

Balancing the Technology Role



*Natural Gas Technology:
Investment in a Healthy U.S.
Energy Future*

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National Energy Technology Laboratory



www.netl.doe.gov



NETL Plays Key Role in Fossil Energy Supply, Delivery, and Use Technologies

Electric Power Using Coal



Coal Production



Environmental Control



V21 Next Generation



Carbon Sequestration

Clean Liquid Fuels



Exploration & Production



Refining & Delivery



Alternative Fuels



Future Fuels

Natural Gas



Exploration & Production



Pipelines & Storage



Fuel Cells



Combustion Turbines



Natural Gas

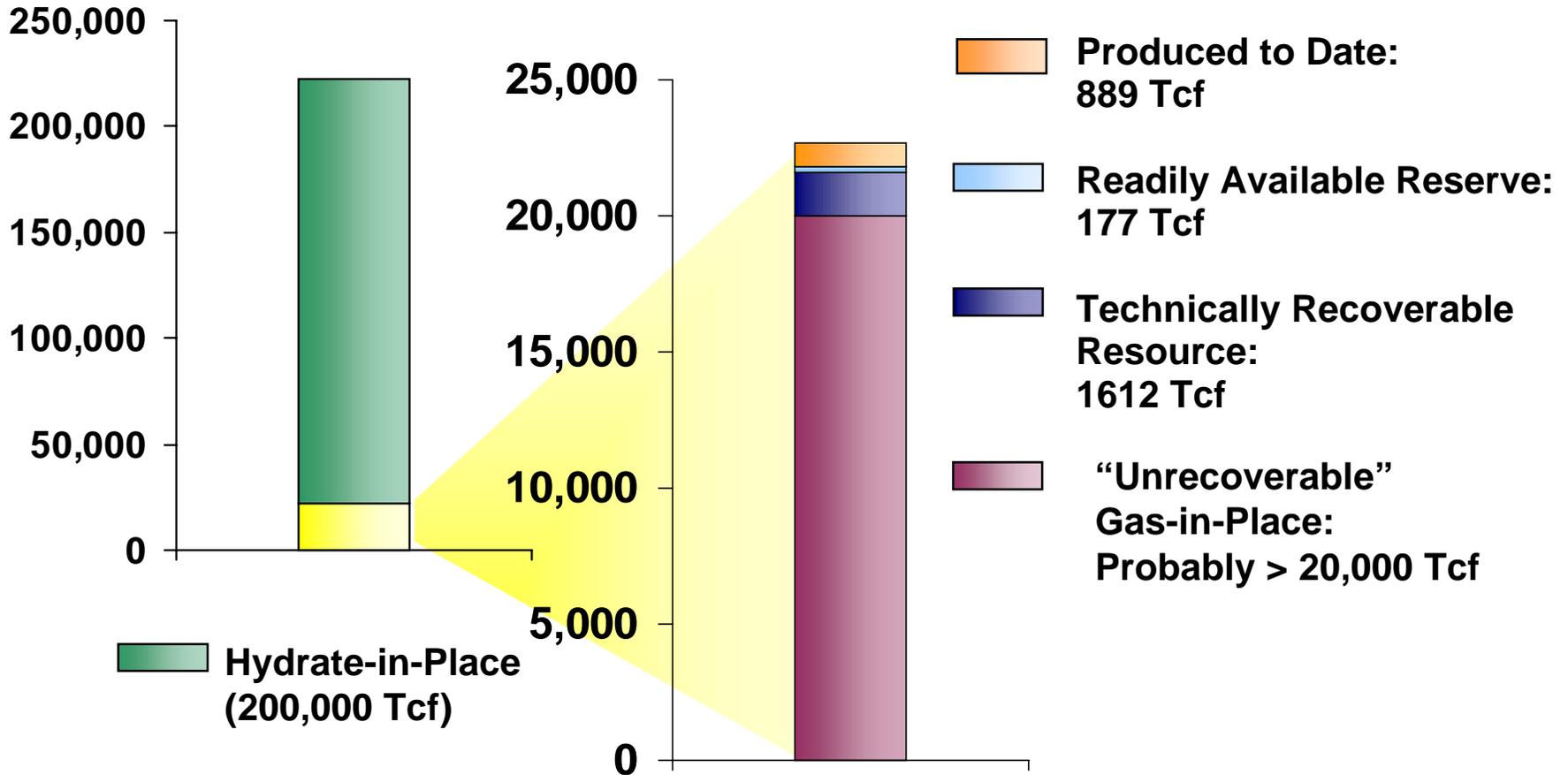
The Fuel of Choice

- **Abundant supplies**
- **Affordable cost**
- **Growing demand**
- **Reliable**
- **Environmentally sound**



Abundant Supplies

Vast Untapped Domestic Resource (Tcf)



Data derived from information from Energy Information Administration and the National Petroleum Council

Methane Hydrates

A Future Source of Clean Burning Fuel...?



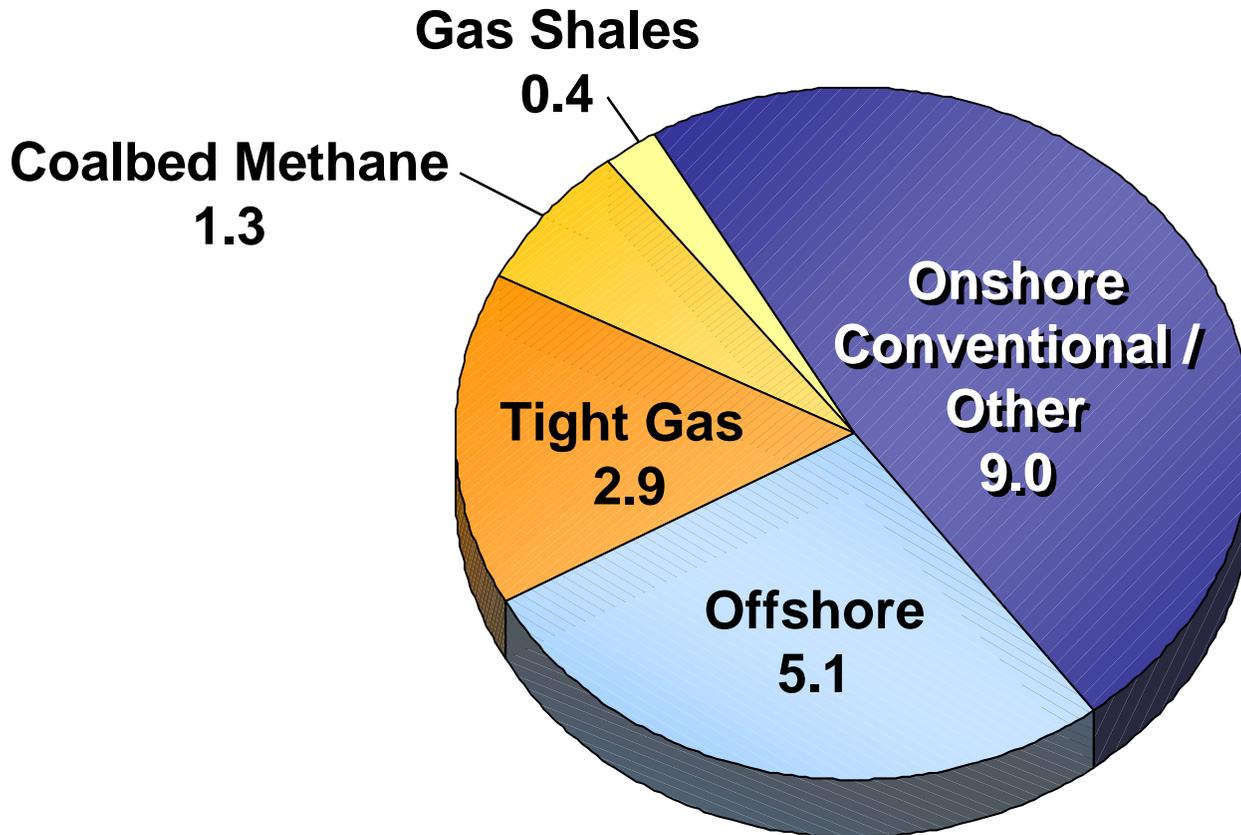
Mallik Research Well



- First dedicated hydrate test well in permafrost
- Drilled in 1998 in Canada
- New production test

