Environmental Impacts of Natural Gas Supply

An R&D Perspective

> **Ron Edelstein**
Gas Technology Institute

NARUC Energy Resources and Environment Committee

Salt Lake City
July, 2004

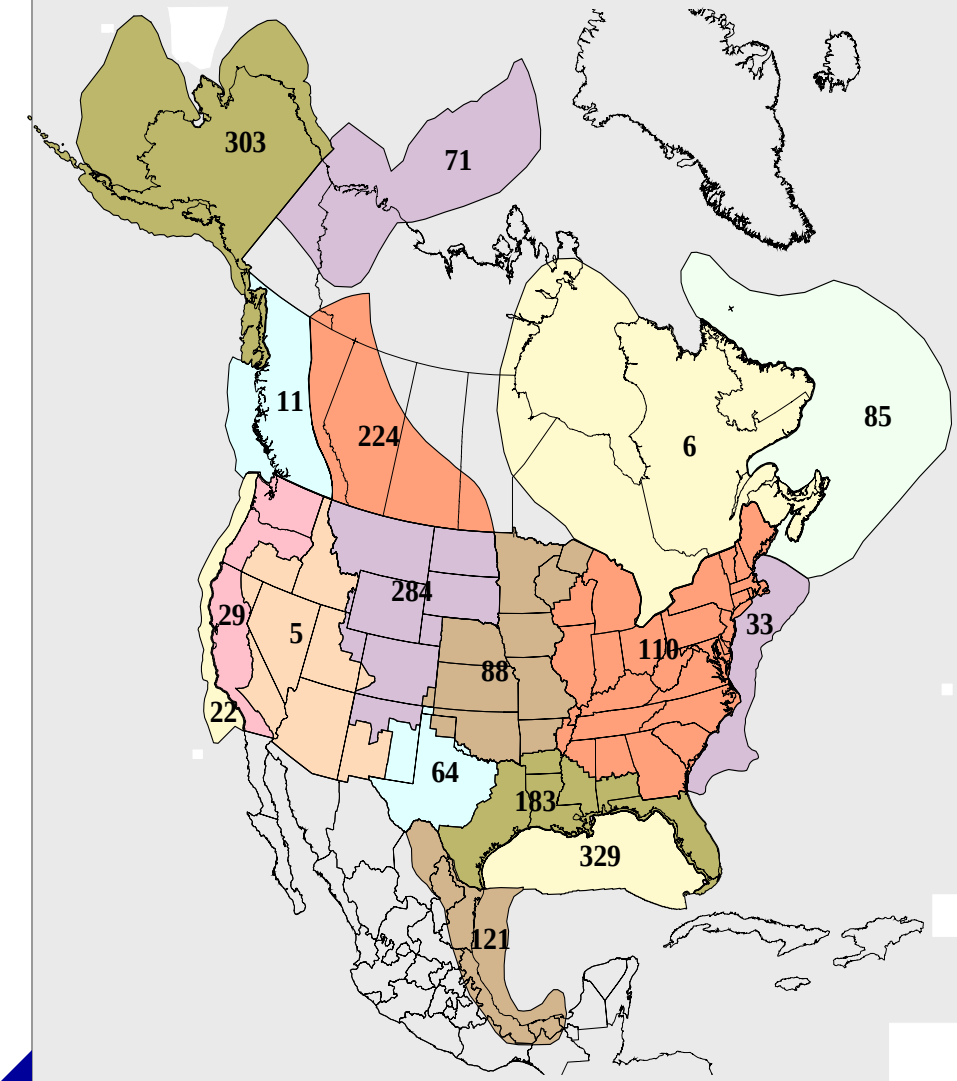
Topics

- **Natural gas supply and demand to 2025**
- **Environmental issues related to natural gas exploration, drilling, and production (supply)**
- **Environmental benefits of advanced technology for natural gas supply**
- **Gas supply environmental research needs**
- **Conclusions**

NPC Gas Supply Finding:

Traditional North American producing areas will provide 75% of long-term U.S. gas needs, but will be unable to meet total projected demand.

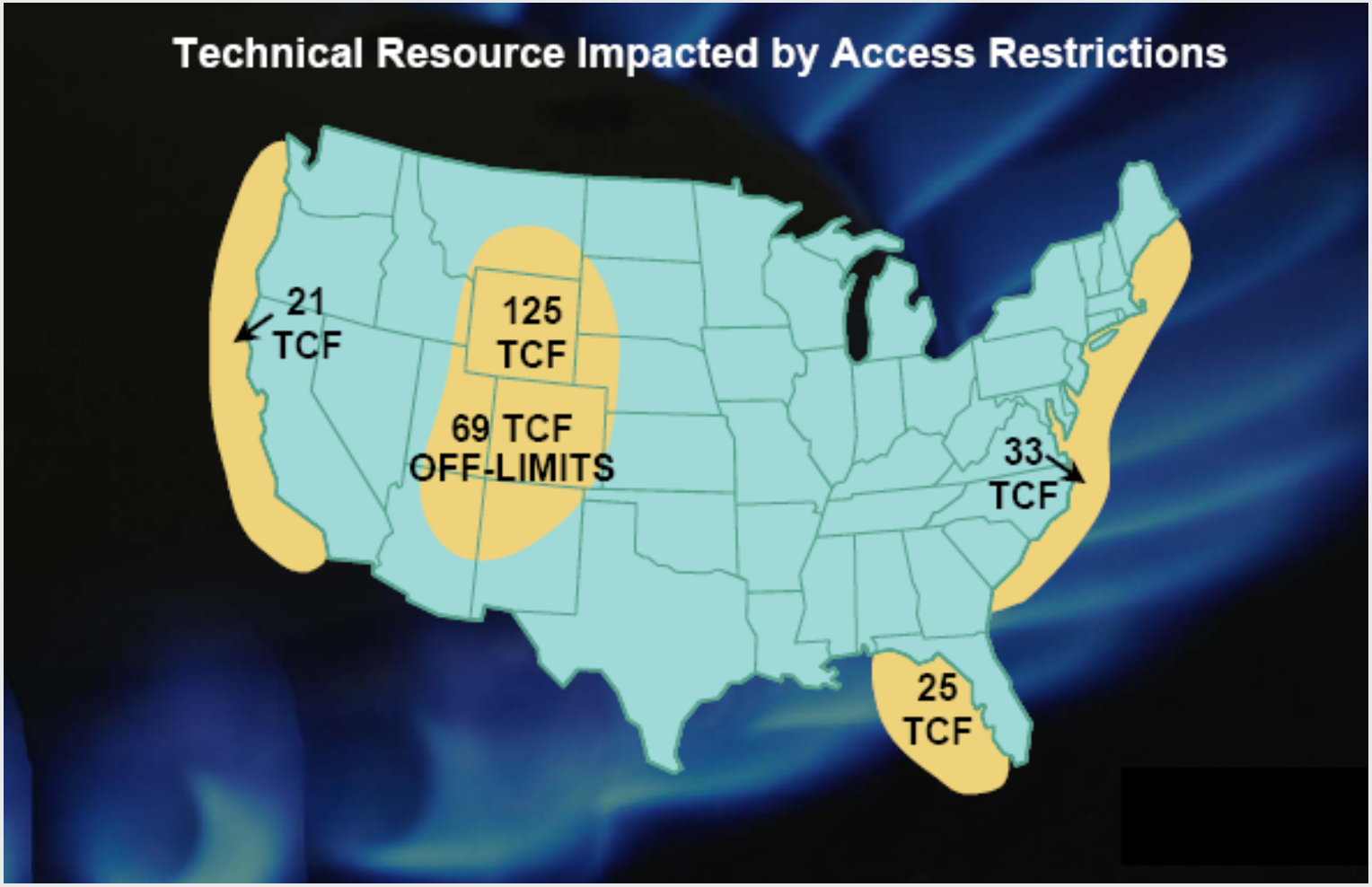
North American Resource Base is Large and Diverse



