

Unconventional Gas in Canada: Past, Present, Future

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(CSUG)

Canada Think Day

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Canadian Society for Unconventional Gas

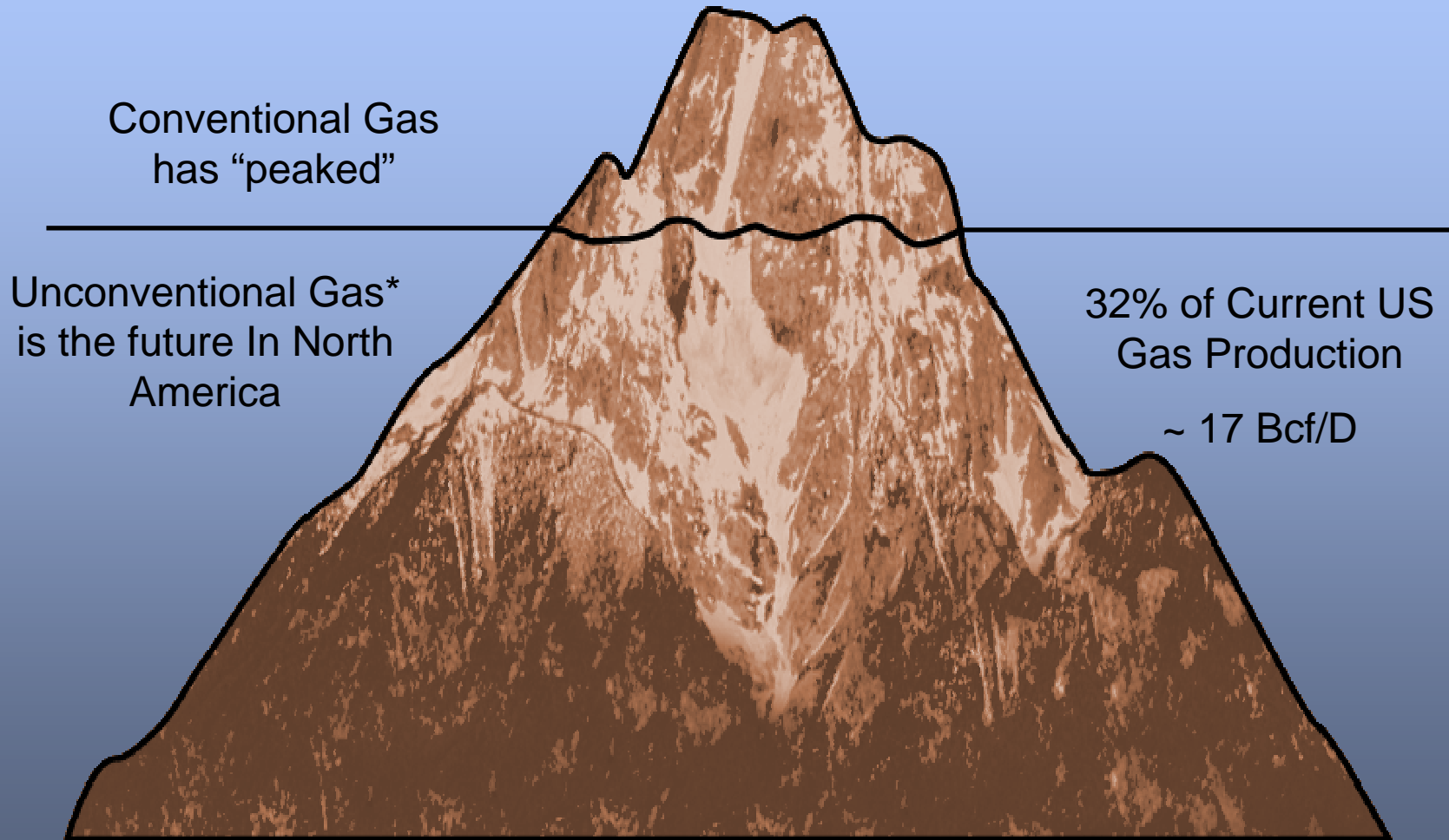
Mission Statement

- To facilitate the factual and collaborative exchange of unconventional gas knowledge and challenges among government, regulators, industry and public stakeholders for the exploration and production of the resource in an environmentally sensitive and economical manner.

What is Unconventional Gas?

- Natural gas contained in “difficult-to-produce” rock formations which require special drilling, completion, stimulation, and/or production techniques to achieve economic production
- Examples:
 - Natural Gas from Coal (NGC) or coalbed methane (CBM) found in coal seams
 - Tight Gas, found in sandstone and limestones
 - Shale gas, found in shale
 - Gas Hydrates, ice-like substance on the ocean floor
- Common trait – *big resource, long life*

Unconventional Gas is a Growth Industry



*Coalbed Methane, Tight Gas Sands, Gas Shales in
Canada and the US

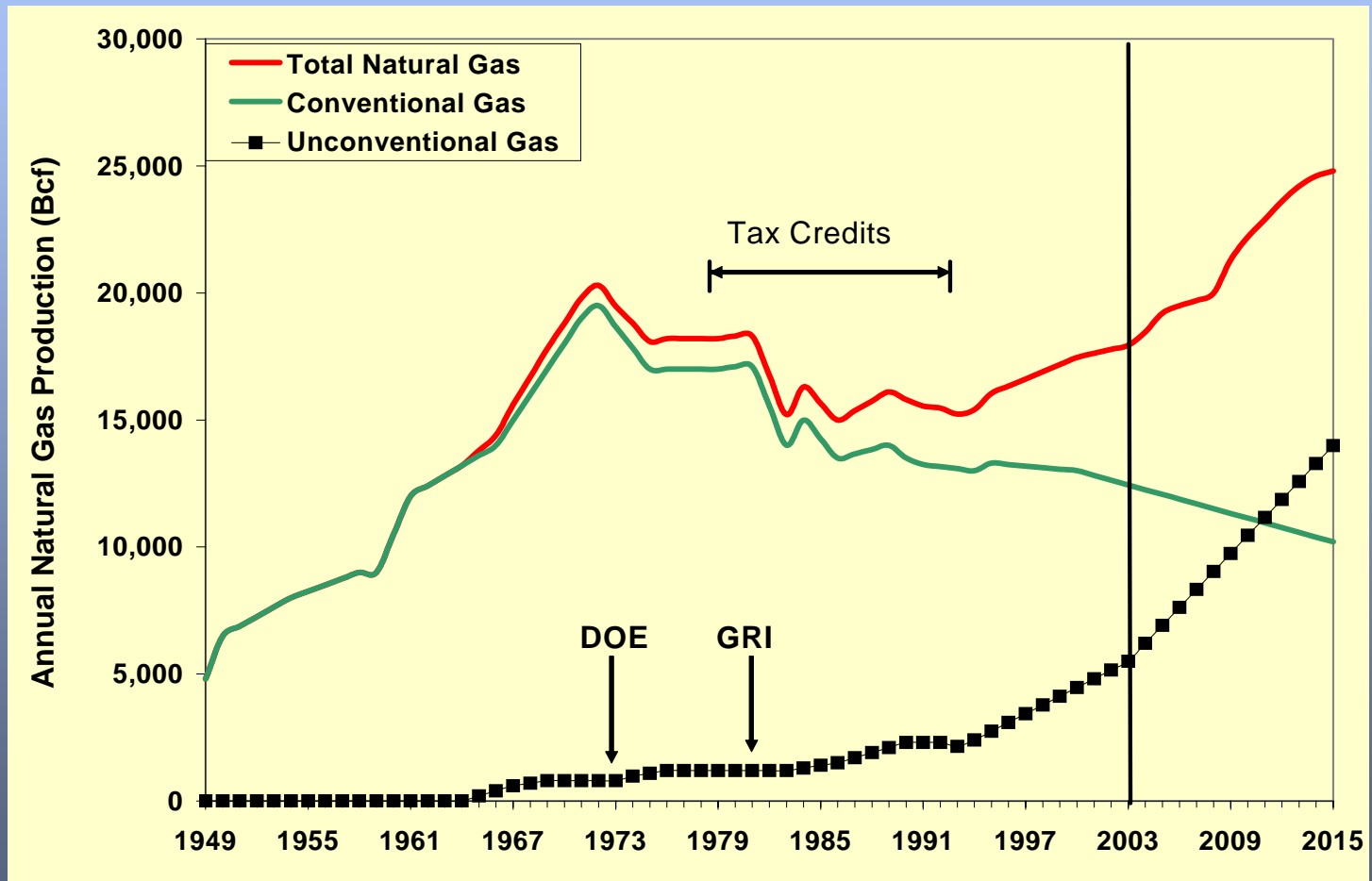
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Canadian Unconventional Gas Potential is Huge

- Resource estimates are over 2,000 trillion cubic feet (Tcf), excluding gas hydrates
 - Current Canadian production of natural gas (both conventional and unconventional) is ~ 6 Tcf/yr, about the same as unconventional gas production in the US
 - Canada uses about 3 Tcf/yr, domestically
 - ***How do we turn this resource into reserves?***
 - US analogy leads to estimates of >100 Tcf recoverable
 - Conventional Canadian reserves are ~ 58 Tcf