Total Domestic Production 2001

18.7 Tcf

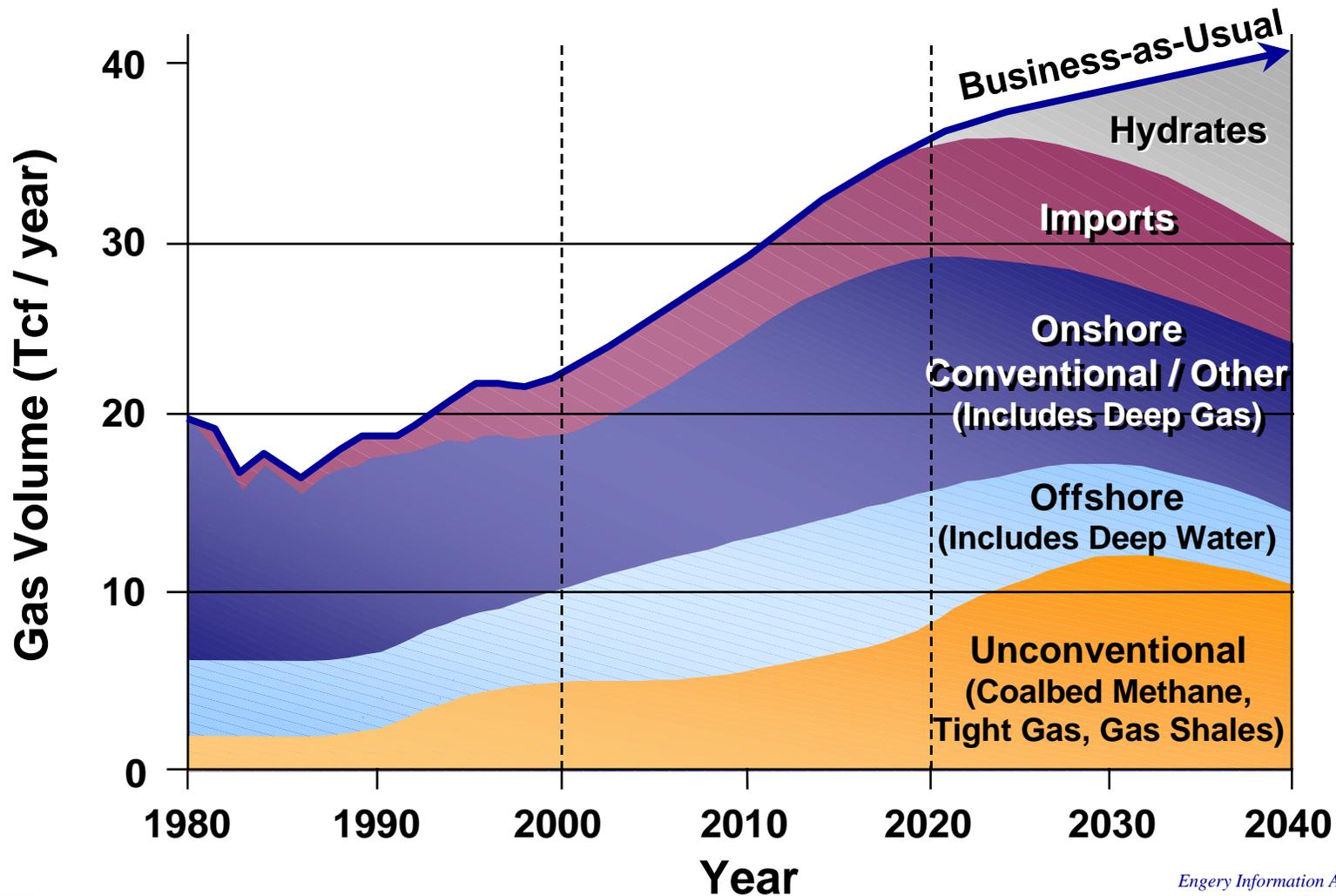


New Technology

- Finding it
- Drilling it
- Producing it

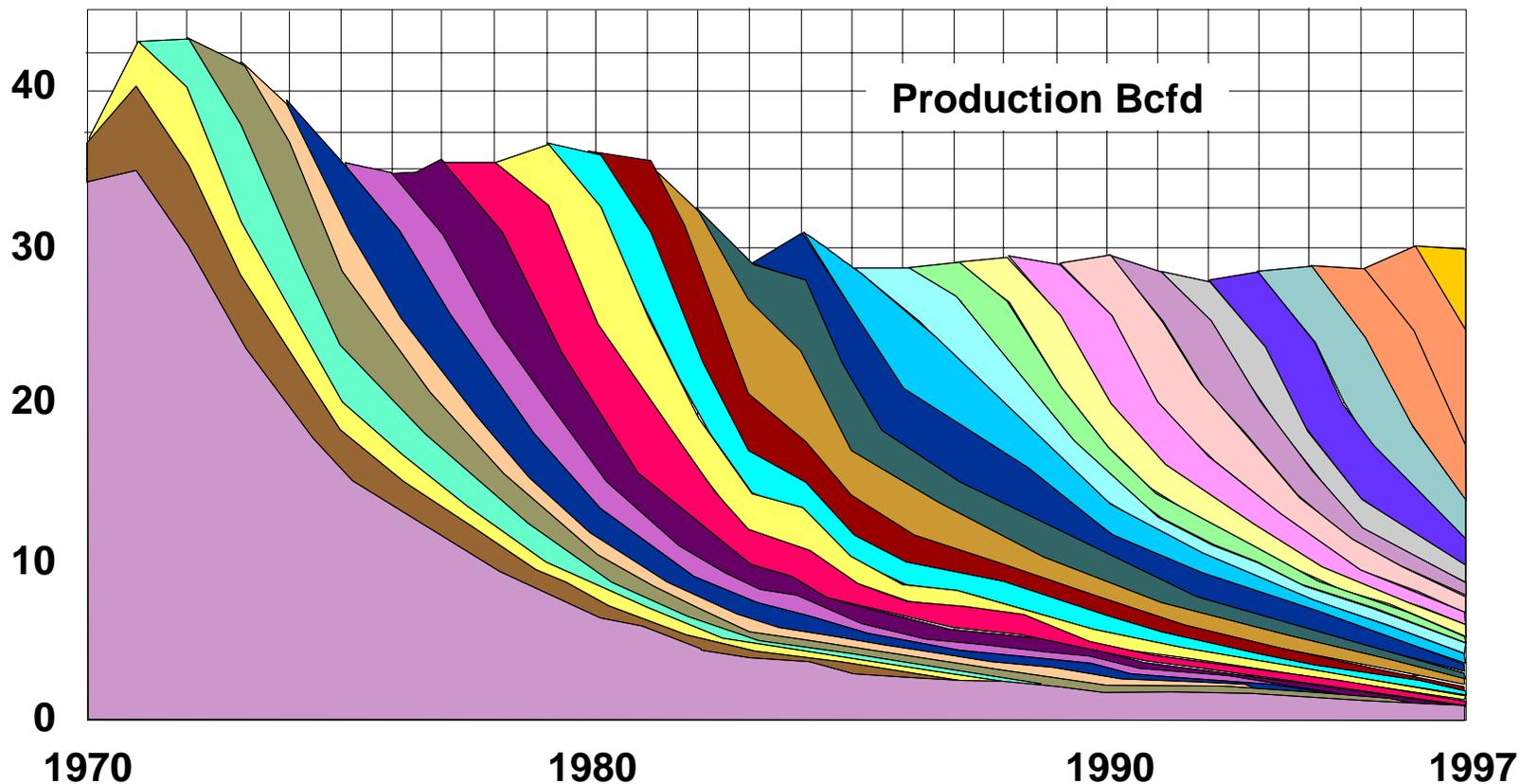


U.S. Gas Production Coming From More Hostile Environments



We're Draining Natural Gas Wells Quicker

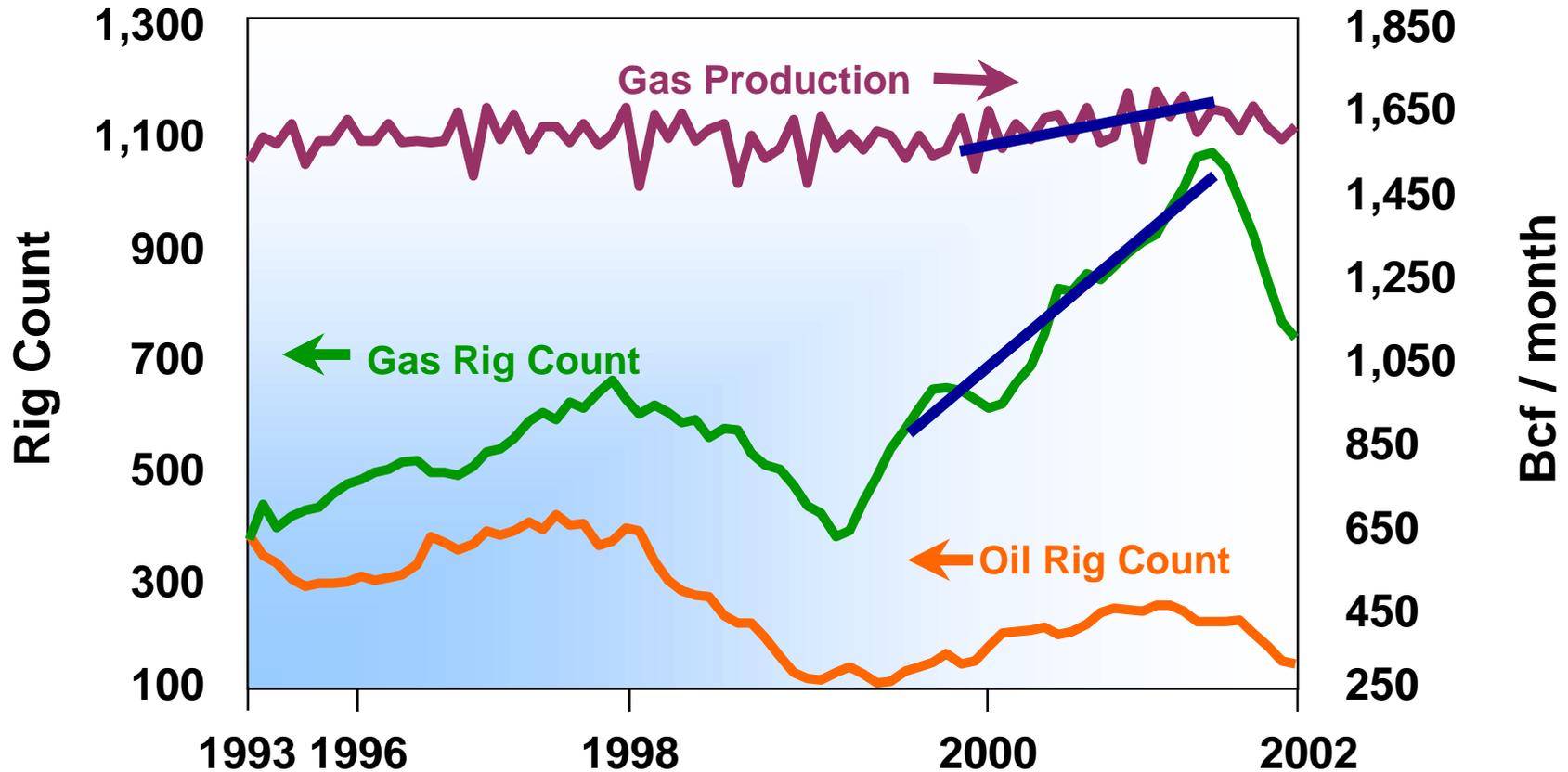
Production Decline Curves



ARI Annual gas production replacement in Gulf Coast Area
Vintaged by year of completion
After Potential Gas Committee 1998, data from PI/Dwight's

U.S. Drilling Rig Count vs. Gas Production

Production Lag Suggests Shrinking Gas Surplus



Natural Gas

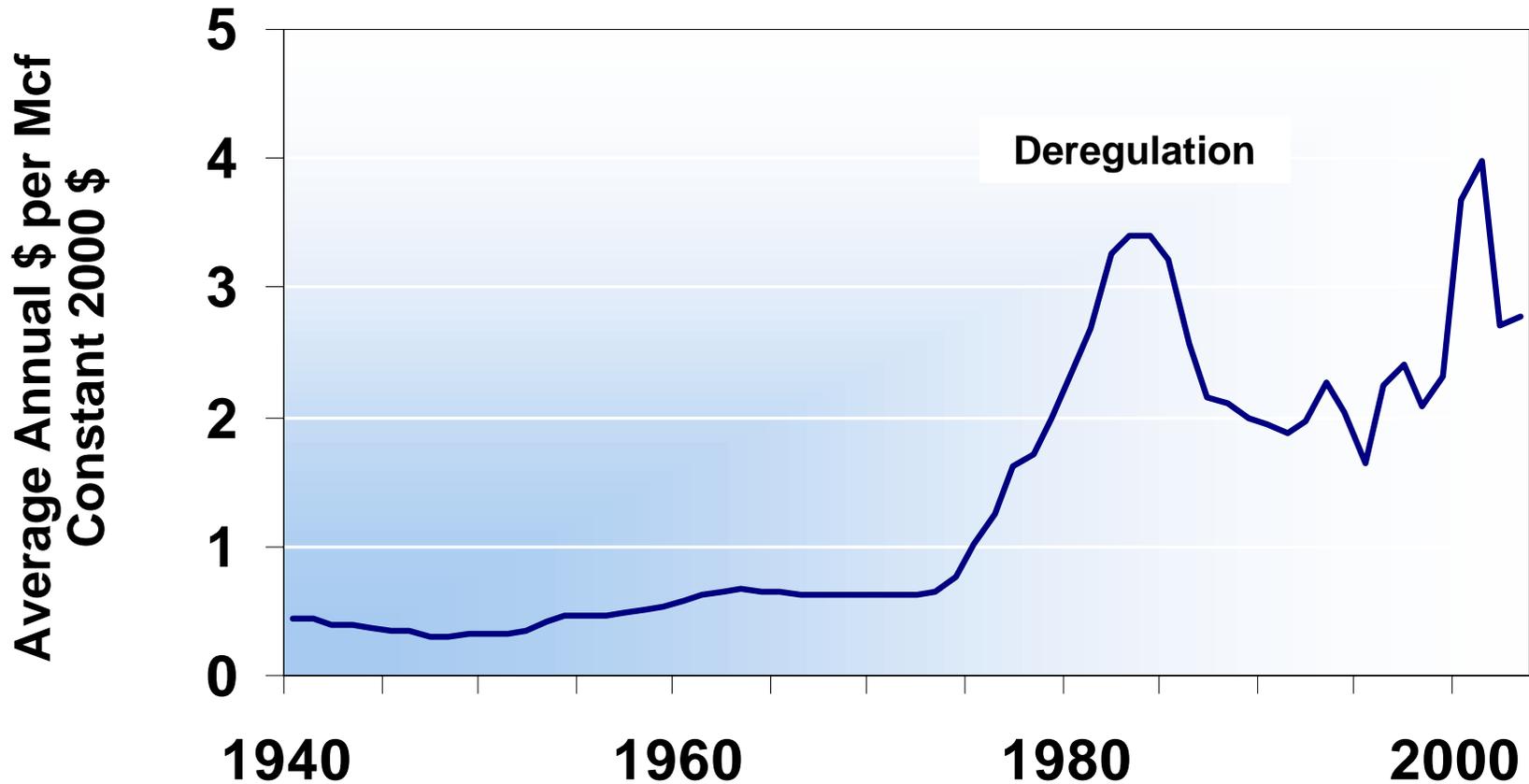
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Natural Gas Wellhead Prices

