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International Natural Gas Market Developments to 2030

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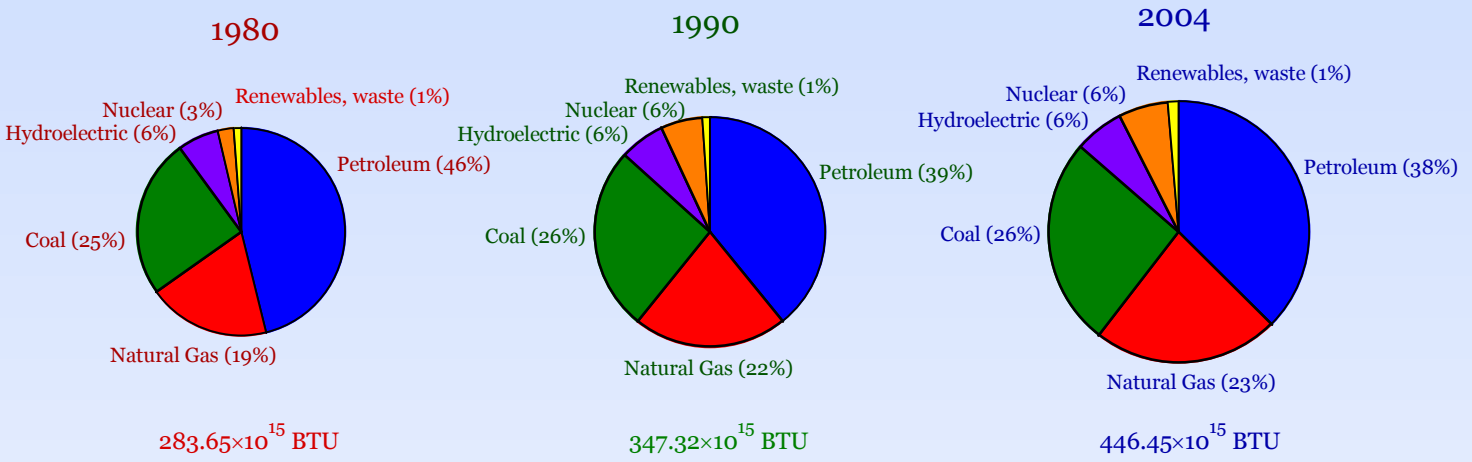
Global Trends in Natural Gas

- World natural gas demand doubled from 1980-2004
- Average annual growth of 2.5% is triple that of oil and double the coal growth rate



Source: EIA

- Key reasons for the increase in demand :
  - Environmental pressure, wholesale electricity market competition, technical change (combined cycle gas turbines) and economic growth in Asia
- The gas share may continue to rise if gas supplies transportation fuel
- Possible challenges to a gas future include:
  - Lack of investor confidence, political instability in supplier nations, local opposition to infrastructure, slowdown to electricity reforms, alternative energy technologies perhaps assisted by further improvements in long-distance electricity transmission