Technically Recoverable Resource Base

1,969 Tcf

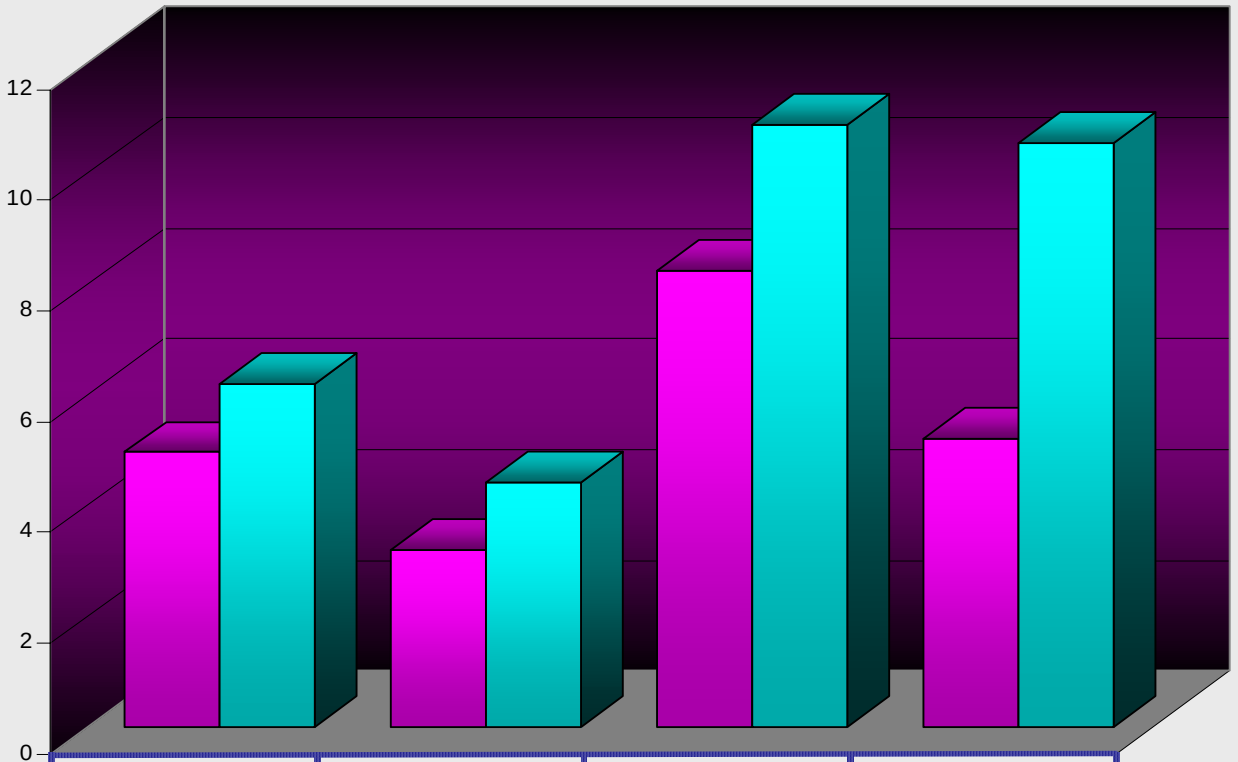
Access Restrictions



Resource vs. Production

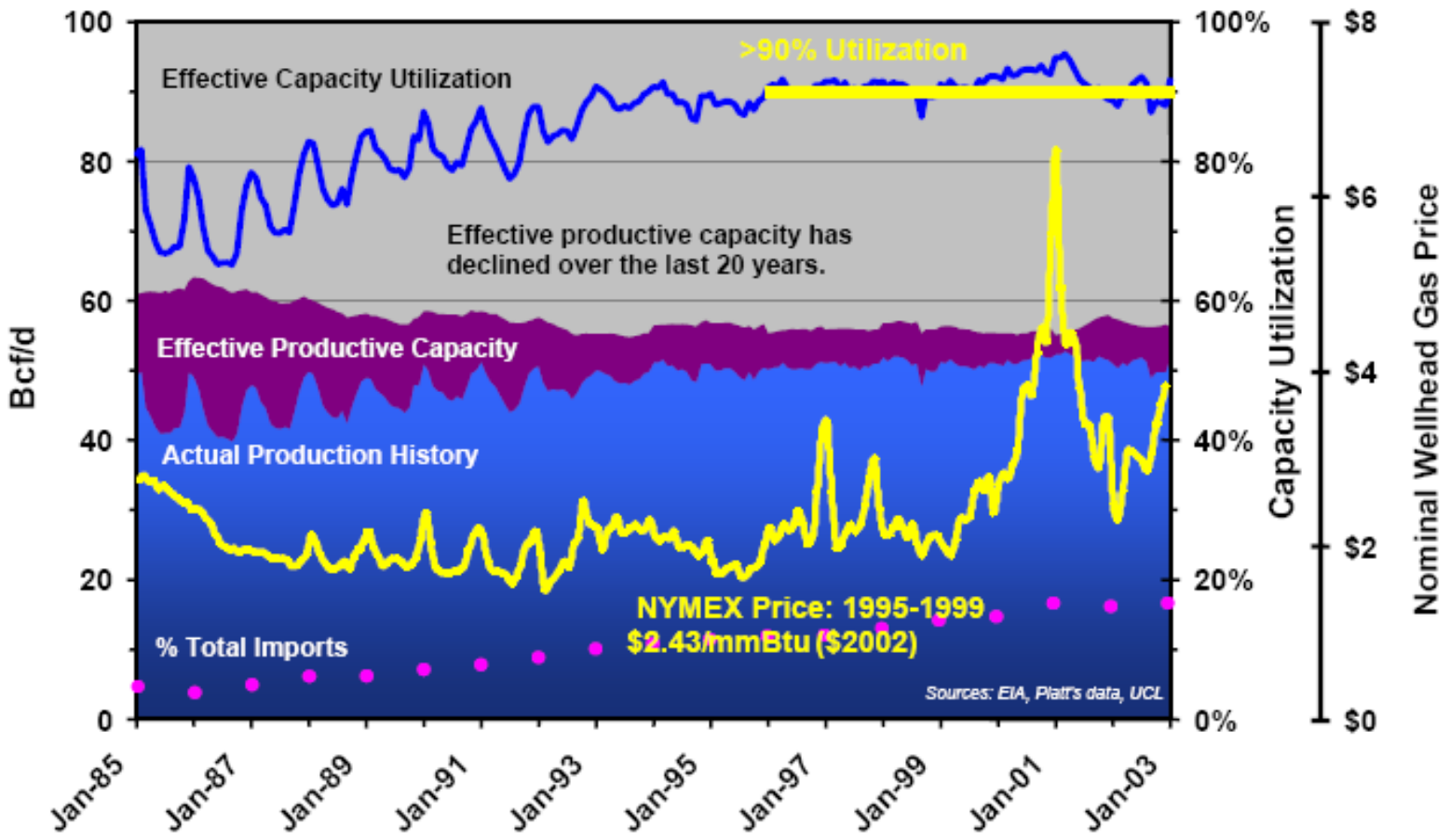
- Technically recoverable resource base sufficient for 70+ years at current rate
- Demand growth fueled by power generation
- Production declines as resource base matures
- Need additional production and import capacity