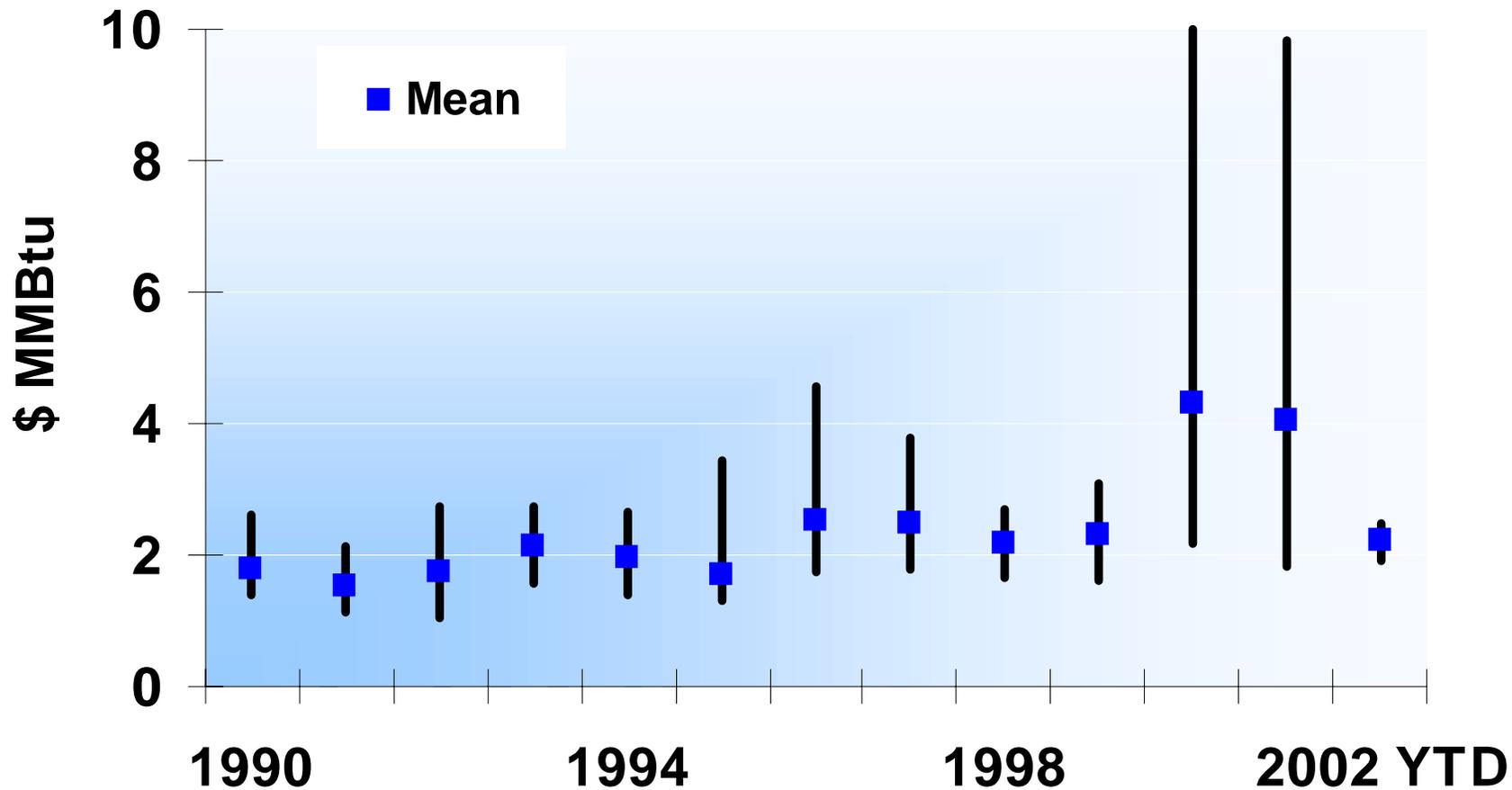
Spike Surpassed Mid-1980s Peak



Steminski, DOE/EIA NEMS Conference March 12, 2002
U.S. DOE/EIA; Deutsche Bank estimates

U.S. Natural Gas Prices 1990-2002

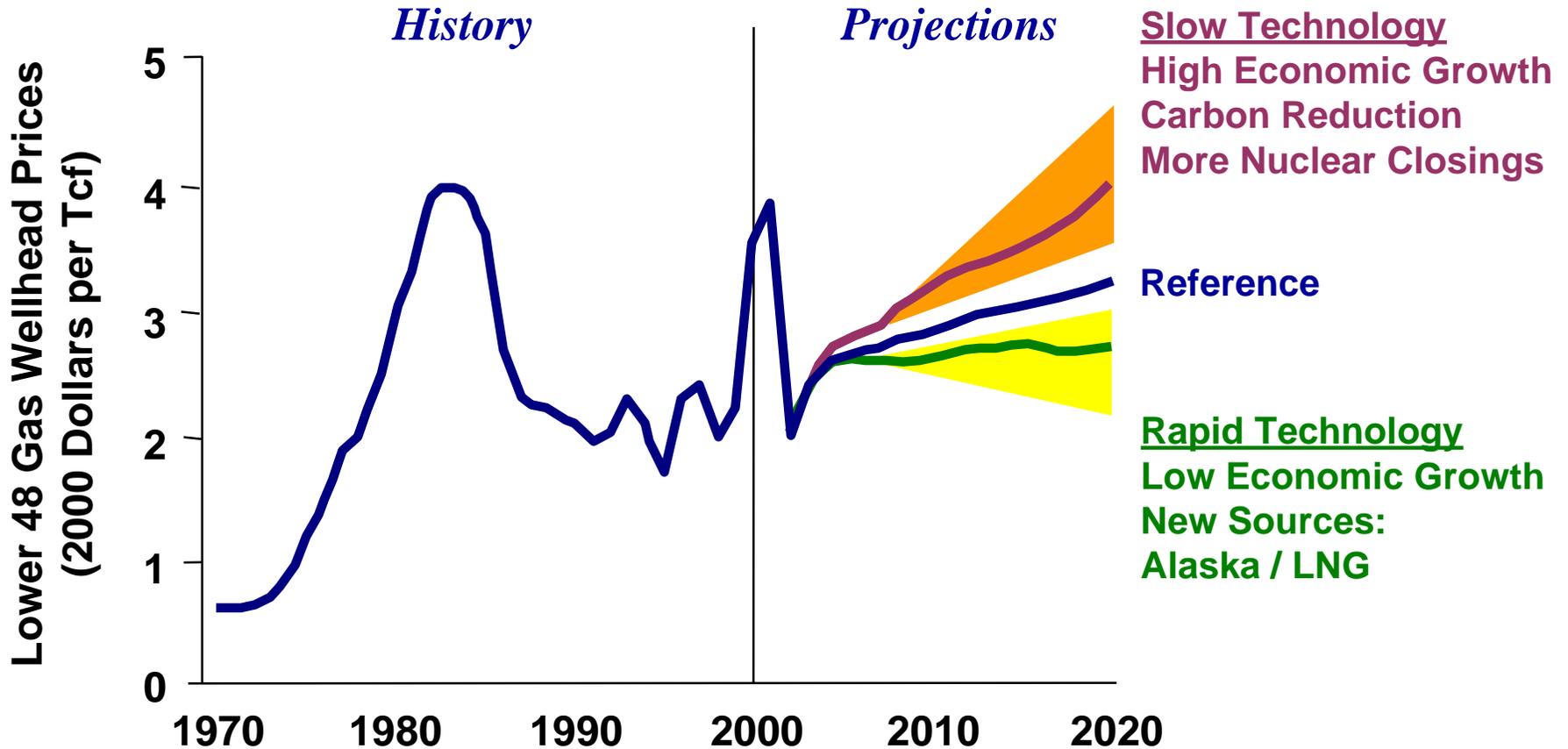
Unprecedented Volatility in 2000-2001



Sieminski, Deutsche Bank, DOE/EIA NEMS Conference March 12, 2002
Nymex; Bloomberg; Deutsche Bank (YTD March)

Natural Gas Prices

Projections Change With Assumptions



Natural Gas

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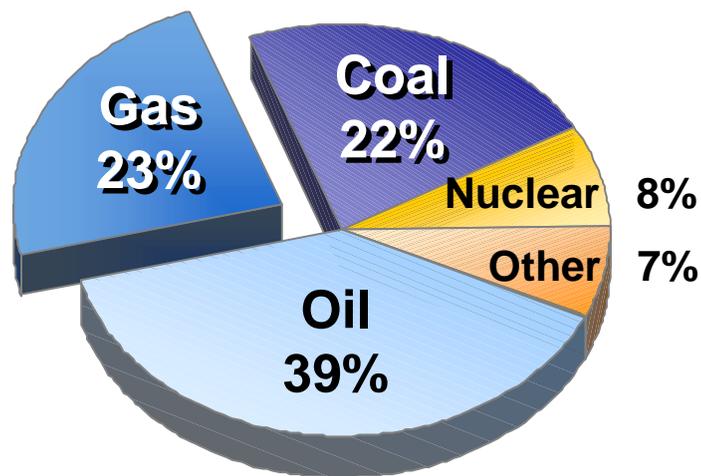