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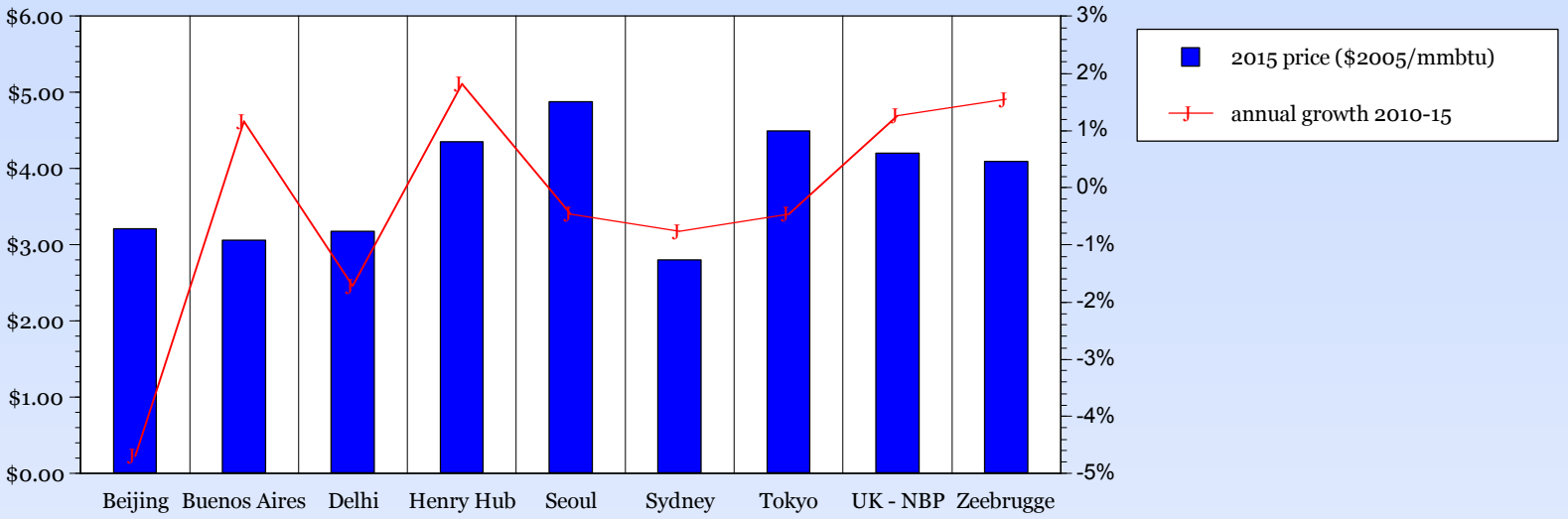
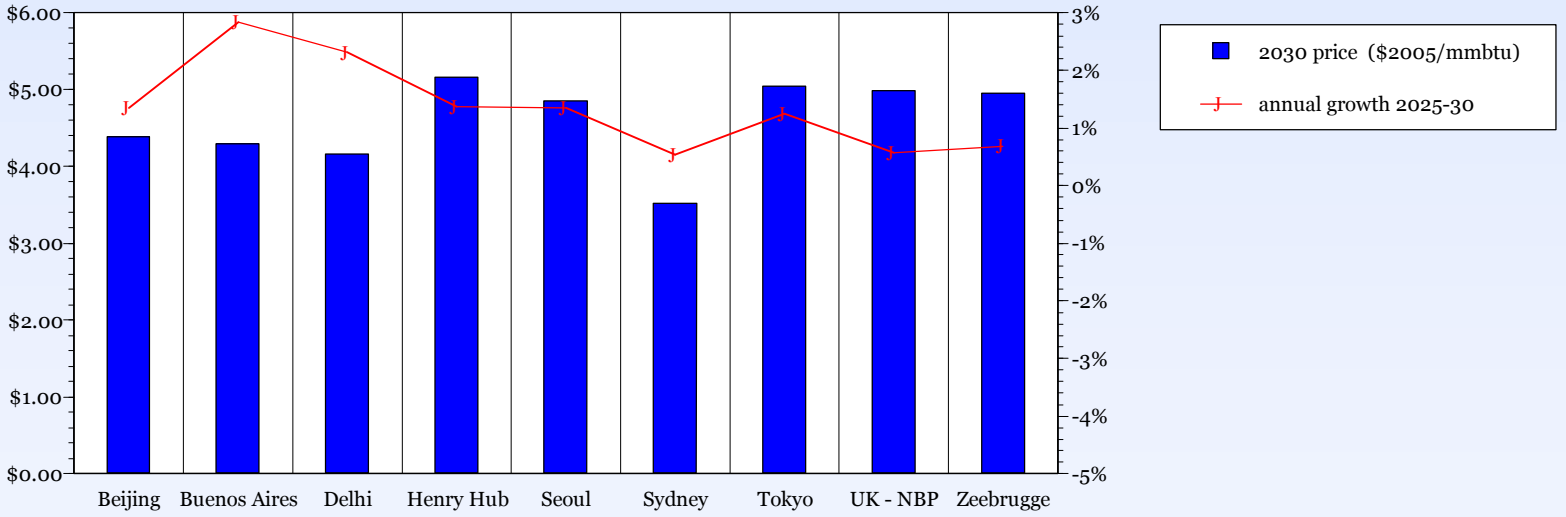
Prices 2015, 2030





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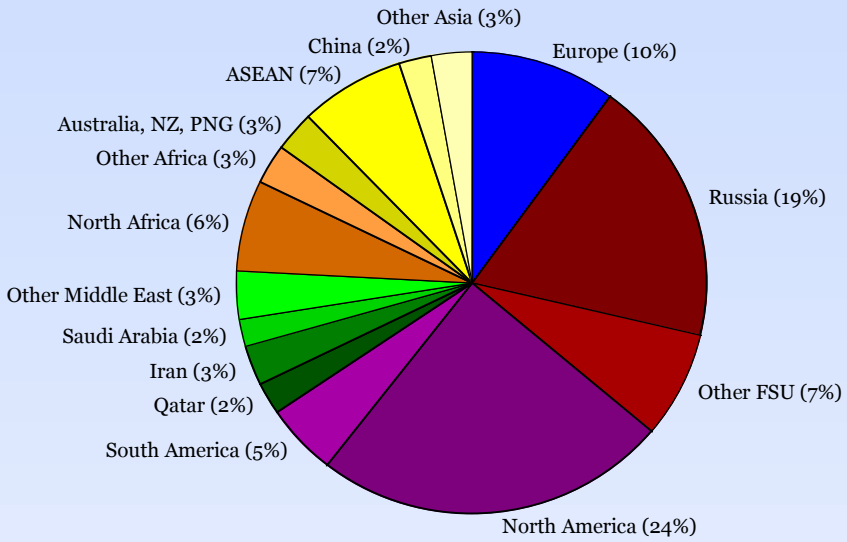
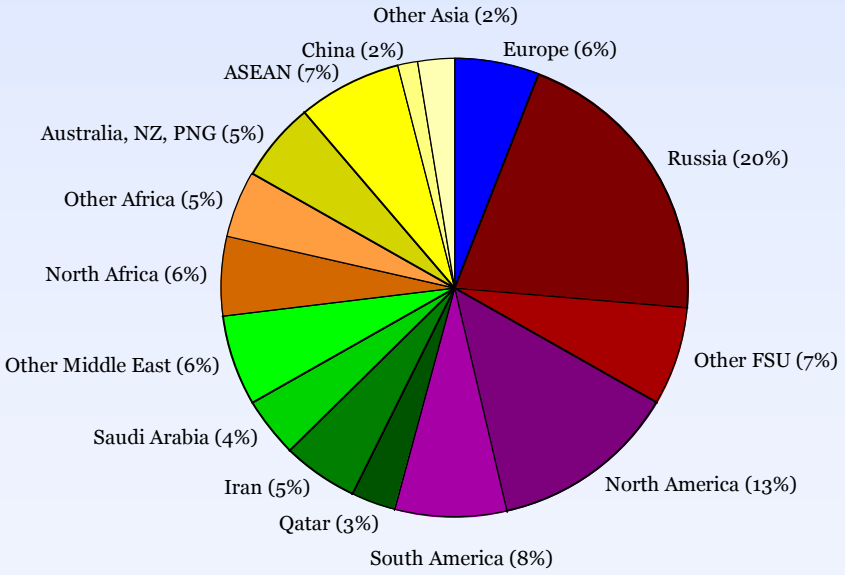
Supply 2015, 2030