Demand Growth by Sector

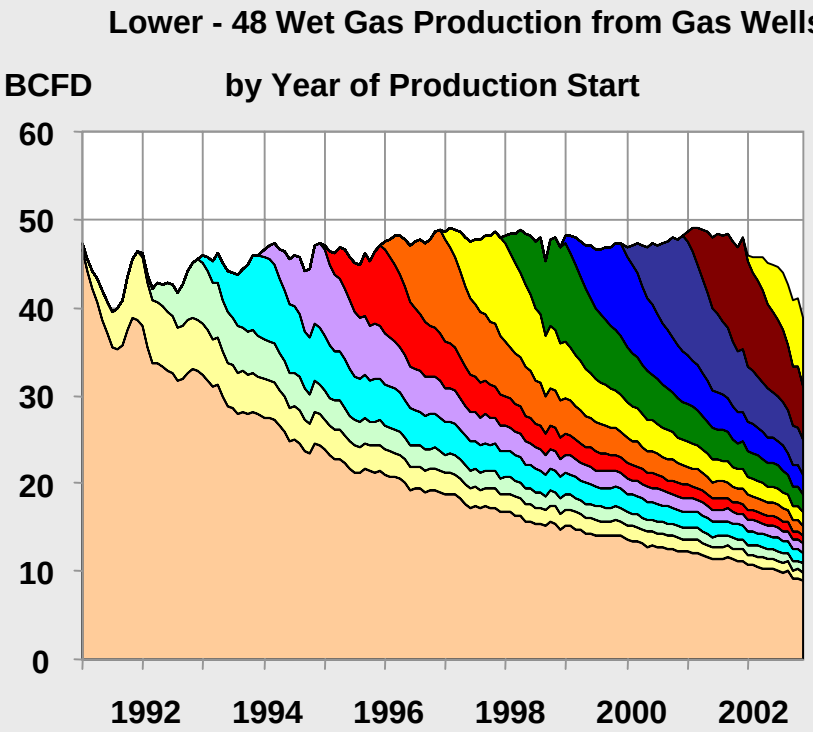


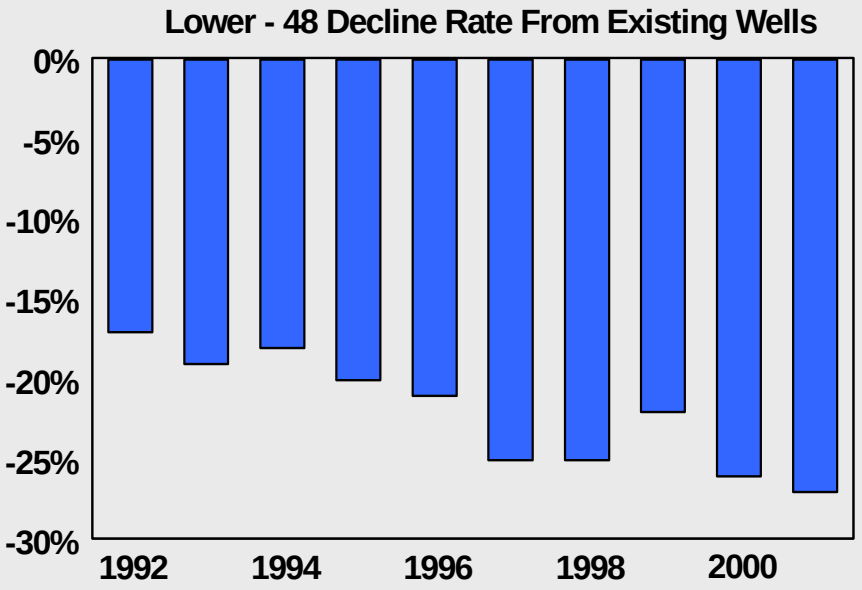
	Residential	Commercial	Industrial	Electric
2001	4.98	3.2	8.25	5.23
2025	6.22	4.43	10.91	10.56

