

Energy security
or
Where will our energy come from?

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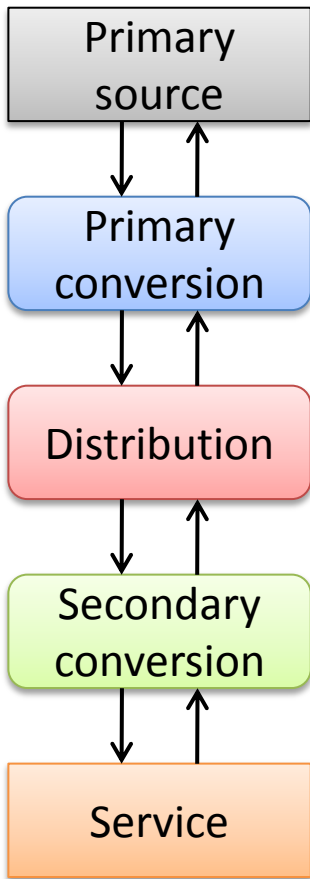
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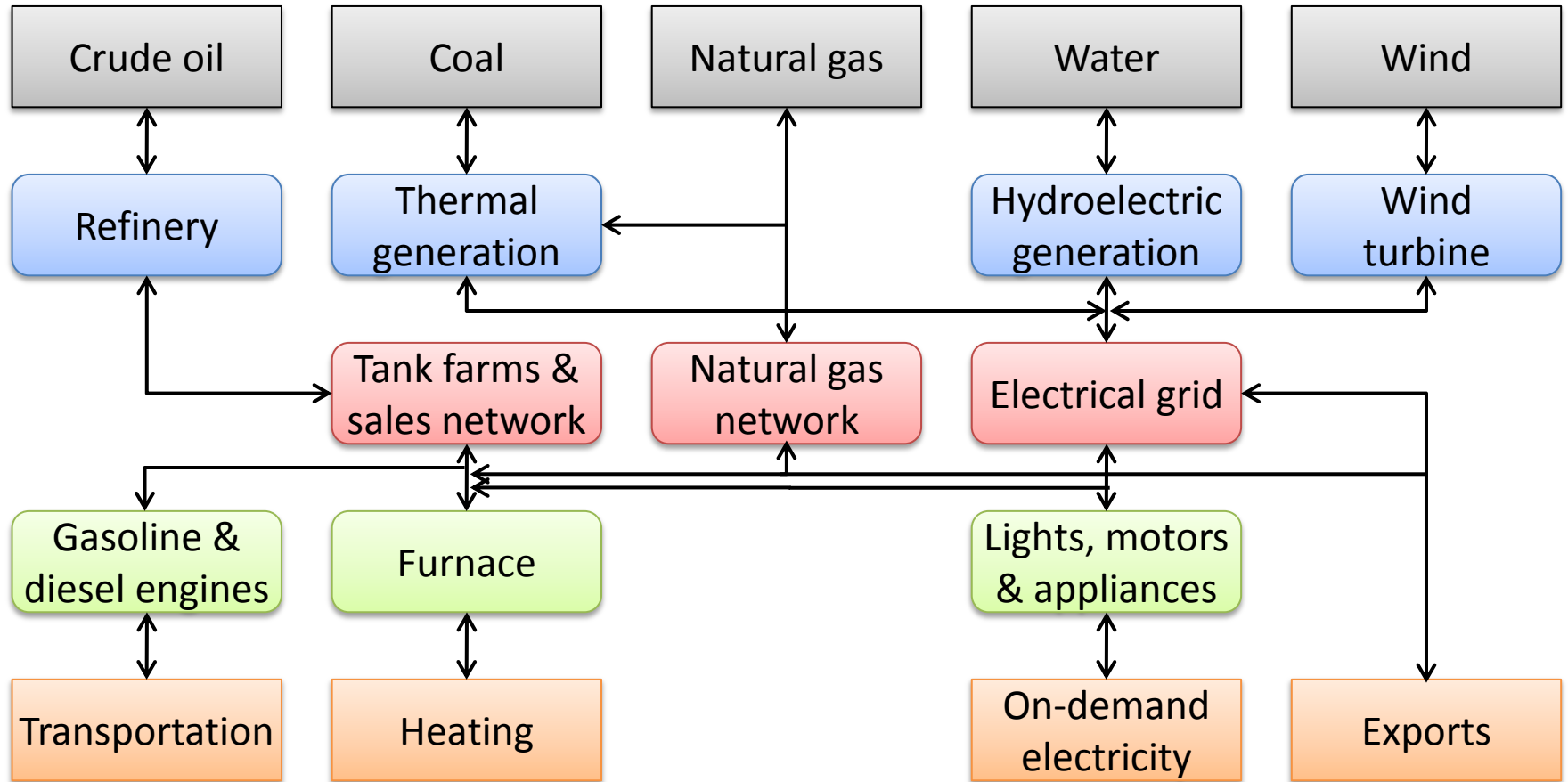
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The components of an energy system

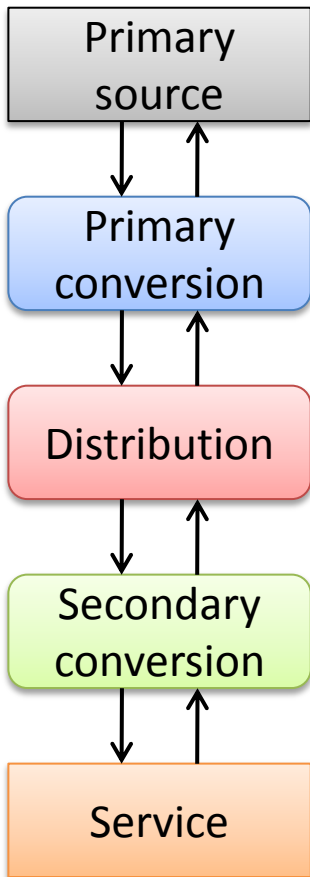


- Primary source: A form of energy found in nature
- Primary conversion: A process that converts primary energy into a more usable form (secondary energy)
- Distribution: A process that can distribute (and possibly store) secondary energy
- Secondary conversion: A process that converts secondary energy into a form to meet the application's needs
- Service: An application requiring tertiary energy

Nova Scotia's energy system



What can fail in an energy system?