U.S. Unconventional Gas Production History and Forecast



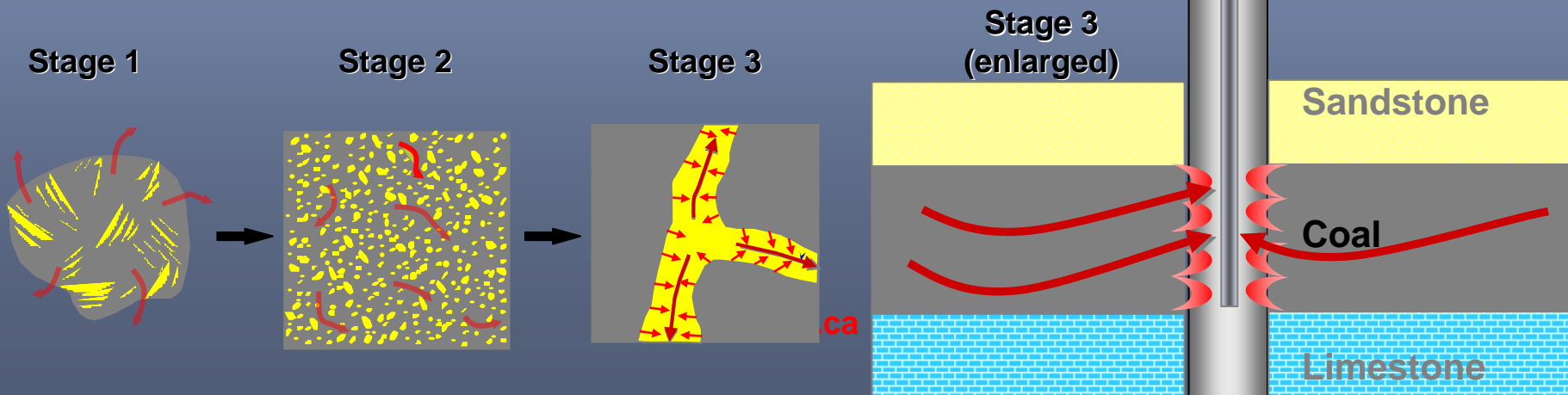
EIA (1949 – 1990) and NPC (1991 – 2015)

Relevance to Canada

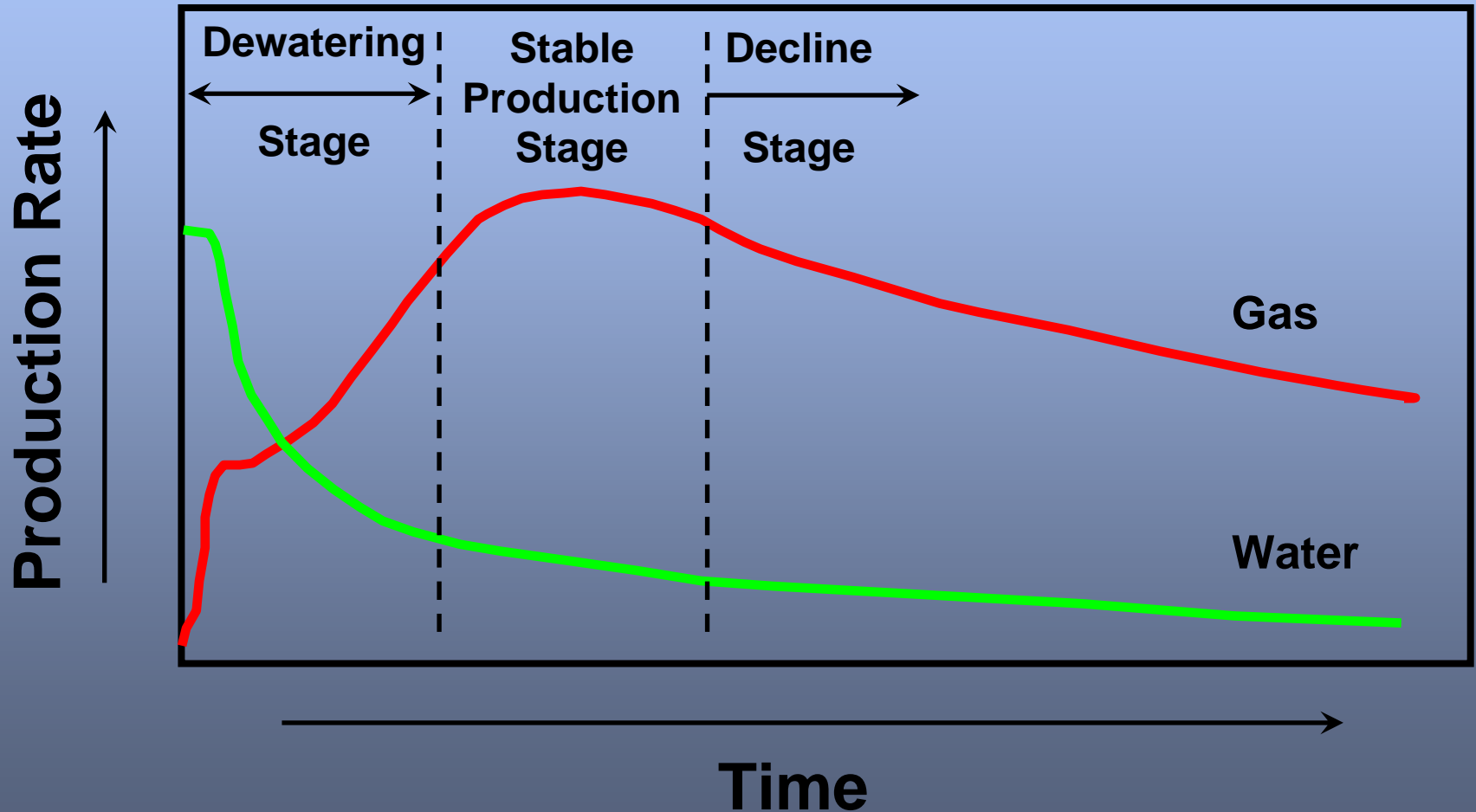
- Canadian NGC industry is just getting started
- Canadian industry is benefiting from technologies and experience over last 30 years in U.S.
- Alberta has advantage of a regulatory regime that will not allow some of the negative U.S. experiences to occur

NGC is “Unconventional” Gas

- “Oil sands” of gas
- Much of gas is “sorbed” on the coal
- Water initially produced typically to “dewater” or “depressure” coal
- Permeability comes from “cleats
- Low gas rates