U.S. Dry Gas Production, Capacity and Utilization



Production Performance – Decline Trends





Impact of Alaskan and Canadian Gas

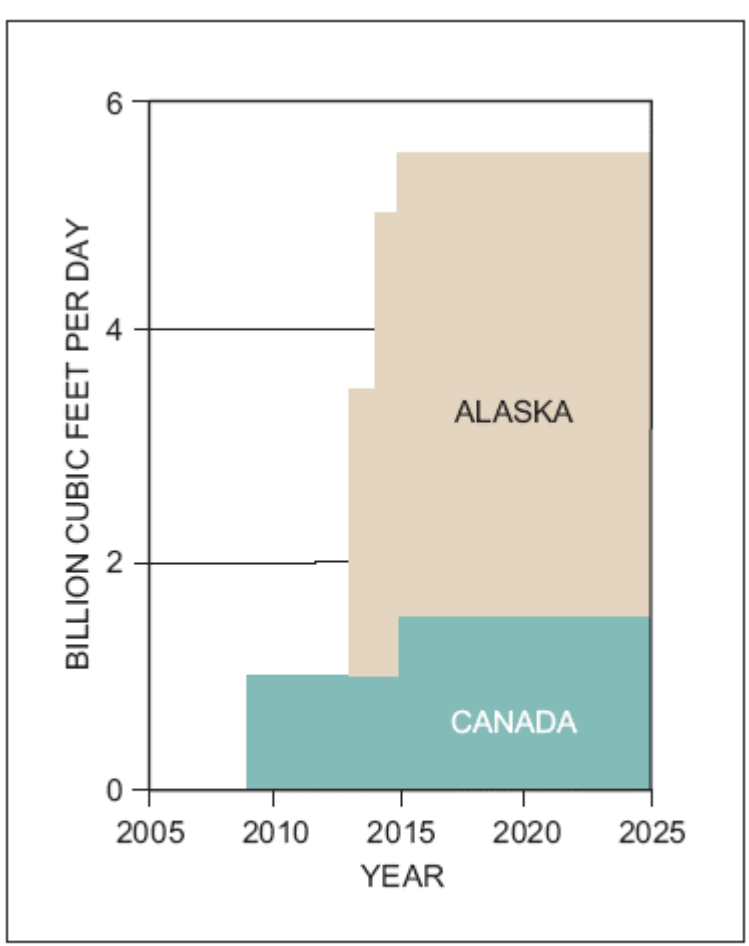
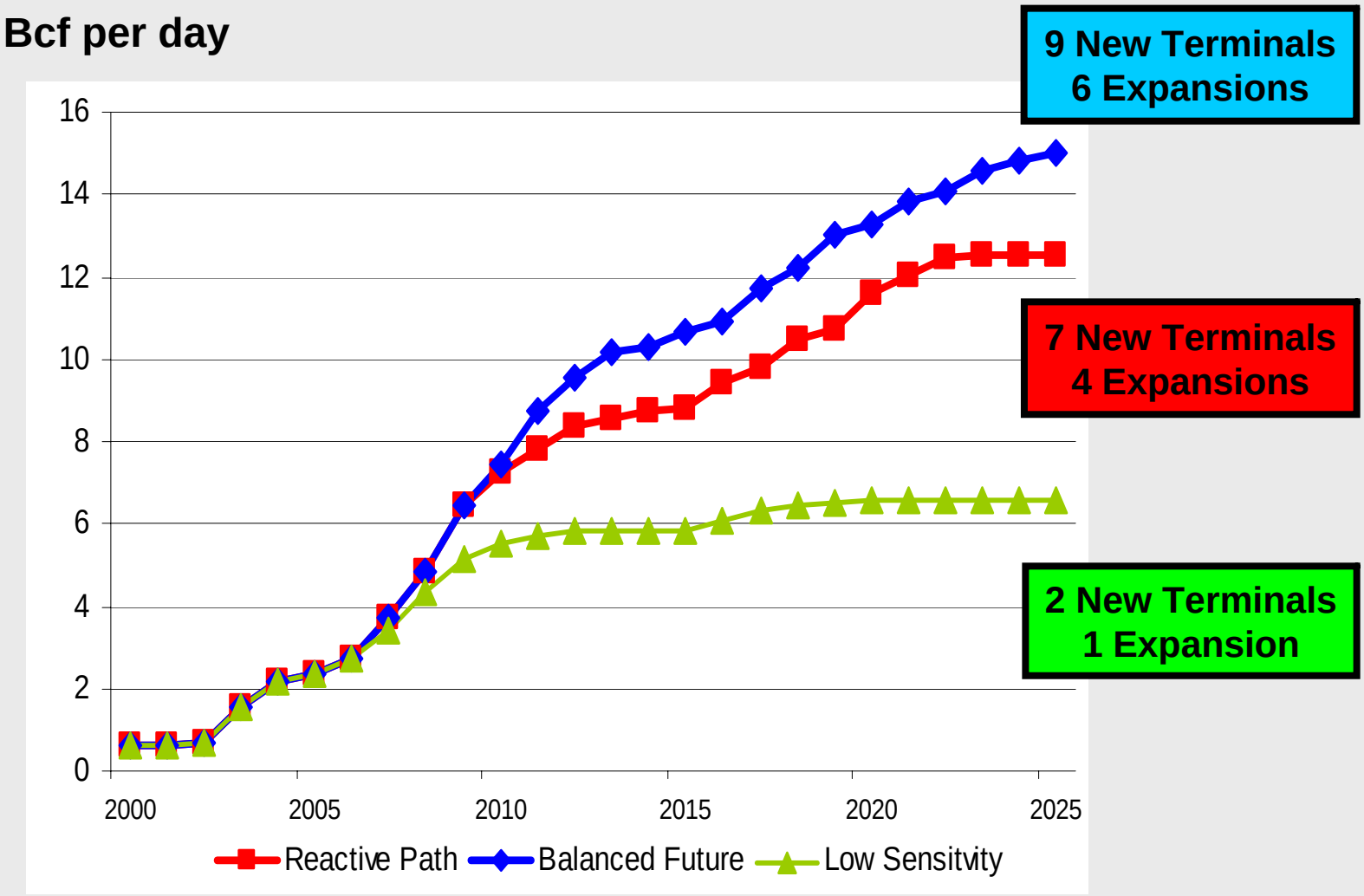
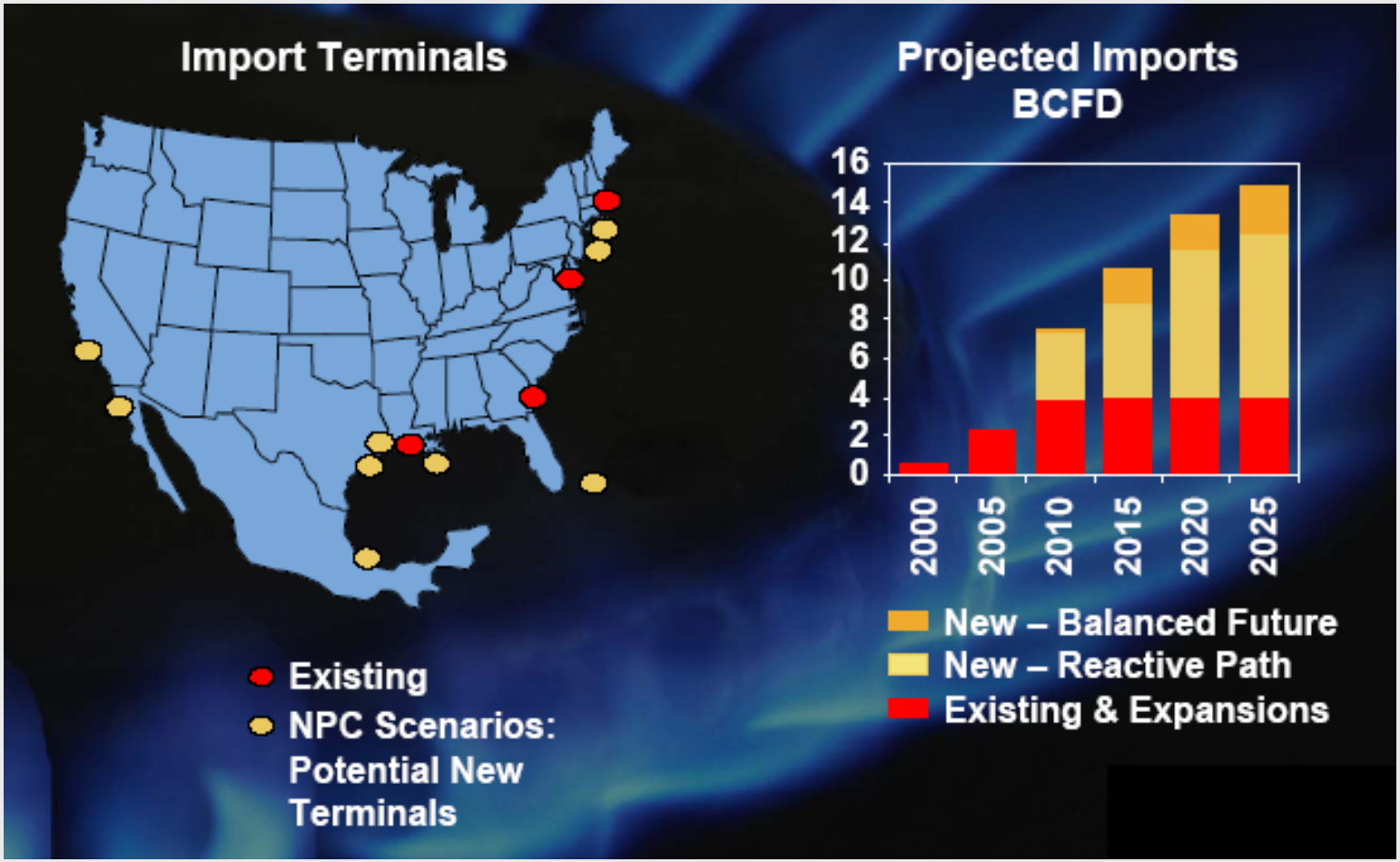