- Primary source:
 - Long-term decline in availability
 - Short-term loss of availability
 - Loss of public acceptability
 - Loss of affordability
- Primary conversion, distribution and secondary conversion:
 - Short-term loss of availability
 - Loss of public acceptability
 - Loss of affordability
- **Where will the energy (and money) come from to ensure that the energy service demands of the jurisdiction are met?**

Energy security

- The International Energy Agency's definition: **“The uninterrupted physical availability [of energy] at a price which is affordable, while respecting environment concerns”**
- To a consumer, an energy source can be considered “insecure” if:
 - Loss of supply or failure of infrastructure
 - Inability to pay
 - Unacceptable environmental impacts
- Why is it important?
 - Economic growth
 - Poverty reduction
 - Political stability

Energy security criteria (four 'A's)

Availability: changes in short-term supply to meet a certain demand

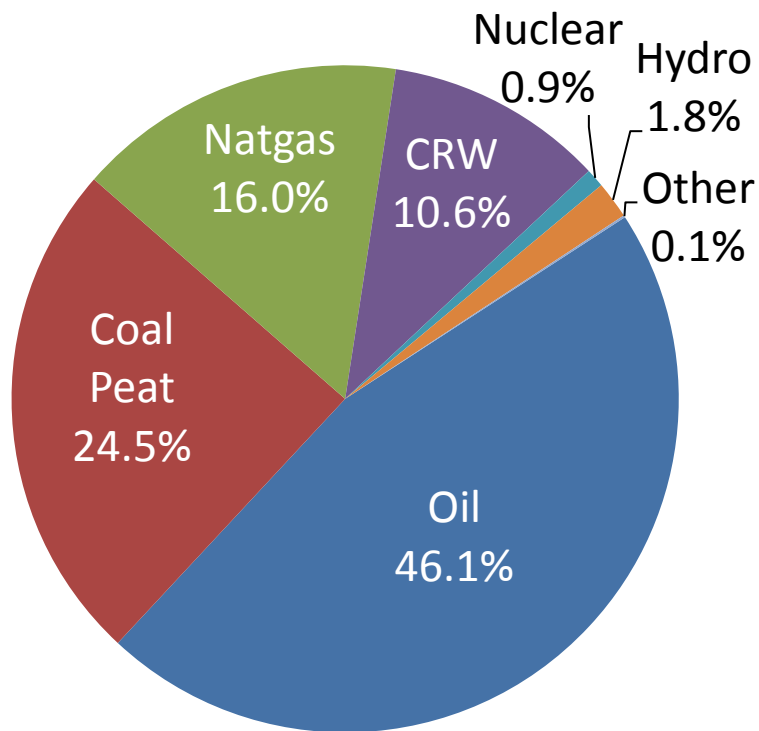
Accessibility: long-term changes or temporal trends in the production or supply of energy from an energy source or supplier

Affordability: ability to pay for the energy demands of an energy service

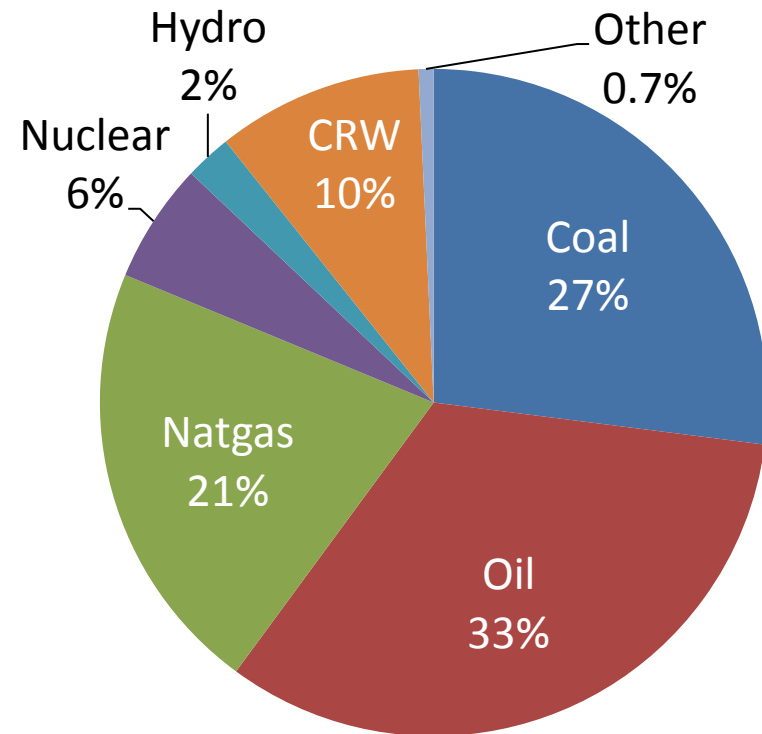
Acceptability: the acceptability of an energy source or processes, or both

