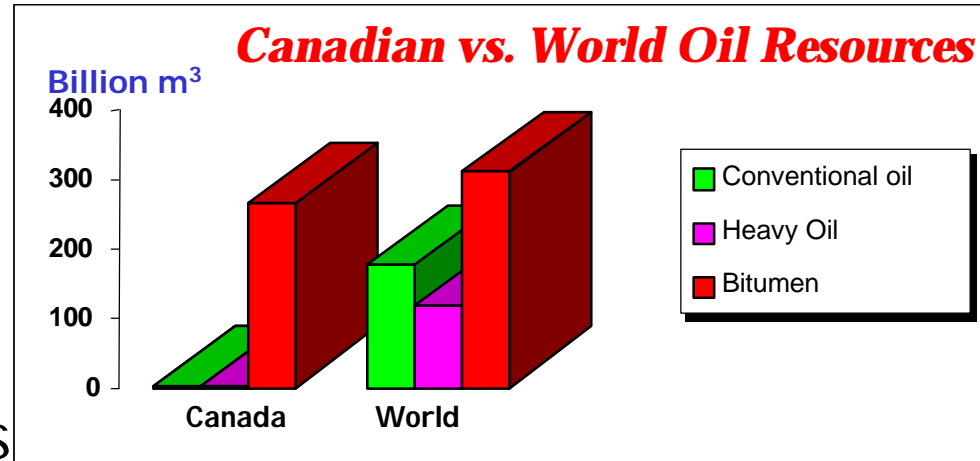


- **Technologies:** CO₂ EOR and other
- **Infrastructure:** Missing pipelines for CO₂
- **Intellectual Capacity:** Needs experience with EOR

Alberta's Oil Sands: Status

- **World's Largest Deposit**

- Reserves – 6.8 billion bbls
- Production – 0.222 billion bbls/year (85% exported)



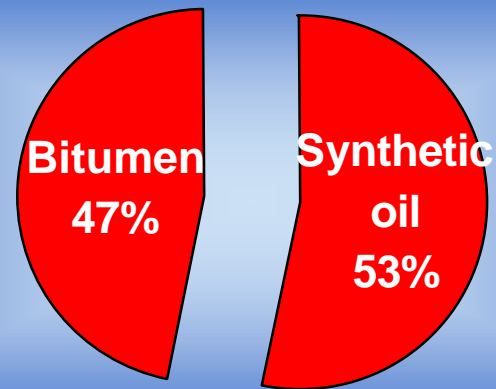
- **Technologies:** World Class – Surface Mining, SAGD, VAPEX, Horizontal Drilling, Cold Production

- **Infrastructure:** \$25 billion spent or committed; \$60 billion proposed over next 7-10 years

