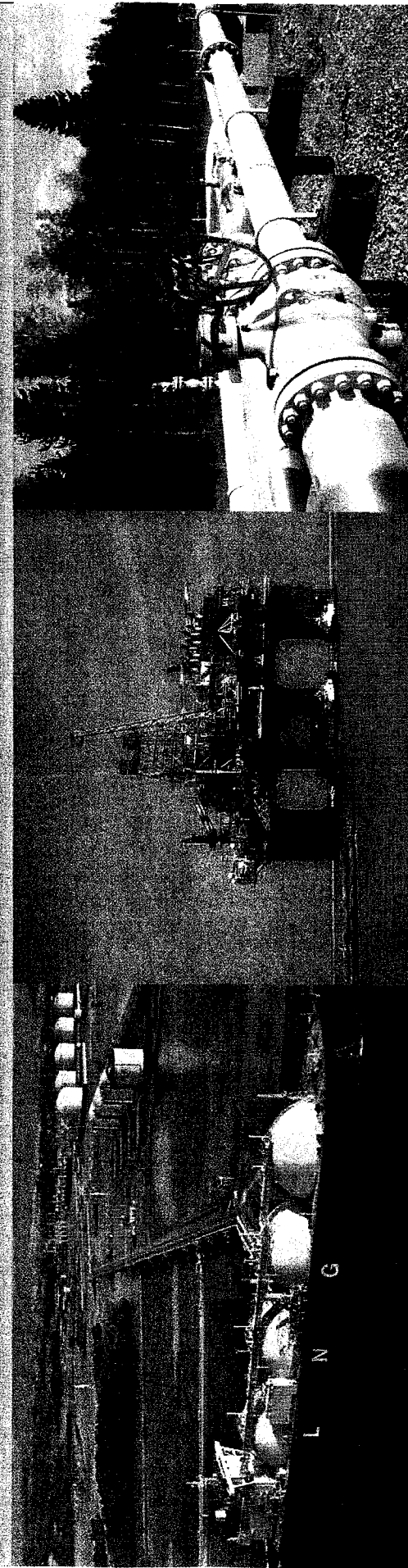


Hyundai S Korea

NARUC Winter Meeting *LNG in a Renewable World*

February 17, 2009



J. Mark Robinson, Director

OFFICE OF ENERGY PROJECTS

FEDERAL ENERGY REGULATORY COMMISSION

Why Natural Gas

- ⇒ It is doable
- ⇒ Issues with Coal, Nuclear, Renewables

Coal: Carbon Capture and Sequestration (CCS)

- ⇒ It's the S
- ⇒ CO₂ is a colorless, odorless gas which is lethal to humans in a concentration of 10-11%.
- ⇒ To sequester CO₂
 - ⇒ Many miles of pipe are needed.
 - Up to 23,000 miles of CO₂ pipeline will be needed between 2010 and 2050 for CCS. (PNNL)
 - ⇒ Permanent, non-cycling storage sites must be found.
- ⇒ Regulatory Environment Does Not Exist
 - ⇒ Current CO₂ pipes are for enhanced oil recovery
 - ⇒ Regulatory regime for large scale CO₂ pipeline siting would need to consider: environmental impacts, safety, eminent domain, landowner impacts with the added concern of CO₂ as an asphyxiant gas.