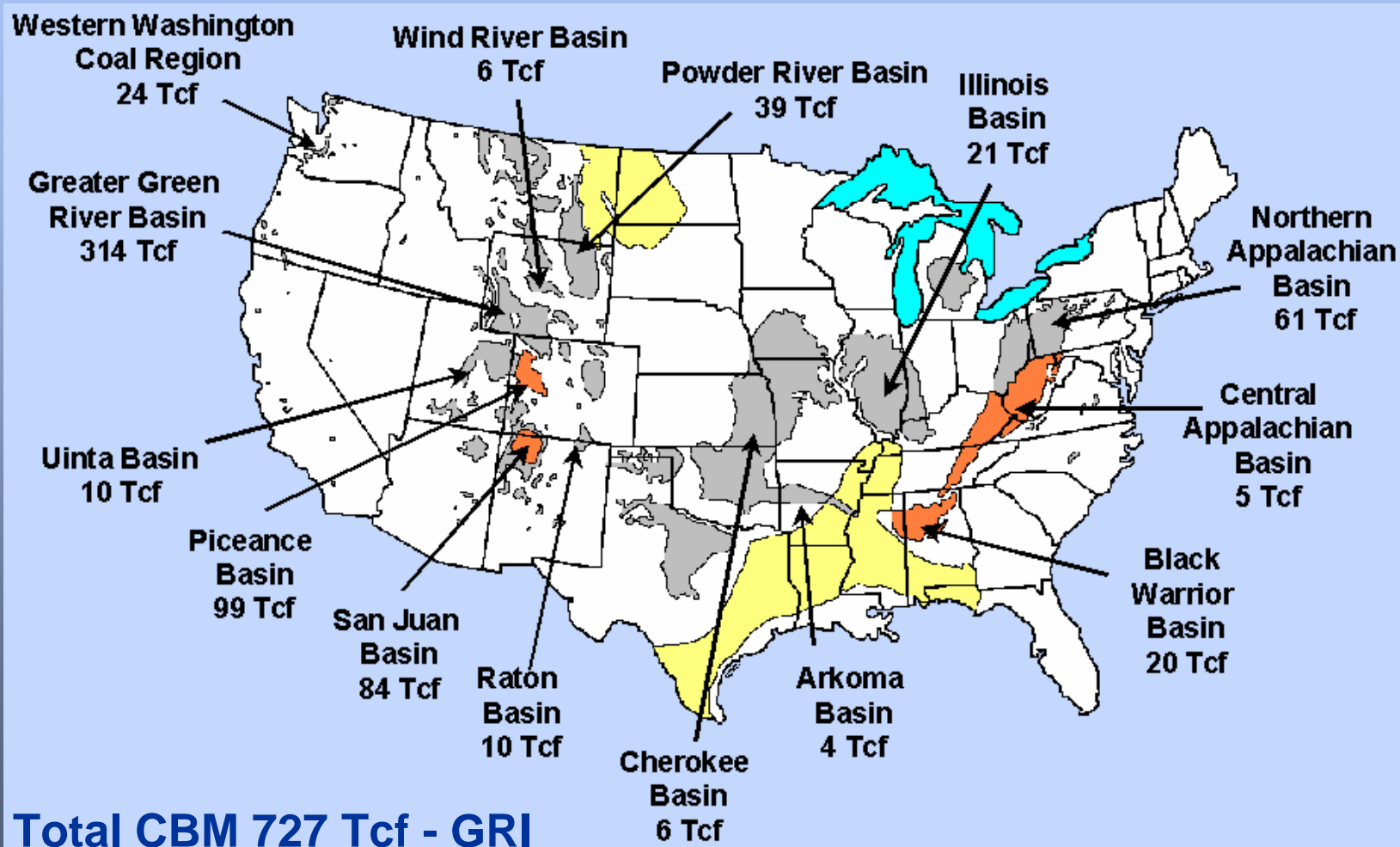
“Typical” NGC Well Production Profile



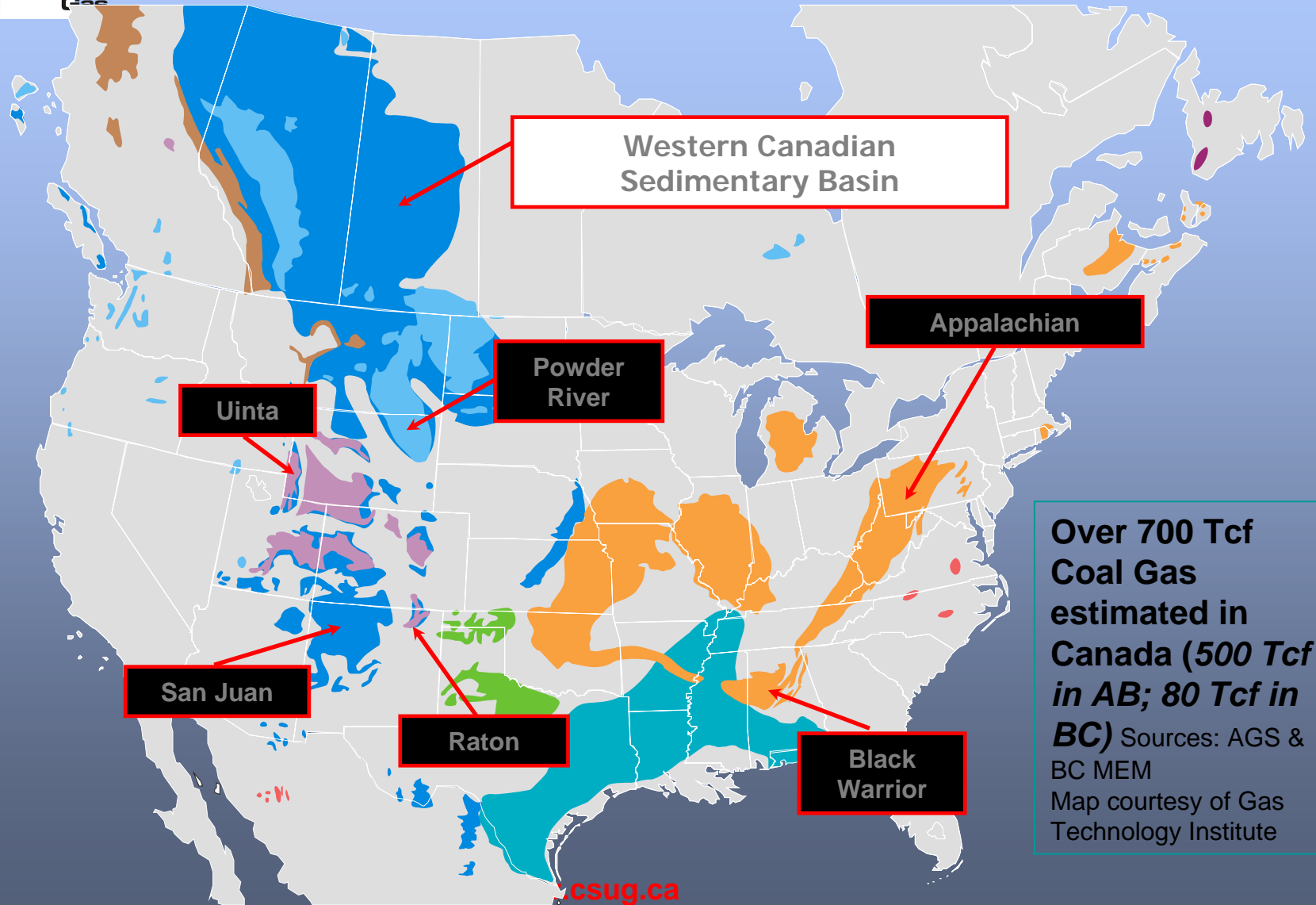
What Is Natural Gas from Coal?

- Sweet gas, generally greater than 90% methane (CH_4), with small amounts of other substances such as carbon dioxide (CO_2) and nitrogen
- NGC is the cleanest burning fossil fuel
- Historically, some “dewatering” has been required to produce NGC
- Each NGC basin is unique in terms of geology, topography, water saturation, water chemistry

14 Different U.S. NGC Resource Basins

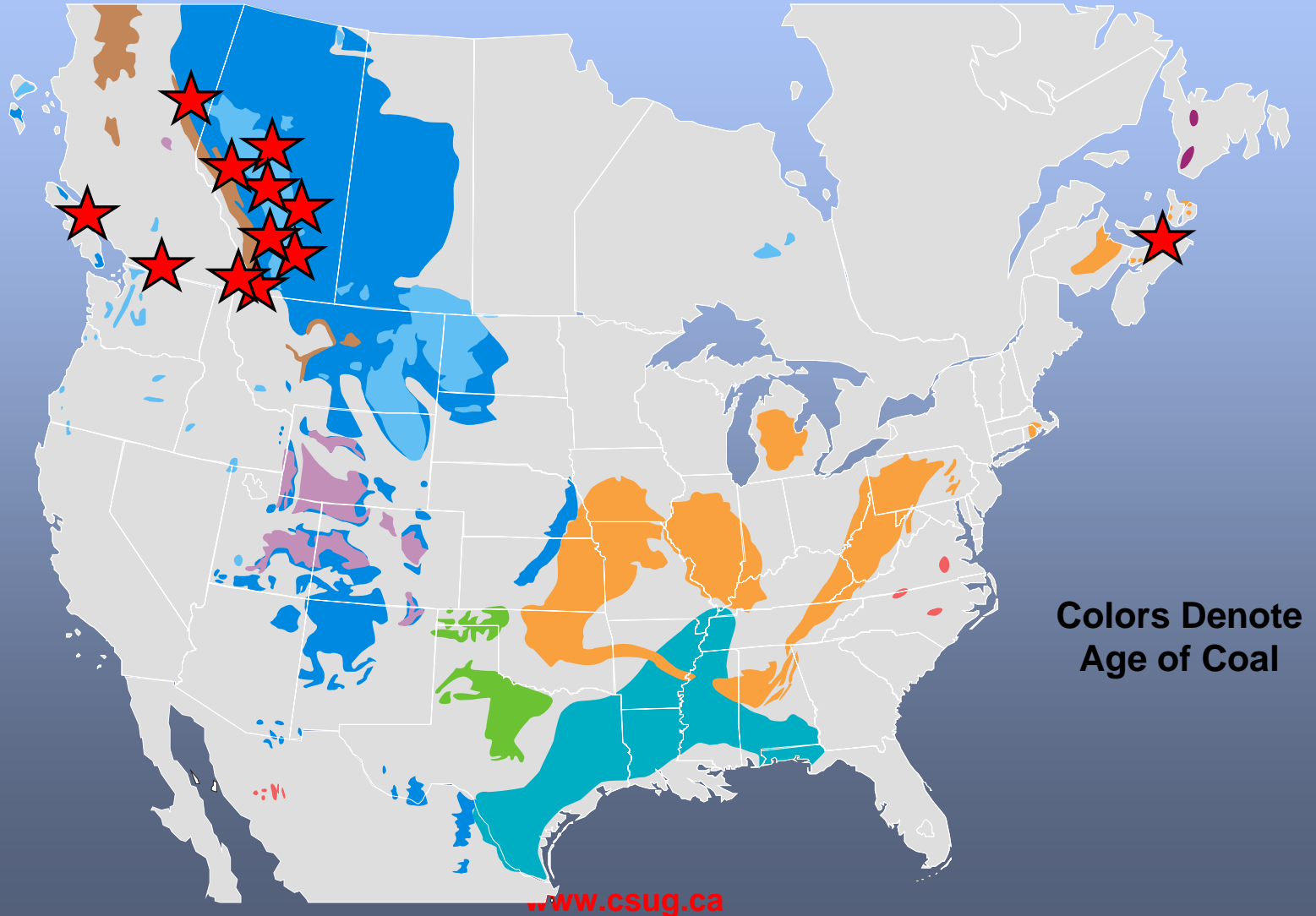


Canada has Lots of Coal and Coal Gas

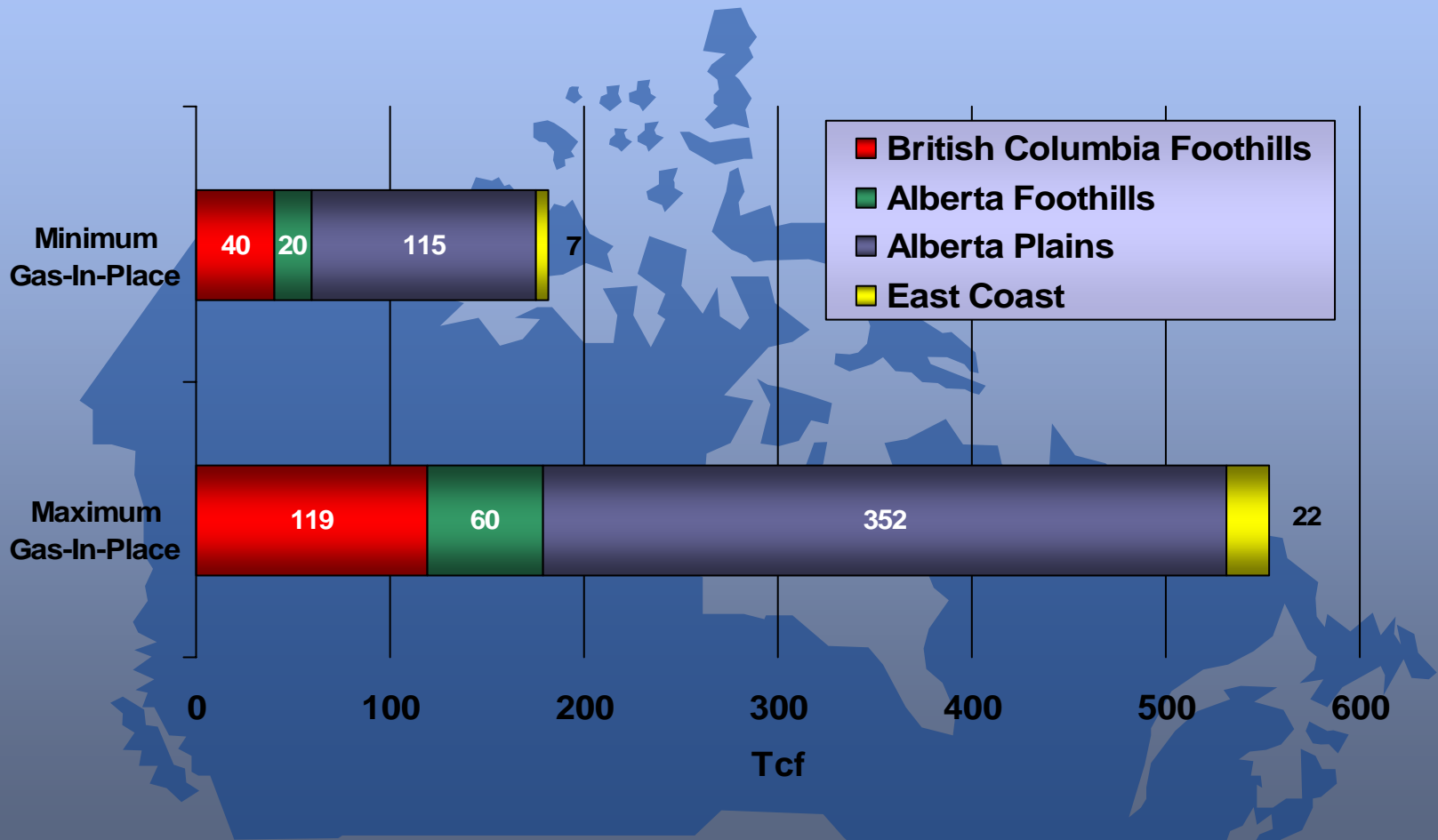


(Various colours shown on coal basins indicate age of sediments)