- **Intellectual Capacity:** Unique, top-of-the-Class

Oil Sands: Key Challenges

Estimated Gross Revenue Loss by Not Upgrading - \$1.6 billion/year

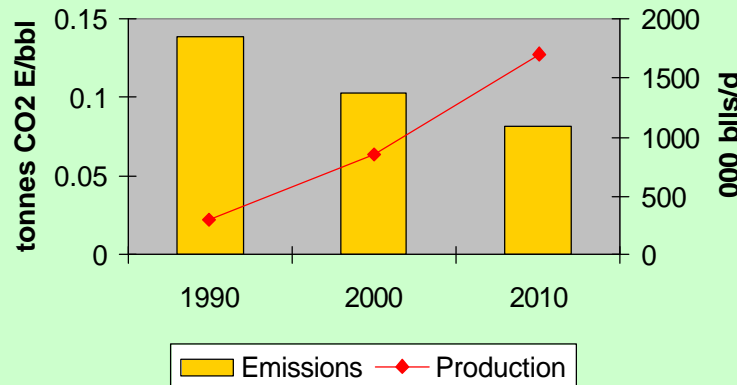


Kyoto Targets might stifle expansion plans

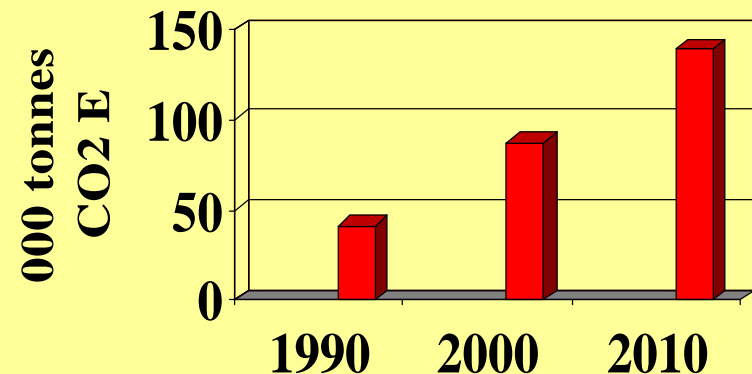
Oil Sands: Future

- Staggering capital costs – high risks
 - Major projects all experiencing cost overruns
- Synthetic crude and bitumen refinery limitations
- Heavily dependent on natural gas
 - Hydrogen production
 - Steam generation
- Water issues
- Energy intensity – GHG Emissions