Figure 4-96. Total Arctic Gas Transported to Market

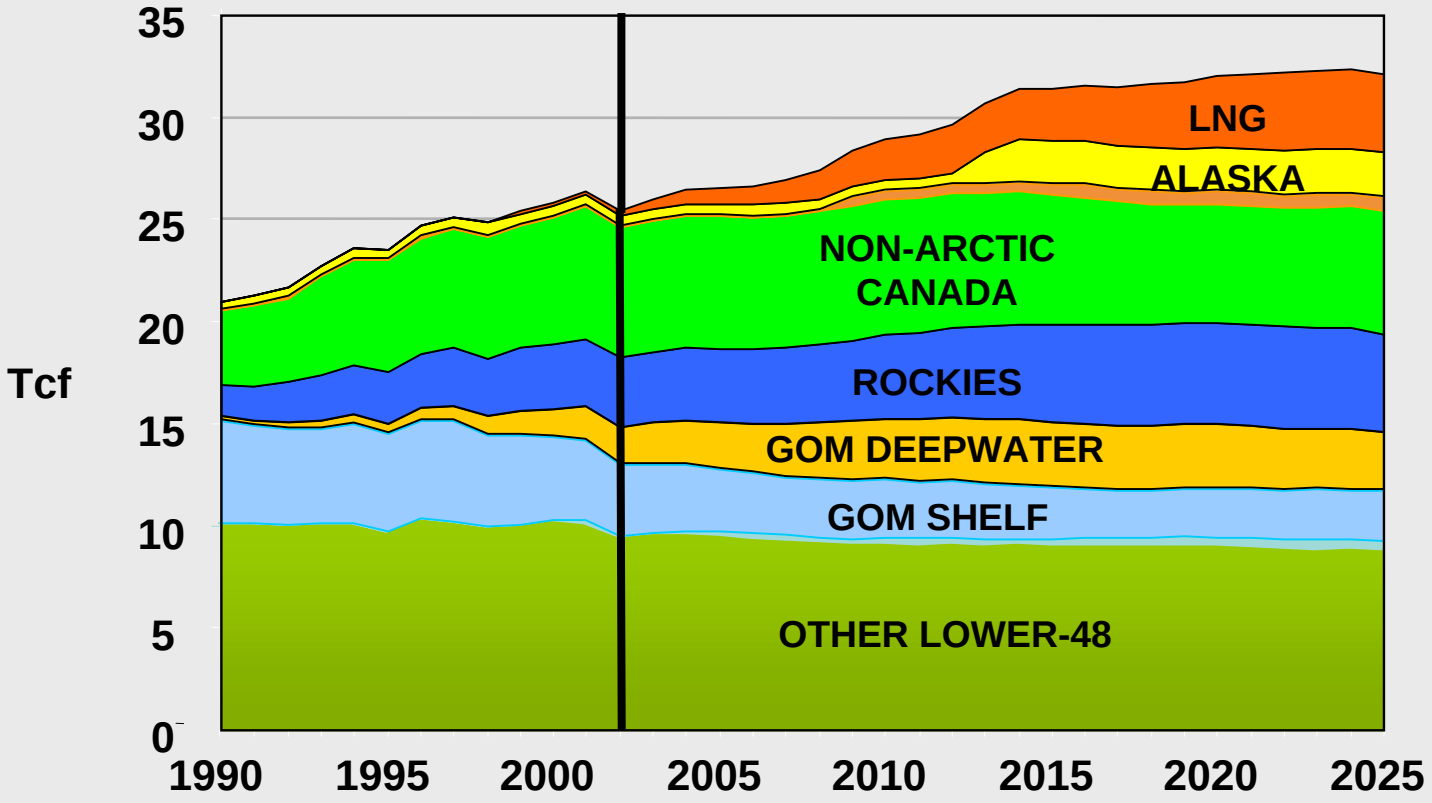
LNG Imports - NPC Scenarios



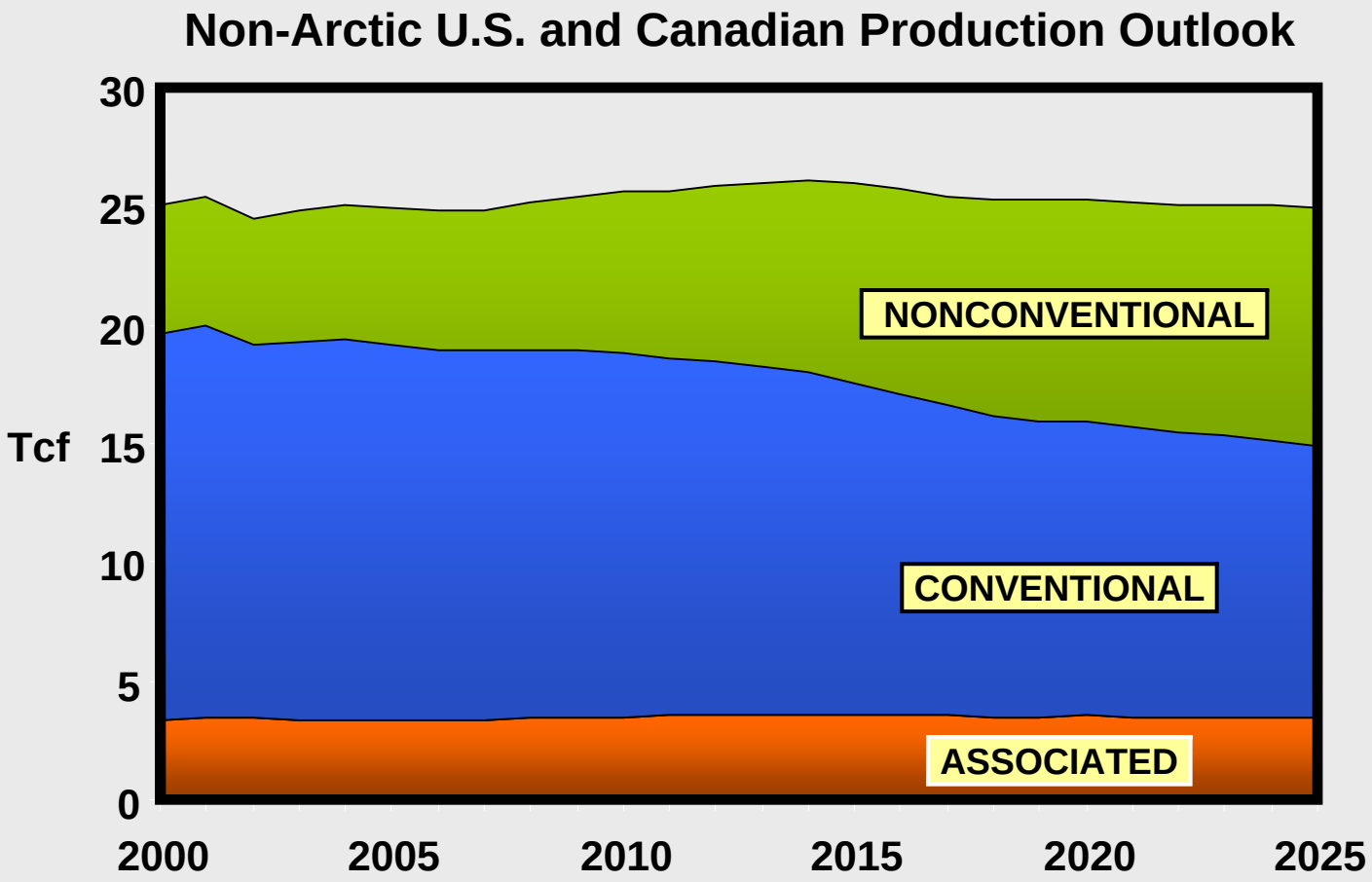
New LNG Terminals are Needed but Face Obstacles