North American NGC Basins

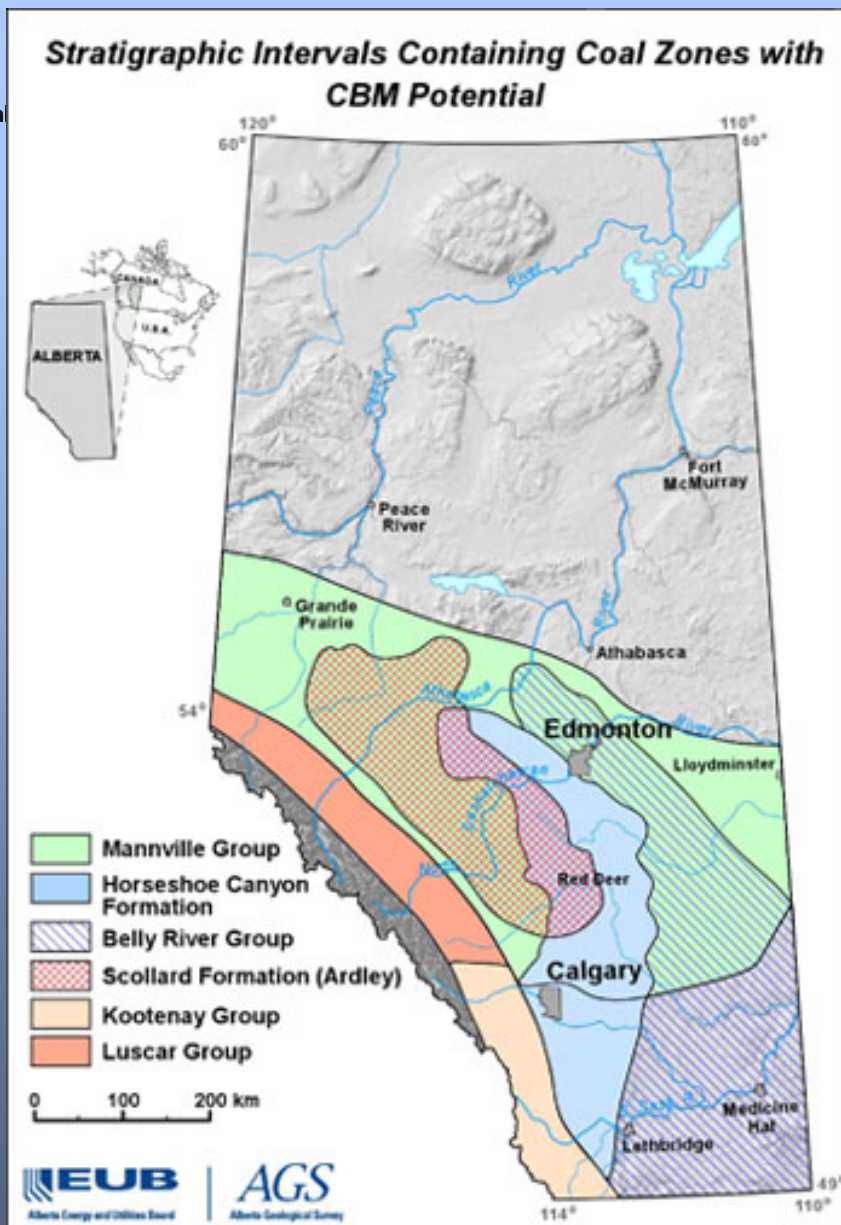


NGC in Canada – Resource Estimates



Three types of NGC plays in Alberta

1. “Dry” coals, practically no water production (HSC)
 - ~91% of existing CBM wells, ~25% of resource
 - Current production ~ 350 MMcf/D
2. Coals that produce saline water (Mannville)
 - ~7% of existing wells, ~60% of resource
 - Commercial development announced in 2005
 - Brine disposed of in approved underground zones
3. Coals that produce non-saline water (Ardley)
 - ~2% of existing wells, ~15% of resource
 - Early evaluation phase



Much of Canada's
NGC Potential is in
Alberta

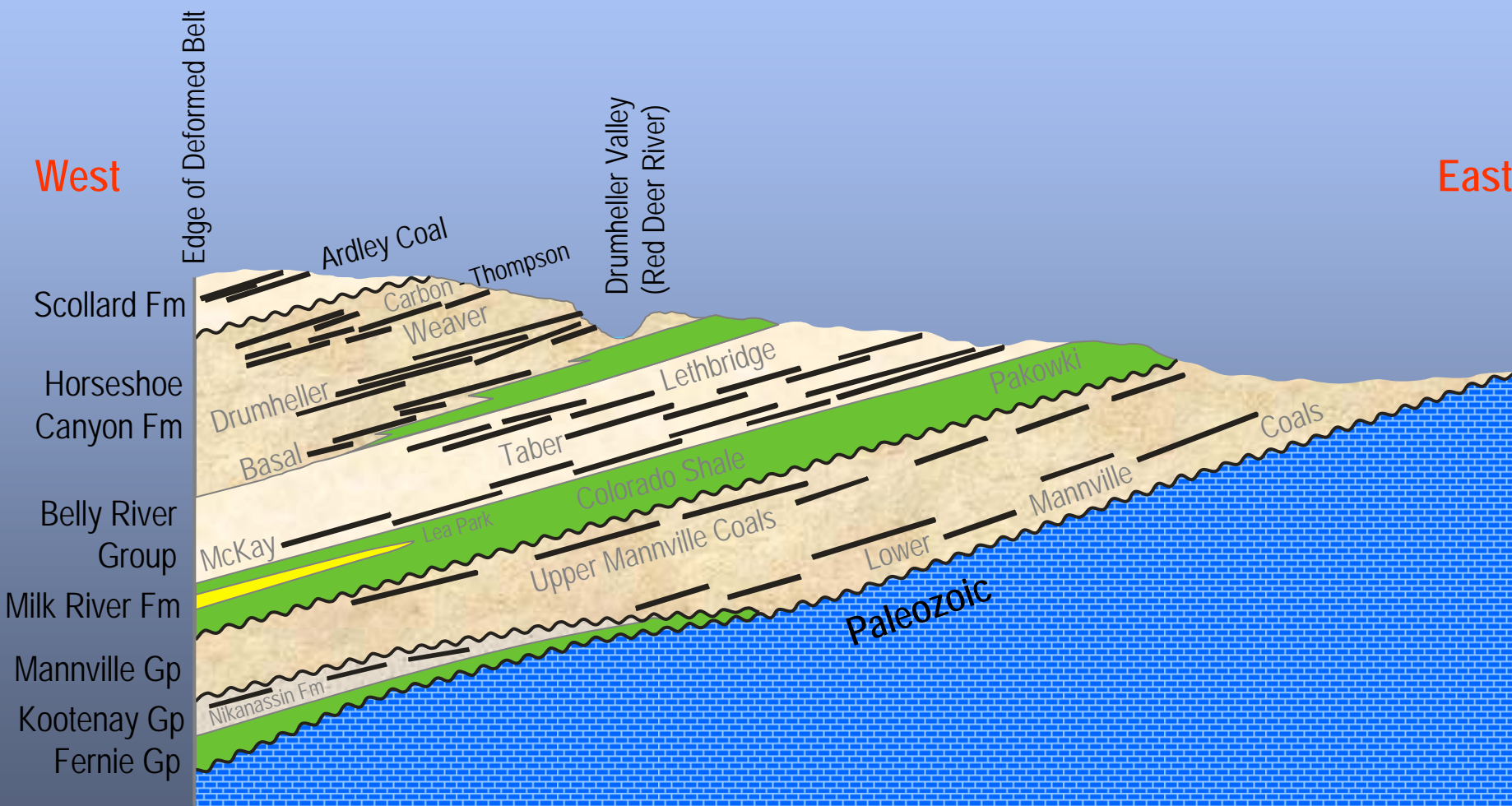
First commercial NGC
well in Alberta in
December 2001

