Traditional Energy and Innovation:

An American Success Story

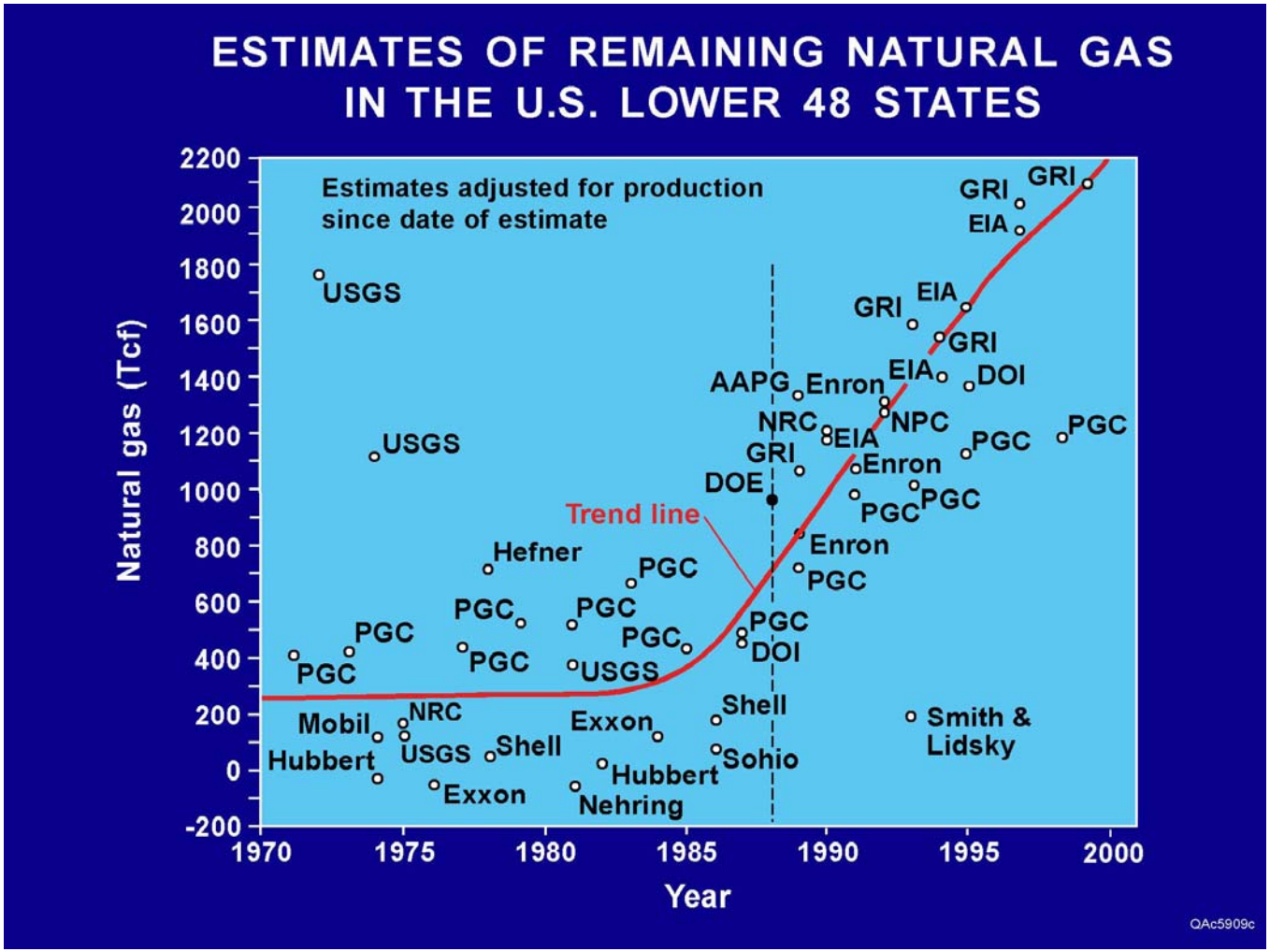
C. Michael Ming

IOGCC 2011 Woodford Summit

Norman, OK

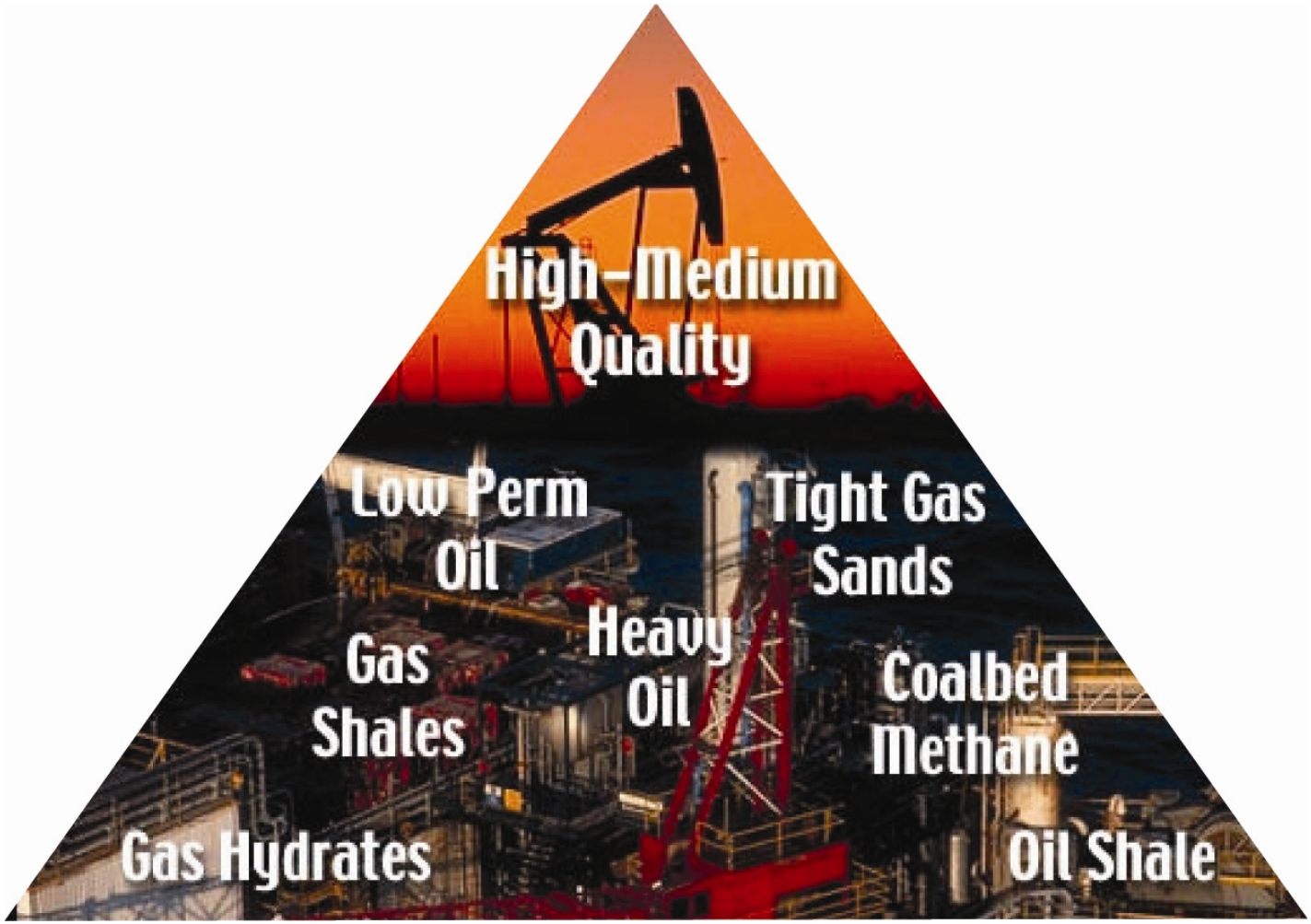
March 29, 2011

U.S. Gas Resource Estimates Continue to Increase