Supply 2015



World total 128.51 Tcf

Supply 2030



World total 159.80 Tcf

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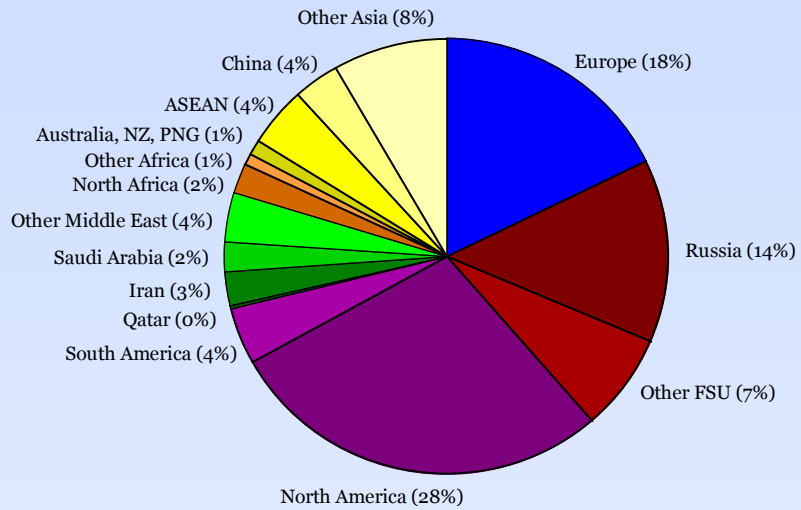
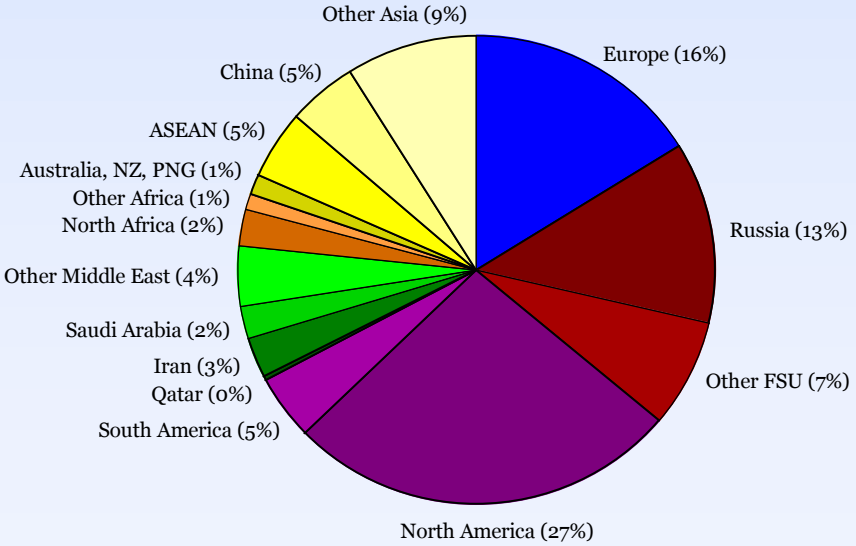
Demand 2015, 2030