Current production is
over 350 MMcf/D

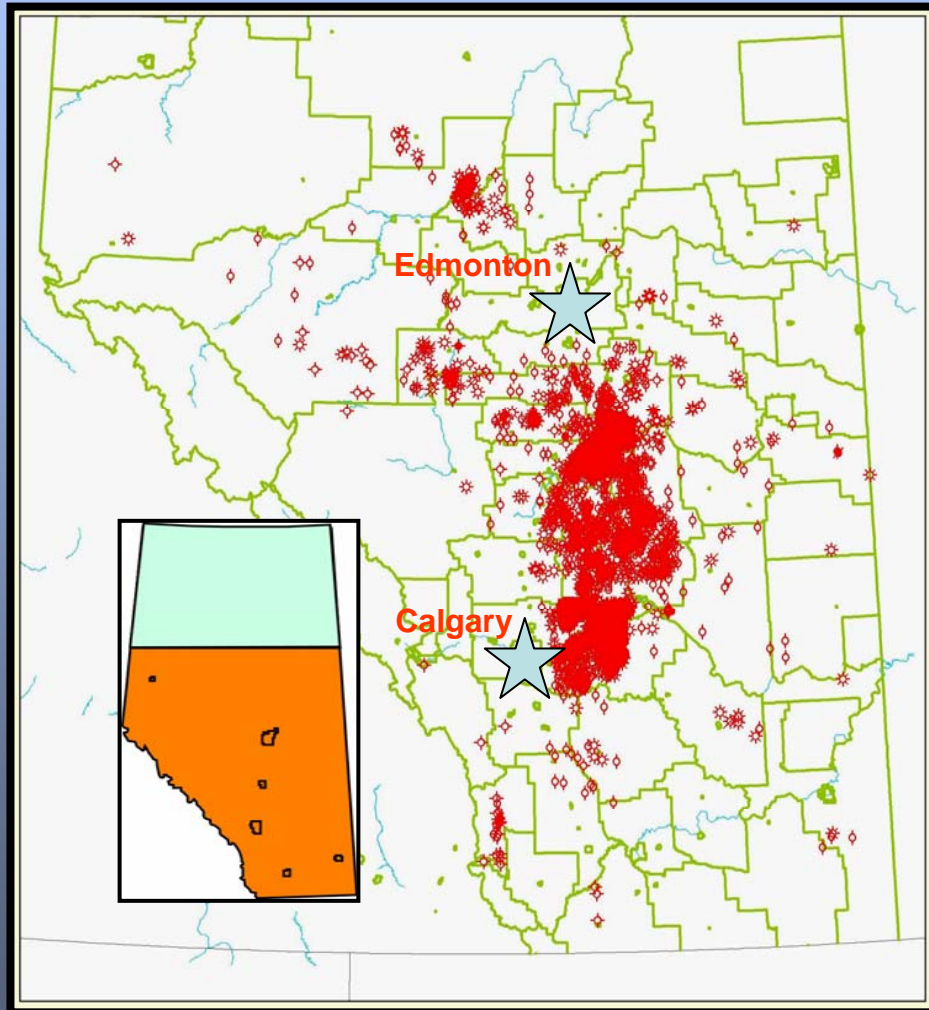
Over 3,000 wells
drilled in 2005

NGC wells accounted
for 15% of all wells
drilled in Alberta in
2005

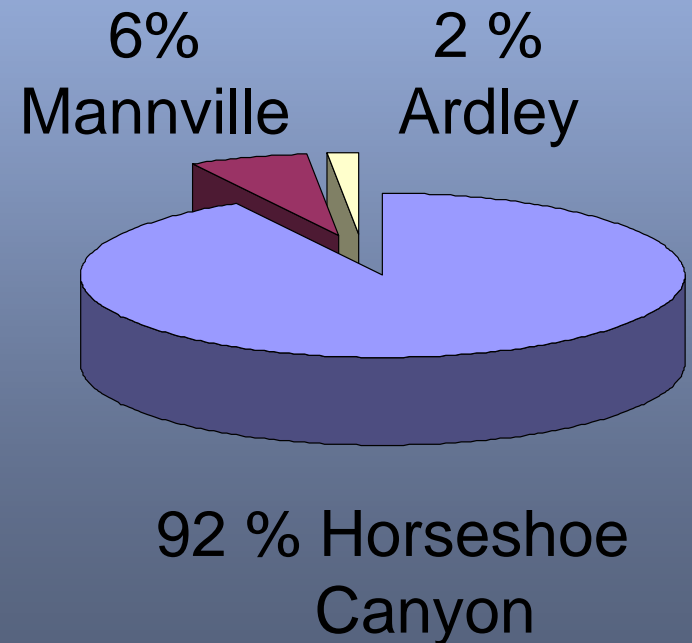
NGC in Canada – WCSB Schematic Cross Section



Alberta NGC Well Locations (Jan 2005)



About 15% of AB wells
drilled in 2005



“Dry” Horseshoe Canyon Coals



Photos courtesy of AGS



Courtesy of CDX Canada

NGC Comparison with Conventional Natural Gas

Typical Conventional Natural Gas

Typical NGC

Depth	150 m to 3,000 m	150 m to 1,500 m
Water	Usually salt water Rates may increase during production life Water is re-injected	Usually no water or salt water in Alberta Rates typically decrease Salt water is re-injected
Compression	Less required	More required
Well Spacing	Initially, one well per section; density often increases	Two to eight wells per section

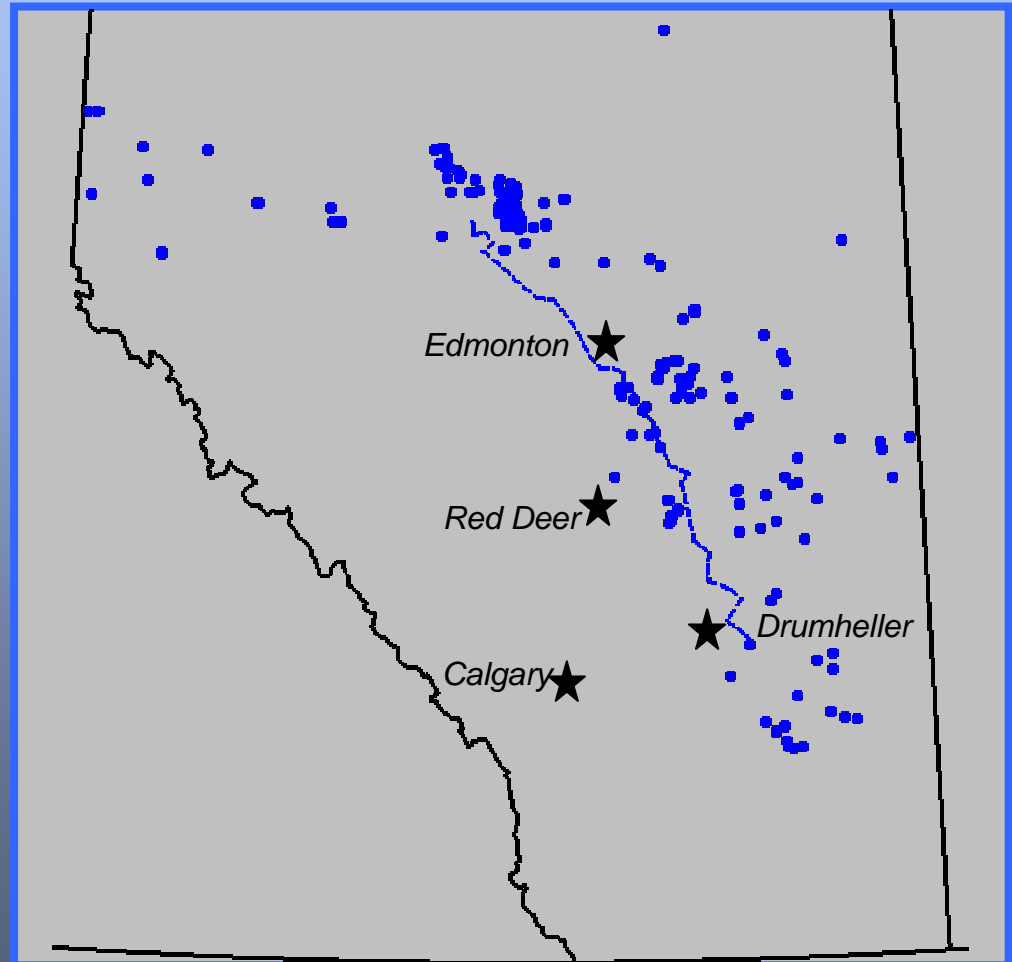
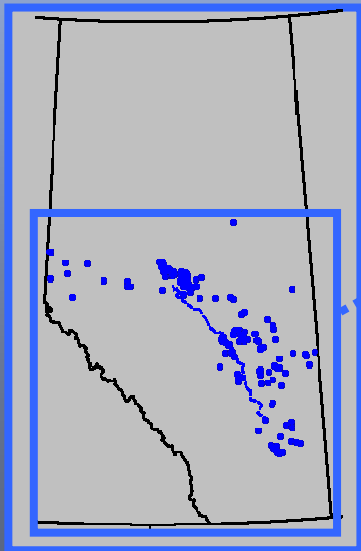
Why has Horseshoe Canyon Worked?

- Committed, experienced industry players
 - Over 50 MM\$ invested before significant production
- Recognition of “dry” coal characteristics
 - Less gas in place and reservoir energy
 - Low rates
 - Reduced capital and operating costs
- Innovation
 - Nitrogen fracs, air-drilling, multi-zone completions, new nitrogen sources
- Adaptation
 - Alberta shallow gas “machine”
- Achieved without significant royalty/tax incentives

Mannville NGC Activity

~ 250 wells tested

- Mannville 1200m
- Mannville CBM



Mannville Development

- Larger resource but reservoir less permeable than HSC
- Industry turning to horizontal drilling
- First commercial development announced in 2005
- Interest growing



Canadian NGC Business has Changed Over Last 5 Years

- NGC is now a serious play and a big part of Canada's energy future
- Competition increasing as more players are involved
 - Leases more costly
- Many Canadian companies are focusing on resource plays like NGC
- The income trusts are getting into NGC as the risk is reduced