William Fisher
COGA 2006

Technology has Driven the Growth



Increased Cost & Risk

Improved Technology

Steve Holditch

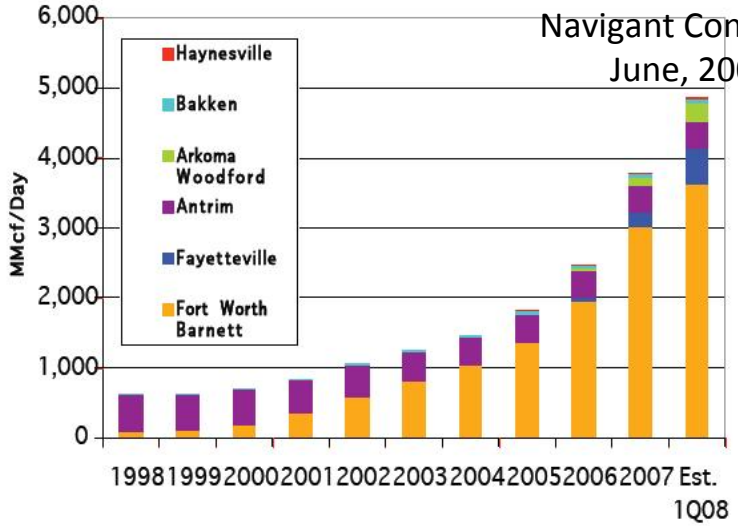
RPSEA Research Partnership to Secure Energy for America