Demand 2015



World total 126.00 Tcf

Demand 2030



World total 154.61 Tcf

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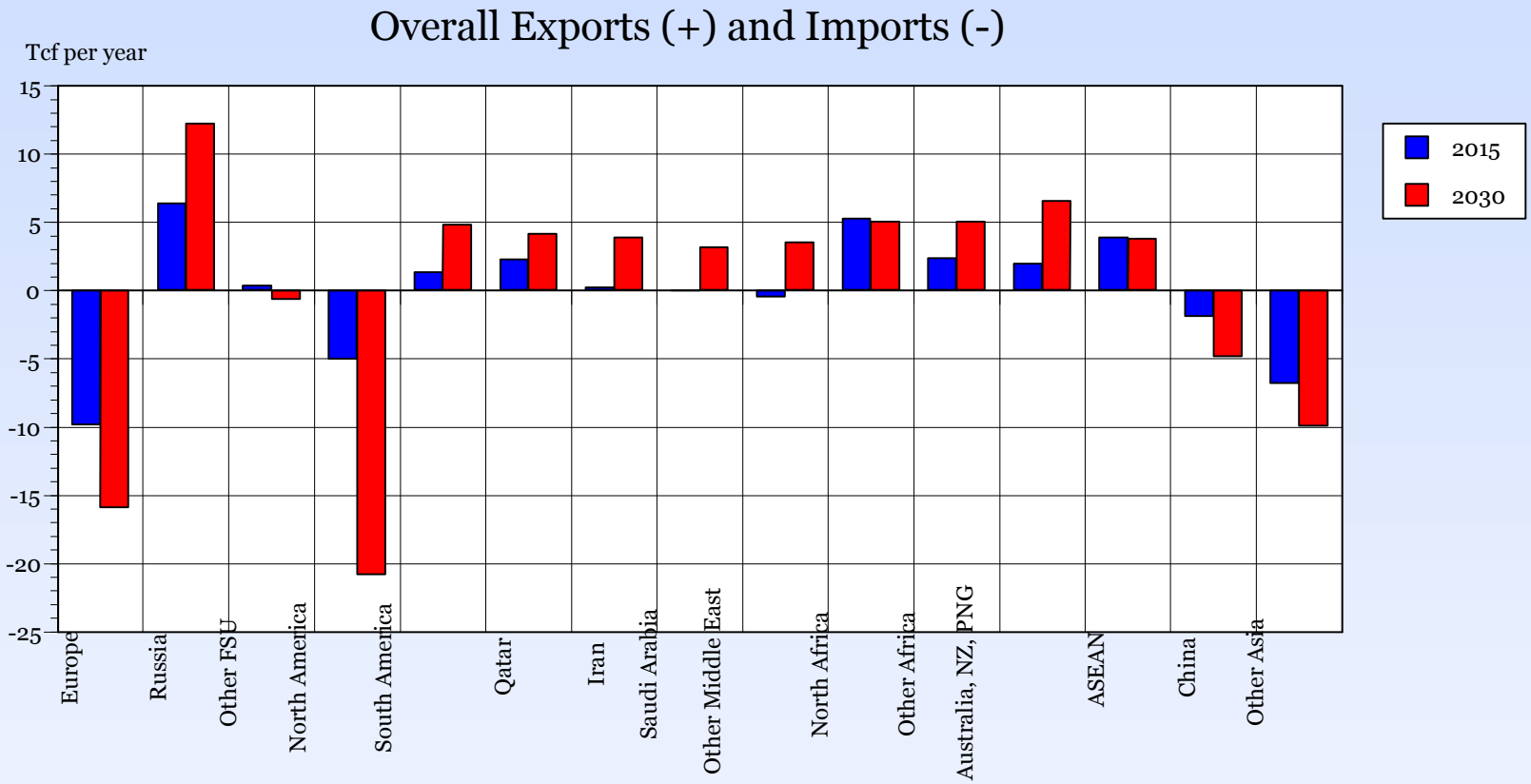
Natural gas trade



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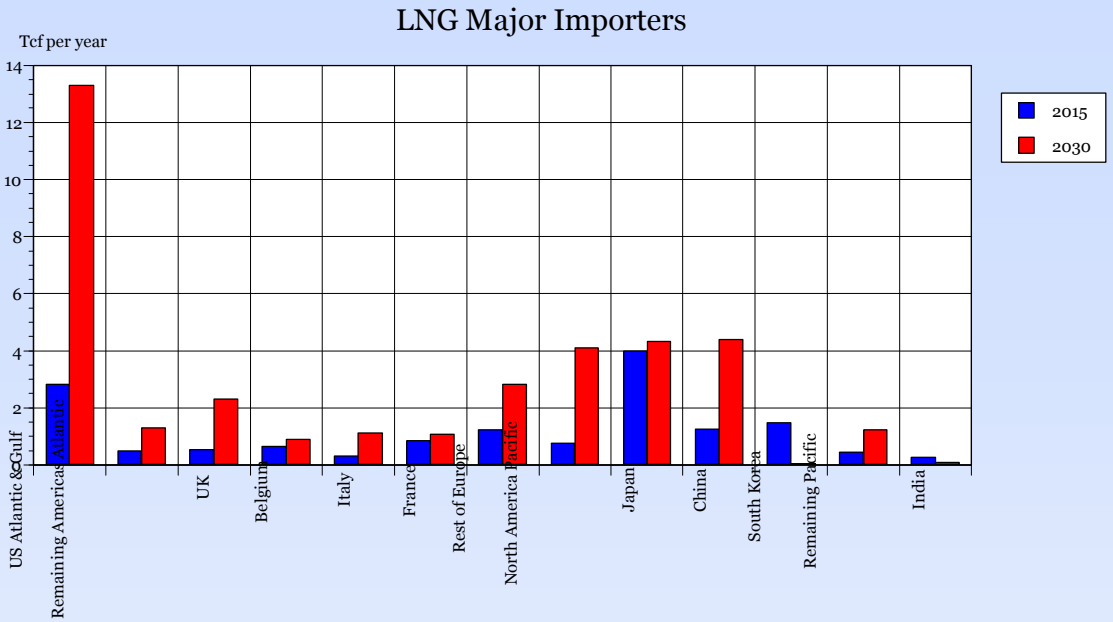
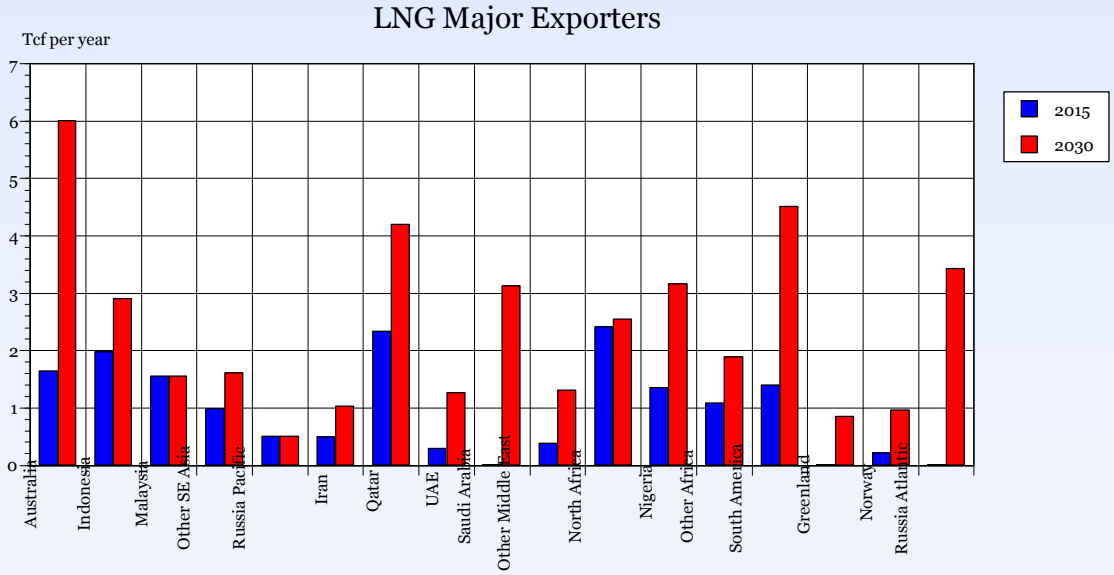
LNG trade