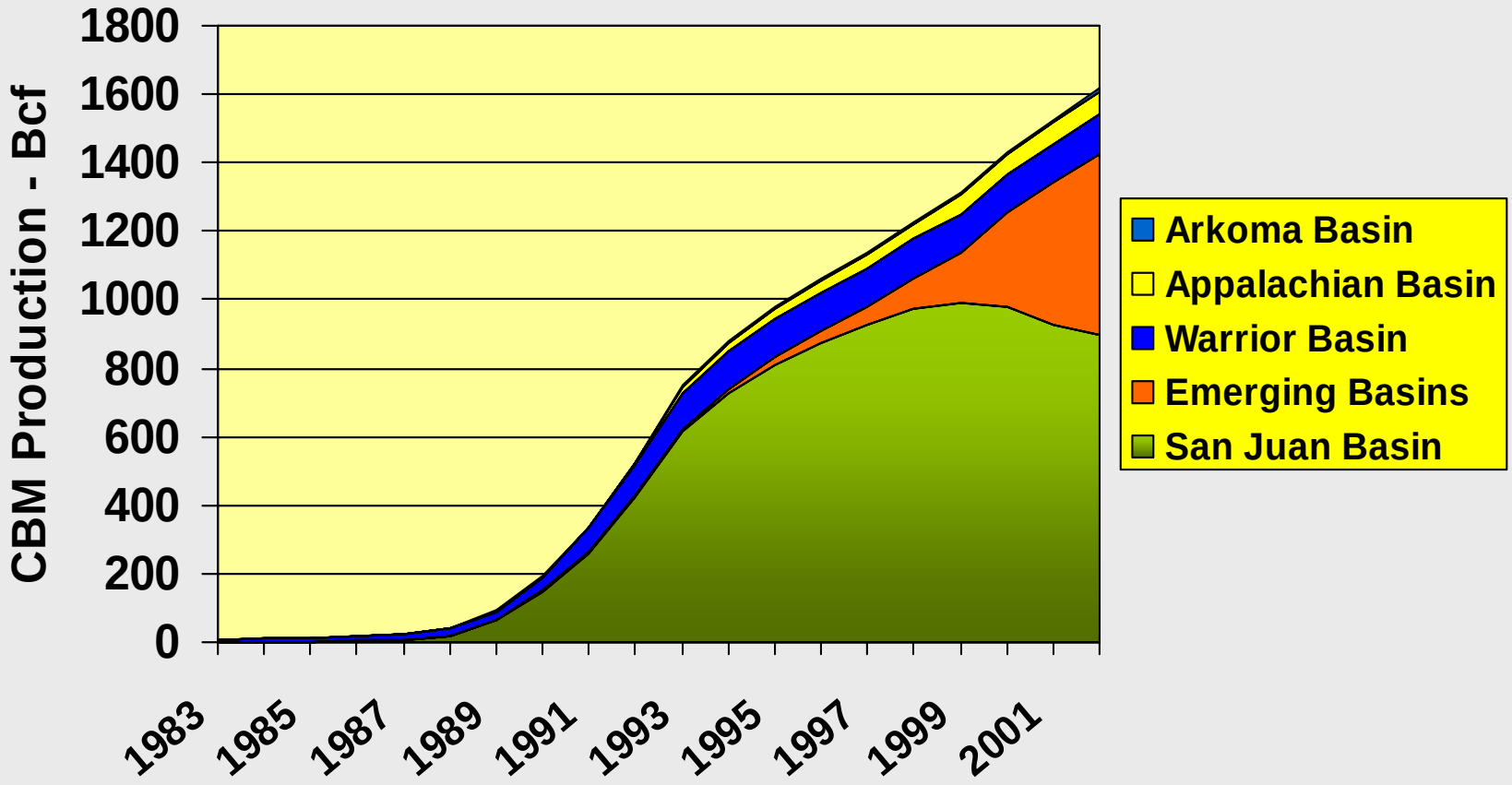
Future Supplies Come from Traditional and New Sources