Natural Gas Provides 1/4 of Energy Needs

1999 Energy Consumption

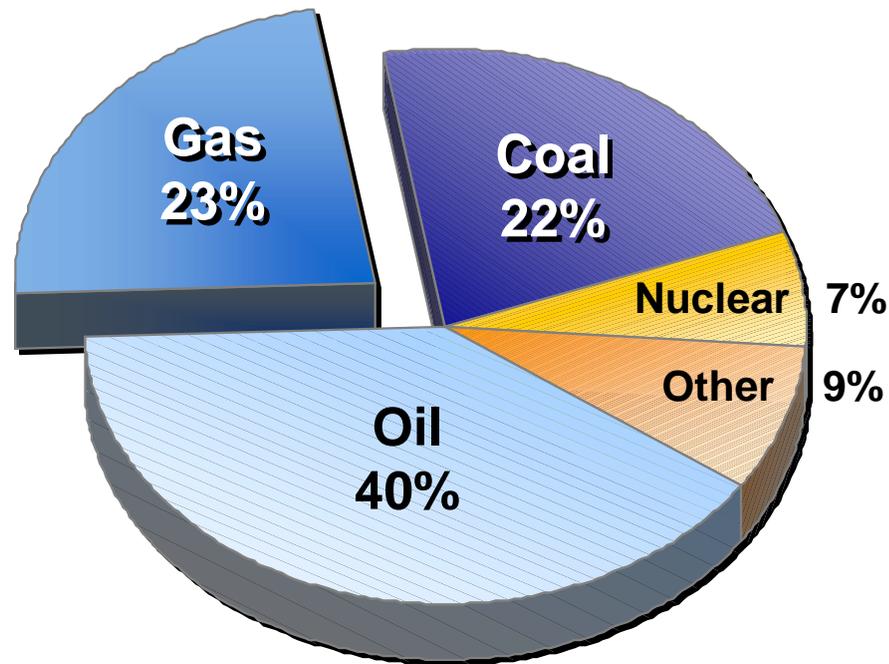
United States

97 QBTU / yr



World

382 QBTU / yr

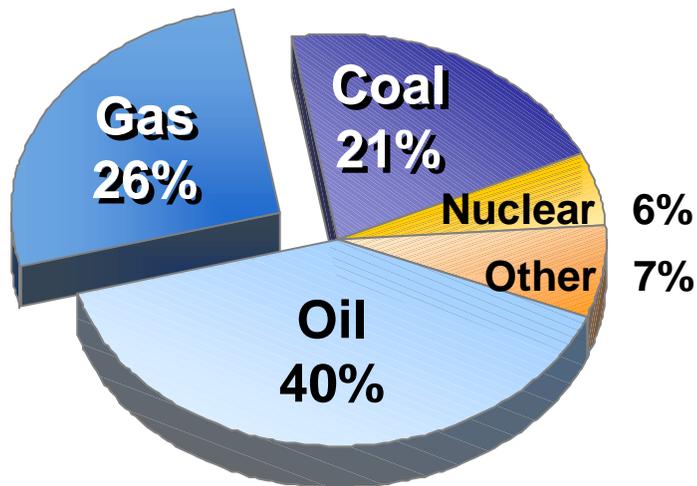


Natural Gas Will Continue To Be Important

2020 Energy Consumption

United States

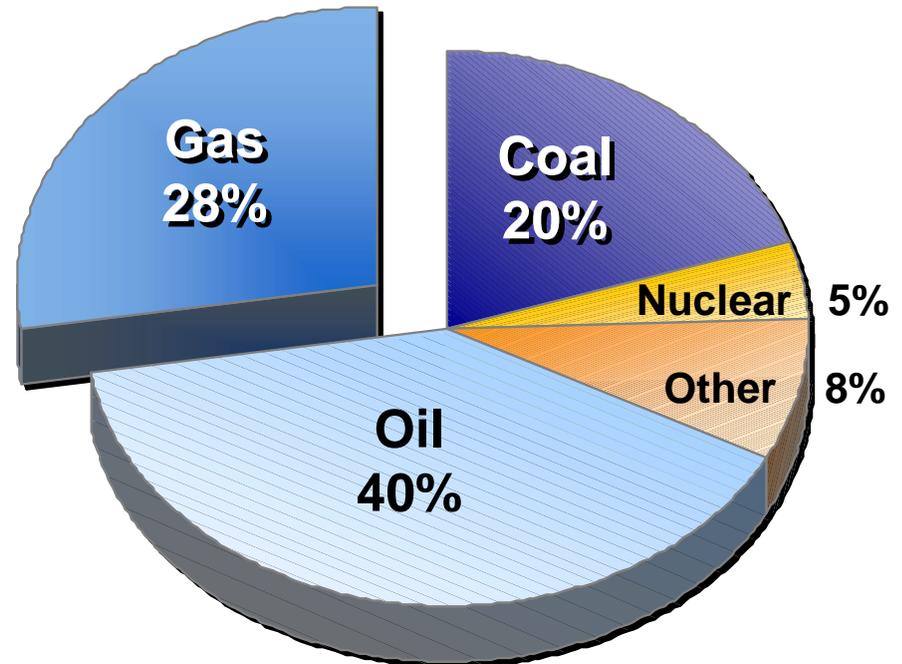
131 QBTU / yr



> 50% Increase
in Gas Demand

World

612 QBTU / yr

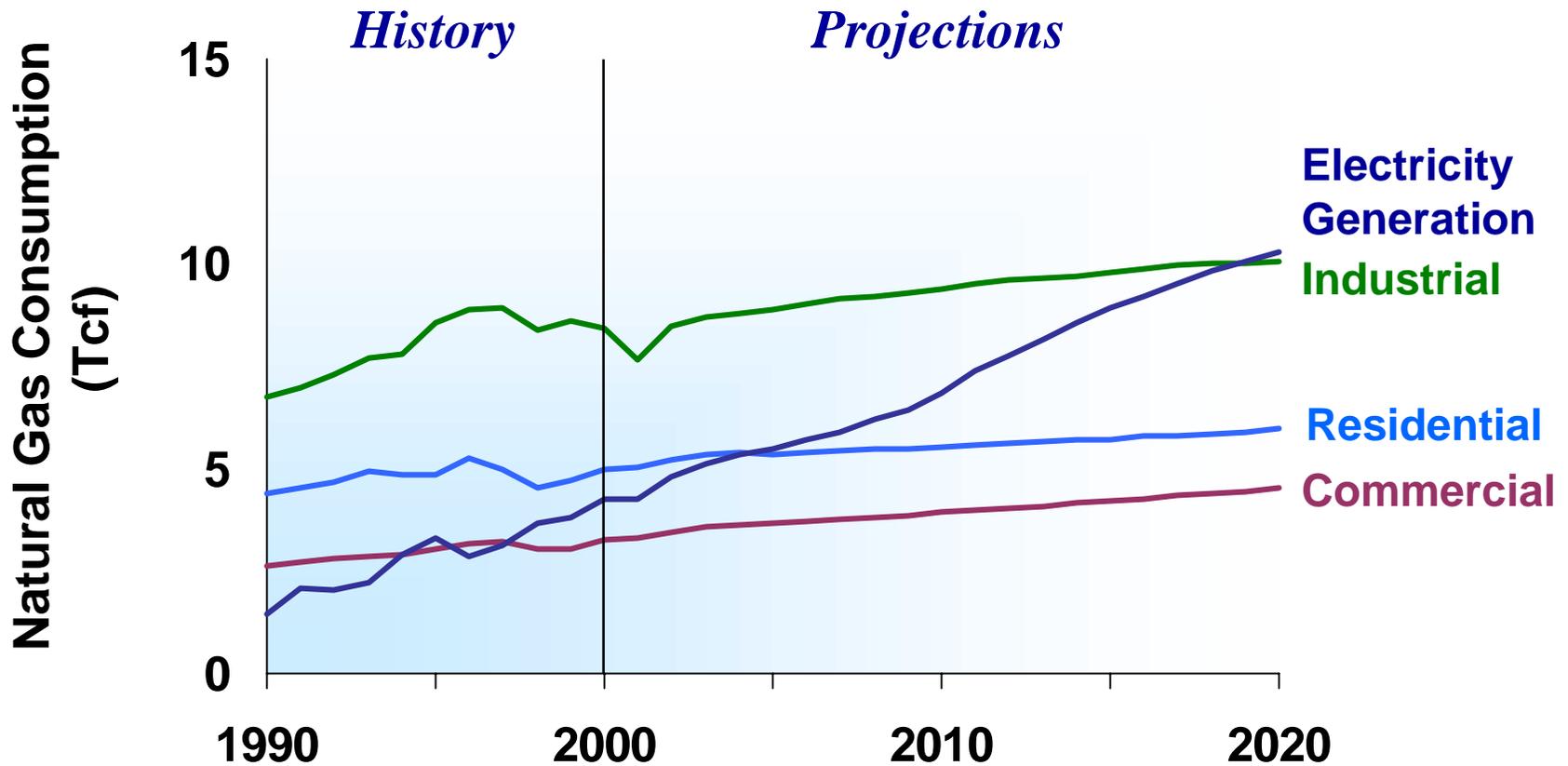


> 90% Increase
in Gas Demand

World data from International Energy Outlook 2002 (March 2002)
U.S. data from Annual Energy Outlook 2000 (December 2001)



U.S. Natural Gas Consumption by Sector 1990-2020

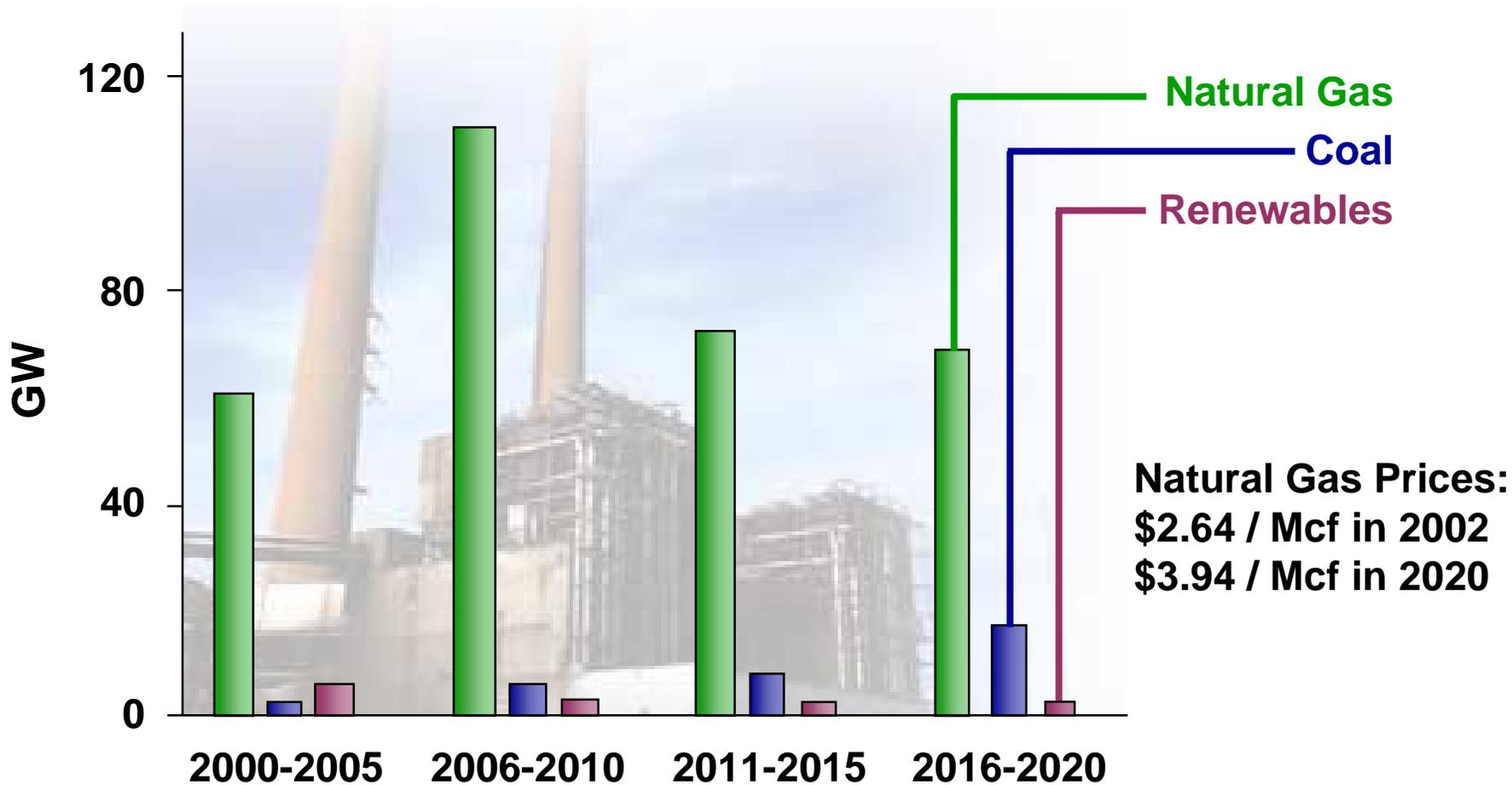


In 2020, 1/3 gas used to generate electricity



355 GW Capacity Additions

Almost 90% Fueled by Natural Gas



Gas-Fired Distributed Power Generation



Fuel Cells



Fuel Cell / Turbine Hybrids



Small Turbines



Microturbines

Distributed Generation

Widespread Adoption Could Further Increase Demand

Why DG?