Natural Gas Demand: Short and Long Run Substitution

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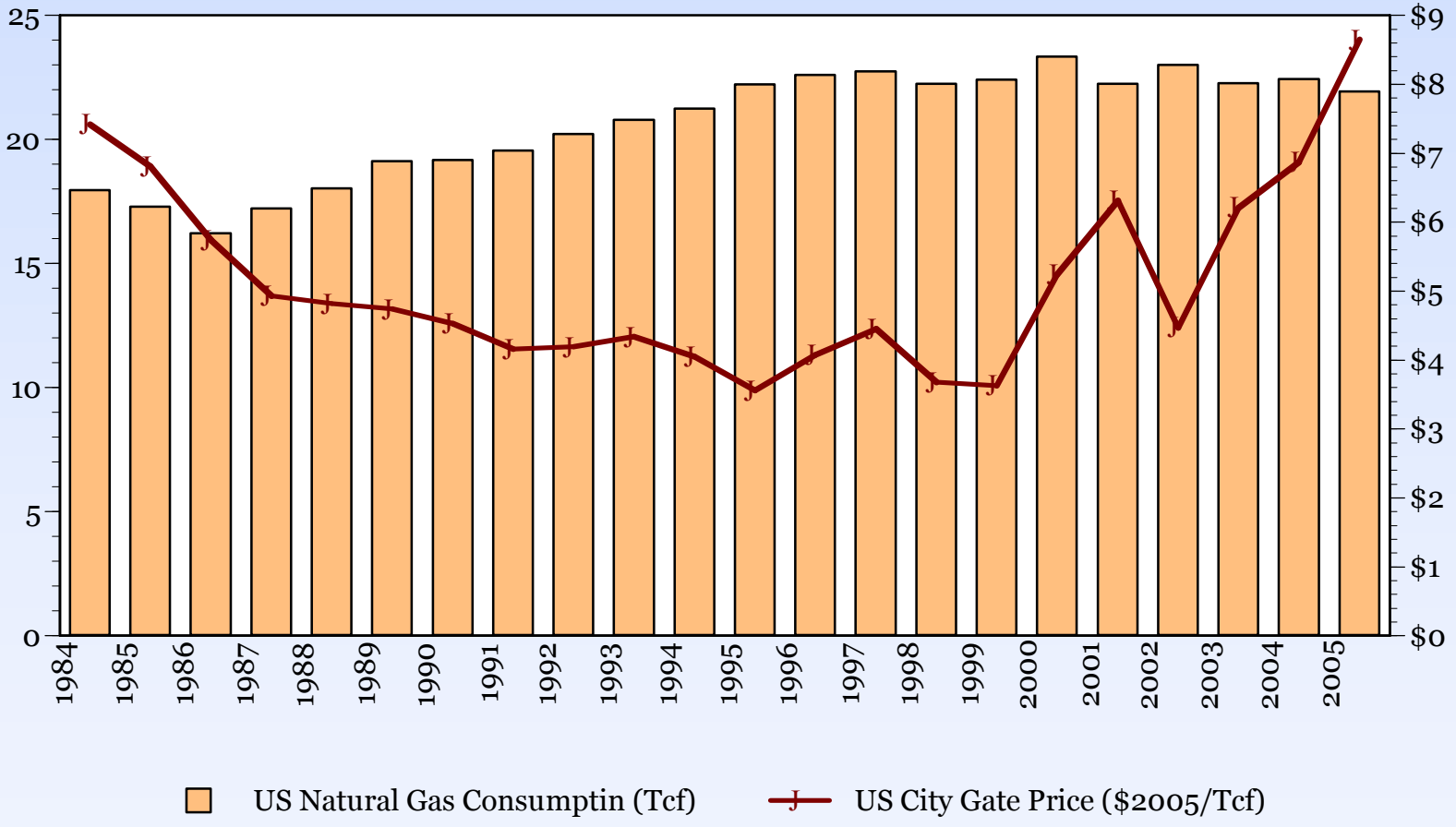
US Natural Gas Demand: 1984-2005