World total primary energy supply

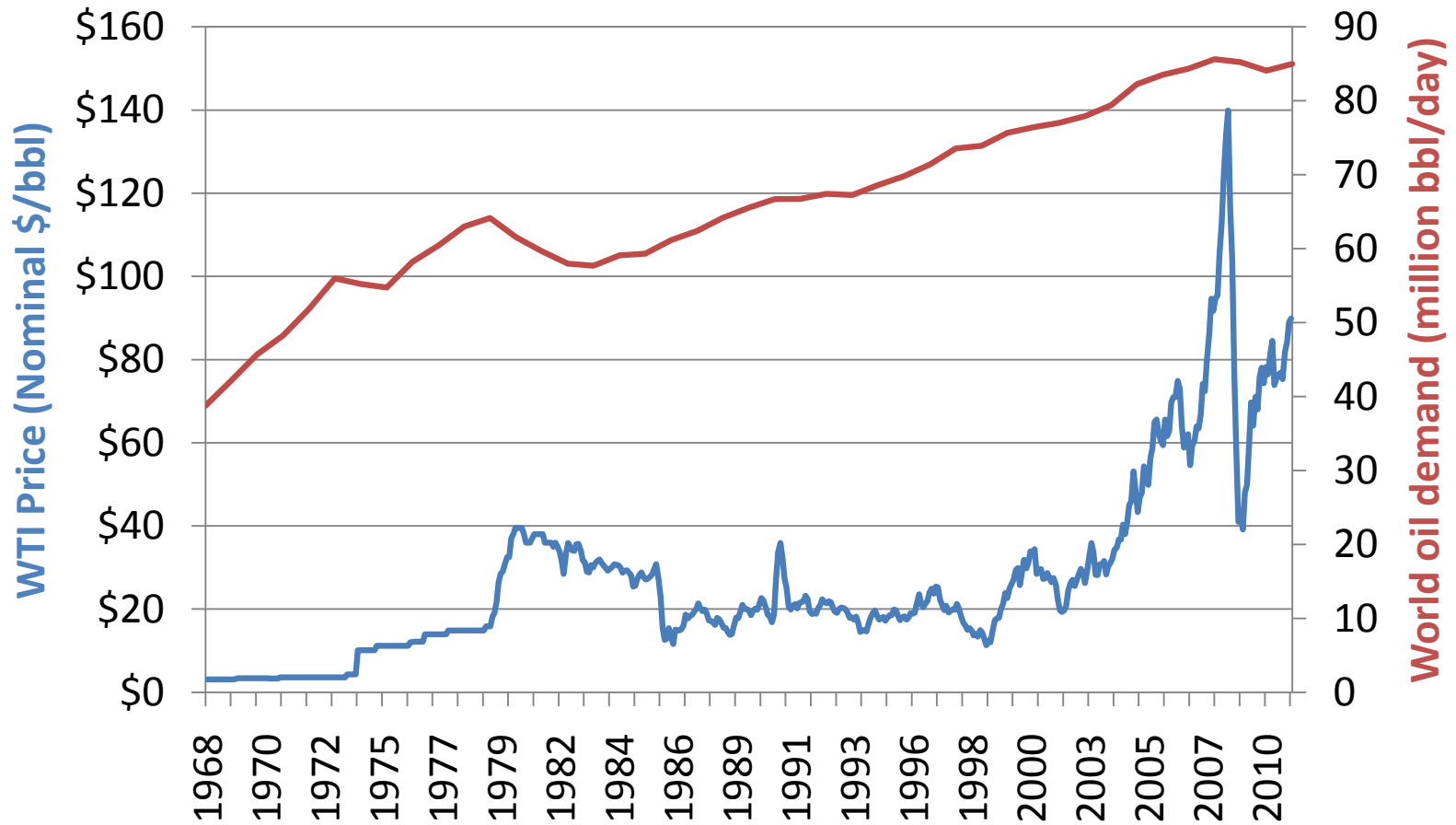
1973: 6,115 Mtoe



2008: 12,272 Mtoe

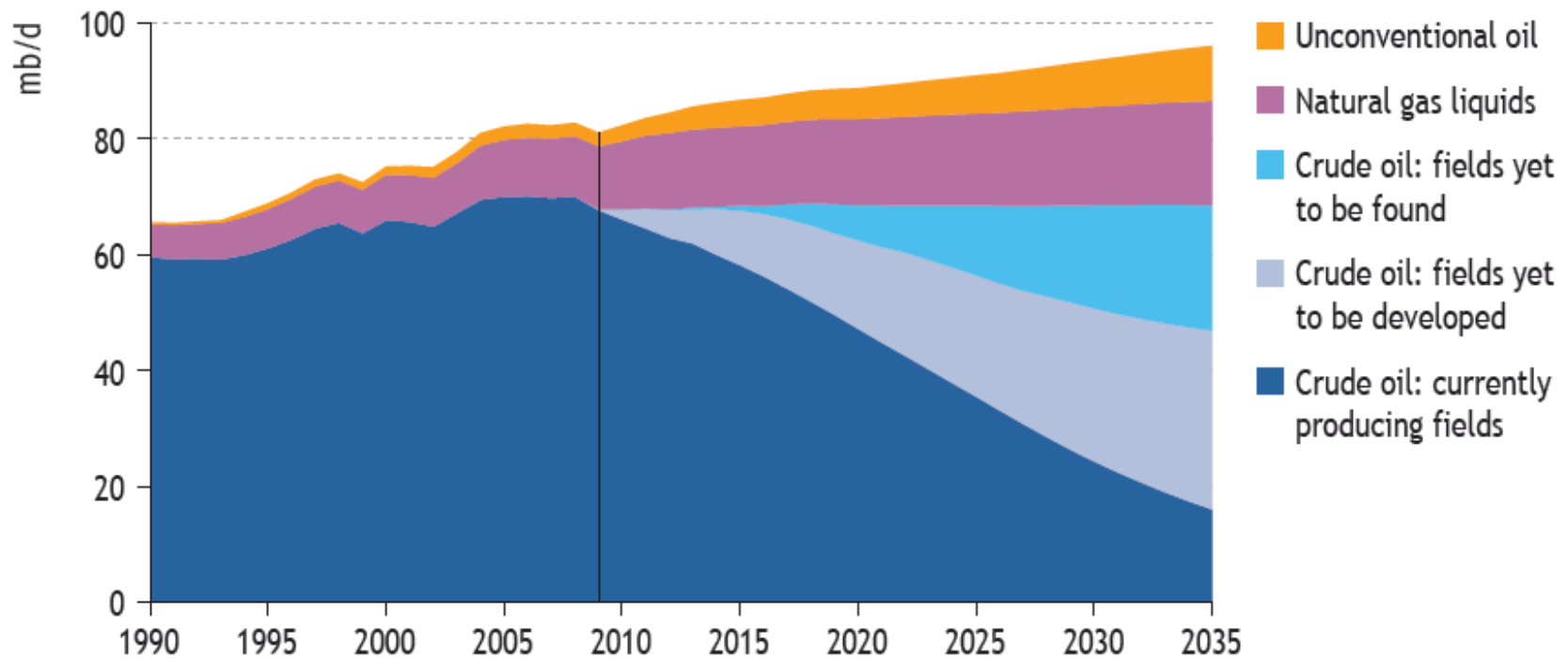


World oil price and demand

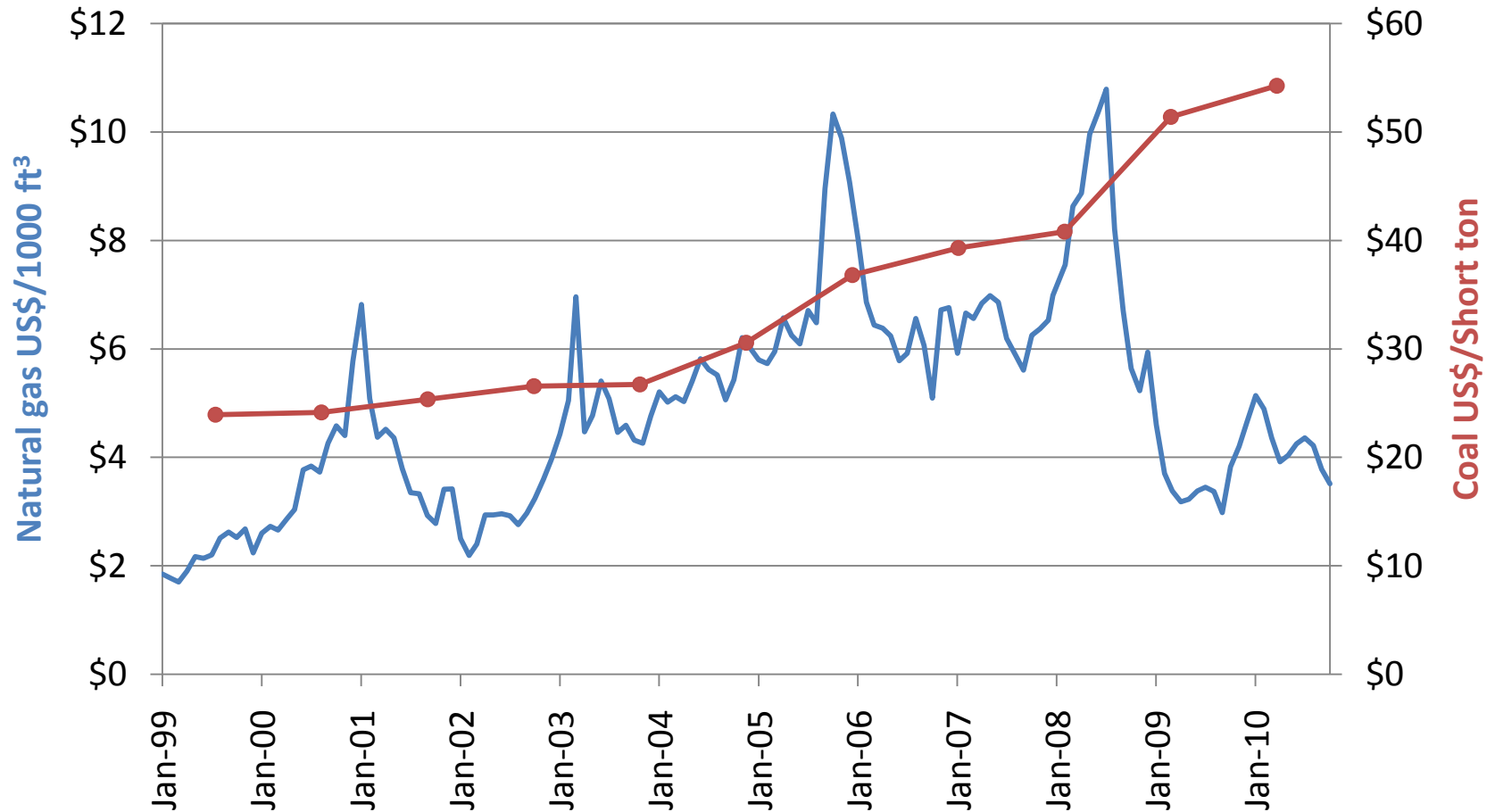


Sources: <http://www.economagic.com/em-cgi/data.exe/var/west-texas-crude-long>
BP Statistical Review of World Energy – June 2009