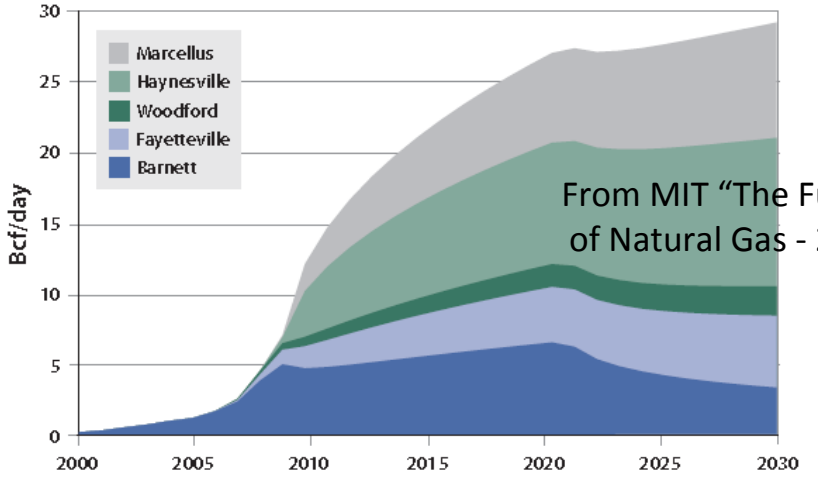
The U.S. Gas Shale Ramp

- The Barnett grew 3000% from 1998 to 2007
- The Eagle Ford, Fayetteville, Haynesville, Marcellus, and Woodford will dwarf this
- Technology improvements in horizontal drilling and fracturing have economically enabled vast new unconventional and conventional resources.

U.S. Shale Gas Production* (MMcf/day)

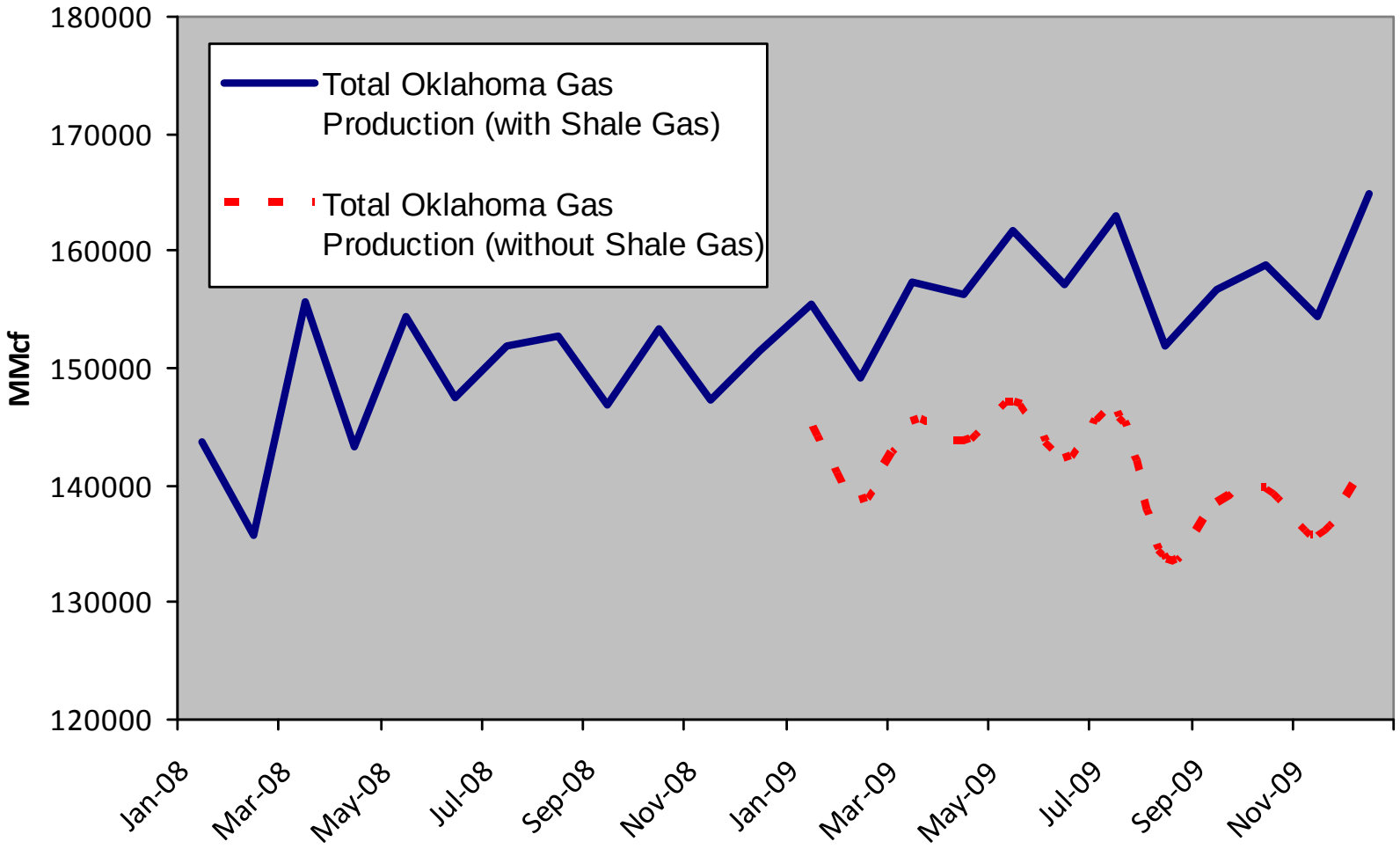
From Rick Smead, Navigant Consulting June, 2009