- The US experience provides evidence of fuel switching
- The demand driver has also changed from industrial activity and space heating to power generation



Average Annual Growth Rate approximately 1% per year

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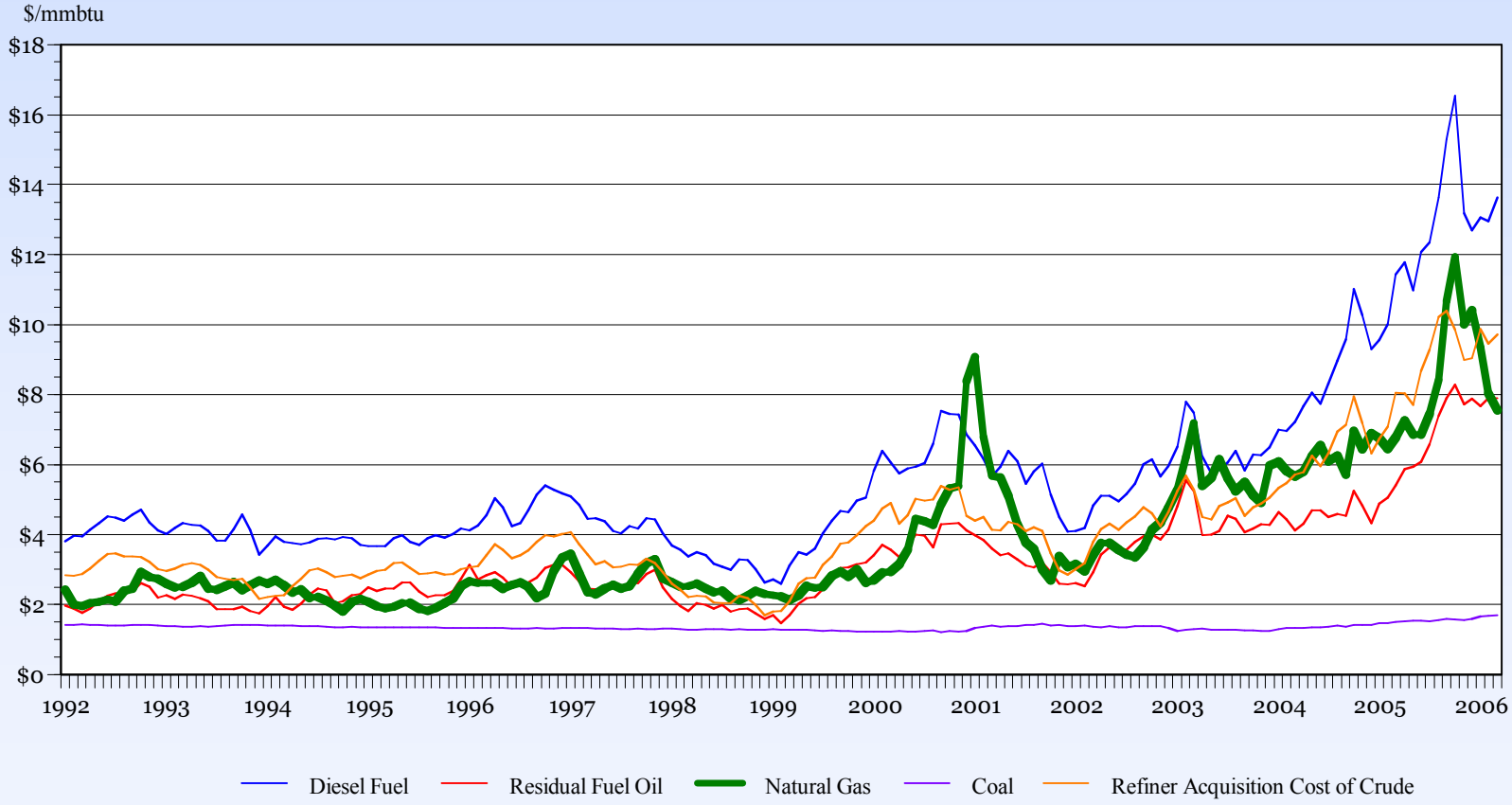
Linkage of crude oil and natural gas prices

- US markets show strong evidence of a link between natural gas and oil prices:



What links oil and gas prices?