Natural Gas from Coals is Growing

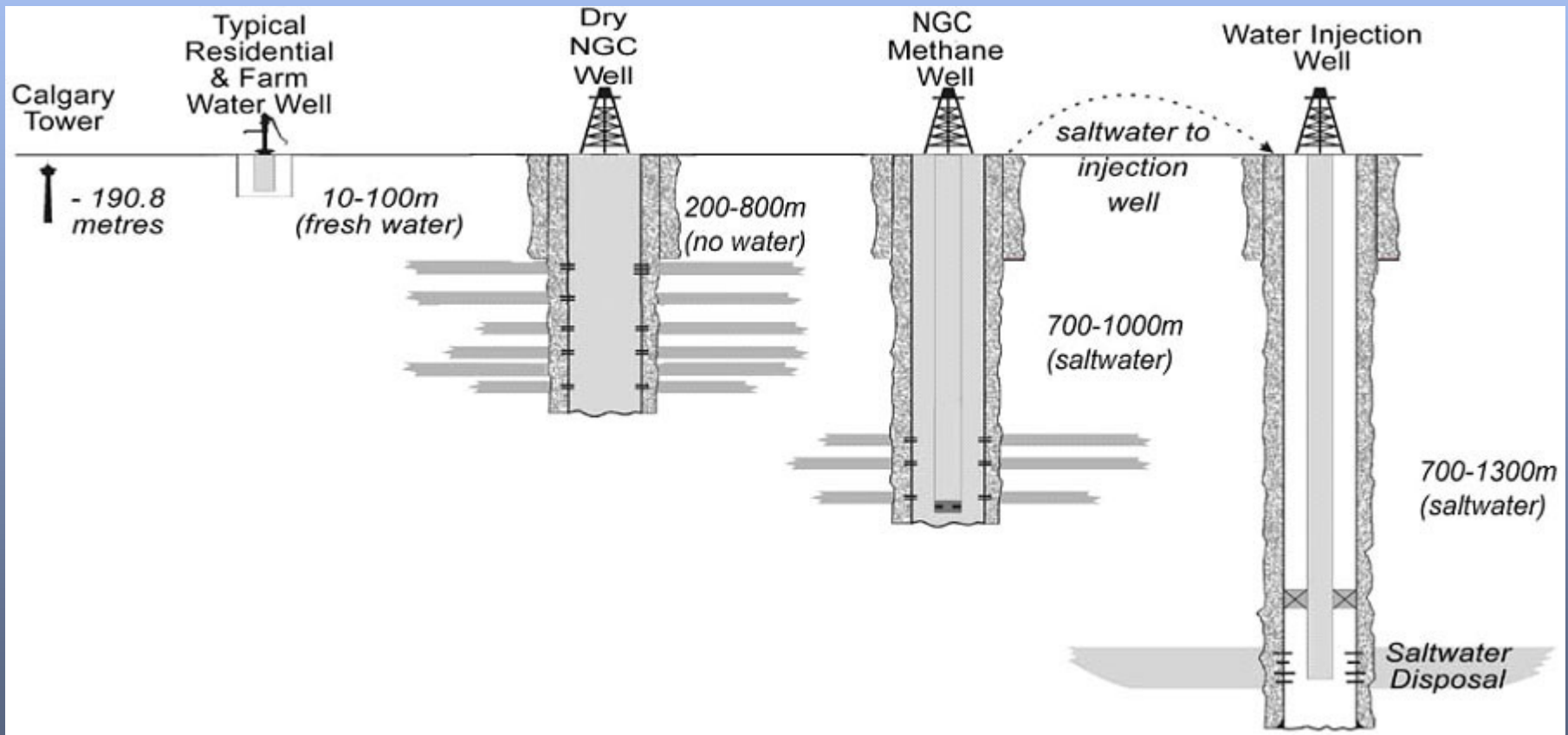
- Resource is ~ 700 Tcf
- 1 billion+ \$ invested in ~ 3,000+ wells in Alberta in 2005
- Current production 350+ MMcf/D
 - ~1.5% of Canadian gas production
 - HSC Largest “dry” coal play in world
 - Mannville emerging play
- NEB stated that NGC will offset decline in conventional production

NGC in Canada – Issues

1. Water Production and Disposal

- When wells produce salt water, it is re-injected deep underground, below fresh water aquifers (this is a conventional Alberta oil and gas technique, used for many decades)
- If fresh water was produced, Alberta Environmental Protection would regulate water management
- All wells have surface and production casing

NGC in Canada – Produced Water Disposal



NGC in Canada – Issues, cont'd

2. Well Density and Surface Disturbance

- Well sites similar to existing conventional gas
- The norm in Alberta and BC is 2 to 8 wells per section
- Surface facilities, including water disposal equipment, are similar to conventional gas

NGC in Canada – Issues, cont'd

3. Air Quality

- NGC is the cleanest-burning form of sweet, dry gas
- NGC is not sour, and contains no liquids or foreign contaminants
- Requires little or no field processing
- Producers are seeking solutions to reduce flaring

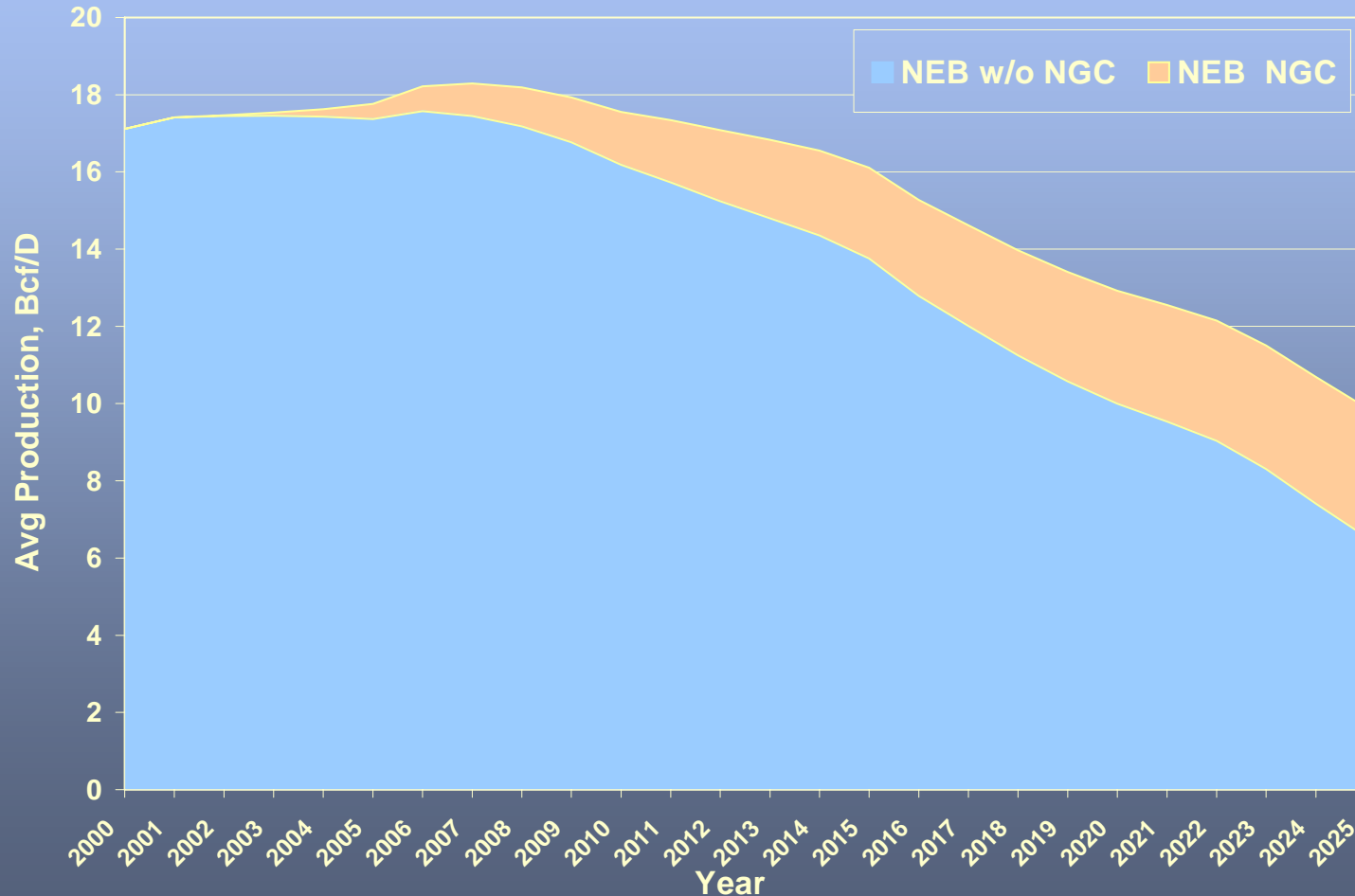
Low-Impact “Dry” NGC Well Site



NGC Compressor Site



NGC is Only Part of Solution



Why Should We Care?

- ENERGY and the ENVIRONMENT are intrinsically linked to the ECONOMY and QUALITY OF LIFE in modern Canada
- Canadians are large consumers of energy, but also care about the environment
- 42% of Canadians believe the oil and gas industry is damaging the environment and is not committed to improving its performance
- Since 82% of our energy comes from fossil fuels (including coal)
- ***Disconnect between the demand for energy and fears related to the production process***

Key Stakeholder Issues in Unconventional Gas

- Many new wells will be required, how will we manage impacts on:
 - Water
 - Air
 - Surface
- Actions currently underway
 - Multi-Stakeholder Advisory Committee (MAC) process on NGC in Alberta
 - Stakeholder engagement in other areas of prospective growth (BC, SK, ...)
 - Water for Life, Clean Air Strategic Alliance (CASA)

Summary

- Differentiate Canadian NGC on its merits – different from US experience
- Unconventional gas is a vital part of Canada's energy future and it is being developed responsibly
- Canada has a strong regulatory structure to manage growth
- All stakeholders must engage to ensure that we “do it right”, harvesting the energy while protecting the water, surface, and air



For more information on unconventional gas and CSUG

- Visit the CSUG website at www.csug.ca (contact information for CSUG board and office)
- Attend CSUG's 8th Annual Conference on Unconventional Gas November 15-17, 2006 Telus Convention Centre, Calgary

The U.S. Industry Today

- 727 Tcf resource, 82 Tcf recoverable* (11% recovery factor)
- 20,000+ wells in over 13 basins
- 4.4 Bcf/D and growing, over 200 Mcf/D/well
 - Still dominated by San Juan Basin (>50%)
- Growth is ongoing, with essential emphasis on managing environmental impact
- U.S. experience has led to NGC developments in Canada, Australia, China, Eastern Europe, ...

* SPE – Holditch, EIA, NPC
www.csug.ca

Key “Learnings” from U.S.

