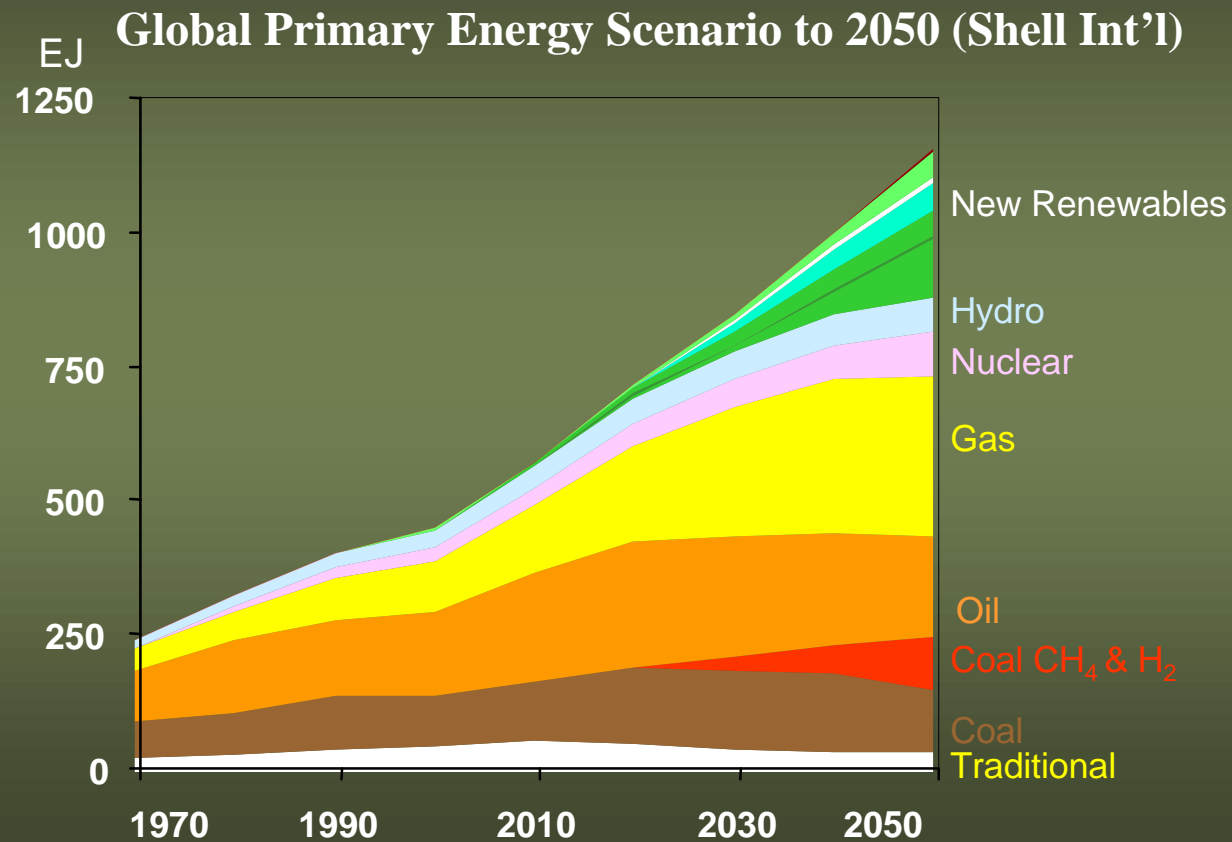


*Canadian Natural Gas Exports  
and  
Promotion of Cleaner Energy  
in the US Market*