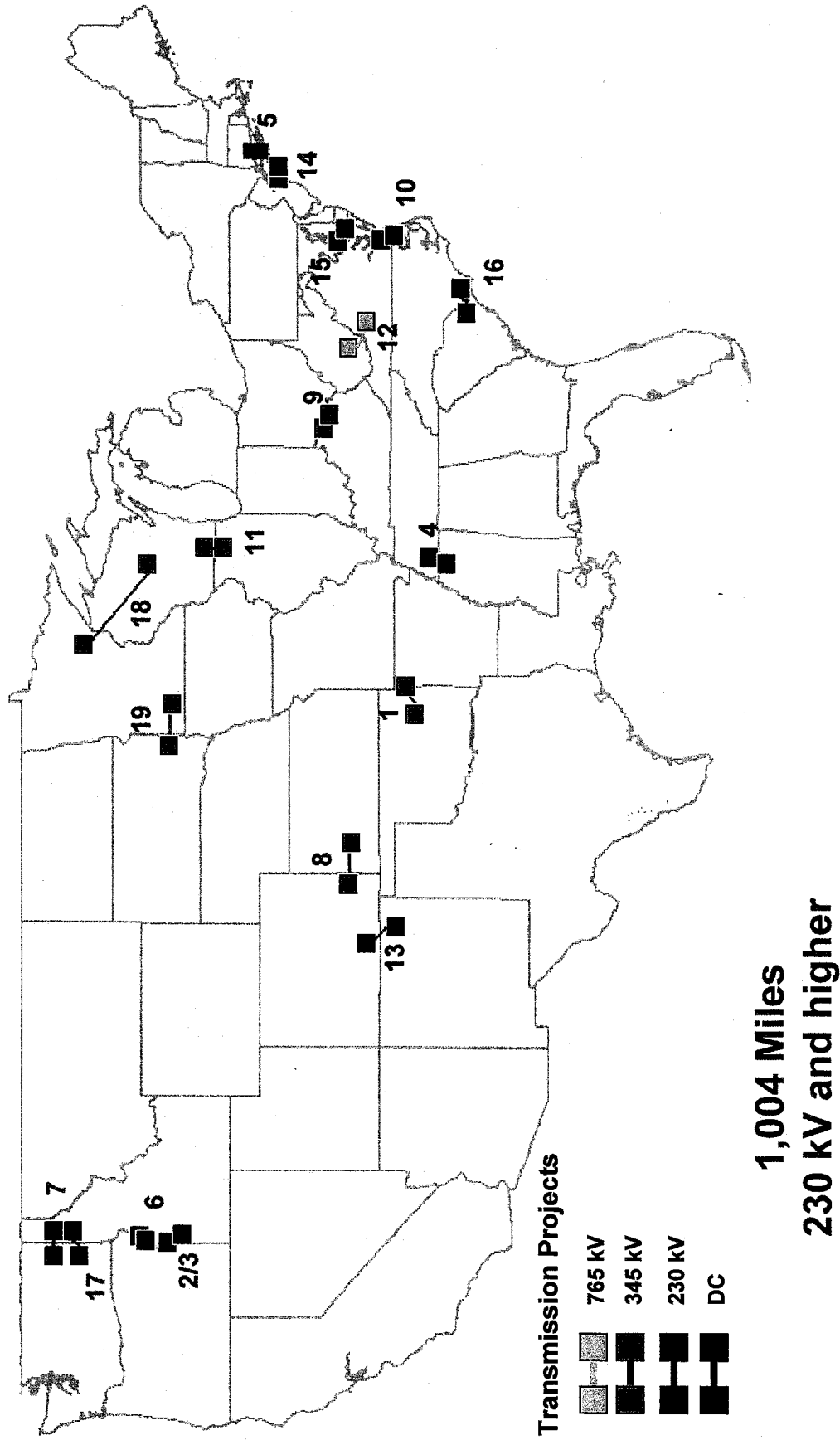
Nuclear Power: Time

- EIA analysis of the Climate Security Act of 2007 estimated a need for 200 new nuclear plants by 2030.
 - ⇒ The NRC expects to receive 23 new nuclear power plant applications representing 34 units between 2007-2010.
- The NRC's new licensing process for nuclear power plants takes about 10 years to complete.
- The capital cost to build a new nuclear plant is conservatively estimated to range from \$4,000/kW to \$6,000/kW.
- The United States currently has 56,000 metric tons of spent nuclear fuel from nuclear reactors. By the year 2035 it is expected to have 119,000 metric tons.
 - ⇒ Yucca Mountain statutory capacity limit is 77,000 metric tons. The country's waste inventory will exceed this limit by 2010.