World oil production to 2035



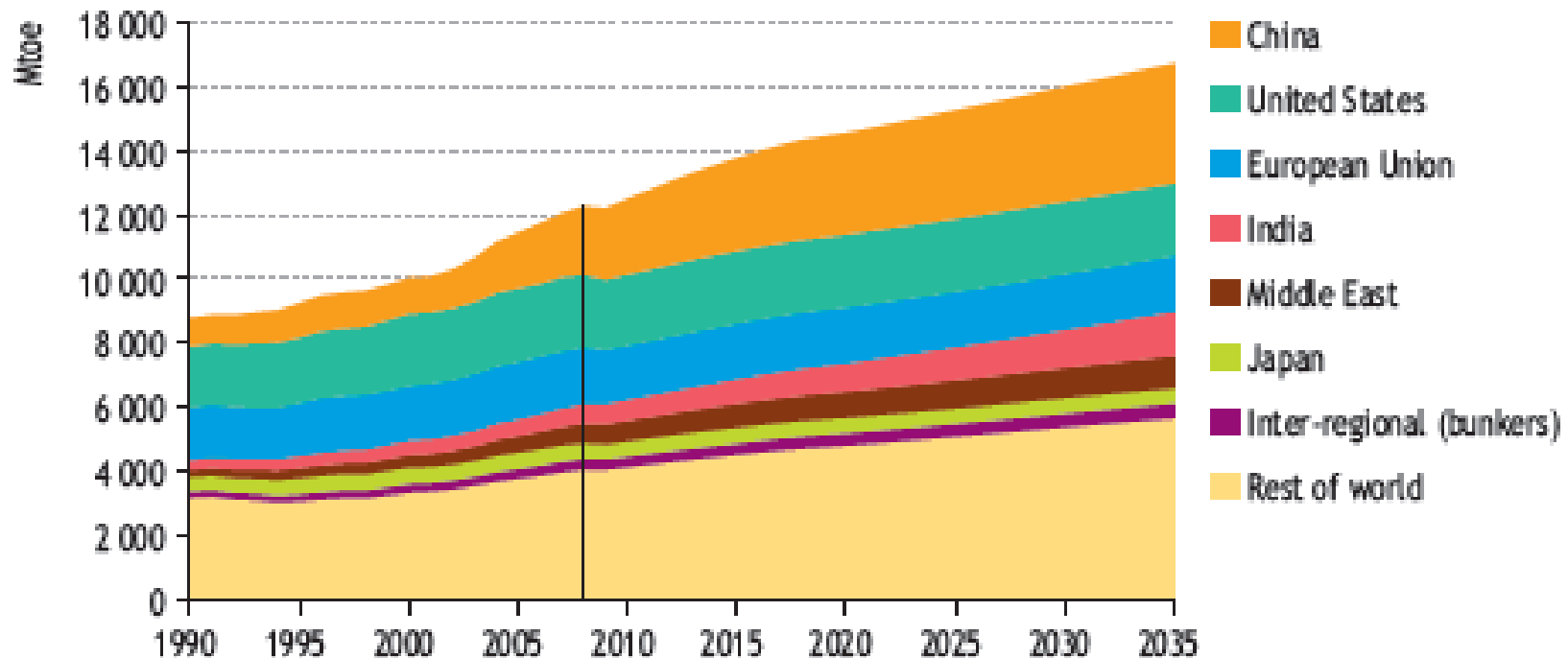
Natural gas and coal prices are volatile



Source: EIA, Natural Gas Wellhead Prices; Annual Energy Review 2010

World primary energy demand to 2035

Figure 2.5 • World primary energy demand by region in the New Policies Scenario



Nova Scotia: Primary and secondary energy

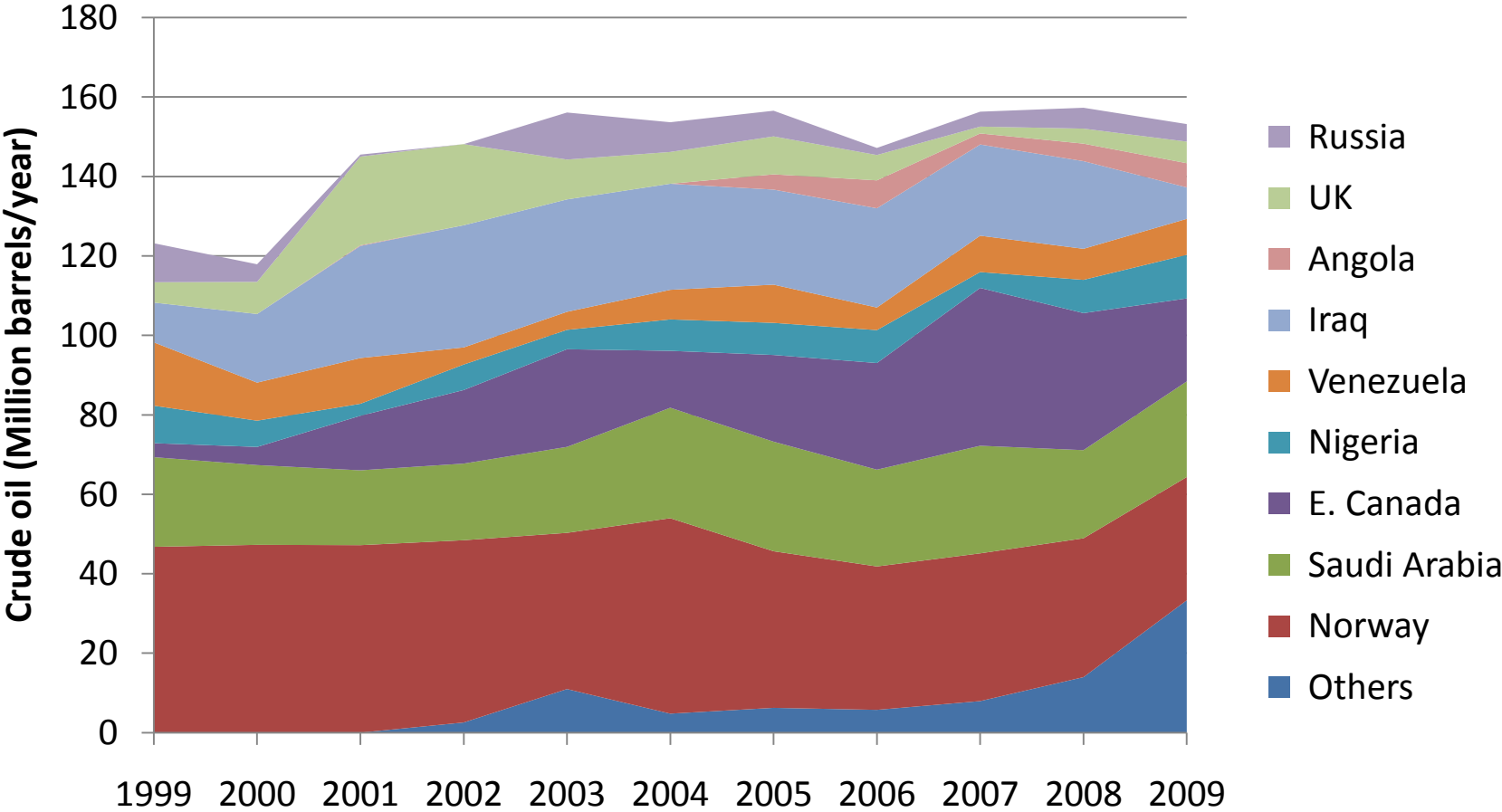
Primary energy sources

Source	TWh
Crude oil	36.5
Natgas	11.0
NGL	1.3
Hydro	2.2
Coal	28.0
Biomass (est.)	5.7
Total energy	84.7