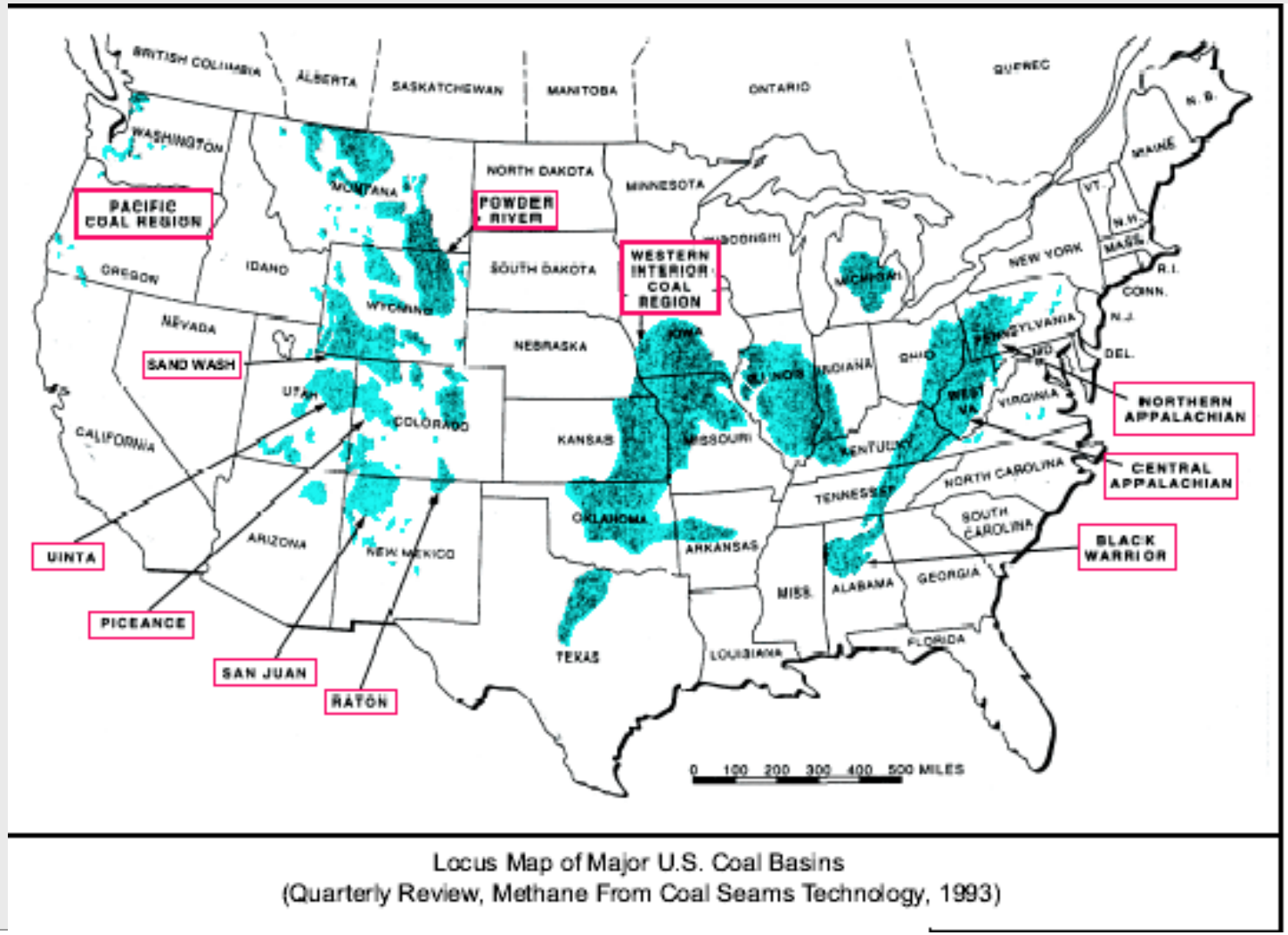
Nonconventional Gas Growth



Coalbed Methane Gas Production

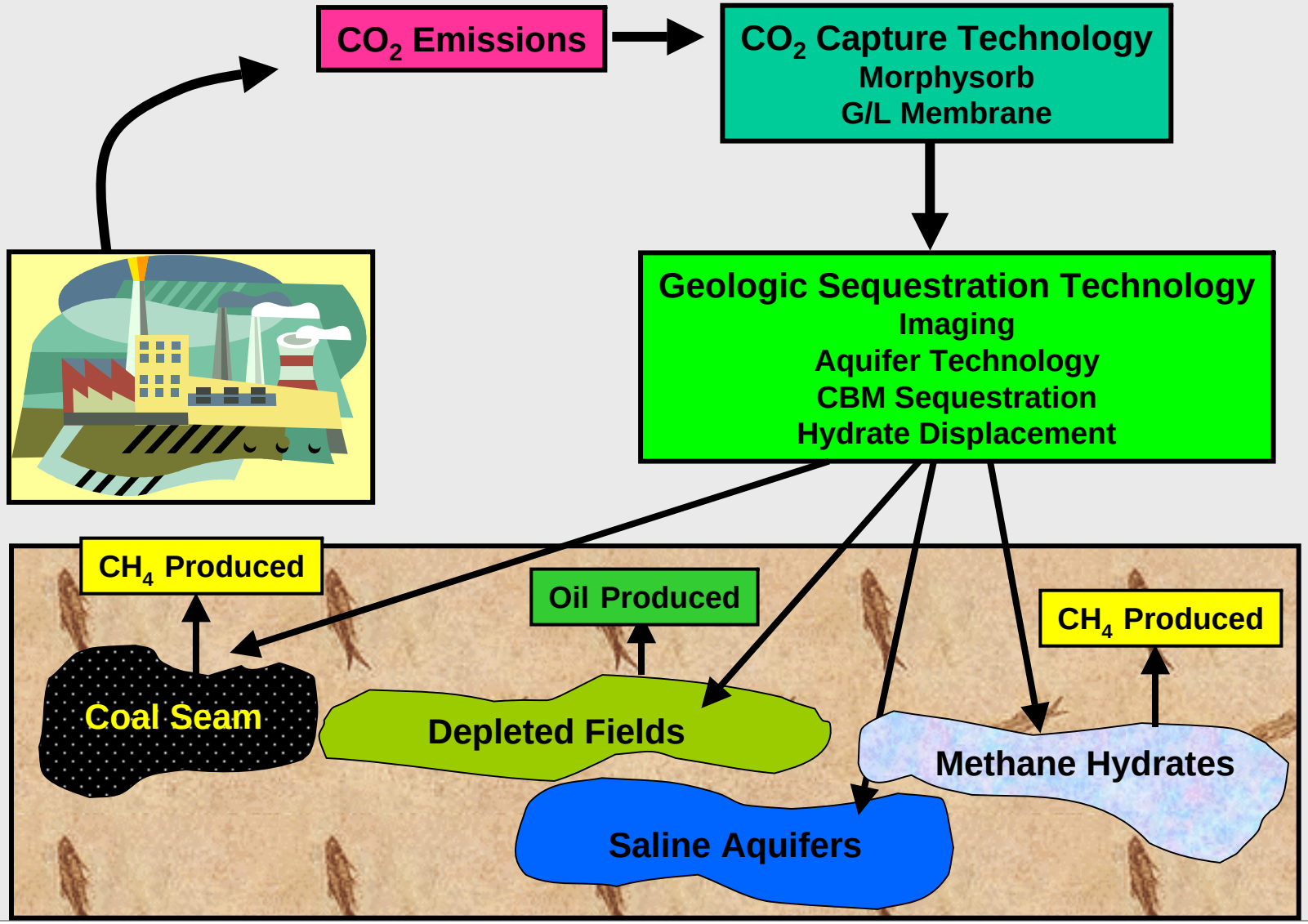


Coalbed Methane Resources



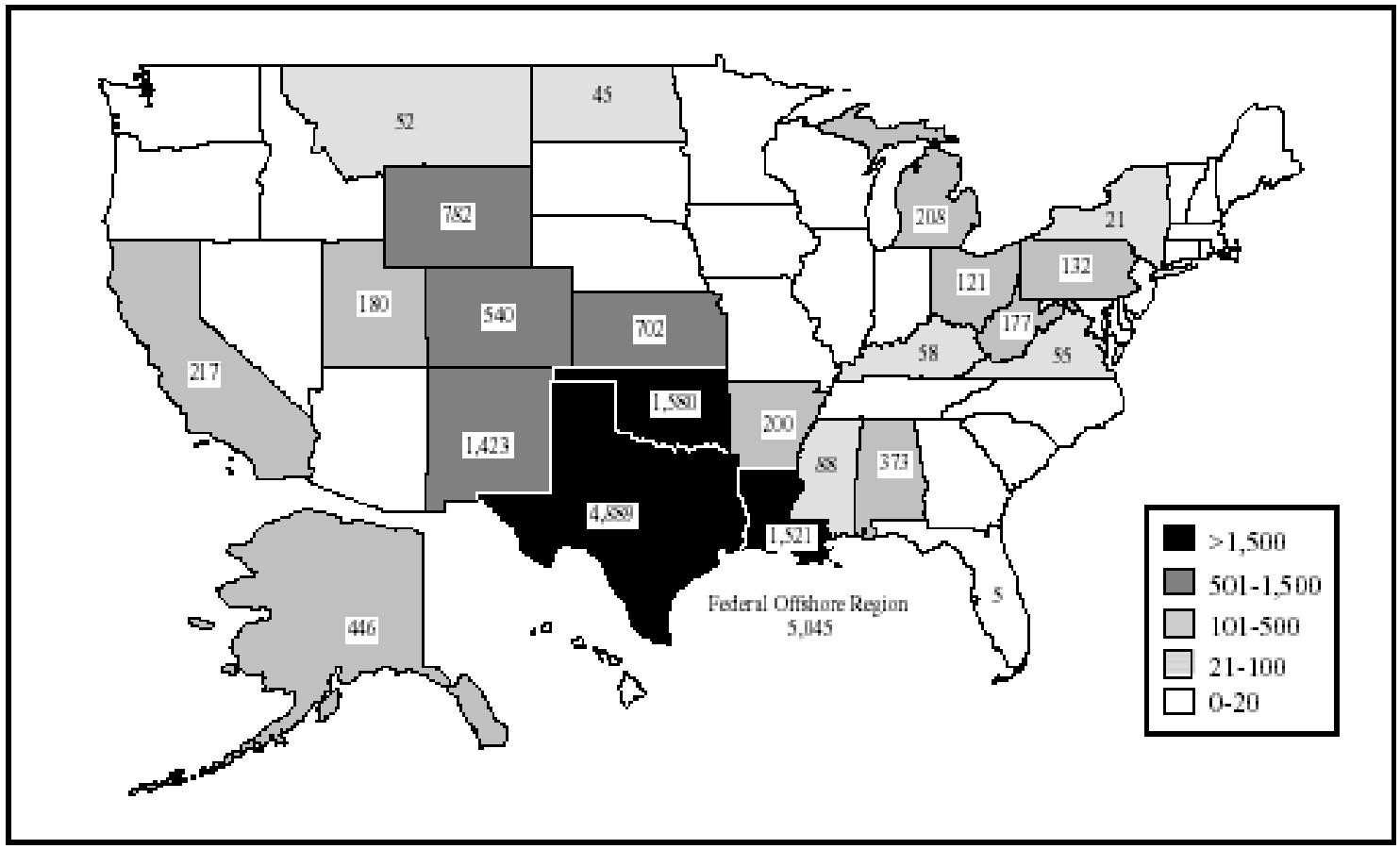
Locus Map of Major U.S. Coal Basins
(Quarterly Review, Methane From Coal Seams Technology, 1993)

CO_2 Capture and Storage



Producing States

Figure 3: 1996 U.S. Natural Gas Production (Billion Cubic Feet per Year)



Note: Small quantities are also produced in Arizona, Illinois, Indiana, Maryland, Missouri, Nebraska, Nevada, Oregon, South Dakota, and Tennessee.

Source: *U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves 1996 Annual Report*, EIA, 1997.

Gas Supply (onshore) Environmental Issues

- **Drilling fluid discharges**
- **H_2S emissions**
- **BTEX from glycol dehydrators**
- **Methane venting**
- **Production water disposal**
- **Gathering line impacts**

Drilling Fluid Discharges

- **May contain clay, barite, bentonite, lignosufonates, starch, soda ash, granular inert material, bactericide, corrosion inhibitors**
- **Potential impact: long-term exposure of biota**
- **Amelioration approaches: Containment and backfilling, recycling, and removal**
- **Drill cuttings also need to be disposed of**

H_2S Emissions

- **H_2S may be a minor constituent of natural gas from certain wells**
- **Health impact of H_2S as a hazardous gas; and formation of SO_2**
- **Amelioration approach: Should be removed during gas processing**

BTEX from Glycol Dehydrators

- **Benzene, toluene, ethyl benzene, and xylene, removed from the gas stream, may be vented to the air**
- **Health impact of BTEX as hazardous gases**
- **Amelioration approach: Should be properly disposed of, not vented, during gas processing**
- **Software from GTI is available for inventorying BTEX**

Methane Venting

- **50-60 Bcf/yr is lost due to methane venting, flaring, and other losses in natural gas production. This is only 0.25% of U.S. natural gas use**
- **Environmental impact: Effect on global warming**
- **Amelioration approach: Minimize sources of methane emissions to the atmosphere**
- **Overall impact of coalbed methane exploitation could *reduce* methane emissions from coal mines, and thus have an ameliorating effect on global warming**

gti

Production Water Disposal

- **Up to 20,000 barrels of water per day of produced waters from a coalbed methane well**
- **Environmental impact: Impact of brines on surface waters and drinking water**
- **Amelioration approach: Reinjection into stable zones or removal, use for secondary oil recovery, or evaporation**
- **One potential benefit, if brine content is low, or can be lowered, may *add* to Western water resource**