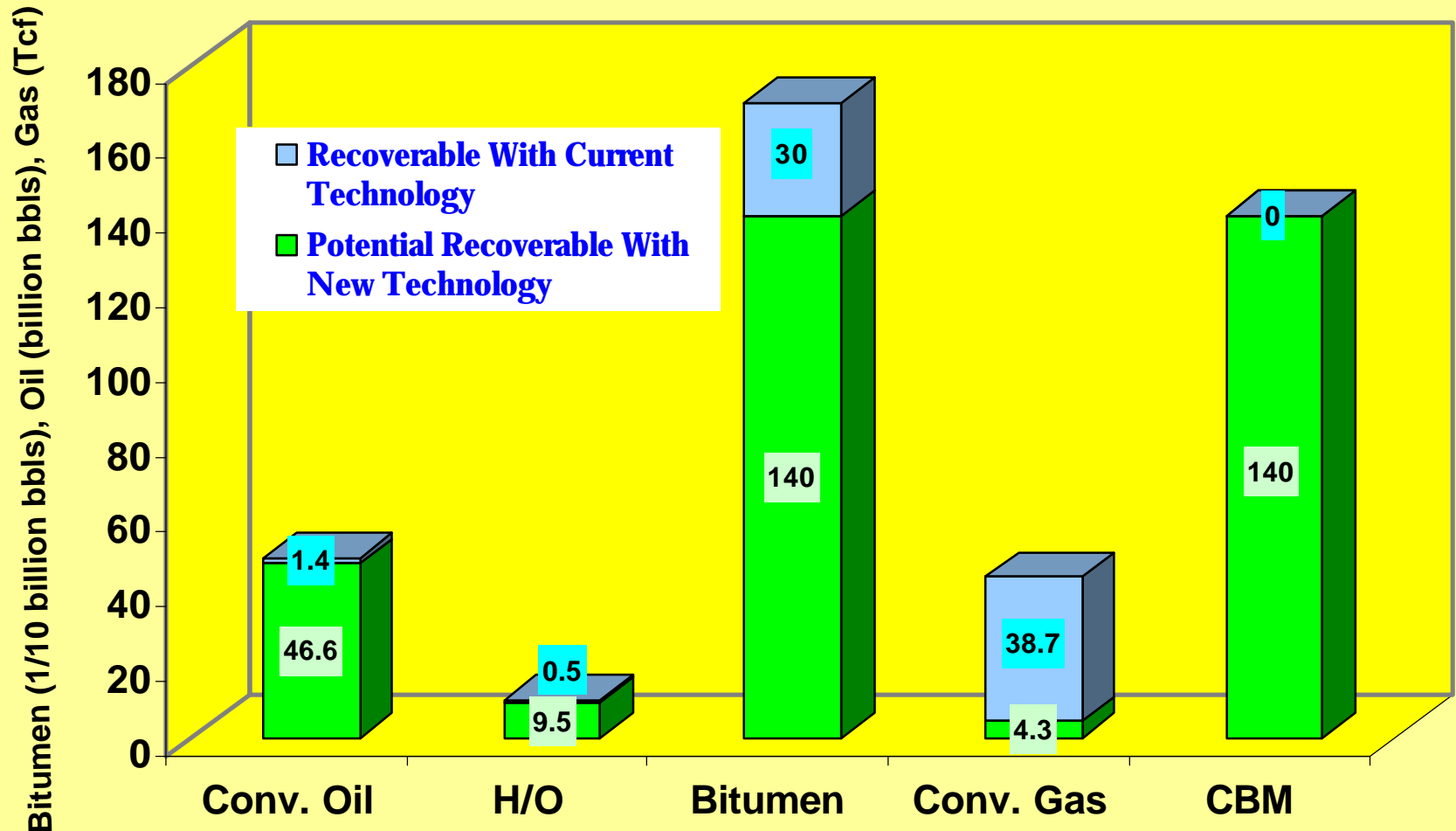
Oil sands energy efficiency gains



Total emissions increase



Alberta's Petroleum Outlook



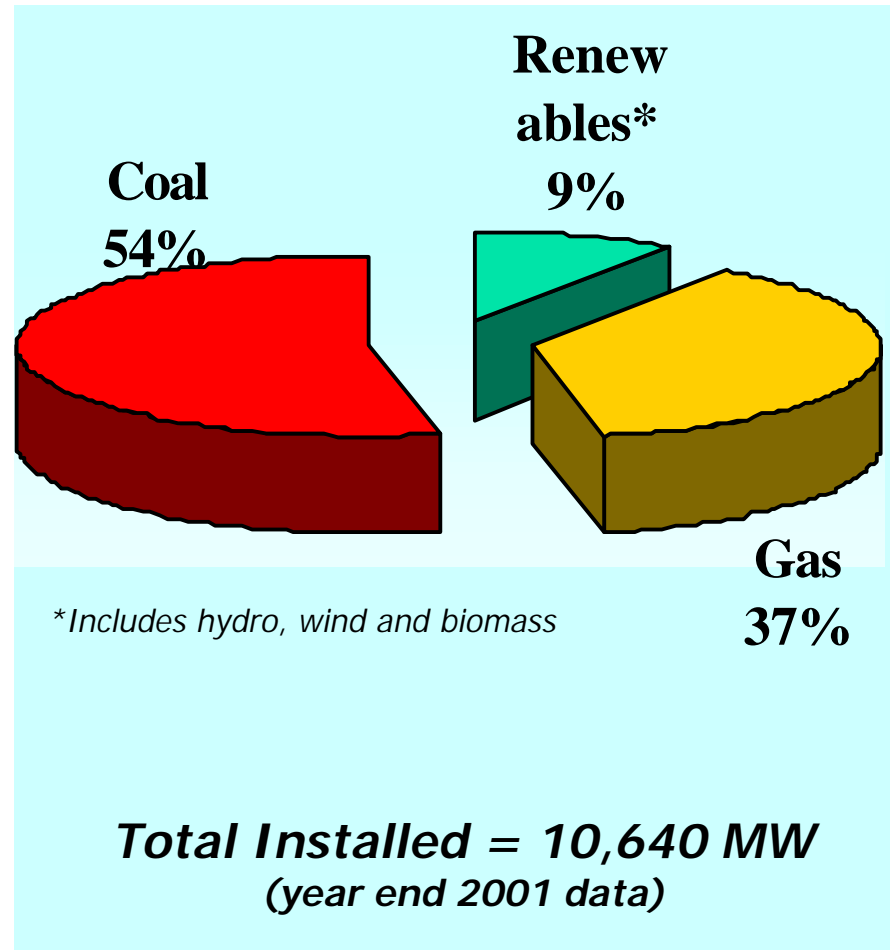
Alberta's Coal: Status

- **Source: Unlimited**
 - Ultimate Potential: 620 billion tonnes
 - Production (2000): 0.035 billion tonnes

- **Alberta's coal reserves**
 - 70% of Canada's
 - 50% of coal produced in Canada
 - 2x the energy of all other natural resources (oil sands, oil and natural gas)
 - 7 Major mines
 - 80% electricity generation
 - Sub-bituminous (low S, clean burning)
 - 20% exported – valued at \$380 million
 - Metallurgical

Coal: Challenge

- In a “carbon constrained world” - coal most vulnerable
 - 25% of Alberta’s emission
 - High cost of CO₂ capture in existing coal plants
- Emission control costs high
 - SO_x, NO_x , PM, Hg
- Technology threats
 - Distributed generation cost reductions