Wind and Solar Energy: Transmission and Land Use

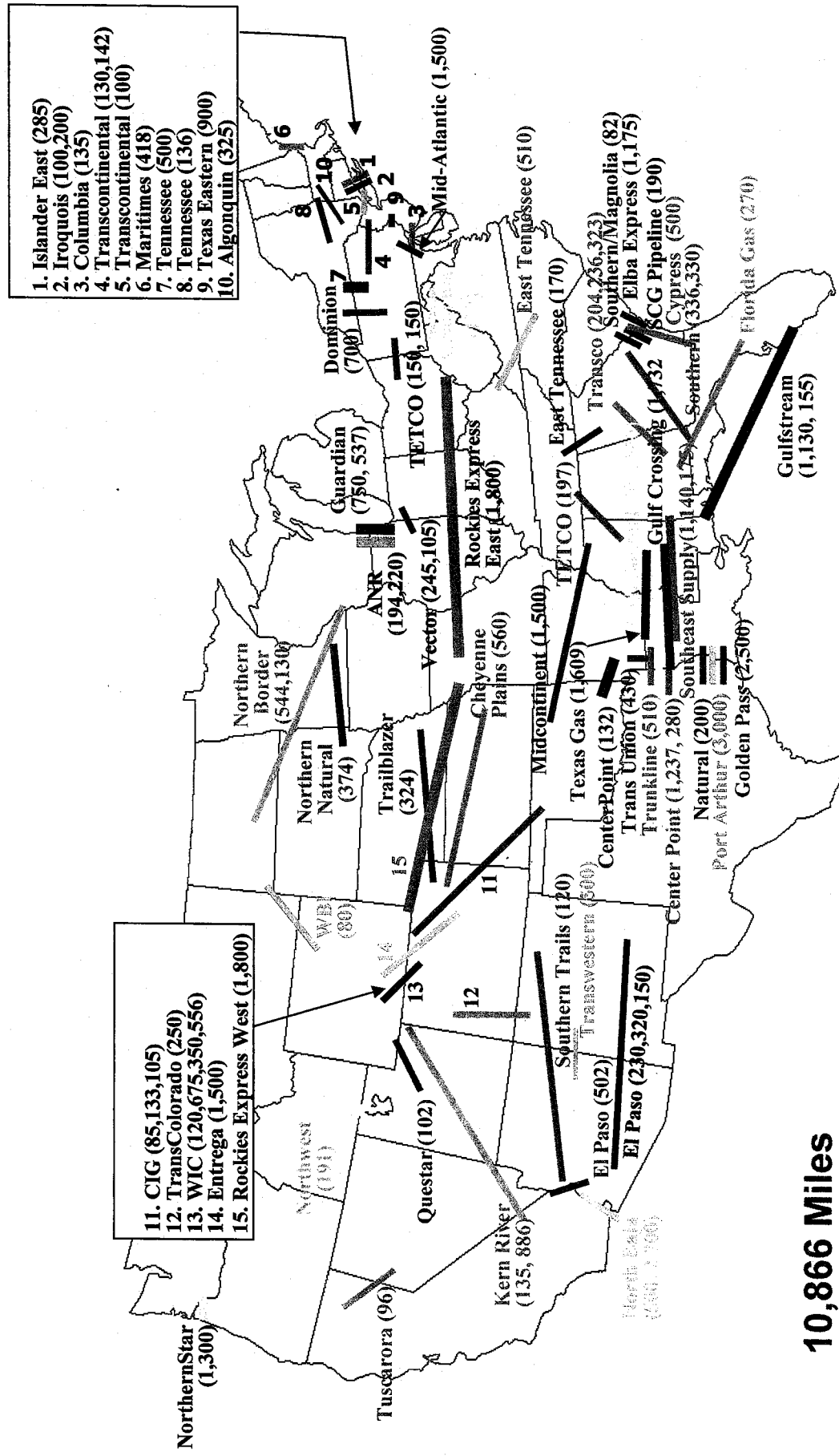
- ⇒ Renewables sources are not near the market
 - ⇒ Electric transmission must be built.
- ⇒ Reliability?
 - ⇒ Wind energy available, on average, 30% to 45% of the time.
 - ⇒ Conversion efficiency of Solar PV cells range between 8% and 17%
- ⇒ Land use for a 500 MW plant
 - ⇒ Natural Gas: 20 to 40 acres
 - ⇒ Wind: 25,000 to 37,500 acres, 250 to 500 acres are under concrete
 - ⇒ Solar: approximately 3,500 acres

Since 2000, 19 transmission lines have been built that physically cross state borders



Sources: Derived from Ventyx Velocity Suite, the C Three Group's U.S. Electric Transmission Database and FERC's Transmission Database