- Complex reservoirs
 - Gas contents, desorption isotherms, cleats
- Each basin is unique
 - Depth, permeability, number of seams, rank, water quality
- Different technologies were adapted to different areas
 - Multi-seam fracs, cavitation, openhole
 - Artificial lift options
 - Gas processing challenges
- New environmental challenges



Research and Fiscal Incentives Catalyzed U.S. Growth in NGC

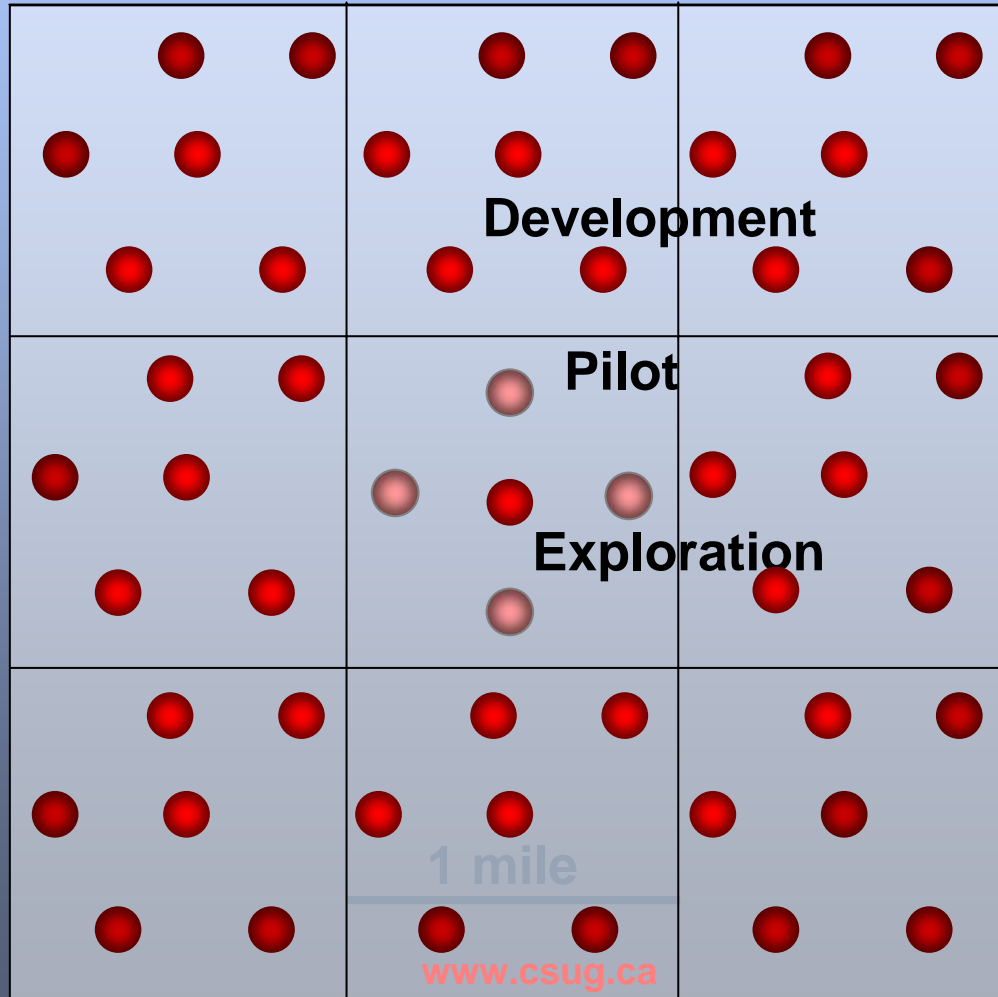
- Gas Research Institute (GRI) and DOE
 - Billions in basic and applied research
 - Massive hydraulic fracturing
 - Reservoir characterization and modeling
 - New tools and technologies
- Tax Credits
 - Attracted investment capital
 - Being considered for renewal in U.S.



Use U.S. Experience to Succeed in Canada

- Build on existing technology base and adapt to unique Canadian coals
- Work with Canadian regulators and stakeholder groups to develop and implement responsible development strategies
 - AB DOE MAC & BC MEM outreach programs
- ***“Do it Right” the first time in Canada***