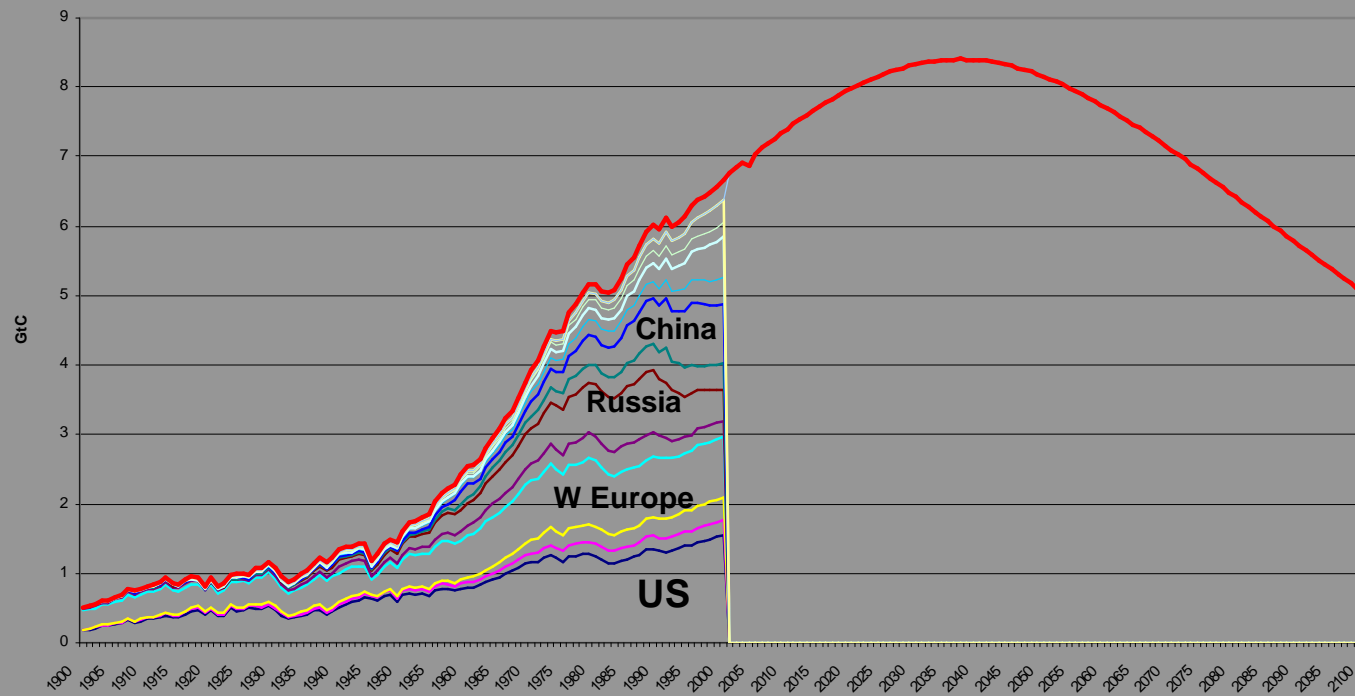
UNFCCC Workshop on  
Cleaner or Less Greenhouse Gas-emitting Energy  
May 7-8, 2002, Whistler, B.C.