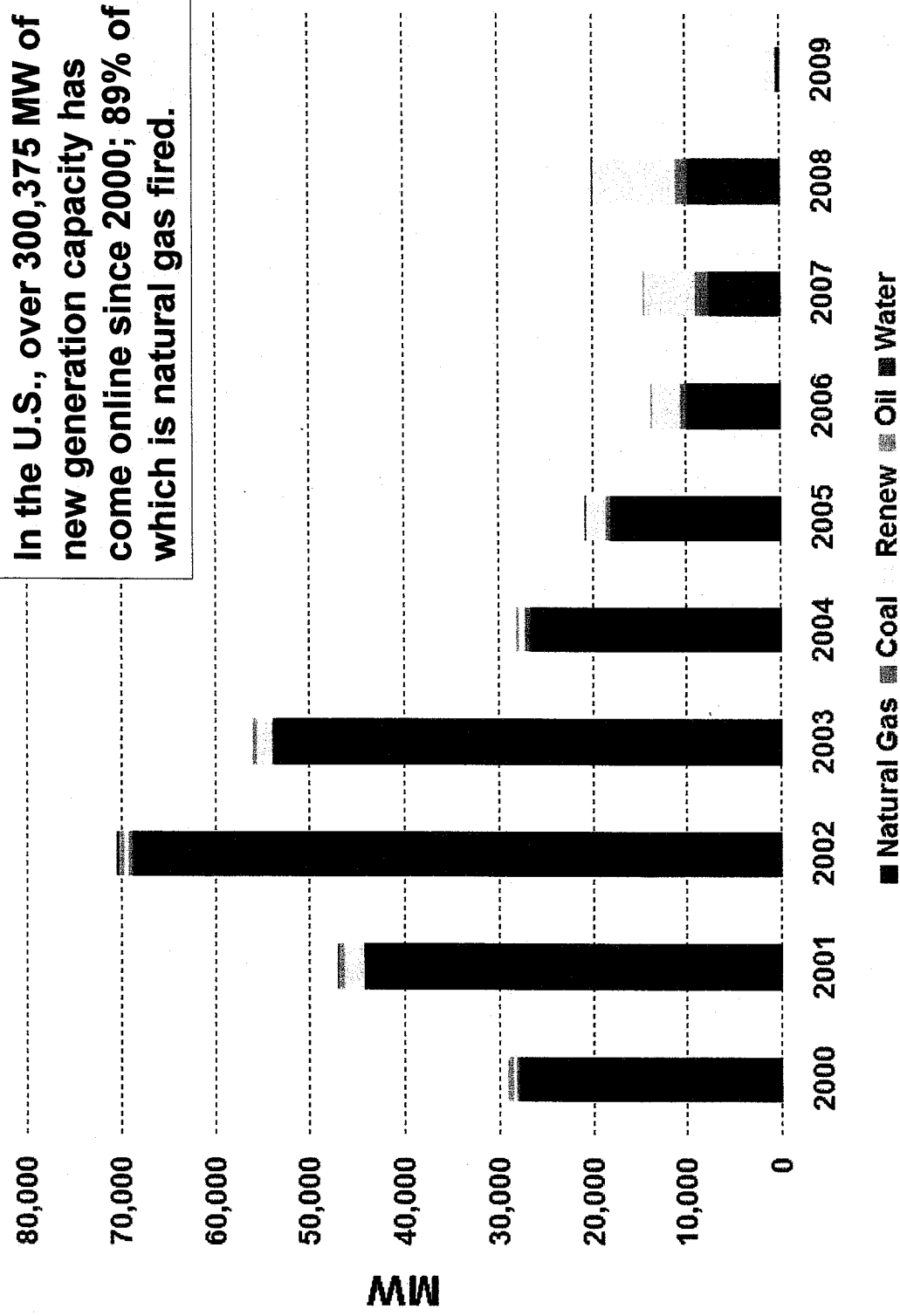
Since January 2000, 84 natural gas pipeline projects have been certified that physically cross state borders.