Exploration, Pilot and Development Wells

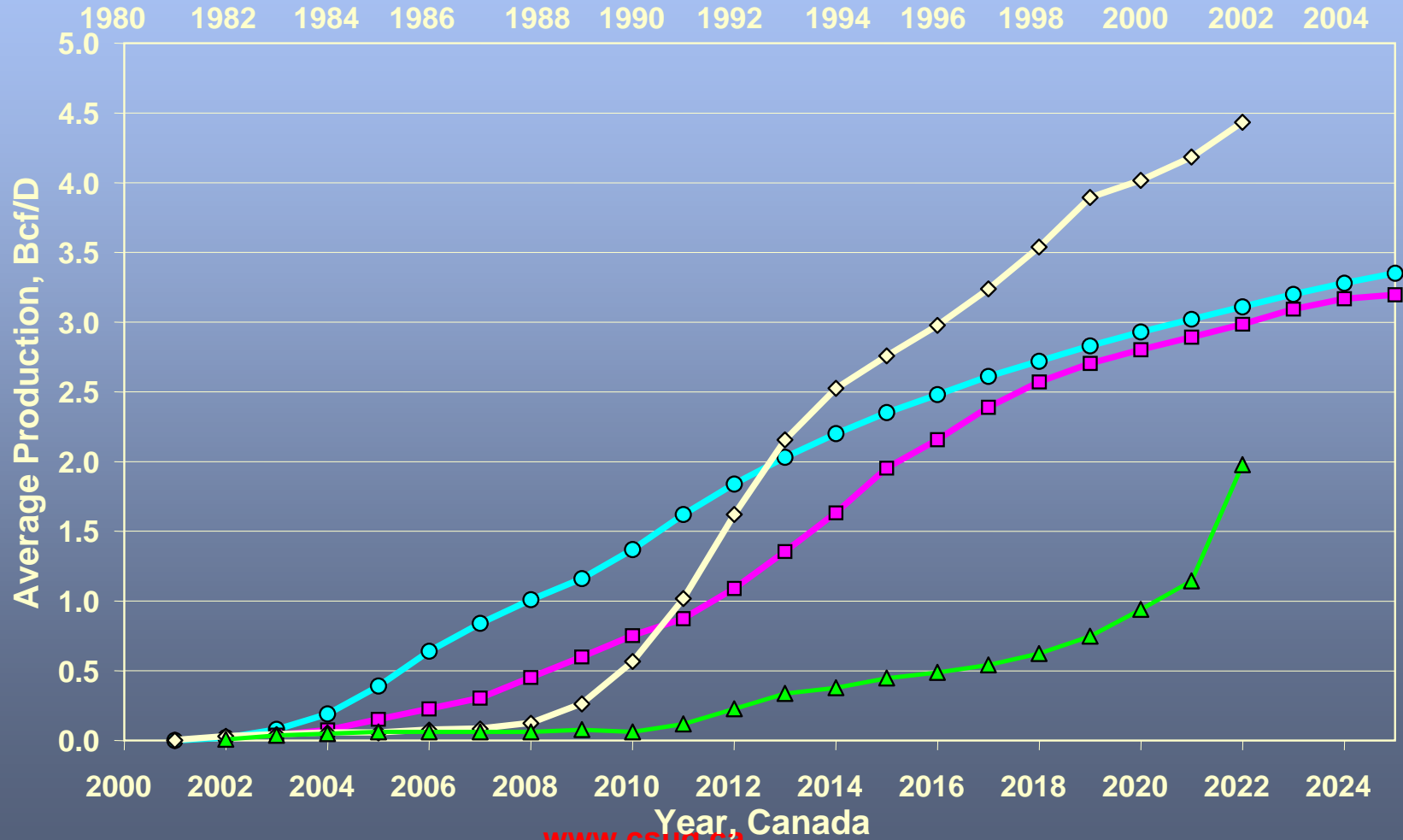


Canada's Potential NGC Production

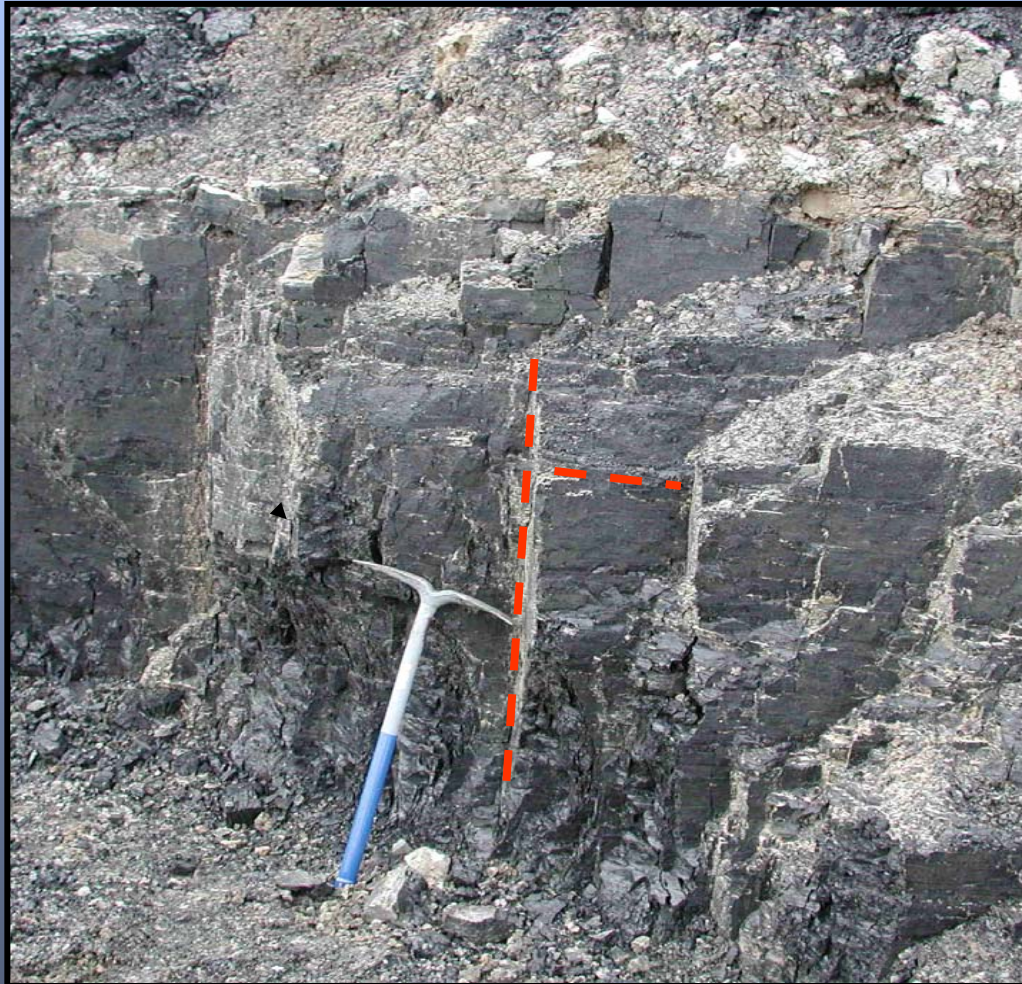
NEB Estimates 75 Tcf Recoverable

◆ U.S. NGC Total ▲ U.S. NGC w/o San Juan ○ NEB Techno -Vert ■ TCPL

Year, United States



Cleats are Essential to Coal Permeability



**Drumheller Coal
Paintearth Mine, Alberta**

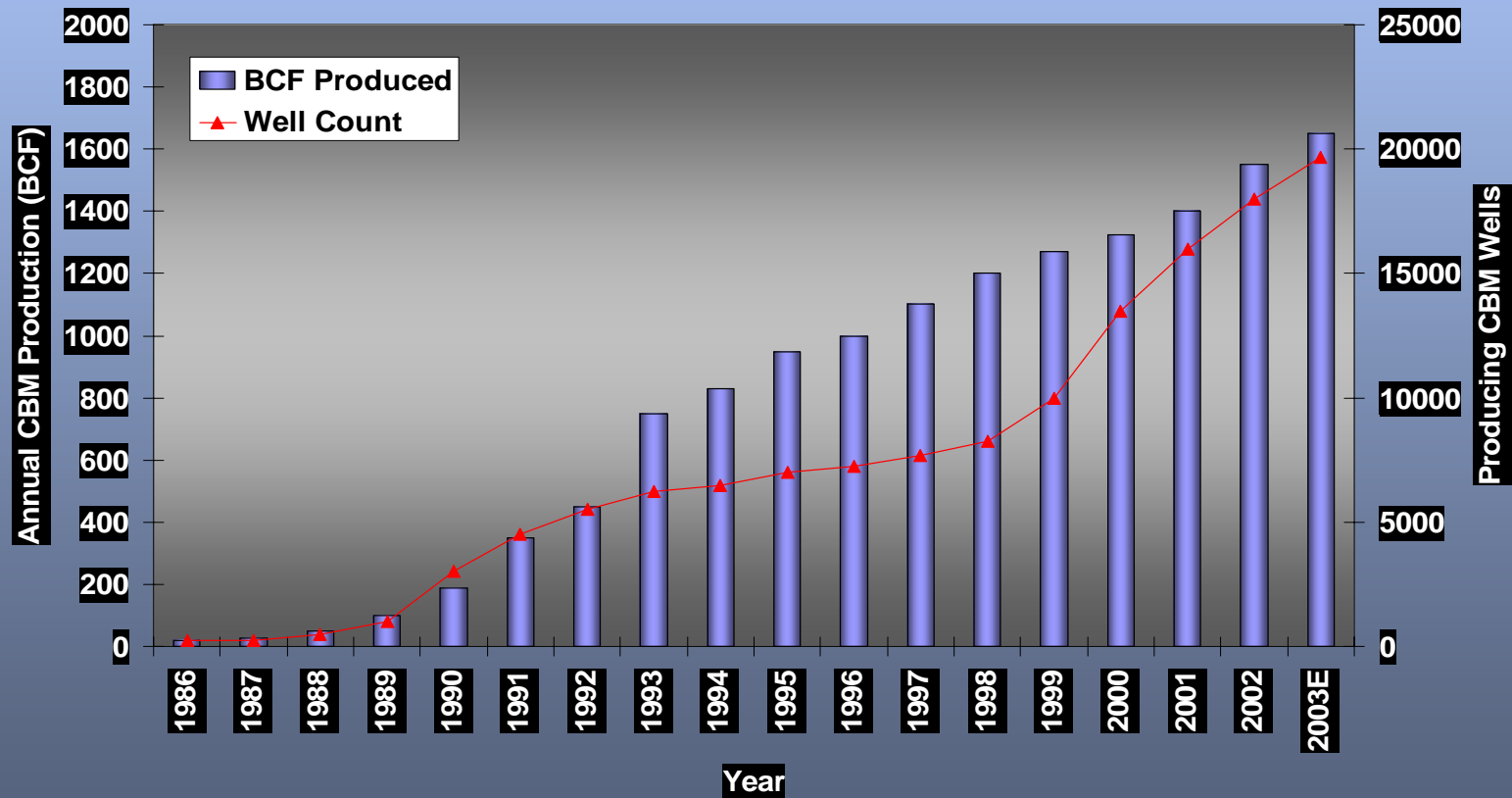
Cleat spacing 10-25cm (face)

(Photo by AGS)

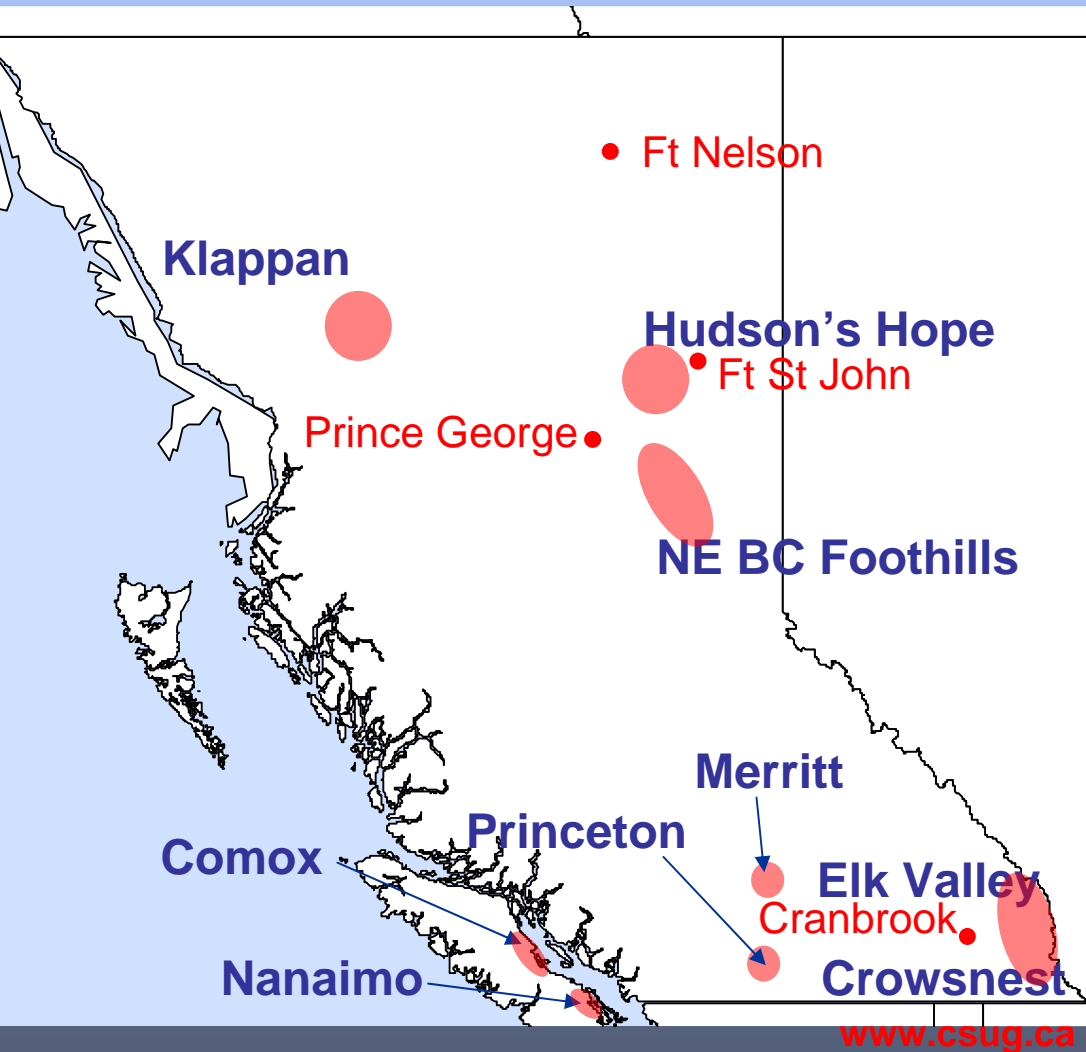
U.S. NGC Production History

2002 NGC production represents ~8% of U.S. natural gas production.

Through 2003 almost 20,000 producing NGC wells in 12 states.



BC Coalbed Gas Activity Areas



< 80 wells
authorized
since 2000
~ 50 drilled

National Petroleum Council Study: *Unconventional Gas is Increasingly Important*

- “Conventional gas production will inevitably decline, and the overall level of indigenous production will be largely dependent on industry’s ability to increase its production of unconventional gas”*
- 80% of gas production in 10 years will be from wells yet to be drilled
- By 2025, unconventional gas will account for about 80% of new drilling and 50% of gas production
- NEB stated that NGC will offset decline in conventional production

* *Balancing Natural Gas Policy: Fueling the Demands of a Growing Economy*, National Petroleum Council report, 2003

Coal has Organic Beginnings



Courtesy CDX Gas

www.csug.ca

Coalification Process takes Time

Deposition of Plant Matter