Rick Hyndman, PhD  
School of Business  
University of Alberta

# Natural Gas will be of growing importance globally for decades



# *Reducing global GHG emissions requires major technological advances*

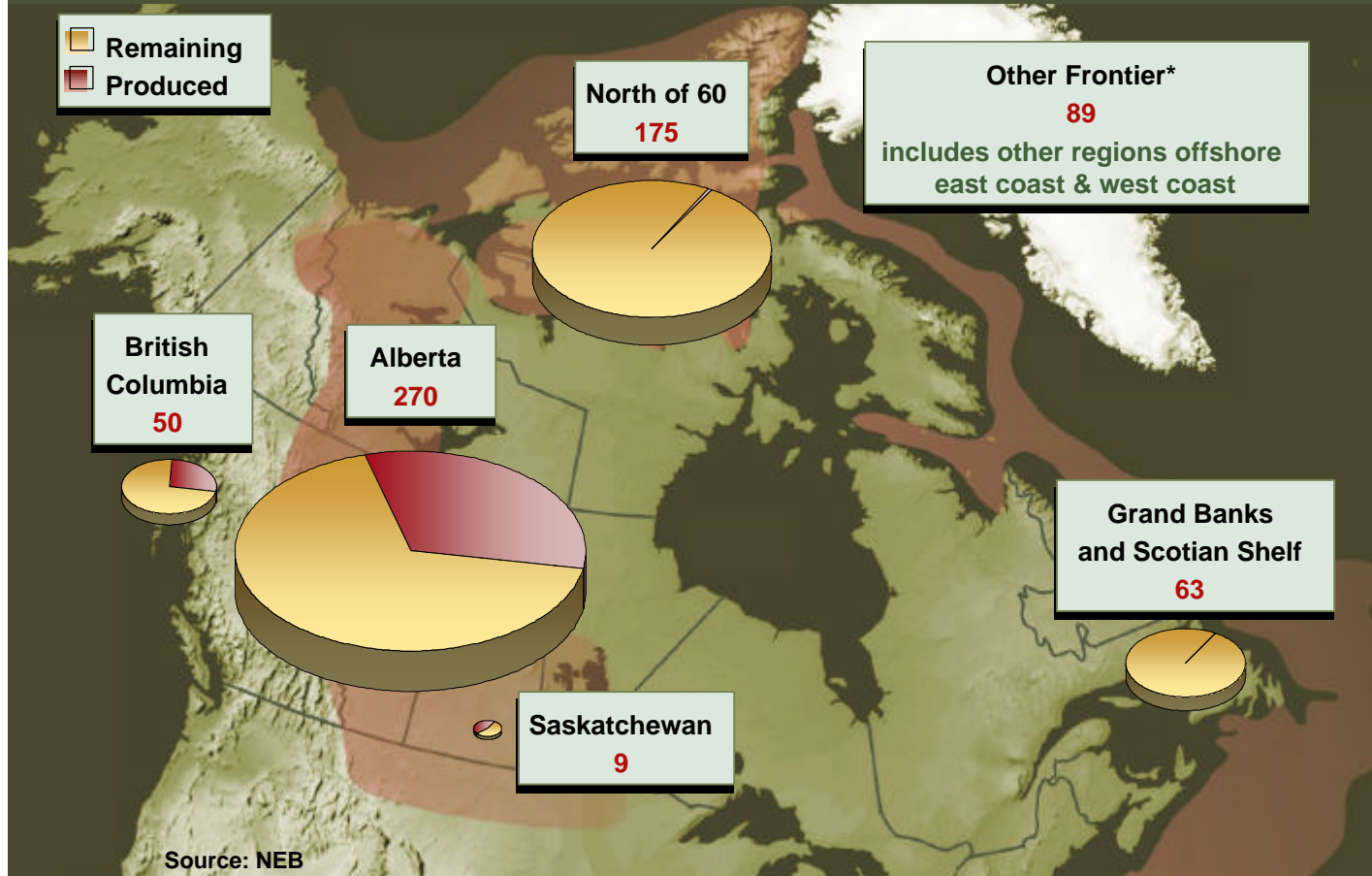


## *Canada & US Gas Supply Basins*



# Ultimate Potential of Natural Gas

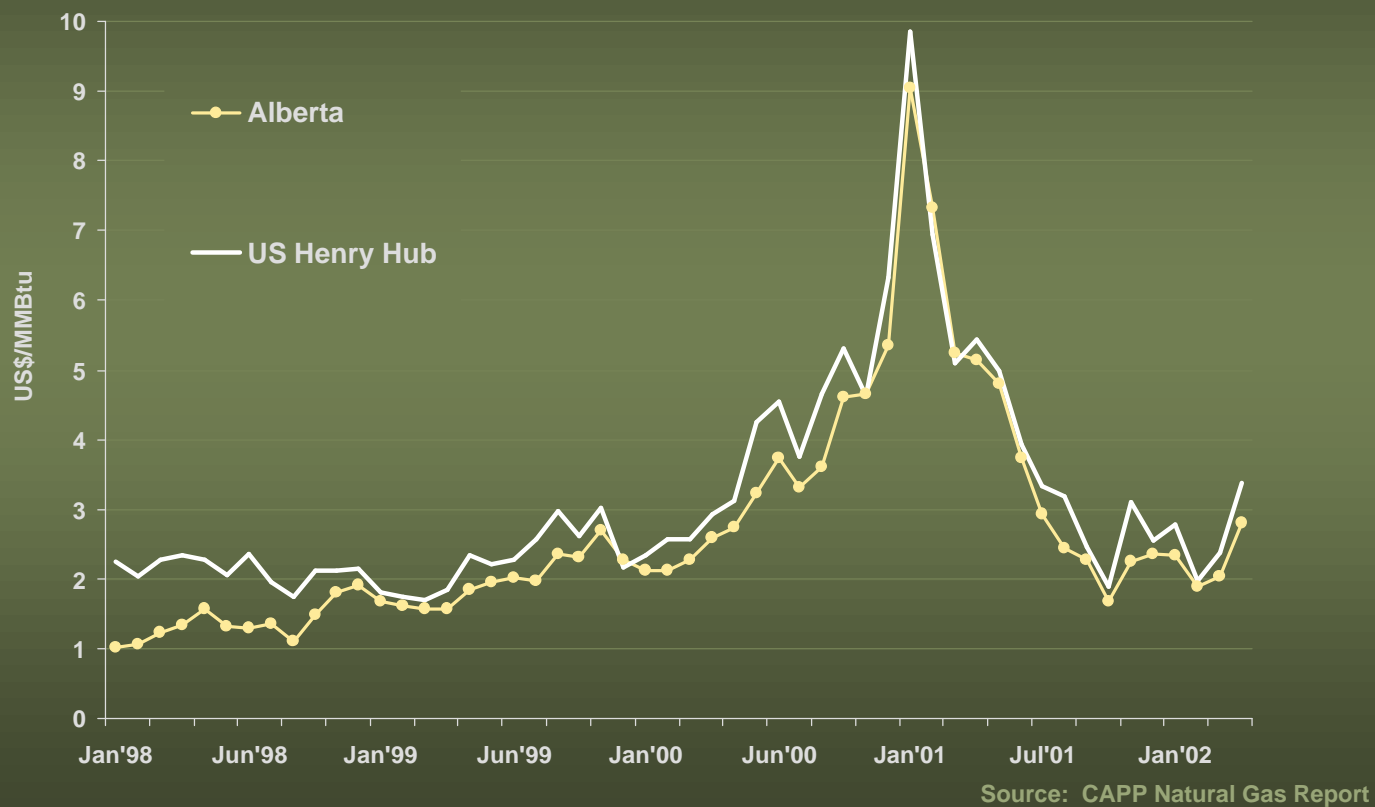