- Customer choice
- Siting flexibility
- Reliability
- Less capital investment risk
- Reduced transmission and distribution investment



Emissions Reduction Proposals

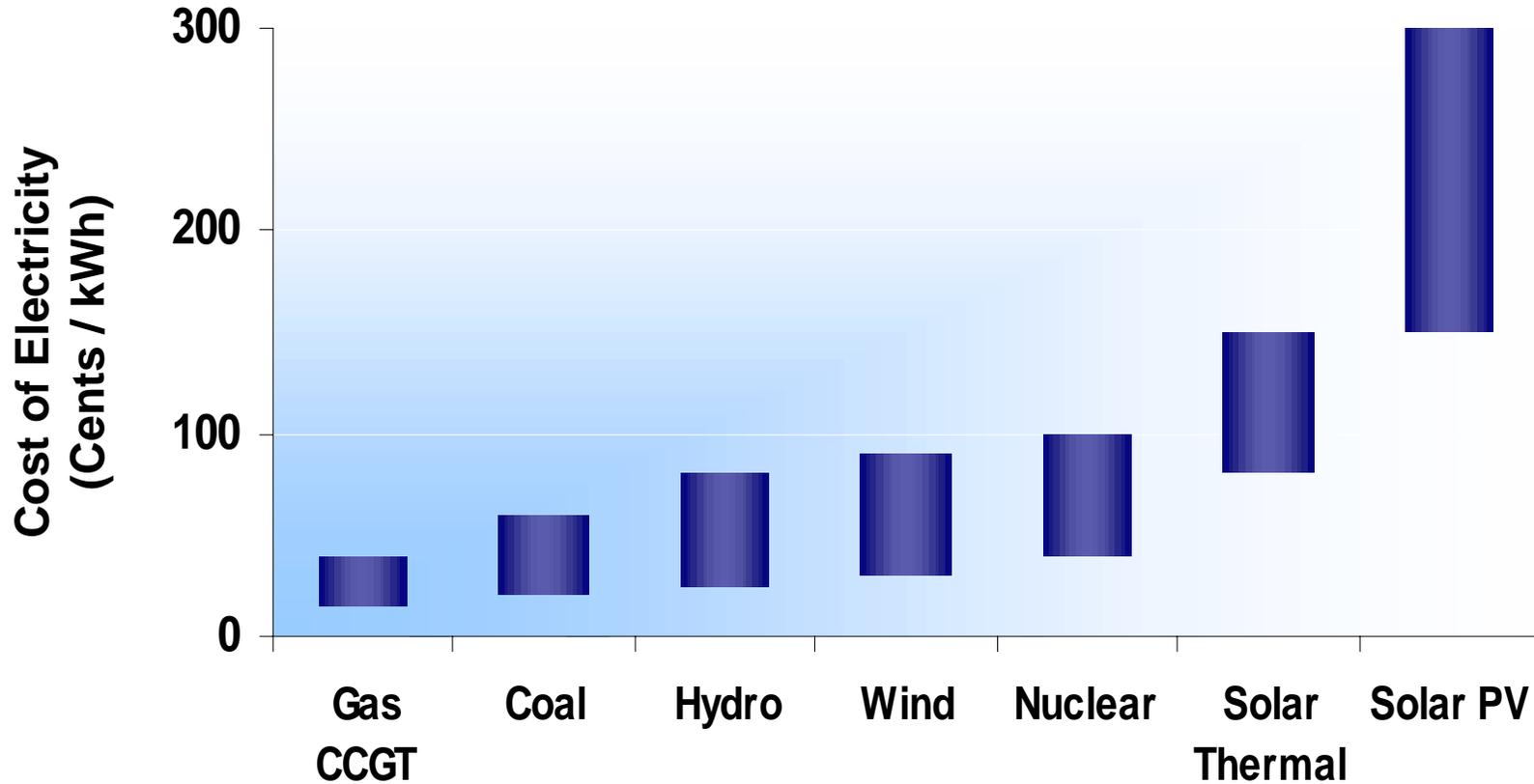
Electric Power Plants

		Clear Skies Initiative		Clean Power Act
<i>Pollutant</i>	<i>Baseline</i>	<i>2008 / 2010 Cap</i>	<i>2018 Cap</i>	<i>2007 Cap</i>
SO₂	8.9 million tons/yr	4.5 million tons/yr	3.0 million tons/yr	2.2 million tons/yr
NO_x	4.0 million tons/yr	2.1 million tons/yr	1.7 million tons/yr	1.5 million tons/yr
Mercury	48 tons/yr	26 tons/yr	15 tons/yr	4.8 tons/yr