From MIT "The Future of Natural Gas - 2010

Shale Gas Impact on Oklahoma Natural Gas Production



Source: EIA

MIT Energy Initiative – "The Future of Natural Gas" Interim Report June, 2010

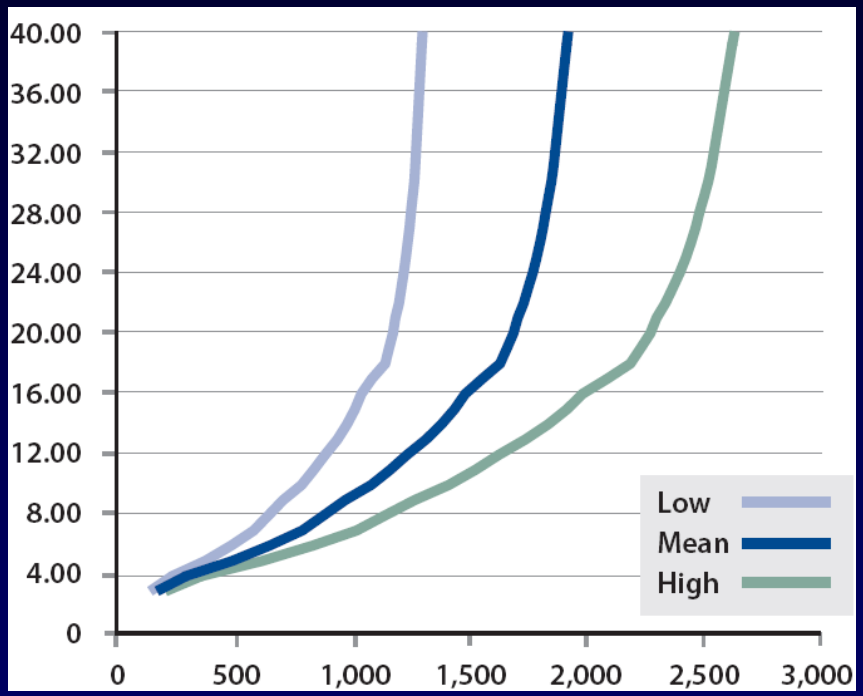
Primary support provided by the
American Clean Skies Foundation

MIT Energy Initiative

U.S. Gas Supply Cost Curve

Breakeven Gas Price*

$/MMBtu

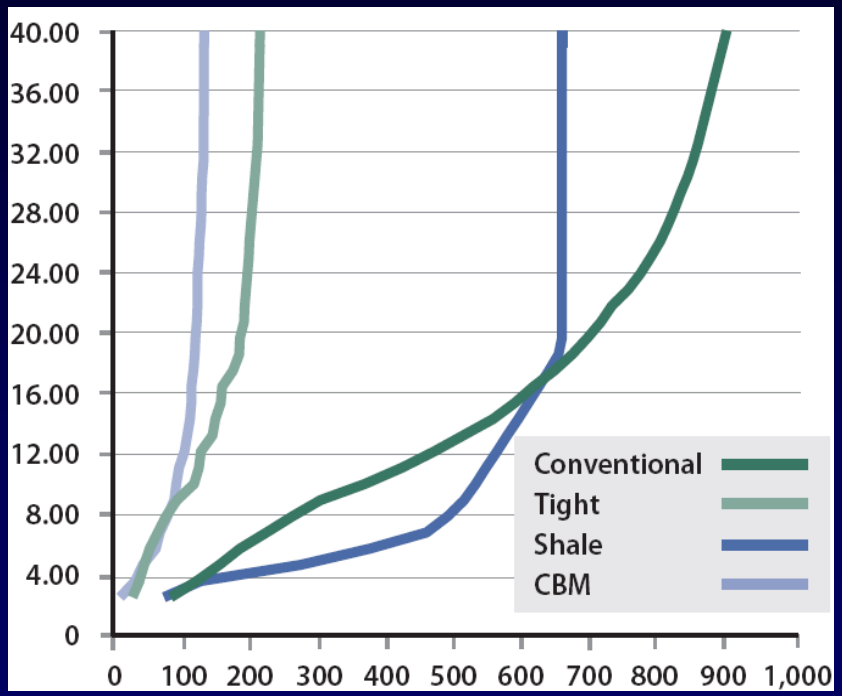


Tcf of Gas

Breakdown of Mean U.S. Supply Curve by Gas Type

Breakeven Gas Price*

$/MMBtu



Tcf of Gas

MIT Energy Initiative

* Cost curves calculated using 2007 cost bases. U.S. costs represent wellhead breakeven costs. Cost curves calculated assuming 10% real discount rate, ICF Hydrocarbon Supply Model