TRILLION CUBIC FEET



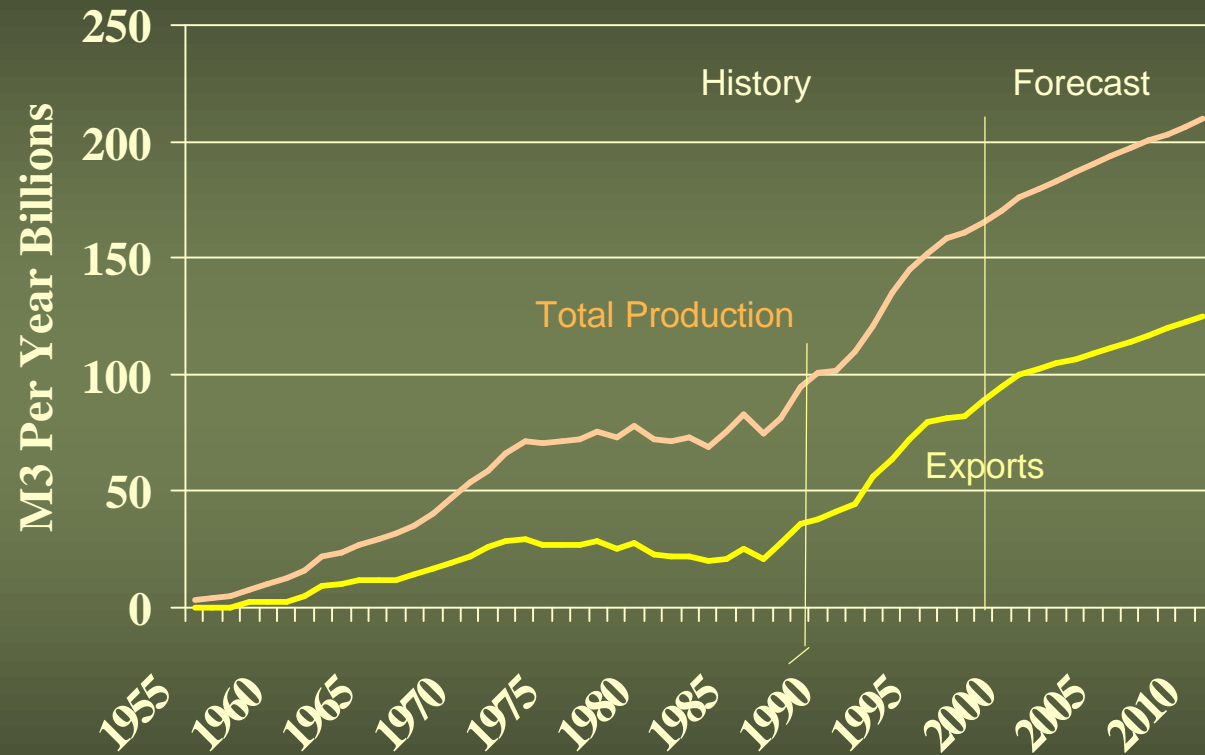
# Canadian & U.S. Natural Gas Pipelines



## Canadian and US Natural Gas Prices



# Canadian Natural Gas Production & Exports





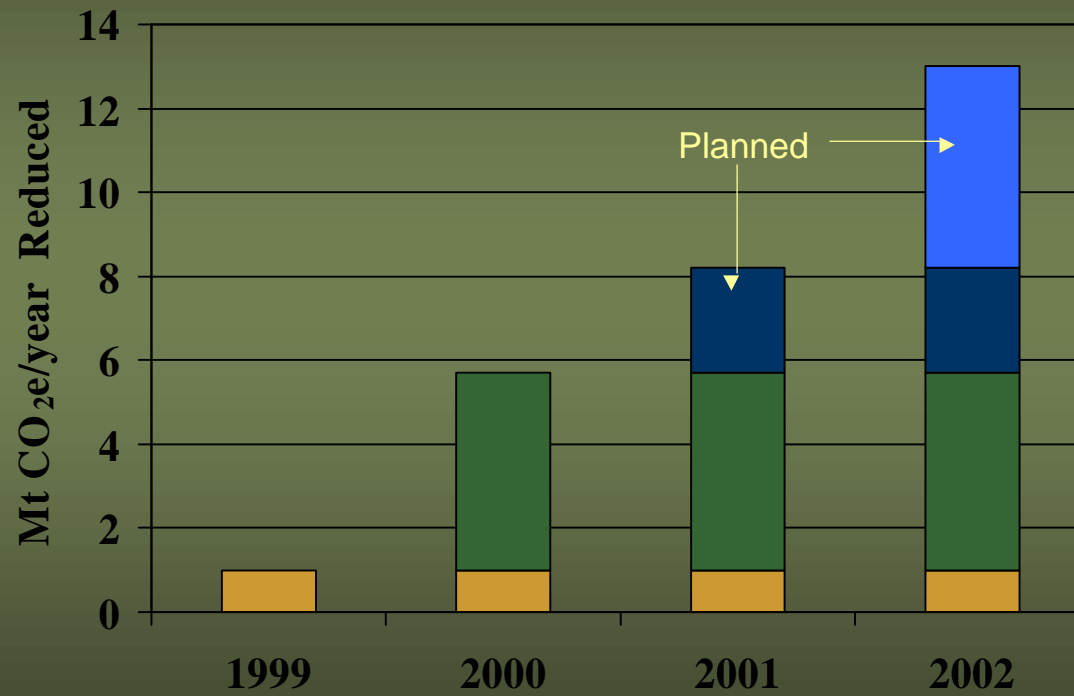
## *US Gas Trade 2001*

*Billions M<sup>3</sup>/year*

1 bcf/day = approx 10 bcm/year

	US Imports	US Exports	US Net Imports
<b>Pipelines</b>			
Canada	108.99	6.88	102.11
Mexico	0.29	3.96	-3.67
<b>LNG</b>			
Algeria	1.84		1.84
Trinidad	2.78		2.78
Qatar	0.64		0.64
Australia	0.07		0.07
Nigeria	1.07		1.07
Japan		0.01	-0.01
Other	0.34		0.34
<b>Total</b>	<b>116.01</b>	<b>10.85</b>	<b>105.16</b>