Secondary energy

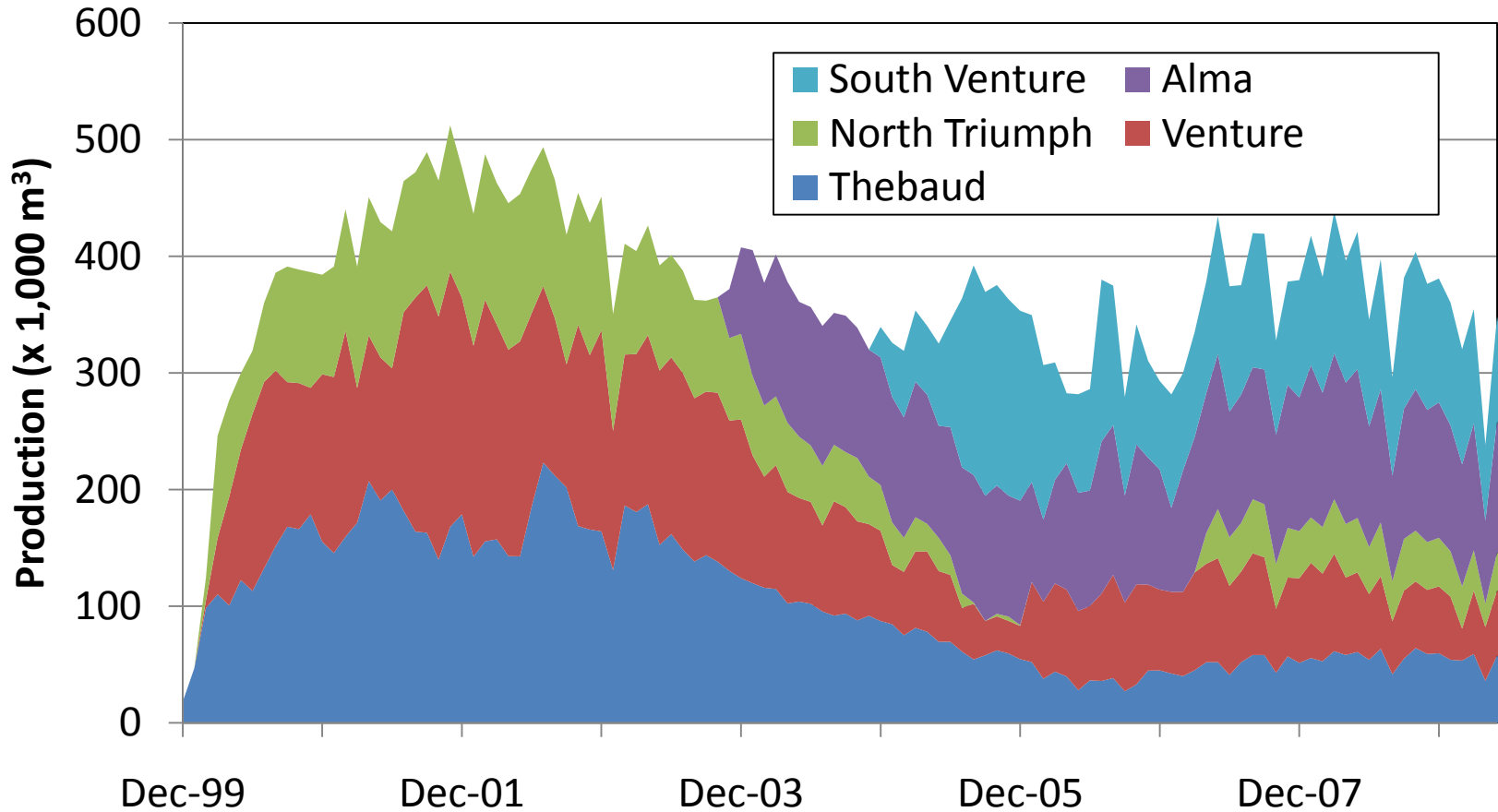
Source	TWh
Natural gas	1.4
Electricity	11.1
Refined petroleum	31.7
<i>Motor gasoline</i>	<i>10.9</i>
<i>Kerosene/stove oil</i>	<i>0.1</i>
<i>Diesel fuel oil</i>	<i>7.3</i>
<i>Light fuel oil</i>	<i>8.1</i>
<i>Heavy fuel oil</i>	<i>3.4</i>
<i>Aviation gasoline</i>	<i>0.0</i>
<i>Aviation turbo fuel</i>	<i>1.9</i>