CC Gas Turbines Have Lowest COE

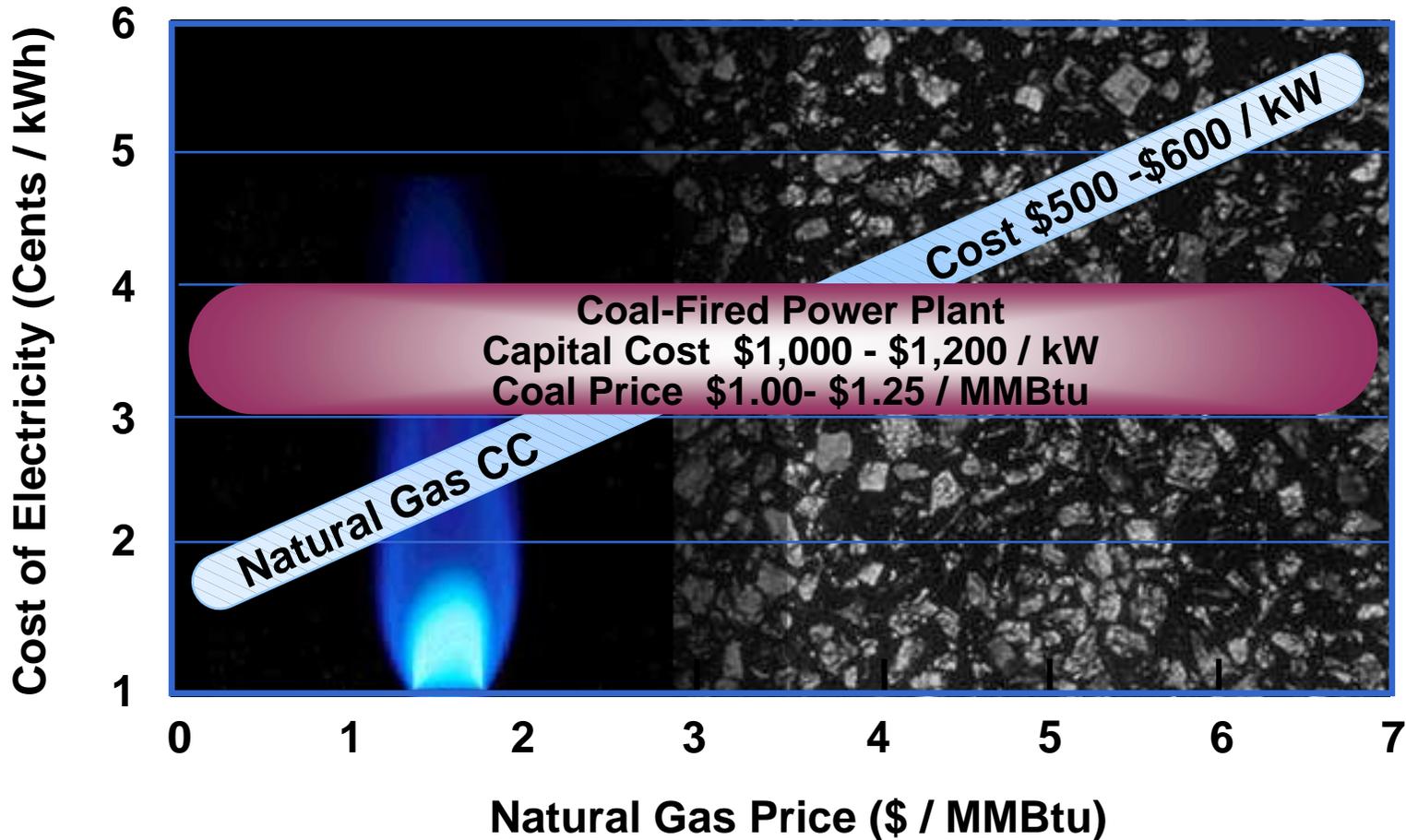
New Baseload Electric Plant Costs



Sieminski, Deutsche Bank, DOE/EIA NEMS Conference March 12, 2002

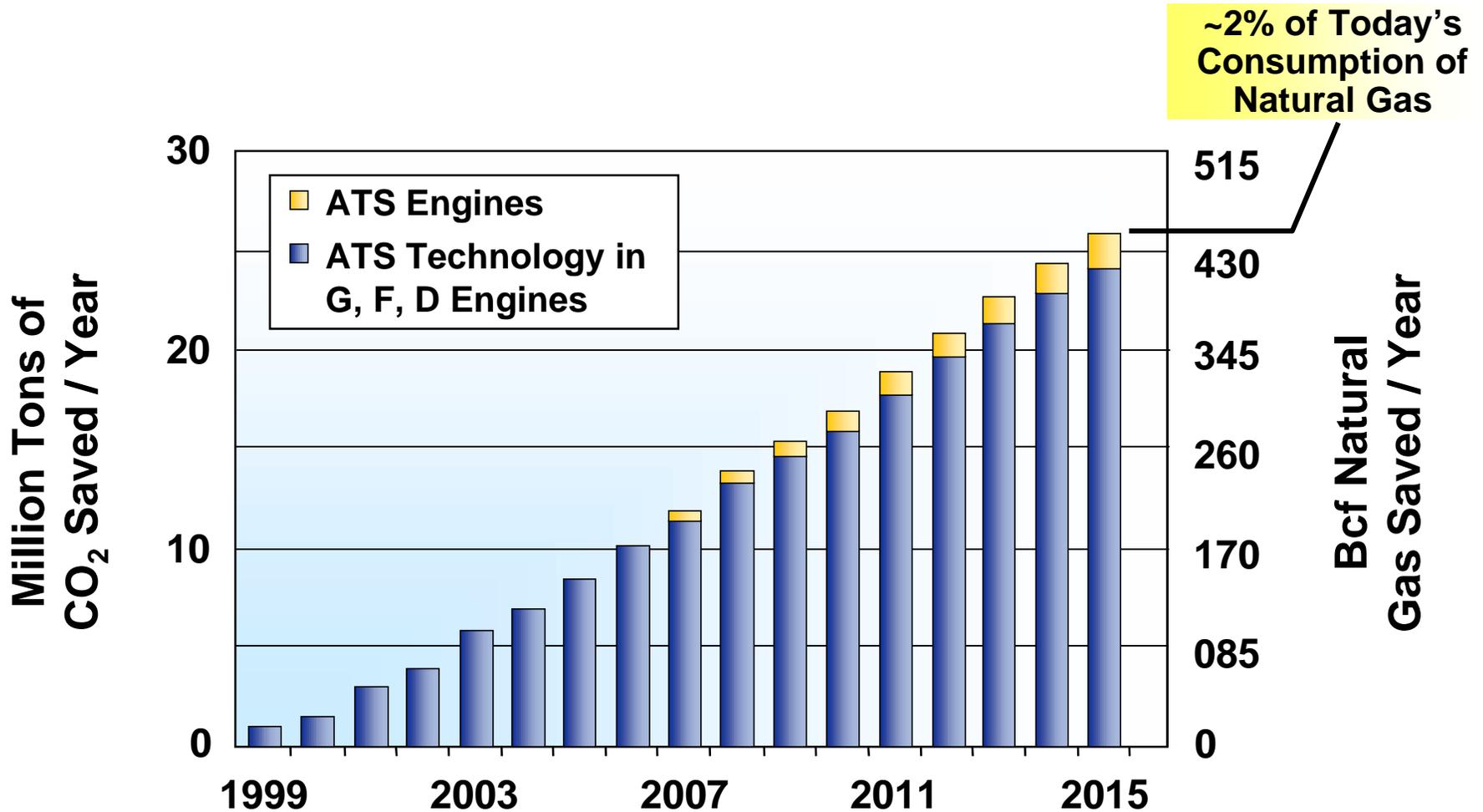
ExxonMobil; Deutsche Bank

New Coal Marginally Competitive with Gas



Gas Turbine Improvements Reduce Gas Consumption

Technology Infusion Into Existing Products



Natural Gas

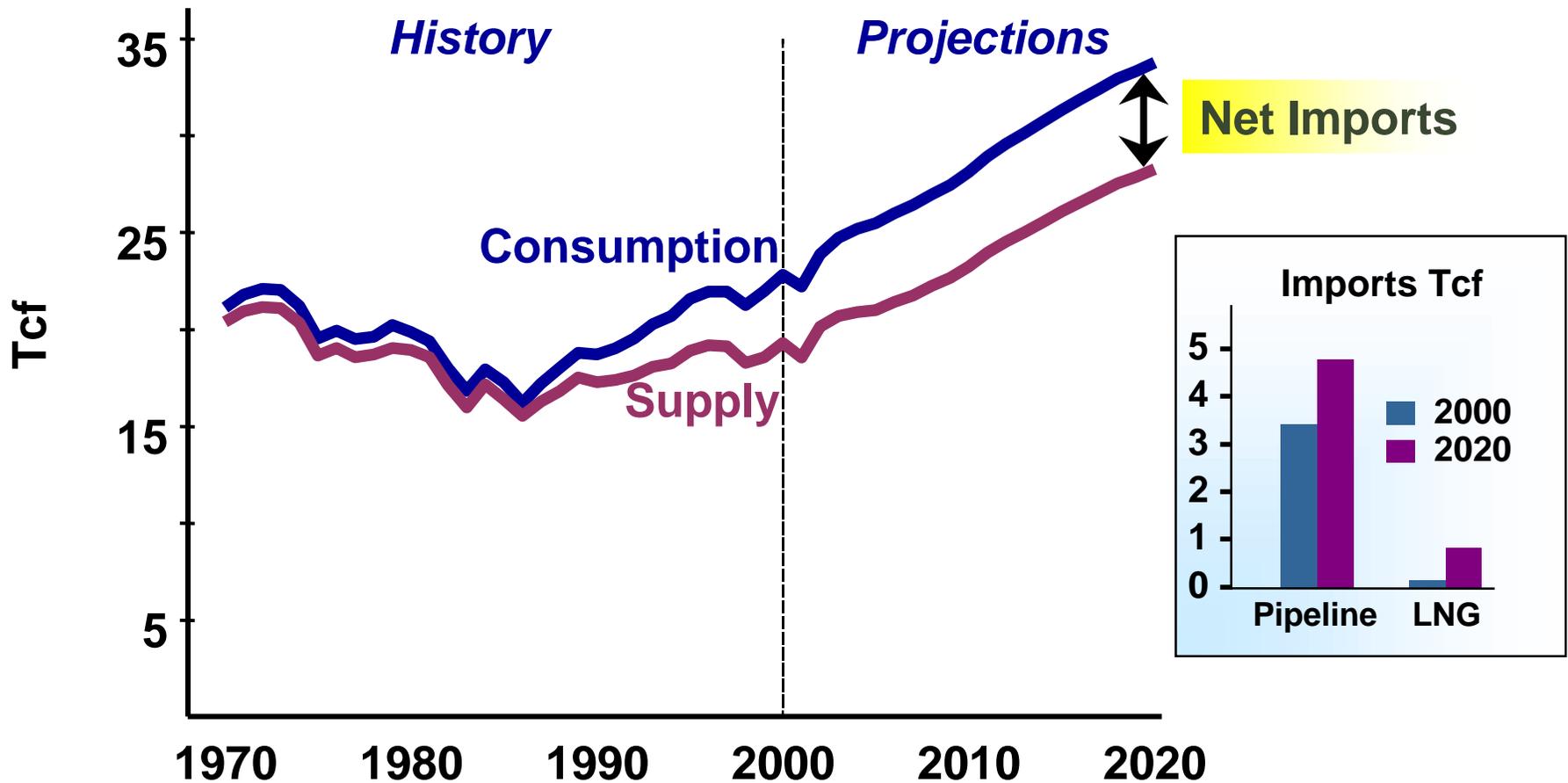
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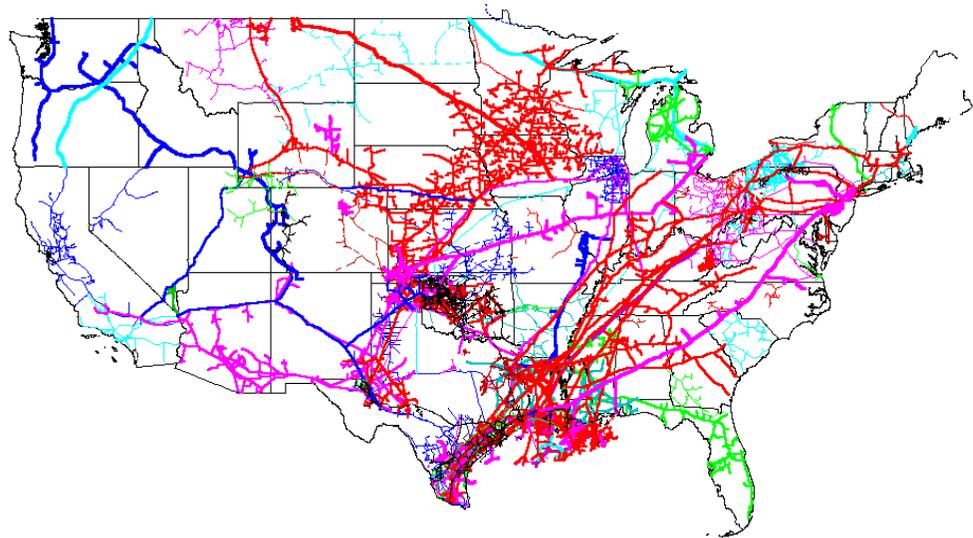
Imports Are Increasing

U.S. Natural Gas Supply & Consumption



Infrastructure Is Stressed

- Aging pipeline and distribution systems
- \$8 billion / yr investment needed in new infrastructure (*NPC, 1999*)
- Growth of distributed power will change infrastructure requirements
- Heightened security concerns



Natural Gas

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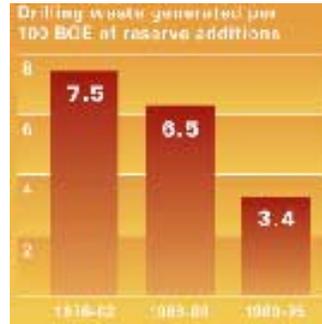


Technology Reducing Environmental Impact

Natural Gas & Oil Supply



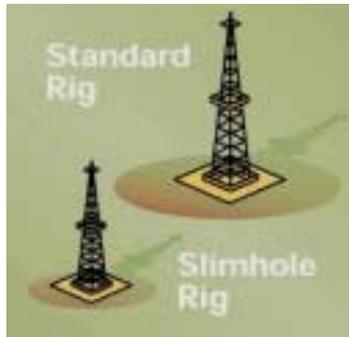
Fewer wells to add same level of reserves