DOE Web site May 2002



CO₂ Management

■ **Alberta CO₂ Source Inventory**

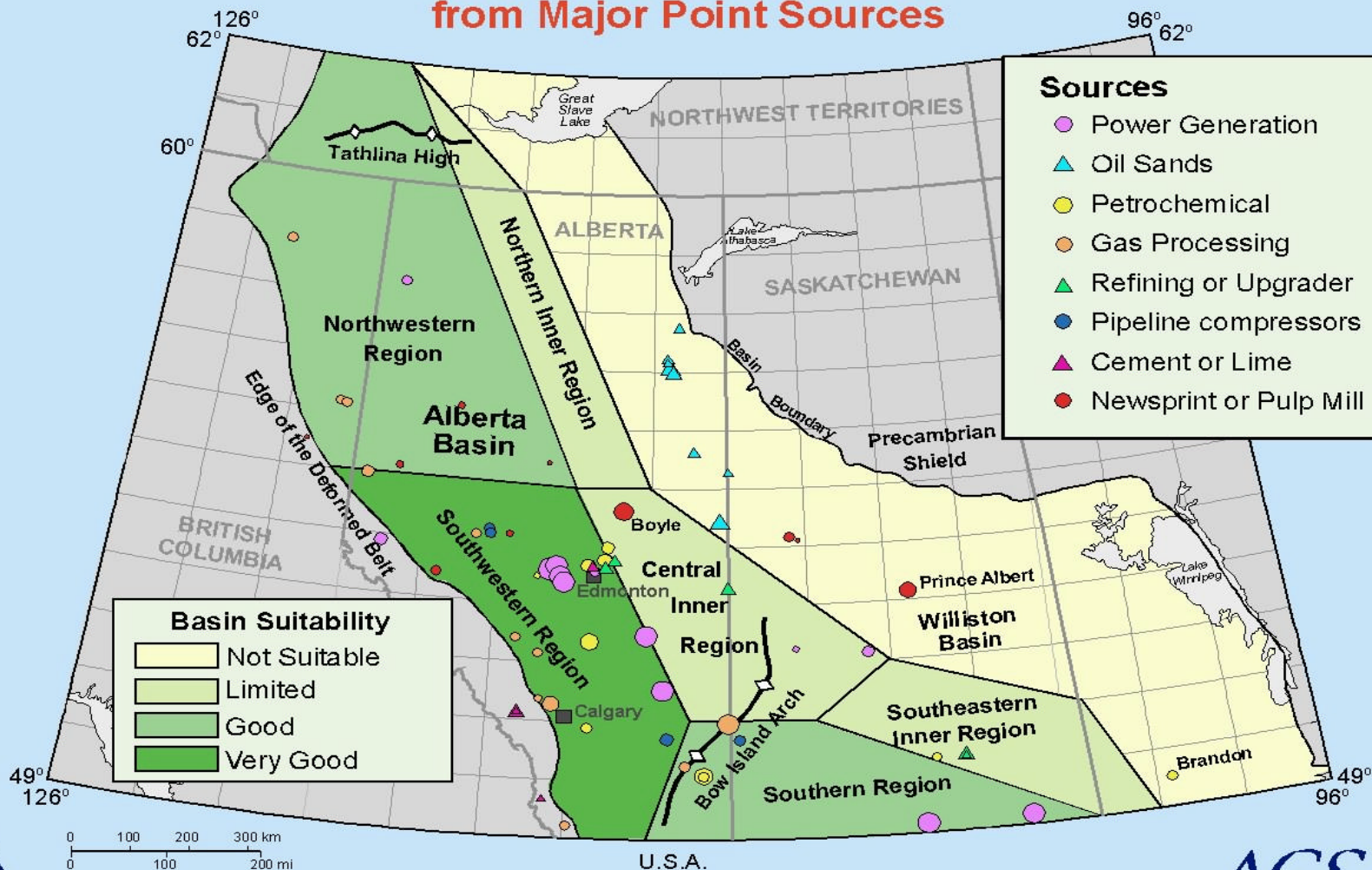
- Currently available (7260 tonnes/d equivalent to 15,000 bbls EOR project)
 - Fertilizer plants, gas plants, petrochemical facilities, ethane processing
 - Purity (30 to 99%)
- Market dependent (54,000 tonnes/d)
 - + hydrogen plants, gas pipelines, power plants