## *Upstream Oil and Gas Emission Reduction Projects: Voluntary Challenge Program*



## *49 Upstream Oil and Gas Companies in the Voluntary Challenge Registry [www.vcr-mvr.ca]*

[ARC Resources Ltd.](#)

[Alberta Energy Company \(AEC\)](#)

[Anadarko Canada Energy Ltd.](#)

[Apache Canada Ltd.](#)

[Archean Energy Ltd.](#)

[BP Canada Energy Company](#)

[Burlington Resources Canada Energy Ltd.](#)

[Calpine Canada Resources Ltd.](#)

[Canadian Forest Oil Ltd. \(CFO\)](#)

[Canadian Hunter Exploration Ltd.](#)

[Canadian Natural Resources Limited](#)

[Chevron Texaco](#)

[Conoco Canada Limited](#)

[Devon Canada](#)

[Dominion Energy Canada Ltd.](#)

[EOG Resources Canada Inc.](#)

[ExxonMobil Canada Ltd.](#)

[Genesis Exploration Ltd.](#)

[Hunt Oil Company of  
Canada, Inc.](#)

[Husky Energy Inc.](#)

[Koch Canada, L.P.](#)

[Marathon Canada Ltd.](#)

[Maxx Petroleum Ltd.](#)

[Murphy Oil Company  
Limited](#)

[NCE Resources Group Inc.](#)

[Nexen Canada Ltd.](#)

[Northrock Resources Ltd.](#)

[PanCanadian Energy  
Corporation](#)

[Paramount Resources Ltd.](#)

[Penn West Petroleum Ltd.](#)

[Petrobank Energy and  
Resources Ltd.](#)

[Petroprep \(Canada\) Ltd.](#)

[Pioneer Natural Resources Canada Inc.](#)

[PrimeWest Energy Inc.](#)

[Pétromont Inc.](#)

[Regent Resources Ltd.](#)

[Richland Petroleum Corporation](#)

[Rife Resources Ltd.](#)

[Rio Alto Exploration Ltd.](#)

[Sabre Energy Ltd.](#)

[Shiningbank Energy Ltd.](#)

[Signalta Resources Ltd.](#)

[Star Oil & Gas Ltd.](#)

[Summit Resources Limited](#)

[Syncrude Canada Ltd.](#)