Lower drilling waste volume



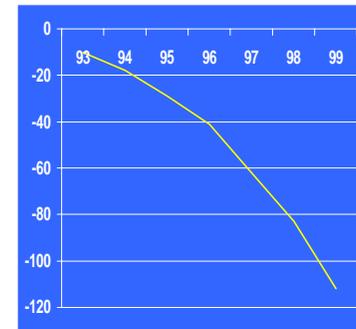
Lower produced water volumes



Smaller footprints

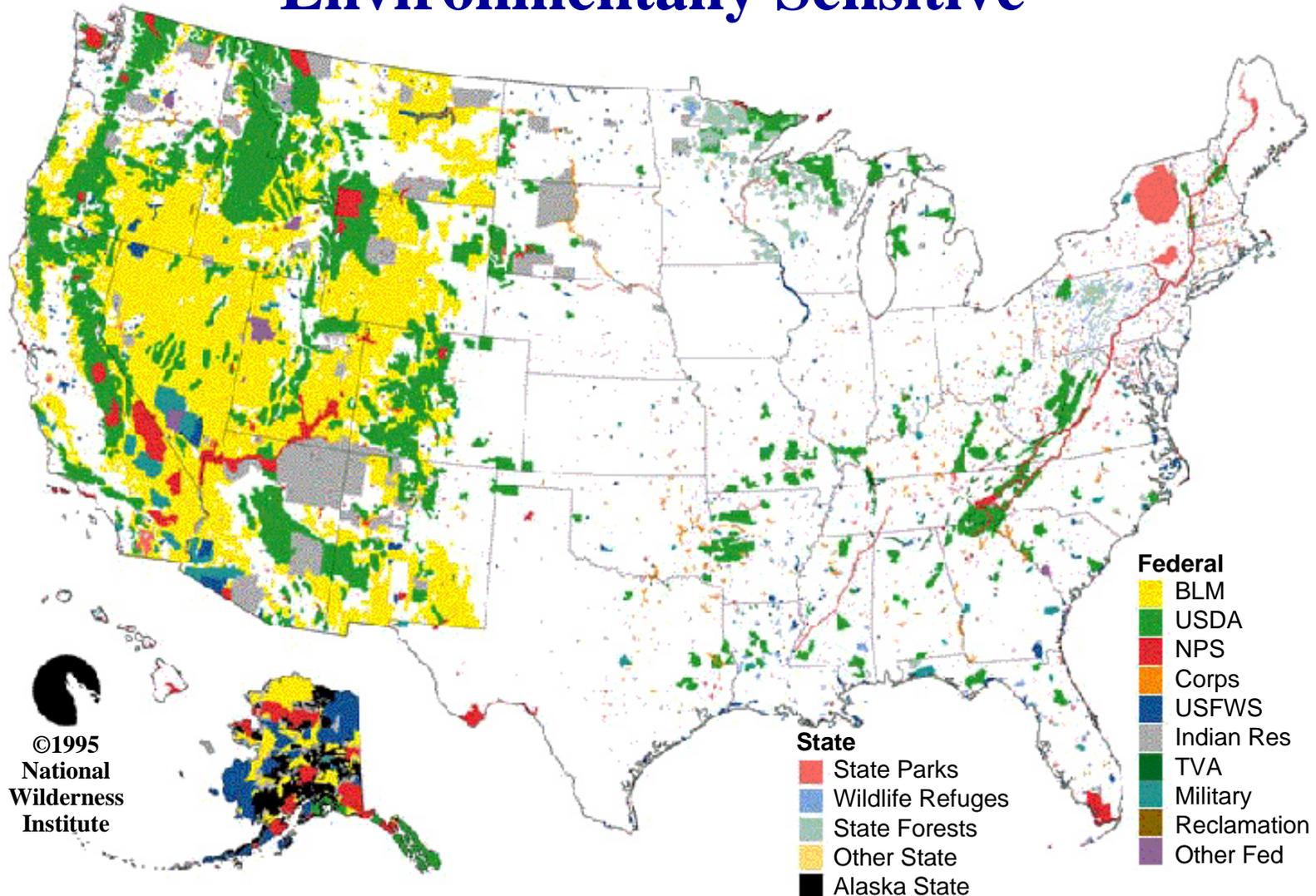


Greater protection of unique and sensitive environments



Reduced air pollutants and greenhouse gas emissions

Government Lands Often “Environmentally Sensitive”



©1995
National
Wilderness
Institute



Natural Gas Reserves Subject to Access Restrictions

U.S. Lower 48

21
TCF

137*
TCF

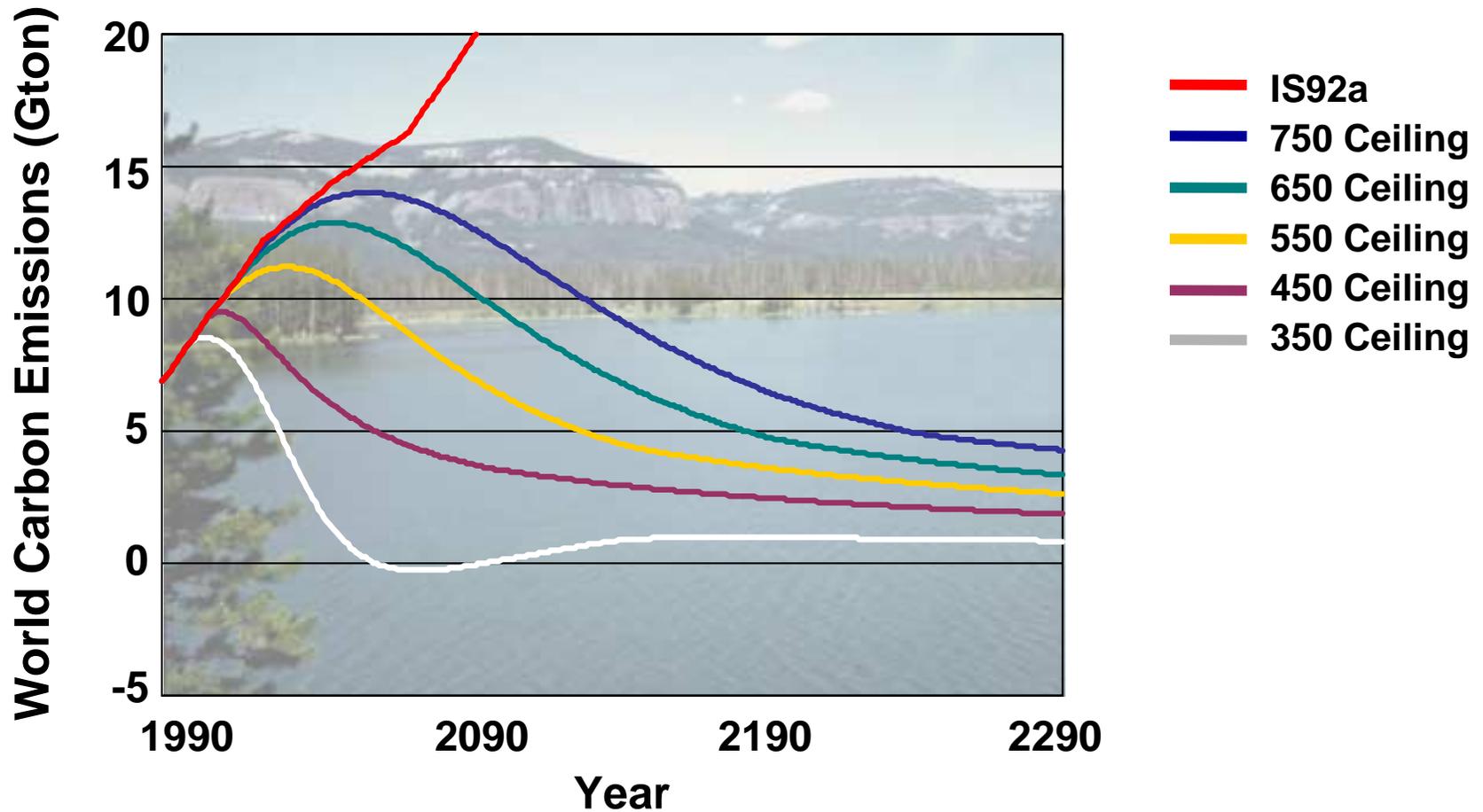
31
TCF

24
TCF

* Approximately 29 Tcf of the Rockies Gas Resources Are Closed to Development and 108 Tcf Are Available With Restrictions



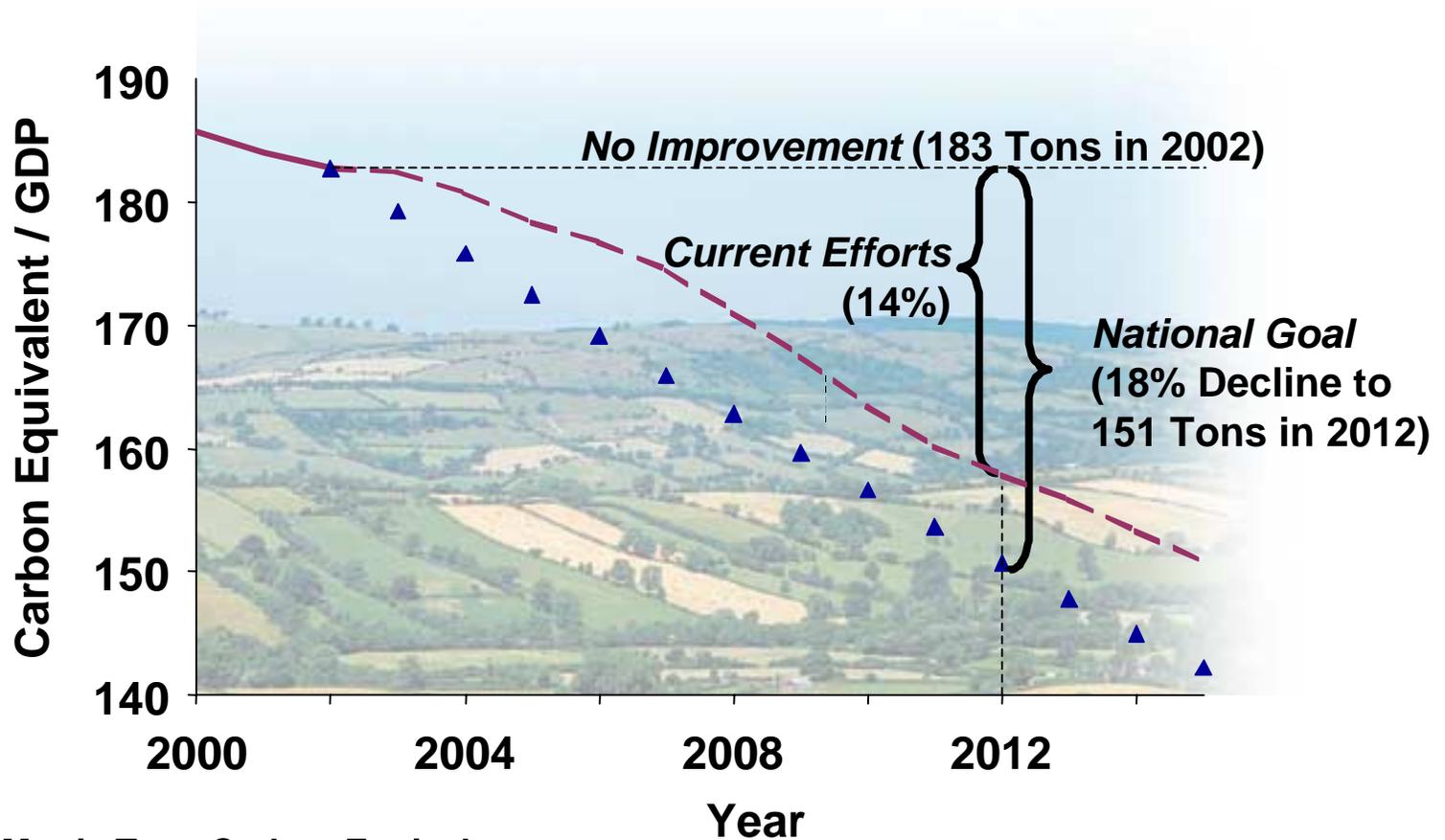
Sharp Reductions to Stabilize CO₂ Concentrations



Wigley, T.M.L., Richels, R., and Edmonds, J.A. *Nature* 379, 240-243 (1996)