- Demand factors
  - Substitution in the generation of electricity
  - Substitution in industrial processes –refining, electricity cogeneration – but in sectors such as chemicals high gas prices cut demand without fuel switching
  - Substitution between gas and heating oil for space heating
- Supply factors
  - Joint production of natural gas and oil can have positive or negative effects
    - Increased oil production also yields additional associated gas
    - Higher oil prices also raise the value of non-gas liquids often produced with gas
    - However, gas can also be re-injected to enhance oil recovery
  - Unconventional oil, such as Canadian tar sands, requires natural gas as input
  - Gas-to-liquids (GTL) conversion (as in Qatar) can lead to direct competition between gas and oil for providing transportation fuel
- Impediments to substitution
  - Environmental factors can affect demand side substitution of oil for gas
  - Short run capital costs can slow development of alternative supplies
  - Uncertainty about future energy prices limits willingness to invest
  - Economies of scale for GTL versus LNG
    - GTL only makes economic sense for smaller scale projects or if oil prices are high

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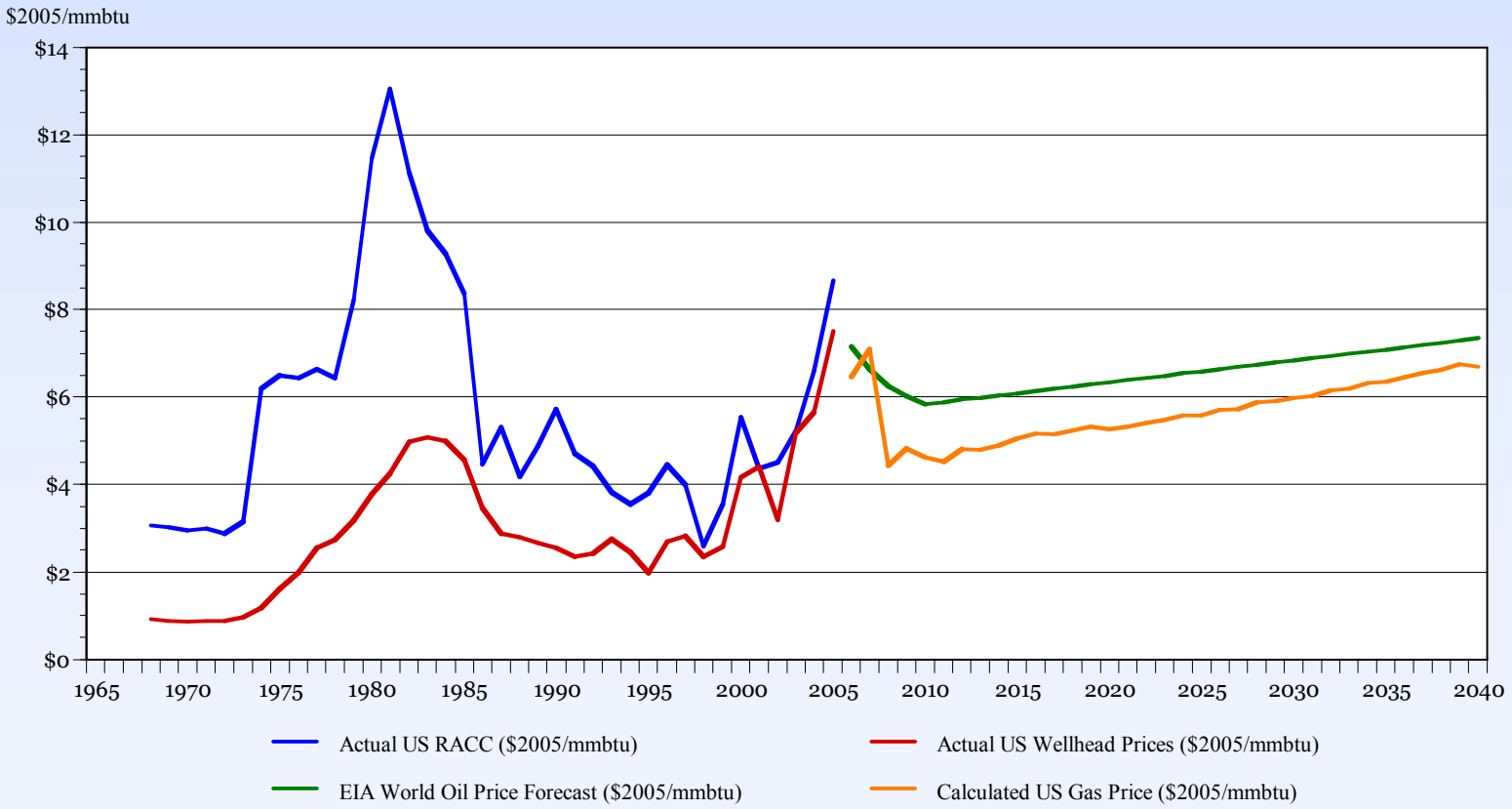
RWGTM Price Forecast in Historical Context

- Oil price forecast is from the US Energy Information Administration
- Gas price forecast is the equilibrium calculated by the RWGTM
- The generally rising ratio of gas to oil prices reflects the assumption that gas tends to supply more energy as economies develop



Natural Gas Supply: Geography, Geology and Geopolitics

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Supply estimates

Region	Proved Reserves[a]	Undiscovered Resource[b]	Share of Total Resource
Middle East	**2565.4**	**1294.7**	**34.4%**
Qatar	910.5	41.1	8.5%
Saudi Arabia	241.8	681.0	8.2%
Iran	971.2	314.6	11.5%
Former Soviet Union	**1952.6**	**1611.3**	**31.8%**
Russia	1680.0	1168.7	25.4%
Asia-Pacific	**391.6**	**688.9**	**9.6%**
Indonesia	97.8	107.7	1.8%
Australia[c]	27.6	338.4	3.3%
Africa	**485.8**	**330.1**	**7.3%**
Nigeria	184.7	123.2	2.7%
Algeria	160.5	49.0	1.9%
North America[c]	**265.1**	**451.5**	**6.4%**
Central and South America	**250.8**	**421.0**	**6.0%**
Venezuela	151.4	101.2	2.3%
Europe	**200.7**	**312.4**	**4.6%**
Norway	84.3	183.0	2.4%
World Total[d]	**6112.1**	**5109.8**	

a - *Oil and Gas Journal* as of Jan. 1, 2006

b - Compiled from USGS, ABARE, and other national sources

c - Includes assessed non-conventional natural gas resources

d - Does not include future growth in existing fields. USGS estimates the World Total at 3305 tcf.