Gathering Line Impacts

- **Right of way impacts of roads and gathering lines in environmentally sensitive areas**
- **Environmental impact: Impact on biota**
- **Amelioration approach: Careful planning to minimize road and right of way footprints and pathways; site revegetation and restoration**

Other Potential Environmental Issues

- **Well and access road footprint**
- **Fracturing fluid environmental impact**
- **Subsidence**
- **Air pollution from on-site prime mover use**
- **Containment ponds**
- **Well blowouts**

Environmental Benefits of Advanced Technology

- **More efficient recovery of natural gas**
  - **3-D seismic techniques have resulted in better site selection, fewer wells drilled to produce a formation, less drilling wastes**
  - **Crosswell seismic technology to more accurately place wells in existing fields**
  - **Downhole telemetry**
- **Cleaner operations**
  - **Closed loop drilling fluids**
  - **V-shaped pit design**
  - **Substitution of drilling fluid additives**
  - **Applying casing cement to CBM wells**
- **Directional drilling for less surface impact**

gti

Environmental Benefits of Advanced Technology (cont.)

- **Reuse of drilling fluids**
- **Material balance and mud system monitoring**
- **Downhole produced water separation**
- **Produced water filter management**
- **Reducing glycol circulation rates**

Ref: EPA document EPA/310-R-99-006

Gas Supply Environmental Research Needs

- **Unconventional gas R&D – production waters, fracturing fluids**
- **Deep gas – H_2S potential**
- **Gas hydrates research**
- **Horizontal well impacts**

Conclusions

- **Natural gas drilling on currently restricted areas, LNG terminals, and the Alaskan pipeline will all be needed to ensure cost-competitive future natural gas supplies**
- **Future supplies of natural gas can be brought into play with minimal environmental impacts if advanced technology and careful planning are used**
- **Advanced technology R&D can help to ensure that natural gas remains the most environmentally benign fossil fuel**

gti

Contact Information and References

- **Contact information:**
  - **ron.edelstein@gastechnology.org**
  - **(847) 768-0898**
- **References:**

  - Bisioi, A. and Boots, S., Energy Technology and the Environment, Vol. 2, 1995
  - EPA/310-R-99-006, EPA Office of Compliance Sector Notebook Project, Profile of the Oil and Gas Extraction Industry, October 2000
  - Mitre Corporation, Health and Environmental Effects of Oil and Gas Technologies: Research Needs, July 1981
  - NPC Report, Environmental Conservation, 1982
  - NPC Report, Balancing Energy Policy - Fueling the Demands of a Growing Economy, 2004