**10,866 Miles
47.72 BCF/D Total**

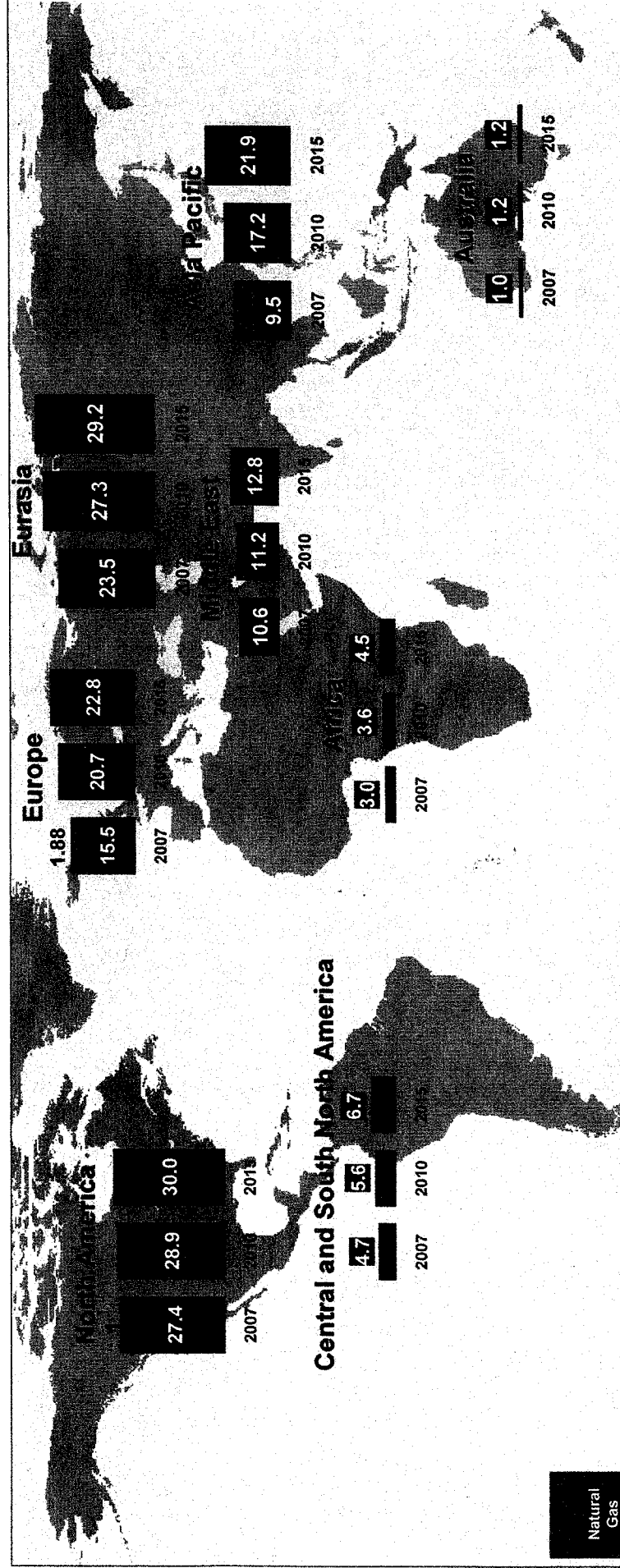
Sources: FERC's Database

Gas-fired generation has dominated recent U.S. expansion of generation capacity



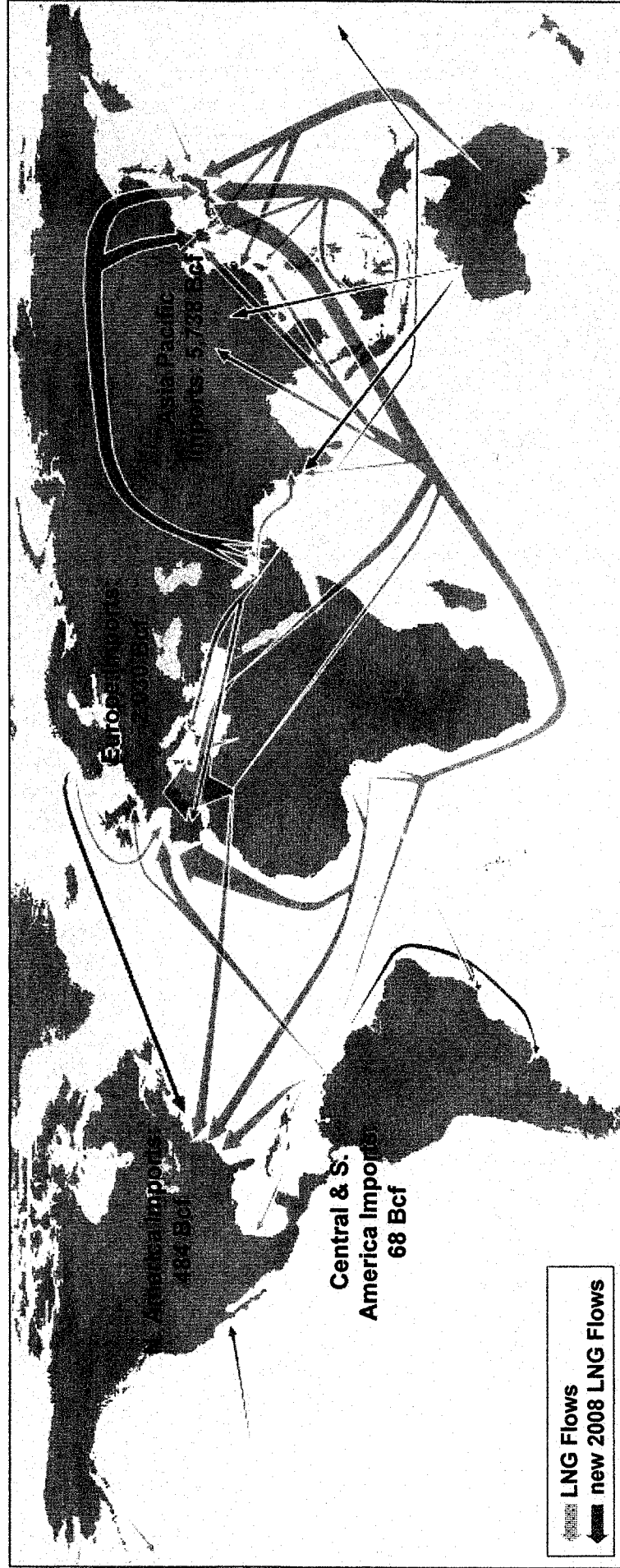
Source: Based on data from Ventyx Global Energy, LLC, Velocity Suite, February 2009.

World Gas Consumption (in Tcf)



Source: Based on data from BP Natural Gas Consumption 2007, EIA's International Energy Outlook 2008, Table A6, and Ventyx Global Decision LLC, Velocity Suite.