Eastern Canadian crude oil imports

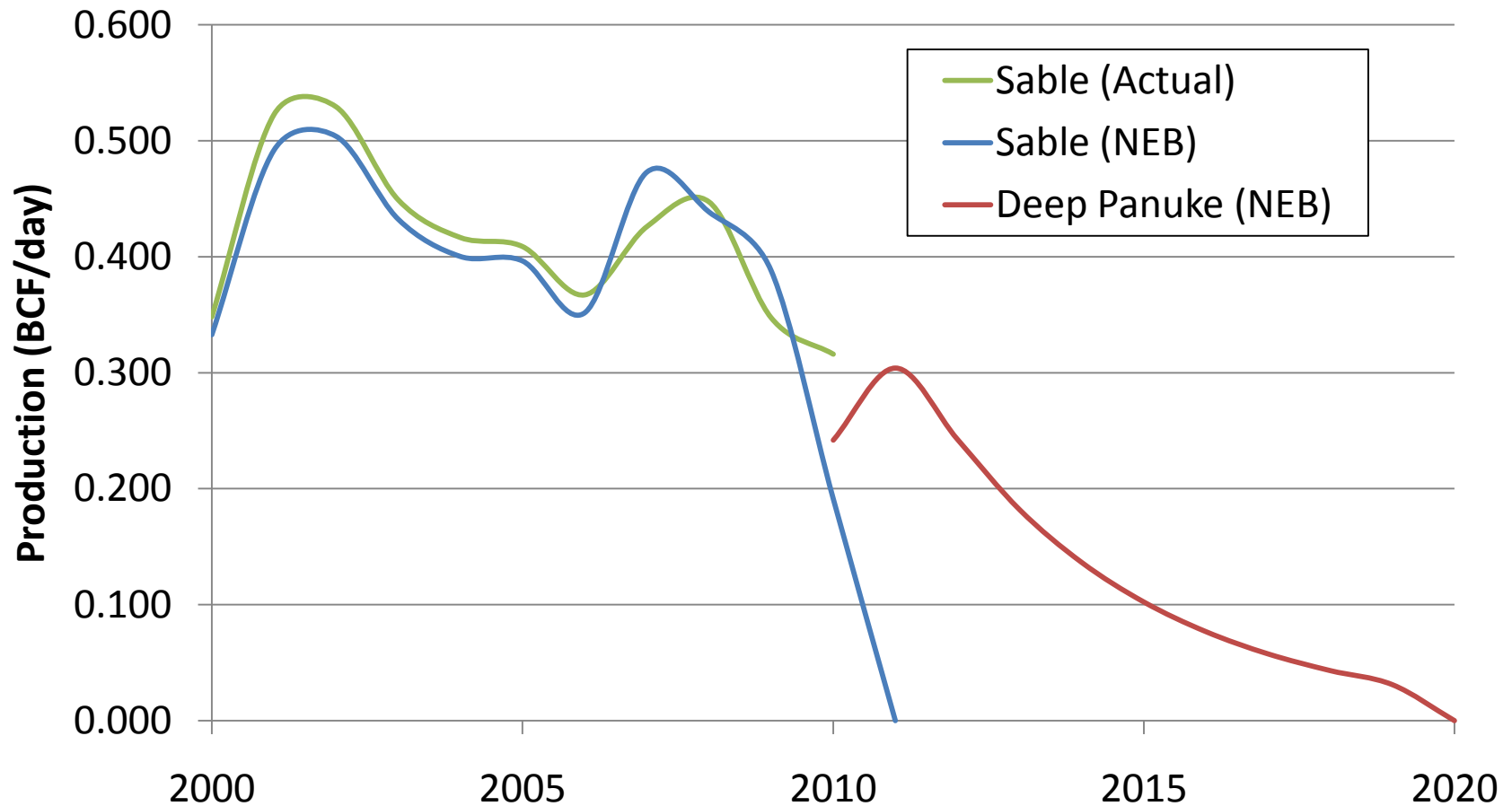


Source: Hughes, Energy security in eastern Canada, *Energy Policy*, 2010

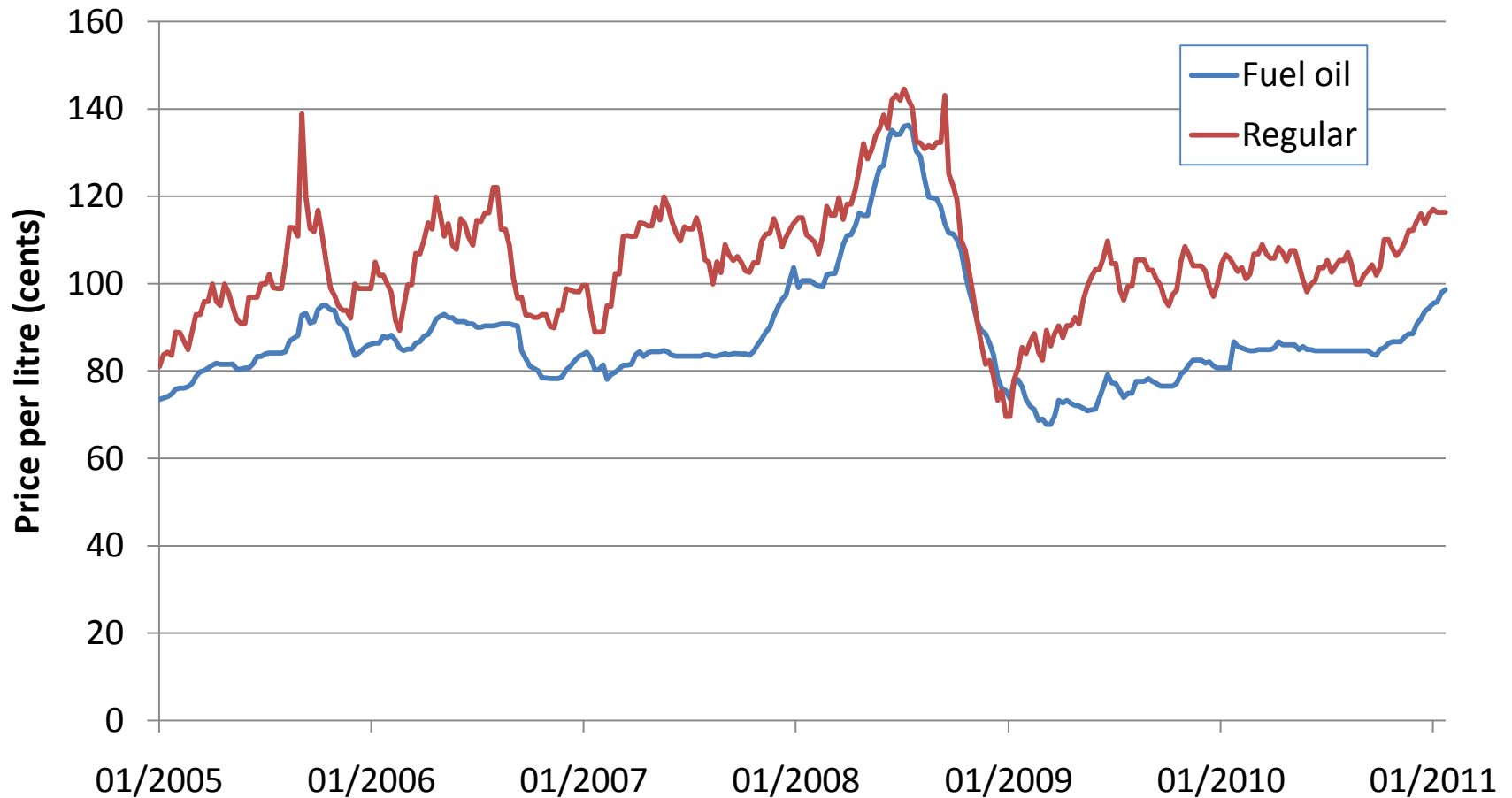
Nova Scotia: Natural gas



Nova Scotia: Natural gas projections



Nova Scotia: Petroleum affordability



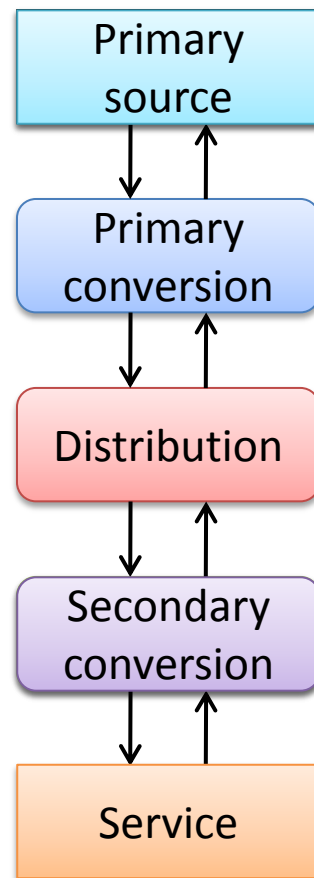
Improving energy security (four 'R's)

Review the current state of a jurisdiction's energy system

Reduce an energy source through conservation measures or energy efficiency gains in energy processes or services

Replace an existing, insecure source or process with one that is more secure and benign