■ **Potential CO₂ Markets**

- Enhanced oil recovery
- Enhanced coalbed methane
- Hydrocarbon solvent recovery
- Gas-over-bitumen

CO₂ Opportunities

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





Hydrogen: Challenge

- **Source:** Alberta is the world's largest repository of hydrocarbon-based Hydrogen
- **Technologies:** Steam reforming of natural gas; coal gasification. Need storage & distribution and fuel cell technologies
- **Infrastructure:** Minimal; need to develop new technologies & build infrastructure
- **Intellectual Capacity:** Minimal but Growing

SWOT Analysis

Strengths:

- World's largest hydrocarbon & hydrogen resources; large agricultural land & forests for renewable energy
- >\$200 billion invested in plants & infrastructure
- Excellent intellectual capital

Opportunities:

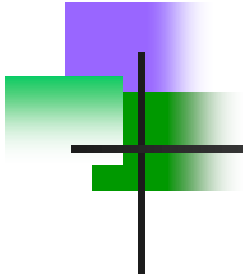
- Coal Bed Methane & maturing conventional oil could use carbon dioxide
- New heavy oil recovery & upgrading technologies
- Use nano-technologies centre

Weaknesses:

- Need to develop bitumen recovery & upgrading and renewable energy technologies
- Need more RD&D investments in Clean Coal, CBM, bitumen
- Need new HQP with experience

Threats:

- If we don't do it, somebody else will – nuclear fusion, solar, wind, hydrogen and hydrates
- Kyoto Protocol may shut down coal-fired power generation & reduce oil & gas exports
- Loss of revenue & jobs



Extra Slides

Biofuels: Challenge

- **Source:**
 - Agriculture waste
- bio-mass (wood waste)
 - wheat, barely, corn, canola oil
- **Technologies** (Renewable and clean)
 - ethanol
 - bio-diesel additive to diesel
- **Infrastructure:** Minimal
- **Intellectual Capacity:** Minimal

Life-cycle analysis – greenhouse gas reduction dependent on feedstock

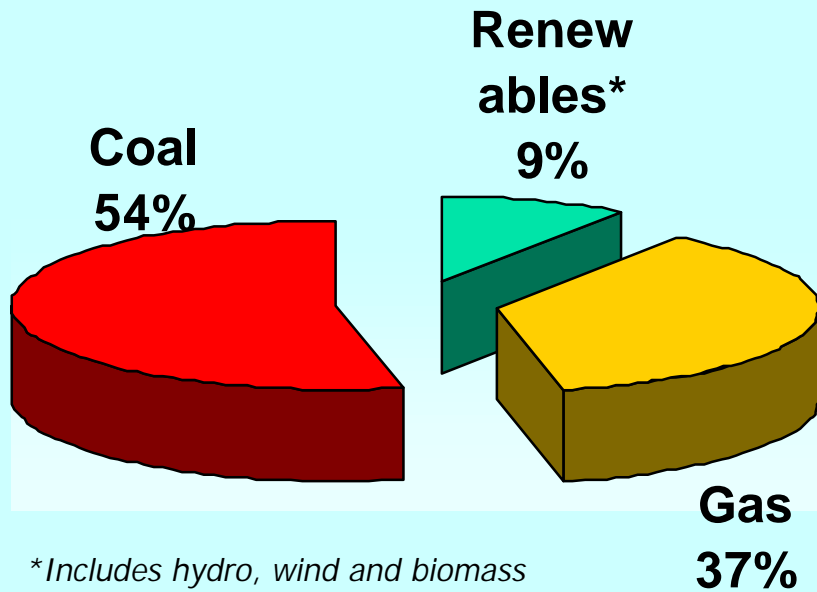


Hydroelectric Power

- Kyoto Clean Development Mechanism (CDM)
 - Building hydro to displace thermal power in developing country
- World Commission of Dams Study - Nov. 2001
(30 dams in Canada, Brazil, French Guyana and Finland)
"All large dams and natural lakes measured emit GHG....in some cases gross emissions can be considerable and possibly greater than the thermal option....hydropower cannot, a priori, be automatically assumed to emit less GHG than the thermal alternatives. Net emissions should be established on a case by case basis."

Power Generation Capacity

ALBERTA (2001 Data)



Total Installed = 10,640 MW

CANADA (1999 data)