2008 LNG Flow Movements

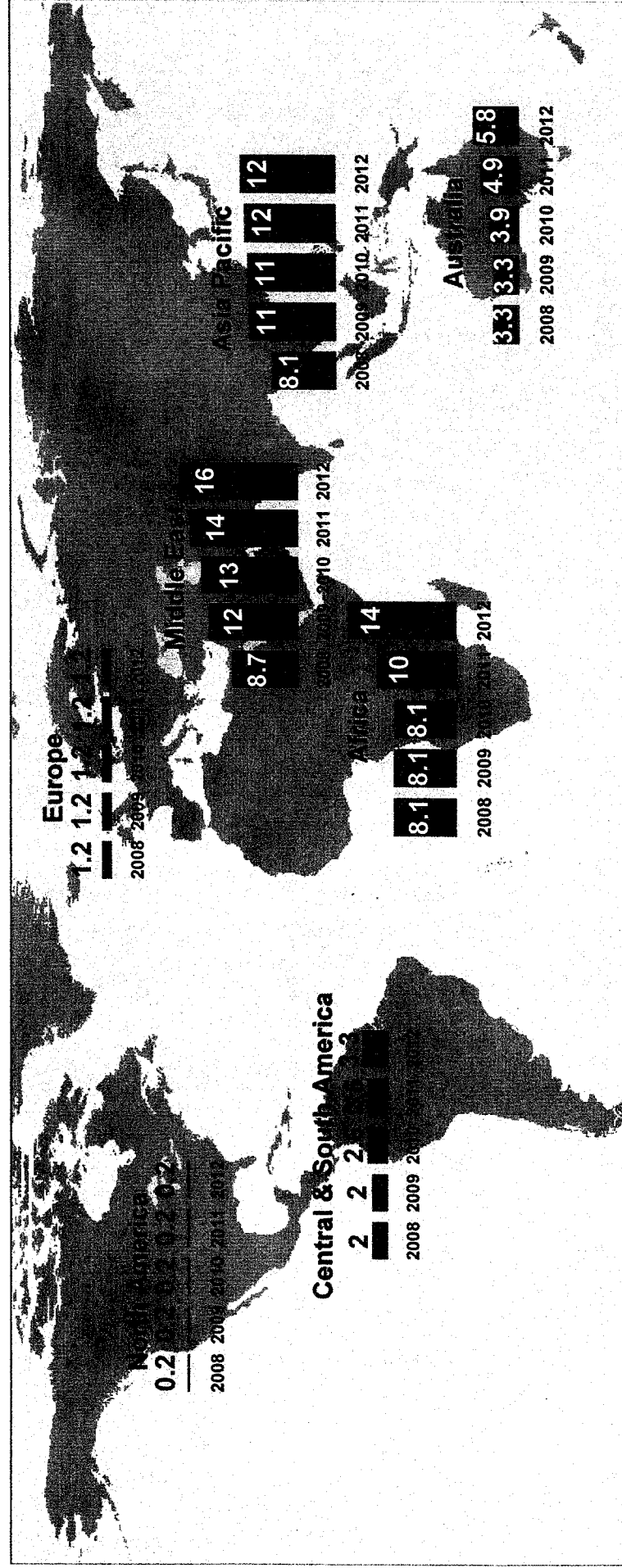


Source: Based on data from CERA Global LNG Balance, February 2009, and Ventyx Global Decision LLC, Velocity Suite.

Variables Affecting LNG Movement

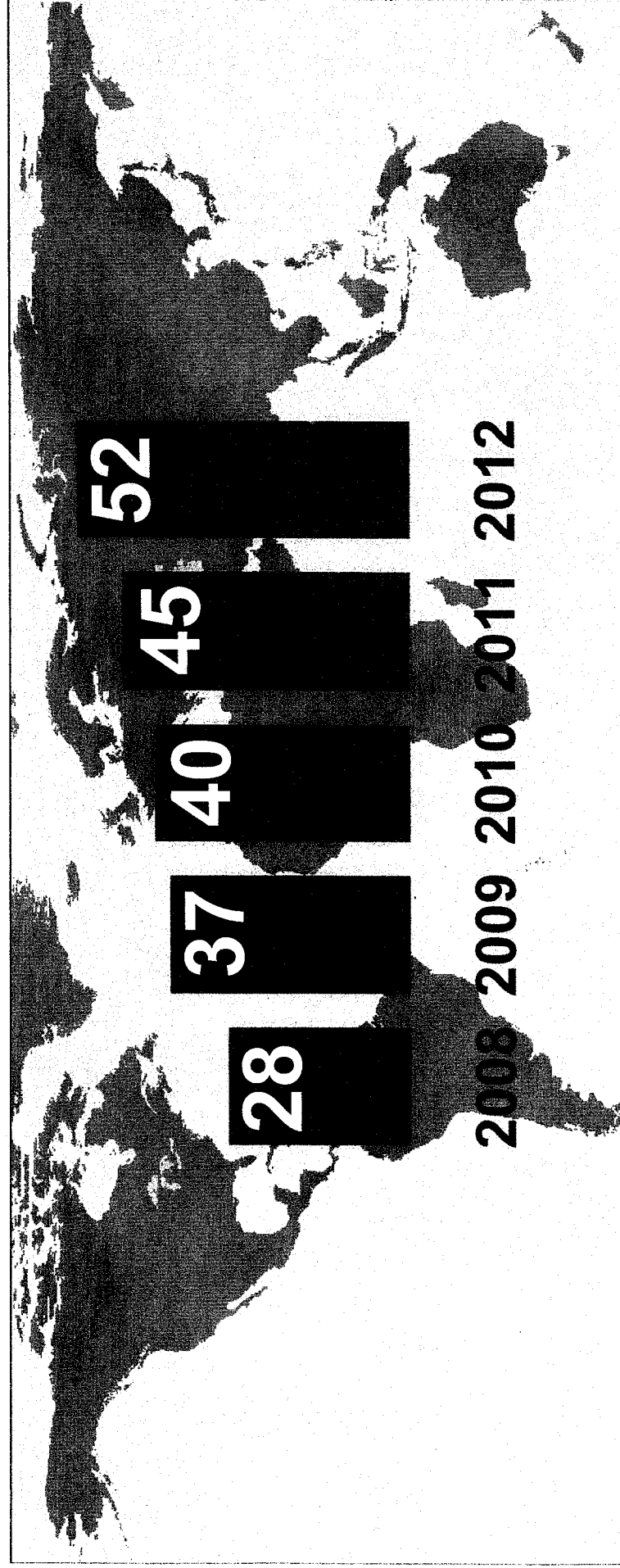
- ⇒ **Market Structure**
- ⇒ **Domestic Supplies**
- ⇒ **Liquefaction Capacity**
- ⇒ **Storage**

LNG Liquefaction Capacity by Region (Bcf/d)



Source: Based on data from Platts LNG Daily's Terminal Trackers, Ventyx Global Decision LLC, Velocity Suite.