Natural Gas Demand

- Resilience in gas use across sectors
- Potential major growth areas:

Electricity

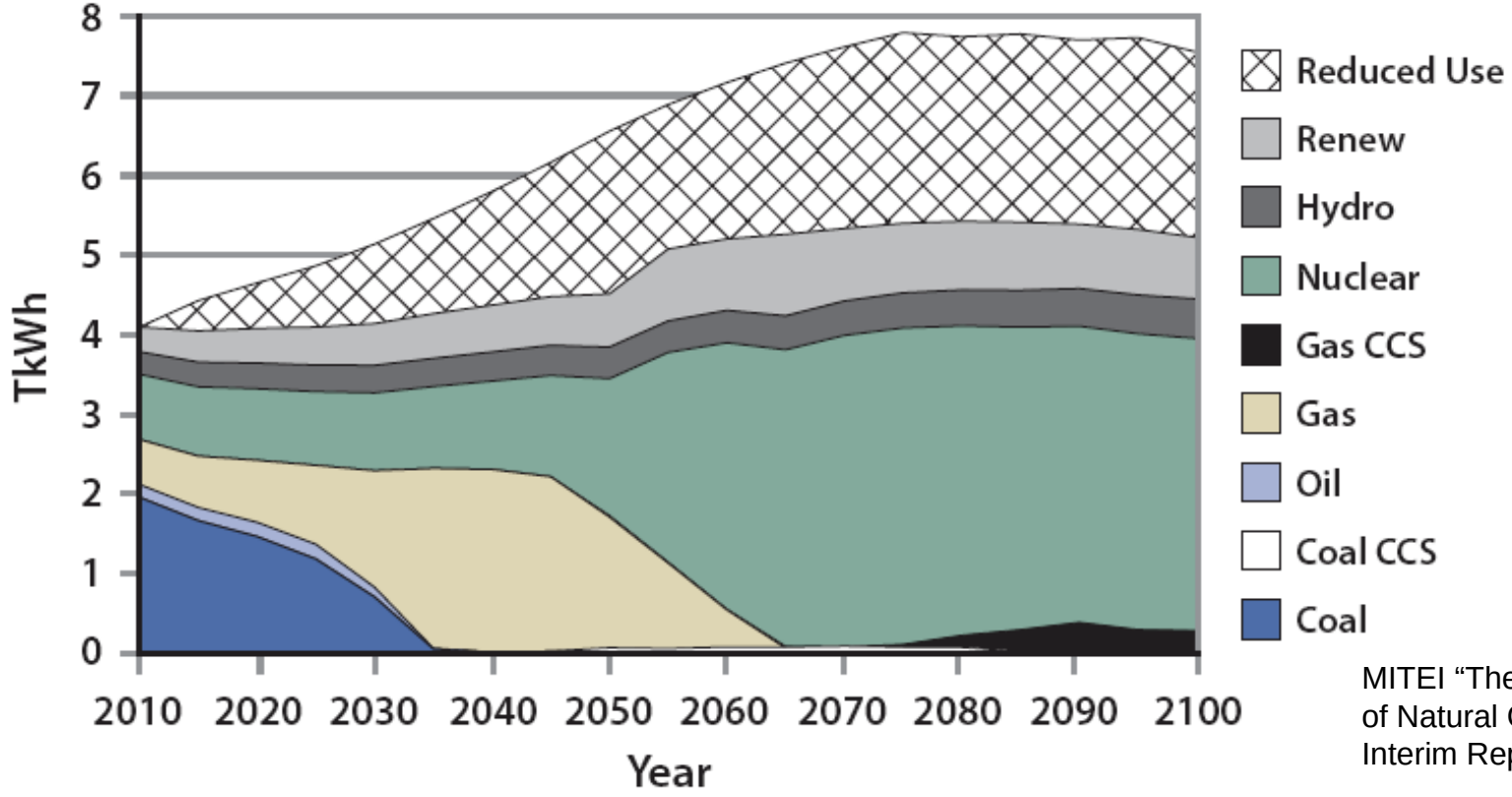
- Natural gas substitution for coal
- Intermittent sources/variability & uncertaint