Presidents Bush's Climate Change Initiative

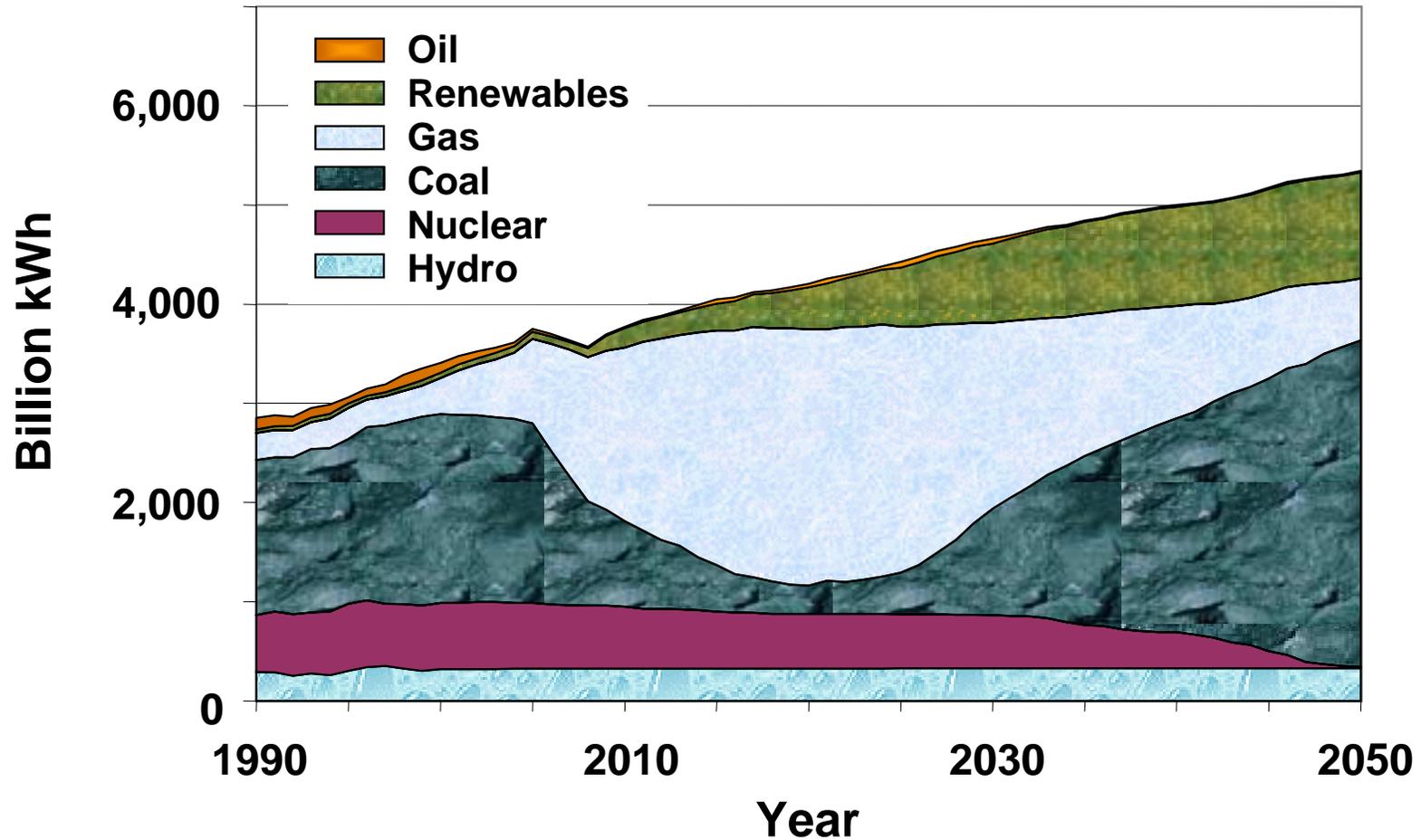
Reduce Greenhouse Gas Emission Intensity by 18% Over Next Decade



Metric Tons Carbon Equivalent per Million \$ GDP, 2001 Dollars

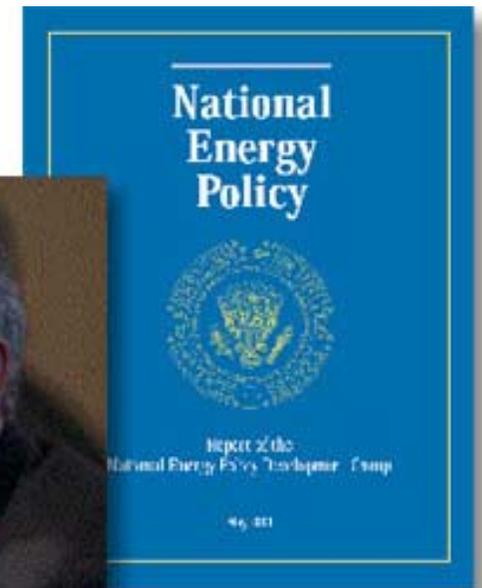


A Scenario for U.S. Electric Generation 1990-2050



National Energy Policy

- Increasing America's domestic energy supplies
- Protecting America's environment
- Ensuring a comprehensive delivery system
- Enhancing national energy security



White House photo: Paul Morse

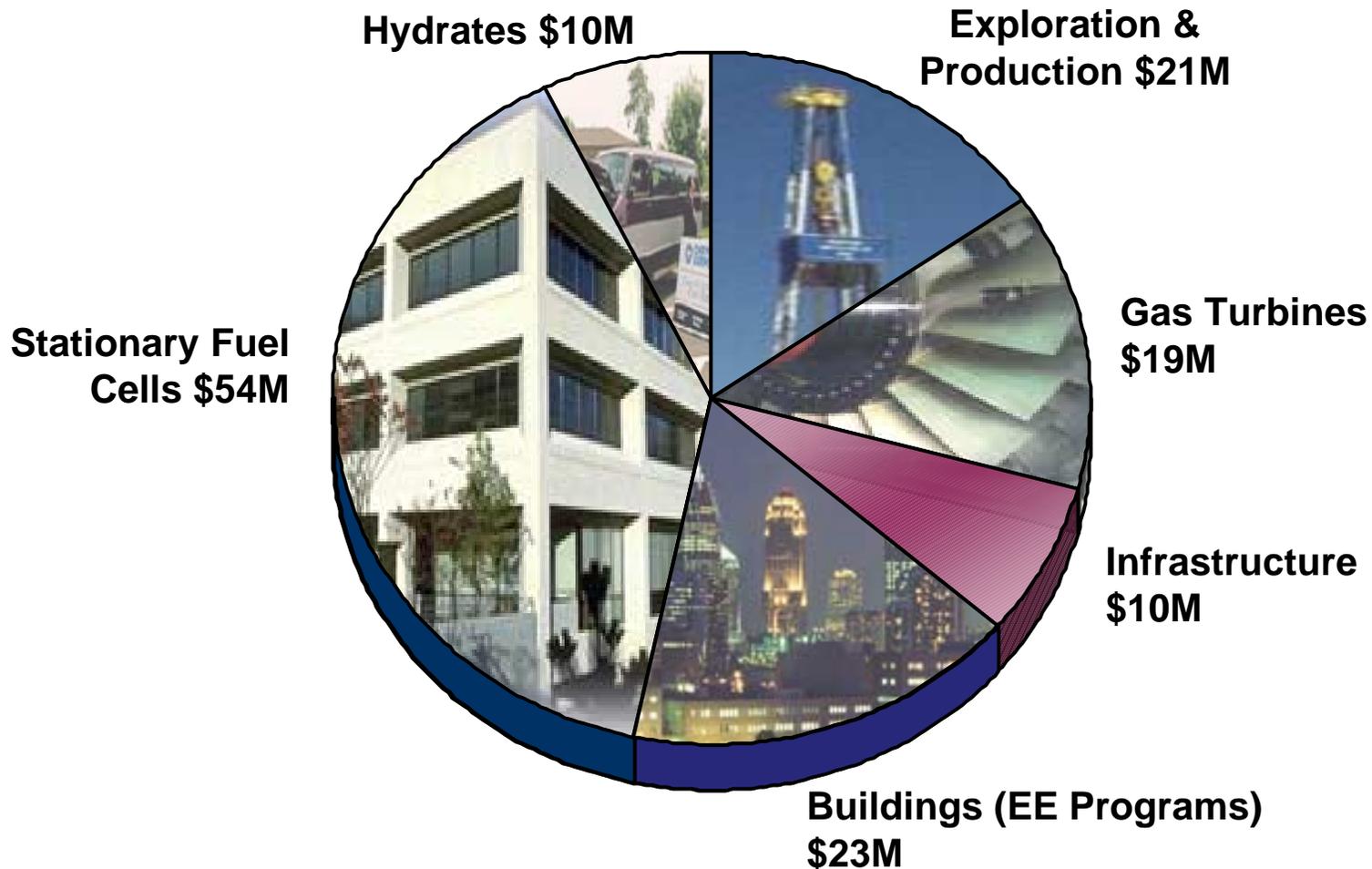
Policy Tools



- R&D funding
- Tax codes
- Price supports
- Portfolio standards/mandates
- Direct purchases
- Subsidies
- Consumer education
- Financing

NETL's FY 2002 Natural Gas Budget

\$137 Million



Draft OMB Scoring Criteria *Applied R&D Investments*

- Market barriers to private sector investment
- Best “tool” is Federal R&D
- Multi-year R&D plan exists
- Competitive merit-based activity / peer reviews
- Industry involvement
- Performance indicators
- Off ramps
- Technological risk
- Clear public benefit
- Dollar value of public benefits
- Identified by President as high priority



Energy Bill Comparison

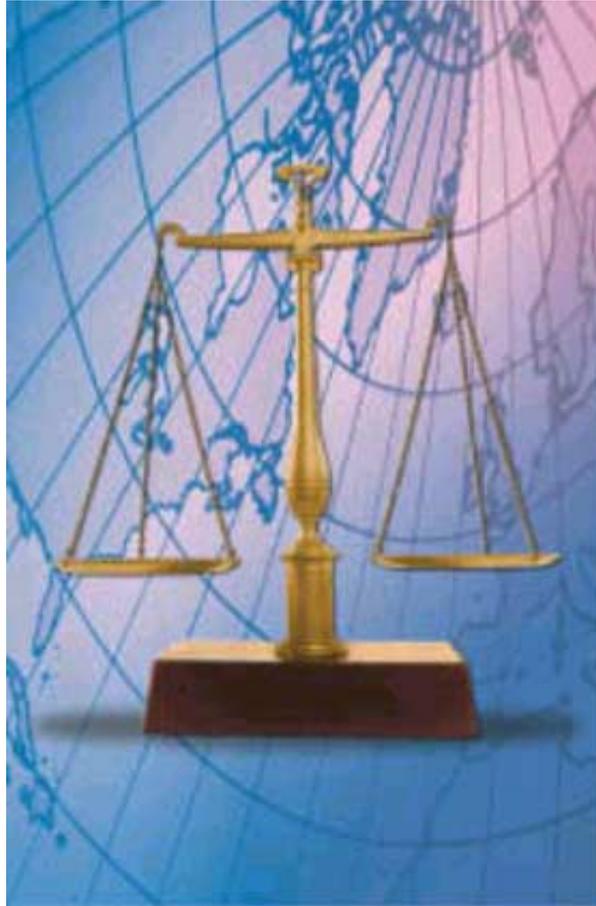
Provisions Impacting Natural Gas

	<u>H.R. 4</u>	<u>S. 517</u>
Arctic National Wildlife Refuge	✓	
Alaska natural gas pipeline	✓	✓
Energy production on public lands	✓	
Hydraulic fracturing		✓
Great Lakes drilling ban	✓	
Pipeline safety legislation		✓
Oil & gas marginal well production	✓	✓
Coal bed methane	✓	✓
Renewable portfolio standard		✓



Balancing Technology and Policy

**Technology
Development**



**Policies &
Regulations**

**Technology Enables Both
Affordable Energy for
Economic Development
and Environmental
Protection**