Global LNG Liquefaction Capacity (Bcf/d)



Source: Based on data from Platts LNG Daily's Terminal Trackers, Ventyx Global Decision LLC, Velocity Suite.

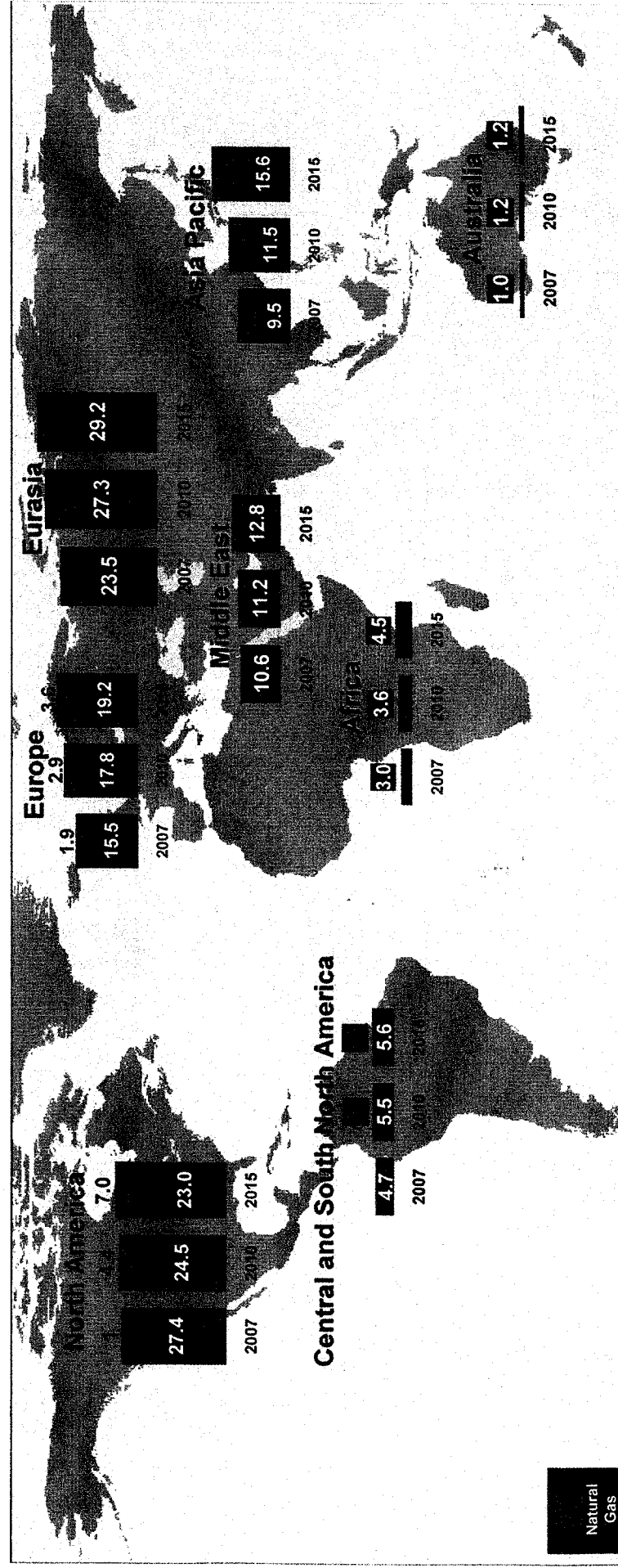
Worldwide Working Gas Storage Capacity



* This represents those European countries that have regasification facilities.

Source: Based on data from IGU 23rd World Gas Conference-WGC 2006, EIA's Estimate of Peak Underground Working Gas Storage Capacity in the US, and Ventyx Global Decision LLC, Velocity Suite.

World Gas Consumption by 2015 (Tcf)



Source: Based on data from BP Natural Gas Consumption 2007, EIA's International Energy Outlook 2008, Table A6, CERA's Global Demand Outlook and Ventyx Global Decision LLC, Velocity Suite.