Transportation

- Long term potential for CNG
- LNG not currently attractive

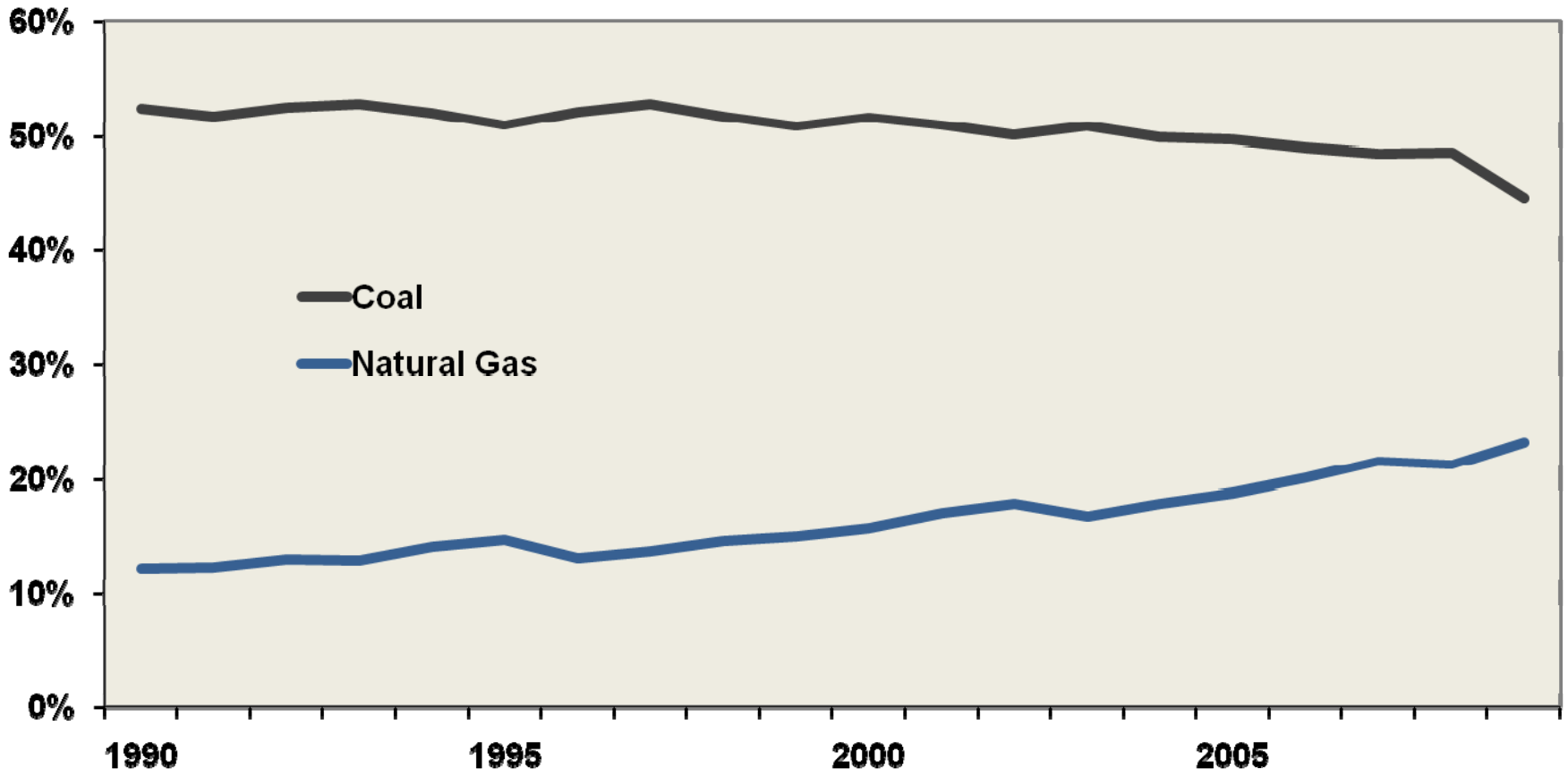
Share of U.S. Electric Generation from all Sources, 2010-2100
Natural Gas – At least a “60 Year Bridge”

Figure 3.9 Energy Mix in Electric Generation under a Price-Based Climate Policy, Mean Natural Gas Resources and Regional Natural Gas Markets (TkWh)