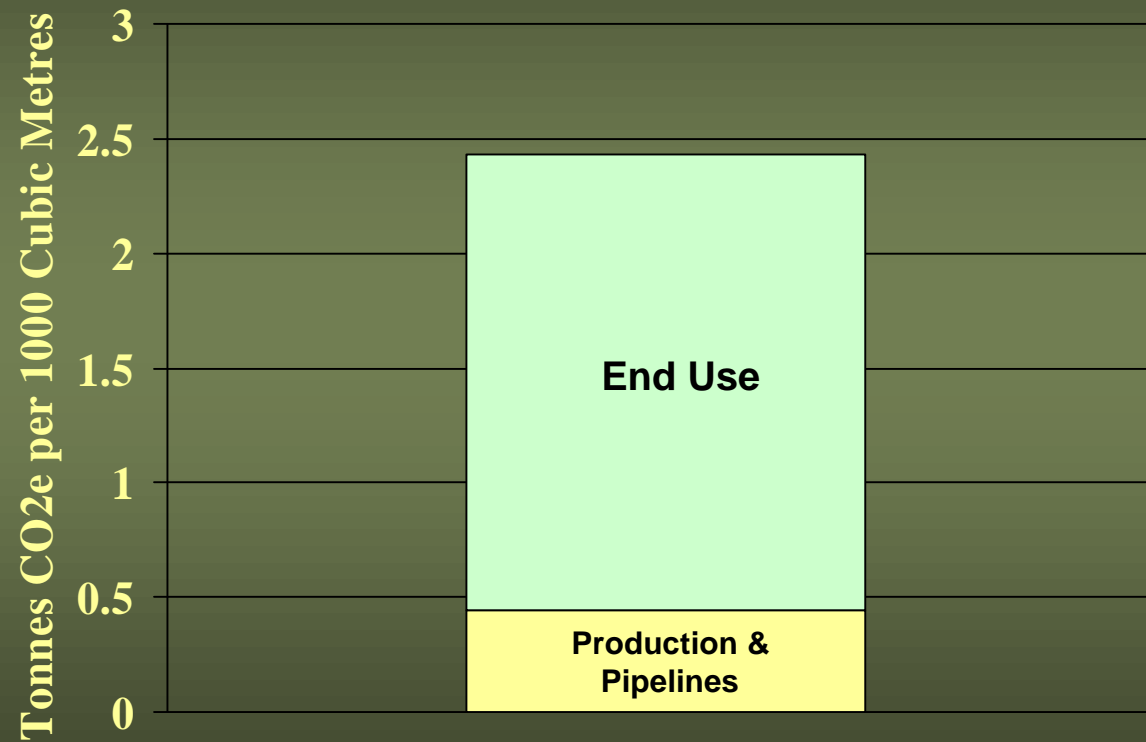
[Talisman Energy Inc.](#)

[Triumph Energy Corporation](#)

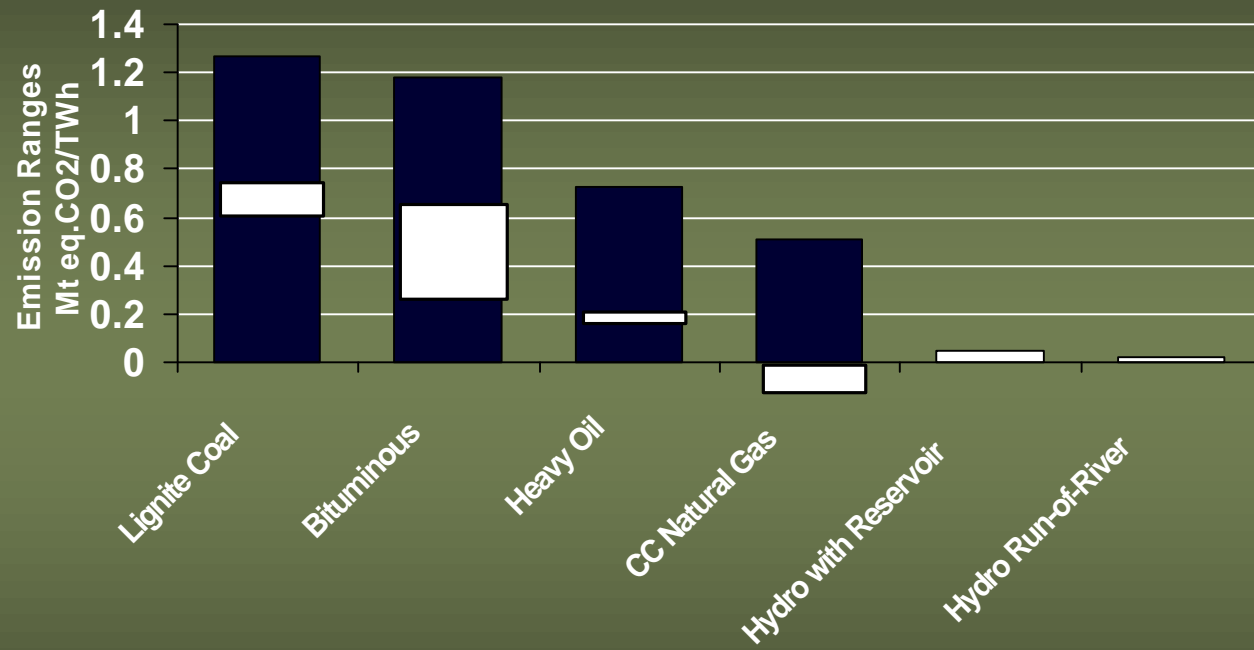
[Unocal Canada Limited](#)