Require new consumption to be from secure and benign sources and processes



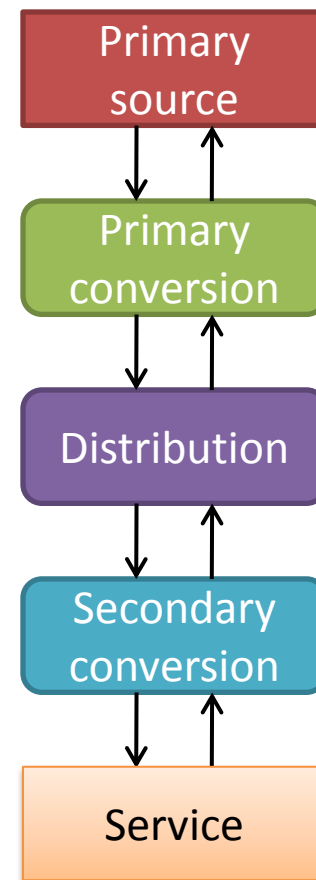
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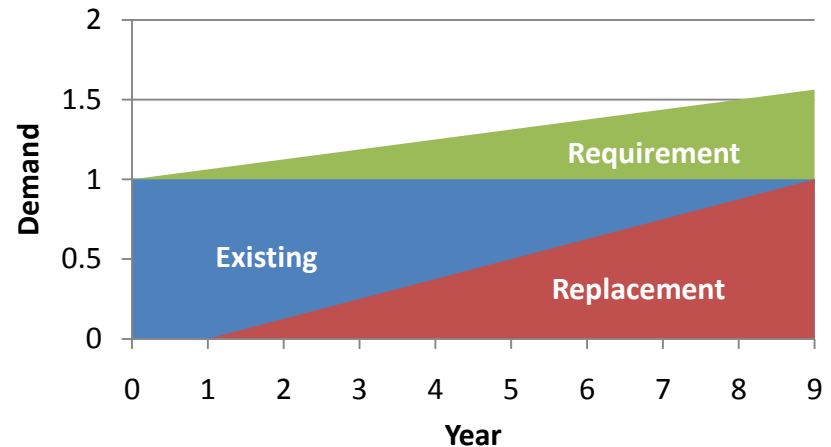
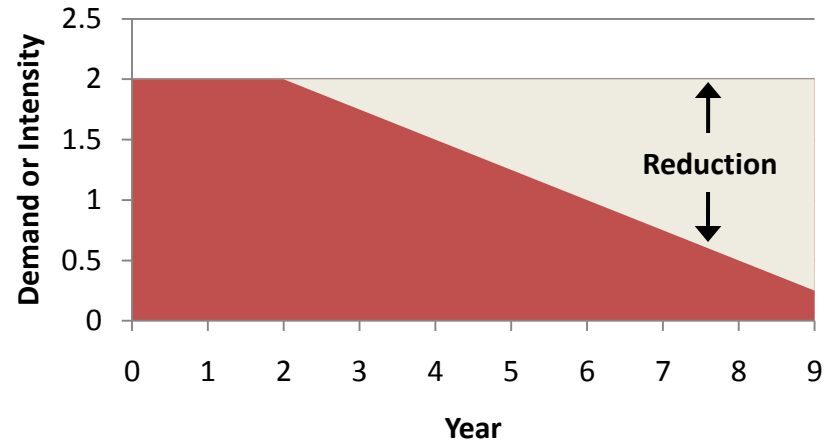
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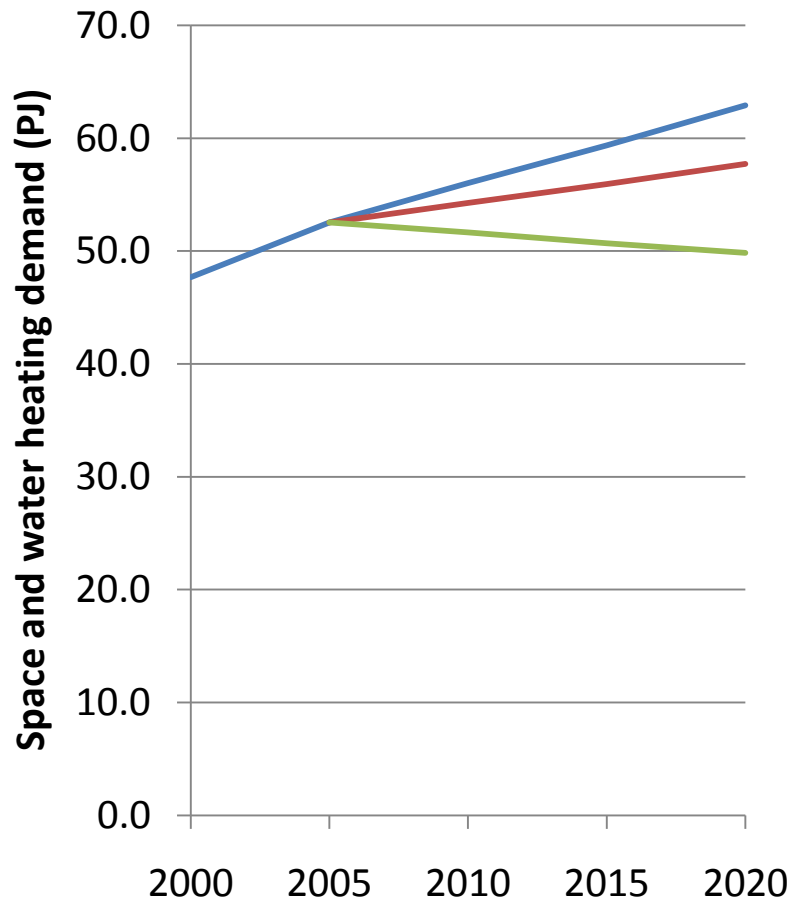
Energy security wedges

- **Wedges:**
 - A systematic approach to addressing climate change
 - Long-term policies that result in a change over time, usually substituting one technology for another
 - Energy security wedges use the four 'R's
- **Reduction** wedges
- **Replacement** wedges:
 - Apply to existing demand
- **Requirement** wedges:
 - Applies to new demand