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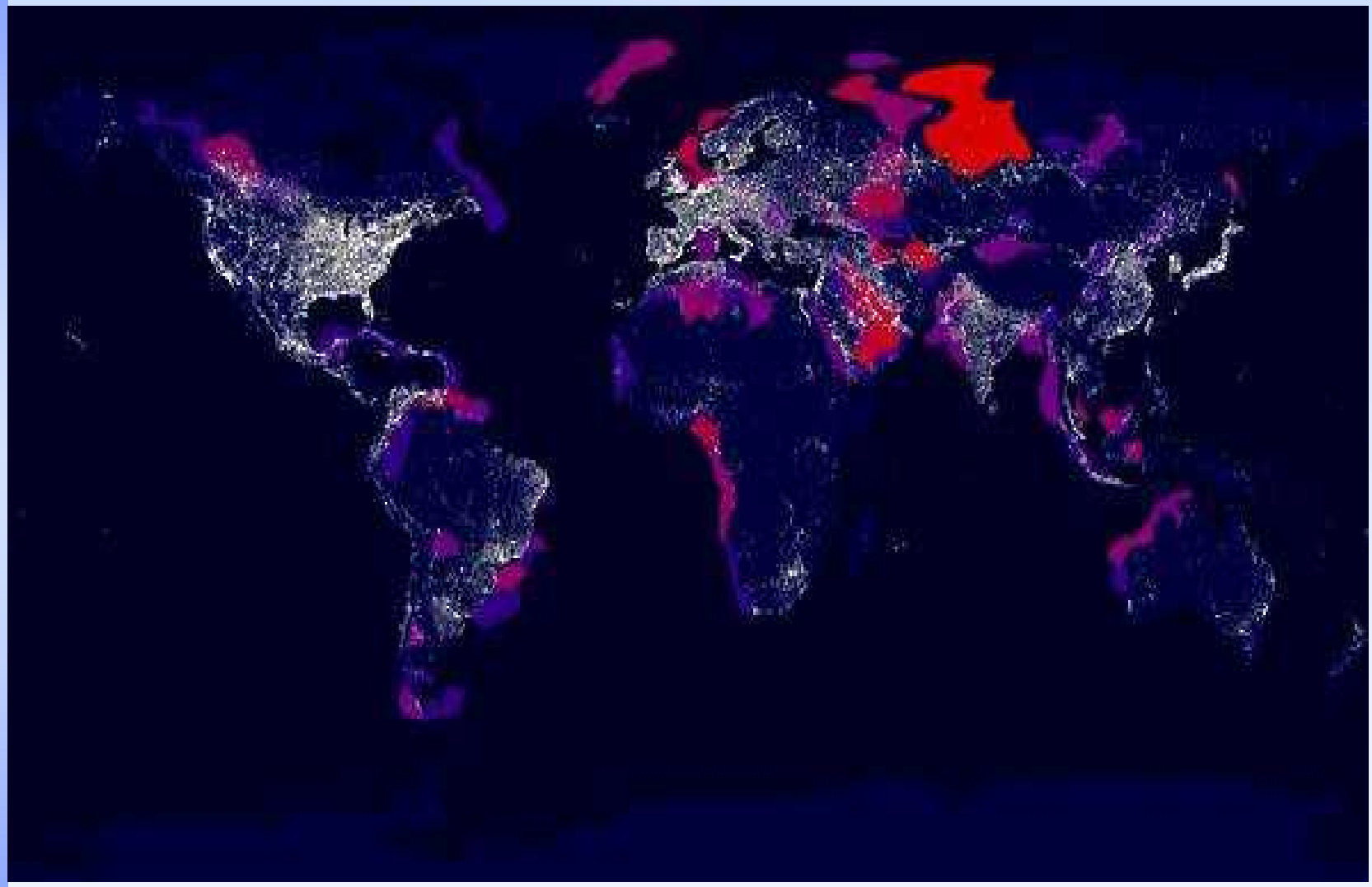
Linking supply with demand



Concluding Remarks

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- Modeling illustrates the key roles Russia and the countries of the Middle East will play in the world gas market
- Prices will be linked through global arbitrage
  - Trade need not actually occur, there simply needs to exist the ability to trade – LNG provides this capability
- Long distance international gas trade provides opportunities for countries to gain from cooperation, but also to lose from conflict
- Absent political constraints, there appears to be substantial gas available to satisfy demand at a reasonable price
  - Political constraints may, however, present the largest impediment to globalization
  - Such political constraints may encourage alternative sources of supply and ultimately alternative sources of energy
  - The development of alternative energy sources later this century will likely mean that substantial natural gas resources will not be exploited for a very long time, if at all

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