[Upton Resources Inc.](#)

## *GHG Emissions from Natural Gas Production and Use*



## *Lifecycle GHG Emissions*



Source: IEA Technical Report, May 2000. *Hydropower and the Environment: Present Context and Guidelines for Future Action*. Vol. II: Main Report, Ch.3: "Comparative Environmental Analysis of Power Generation Options"

## *Market Approach to Constraining GHG Emissions*

- Lower GHG-emitting energy, such as natural gas, is valuable in reducing GHG emissions
- A market-oriented approach to reducing emissions would have that value reflected in market prices and other incentives

*Incentive benefits to Canadian natural gas under implementation of the Kyoto Protocol?*

Depends on policies in Canada and the US

- For domestic consumption, Canadian policies can reflect the large net benefit of end use savings v. production-related emissions
- For exports, it depends on US policies

## *Market Value of GHG Advantages of Cleaner Energy*

- **US policies implementing its contribution to the global effort on reducing GHG emissions are unlikely to have market prices or other incentives that reflect the GHG advantages of natural gas**
- **Canadian gas exports would not get the incentive benefit of natural gas that reflect the global environmental benefits of its displacement of alternatives in the US**



## *GHG Advantages of Natural Gas v. Coal in Power Generation*

- In round numbers, the GHG emission advantage of natural gas v. coal in power generation is approximately .5 tCO<sub>2</sub>e/MWh
- For Canadian natural gas exports that substitute for coal in power generation, the GHG advantage is:

1 mmbtu gas generates:	0.152	MWh
1 mmbtu gas generation in place of coal generation saves:	0.076	tCO <sub>2</sub>
1 10 <sup>3</sup> M <sup>3</sup> of gas generation in place of coal generation saves:	2.691	tCO <sub>2</sub>
1 bcf of gas generation in place of coal saves	0.076	MtCO <sub>2</sub> e

- If all of Canada's current 100 billion M<sup>3</sup>/year of exports displaced coal fired generation, the saving would be roughly 269 Mt CO<sub>2</sub>e/year

## *What is displaced by Canadian Gas Exports?*

Scenario of what is displaced in 2010 by Canadian gas exports of 125 billion M<sup>3</sup> / 4420 bcf

What is displaced in the US by Canadian gas	bcf
US gas <b>production</b> or LNG imports	-1400
Oil, (gas equivalent of)	-1340
Coal, (gas equivalent of)	-1340
Renewables (gas equivalent of)	-340
<b>Total</b>	<b>4420</b>

## *Global GHG Benefits of Canadian Gas Exports*

**Scenario of what is displaced in 2010 by Canadian gas exports of 125 billion M<sup>3</sup> / 4420 Bcf**

Effect of Displacement in US	bcf	MtCO <sub>2</sub> e
Lower US <u>gas production</u> or LNG imports	-1400	<b>-12</b>
Less consumption of <u>oil</u> , (gas equivalent of)	-1340	<b>-105</b>
Less consumption of <u>coal</u> , (gas equivalent of)	-1340	<b>-139</b>
Less consumption of <u>renewables</u> (gas equivalent of)	-340	<b>0</b>
Higher consumption of natural gas	3020	<b>157</b>
Net effect on GHG emissions in the US		<b>-99</b>
Emissions in Canada related to exports	4420	<b>37</b>
Net Global Effect of Canadian Exported Production		<b><u>-62</u></b>

## *Summary*

- **Canadian oil and natural gas industry operates in a competitive, integrated North American market, linked to the world oil market**
- **On a full cycle basis, natural gas has significantly lower GHG emissions than coal and oil**
  - **the large end use advantage is only partly offset by supply-related emissions**

## *Summary 2*

- The US is now out of the Protocol and unlikely to implement policies to reflect the global environmental benefits of Canadian exports of natural gas in market prices and other incentives