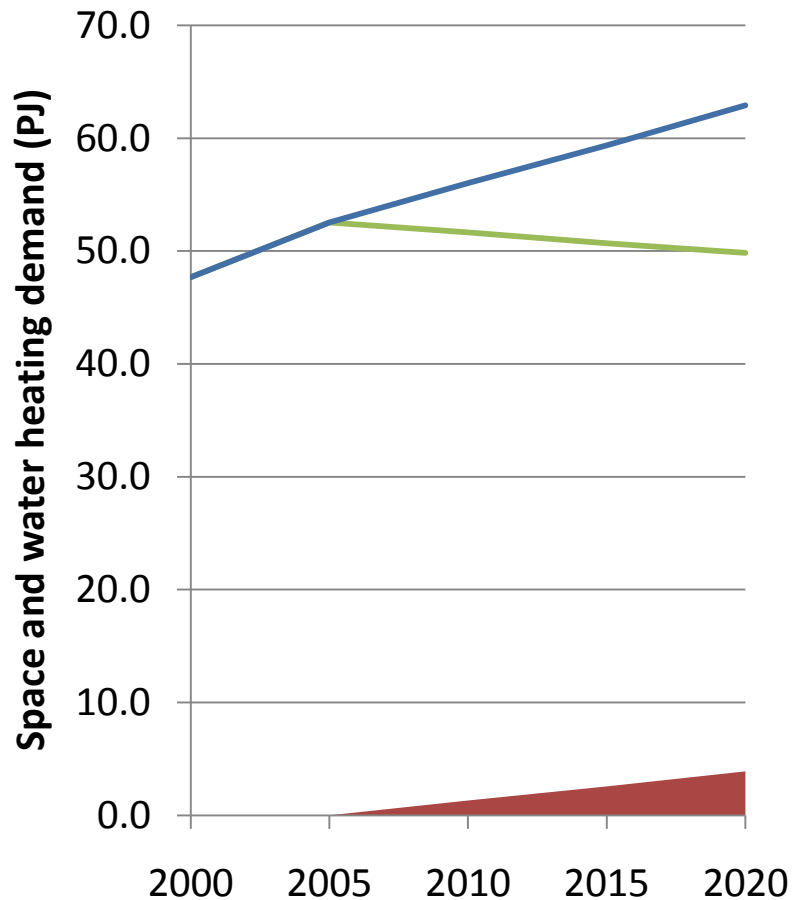
Source: Hughes, Energy wedges: A systematic way of addressing energy security and greenhouse gas emissions', *Fifth Dubrovnik Conference on Sustainable Development*, Dubrovnik, October 2009.

Reduction: Heating



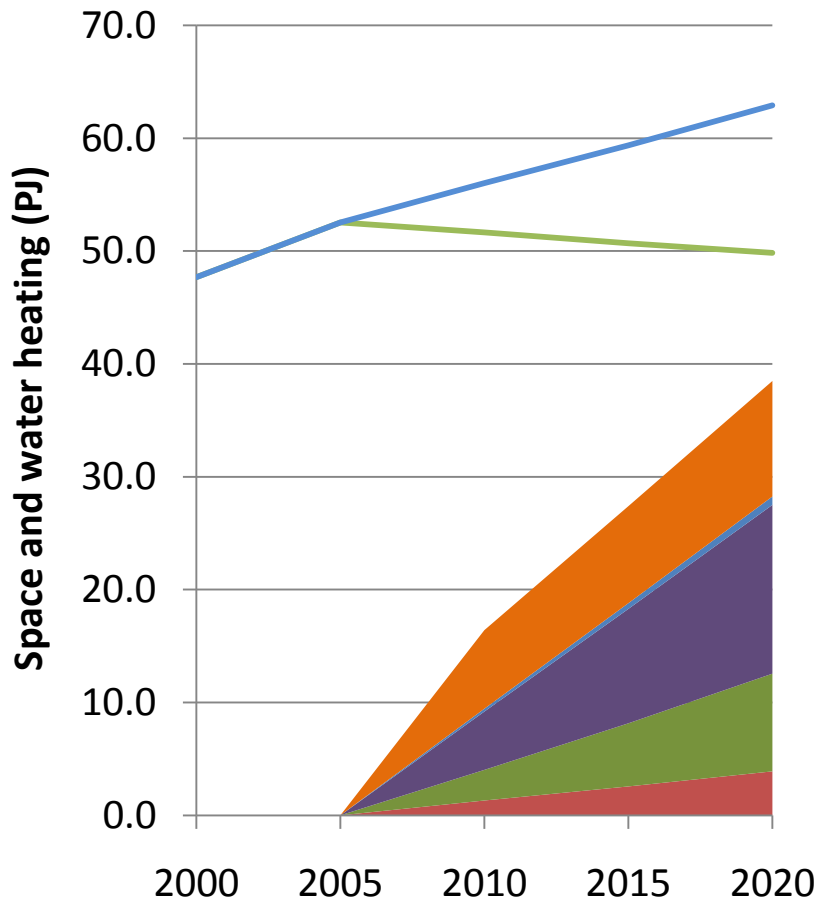
- Baseline (NRCAN)
- New buildings:
 - 50 percent reduction vs. existing buildings
 - Building techniques and materials
 - 5.2 PJ reduction
- Existing buildings:
 - One percent reduction per year
 - Conservation and retrofits
 - 7.9 PJ reduction
- Ideally: 13 PJ reduction

Requirement: Heating (new)



- Baseline (NRCAN)
- Reduction (13 PJ)
- Solar (new buildings):
 - 75% demand from solar
 - 3.9 PJ
- 46 PJ shortfall

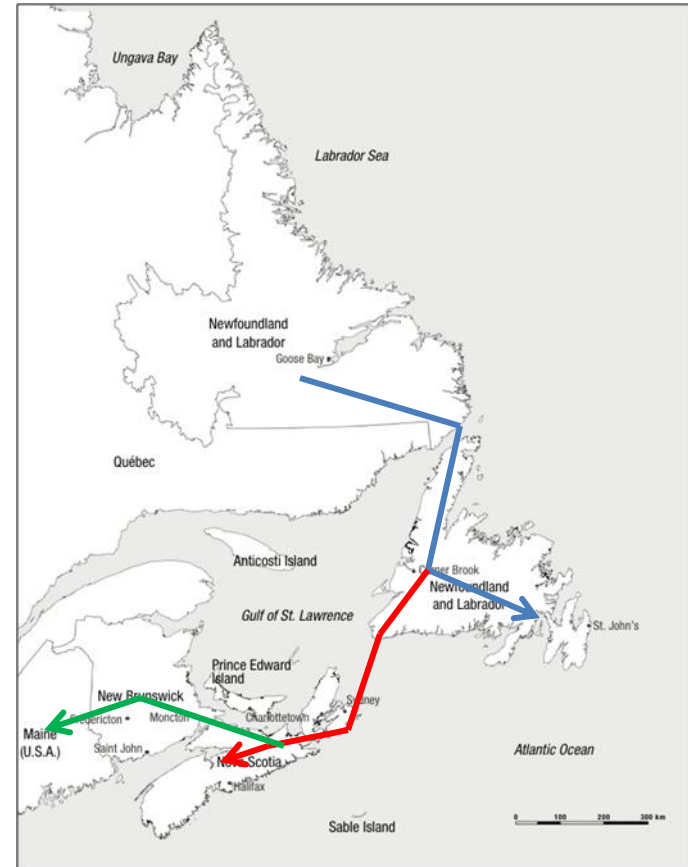
Replacement: Heating (existing)



- Baseline (NRCan)
- Reduction (13 PJ)
- 12.5 PJ shortfall
- Biomass:
 - 20% from biomass
 - 10.2 PJ (700,000 tonnes)
- District heating:
 - 1.5% demand from district heating
 - 0.7 PJ
- Wind heating:
 - 30% demand from wind
 - 15 PJ (1,900 turbines)
- Solar (existing buildings):
 - 15% demand from solar
 - 7.5 PJ
- Solar (new buildings):
 - 75% demand from solar
 - 3.9 PJ

Nova Scotia and the Lower Churchill

- 1 TWh to Nova Scotia
- ~1.2% of primary energy
- ~9% of electricity
- 2 TWh to U.S. will require a new grid from N.S. to N.B.
- N.S.'s Independent Power Producers want to export to U.S.



Concluding remarks

- The world needs energy that is secure and benign: Where will it come from?
- The four 'A's allow the state of a jurisdiction's energy security to be determined.
- The four 'R's allow the development of policies to address energy security issues.
- Energy security wedges track the success of energy security policies.

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