MITEI “The Future of Natural Gas” Interim Report

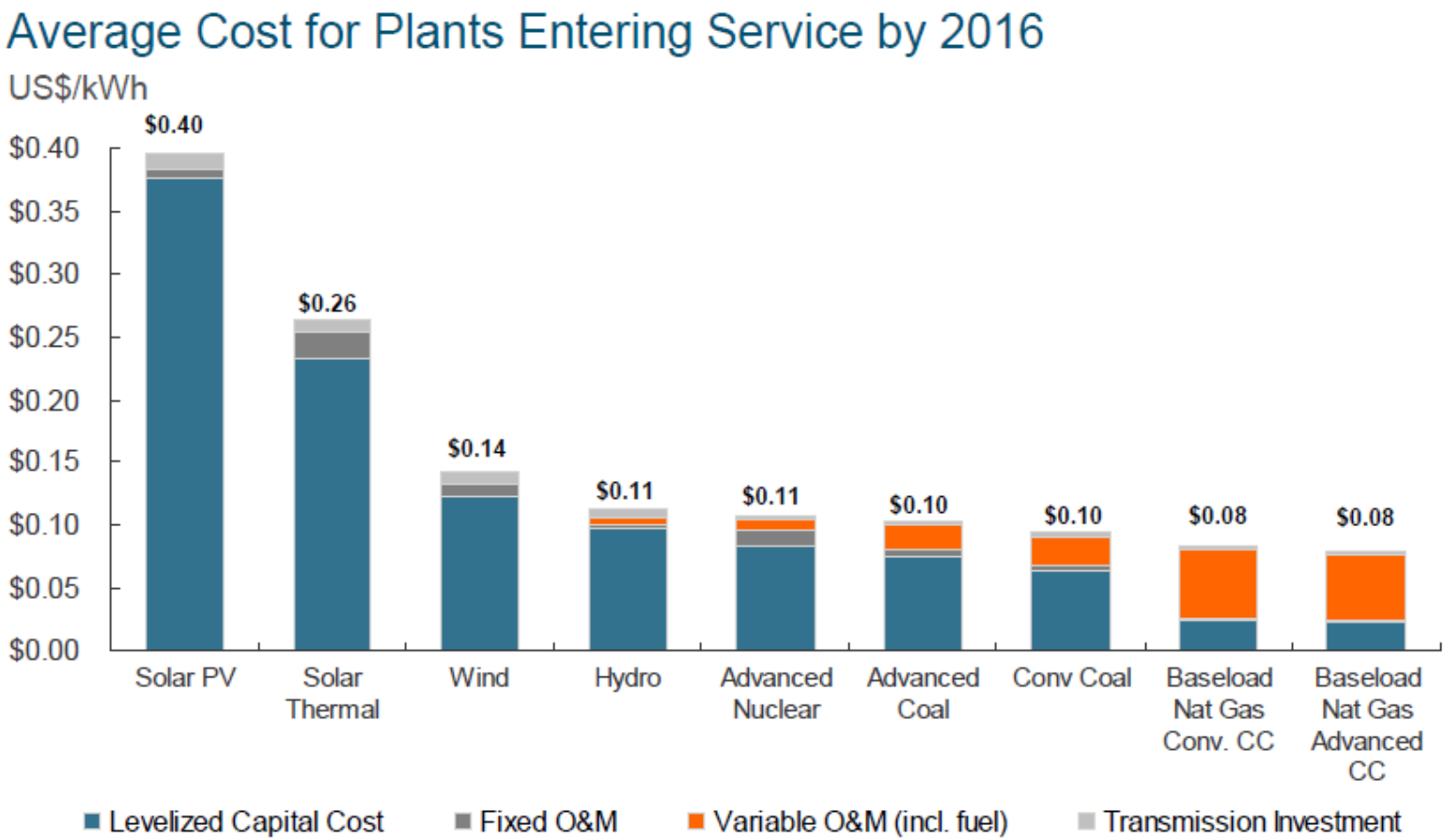
Share of U.S. Electric Generation from Coal and Gas, 1990-2009



WORLDWATCH INSTITUTE

Source: EIA

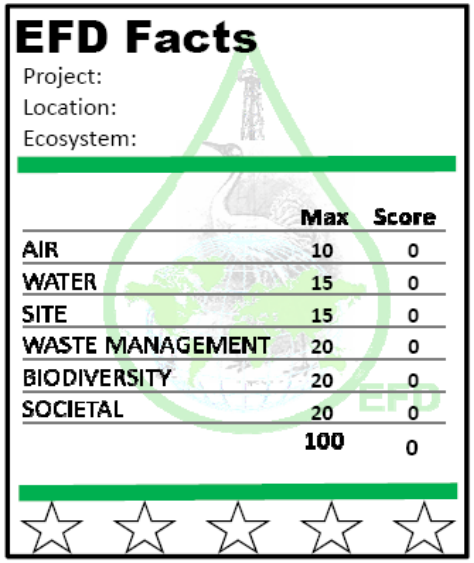
Natural Gas is the Least Cost Option for New Power Generation



Source: EIA Annual Energy Outlook 2009, EnCana

Environmentally Friendly Drilling Systems Program

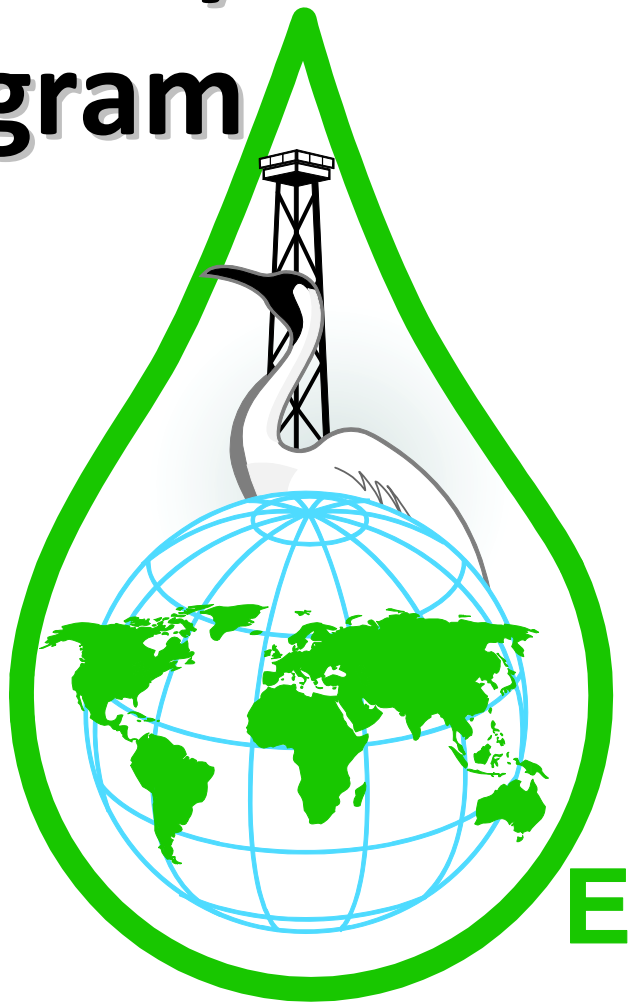
Over 50 organizations collaborating to identify, develop and demonstrate cost effective, low-impact technologies that can be used in environmentally sensitive areas addressing air, land, and water issues.



EFD Facts

Project:
Location:
Ecosystem:

	Max	Score
AIR	10	0
WATER	15	0
SITE	15	0
WASTE MANAGEMENT	20	0
BIODIVERSITY	20	0
SOCIETAL	20	0
	100	0



EFD

EFD

NETL NATIONAL ENERGY TECHNOLOGY LABORATORY

RPSEA Research Partnership to Secure Energy for America

Texas A&M University

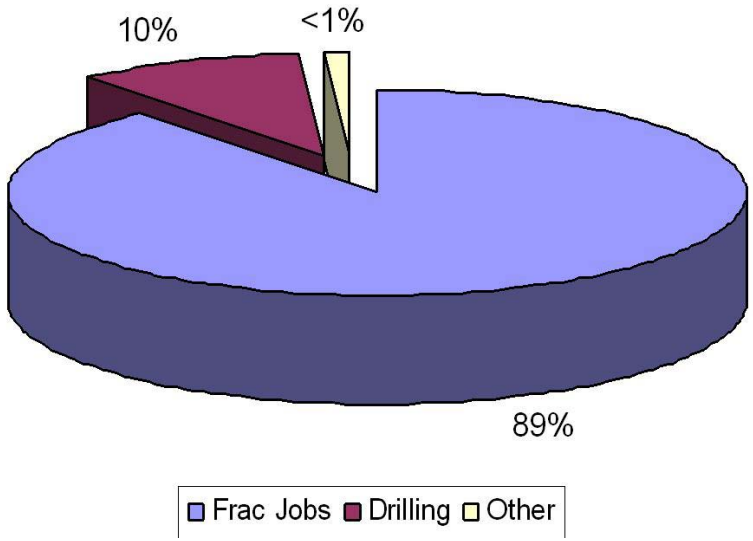
SH

TerraPlatforms L.L.C.

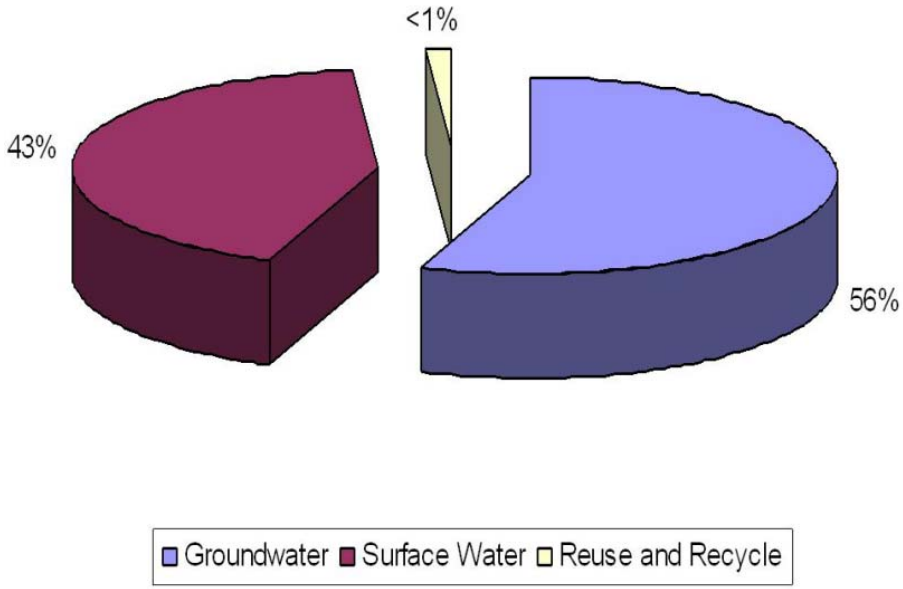
HARC

Barnett and Appalachian Shale Water Management and Reuse Technologies

Water Use by the Natural Gas Industry in the Barnett Shale



Sources of Water Used by the Natural Gas Industry in the Barnett

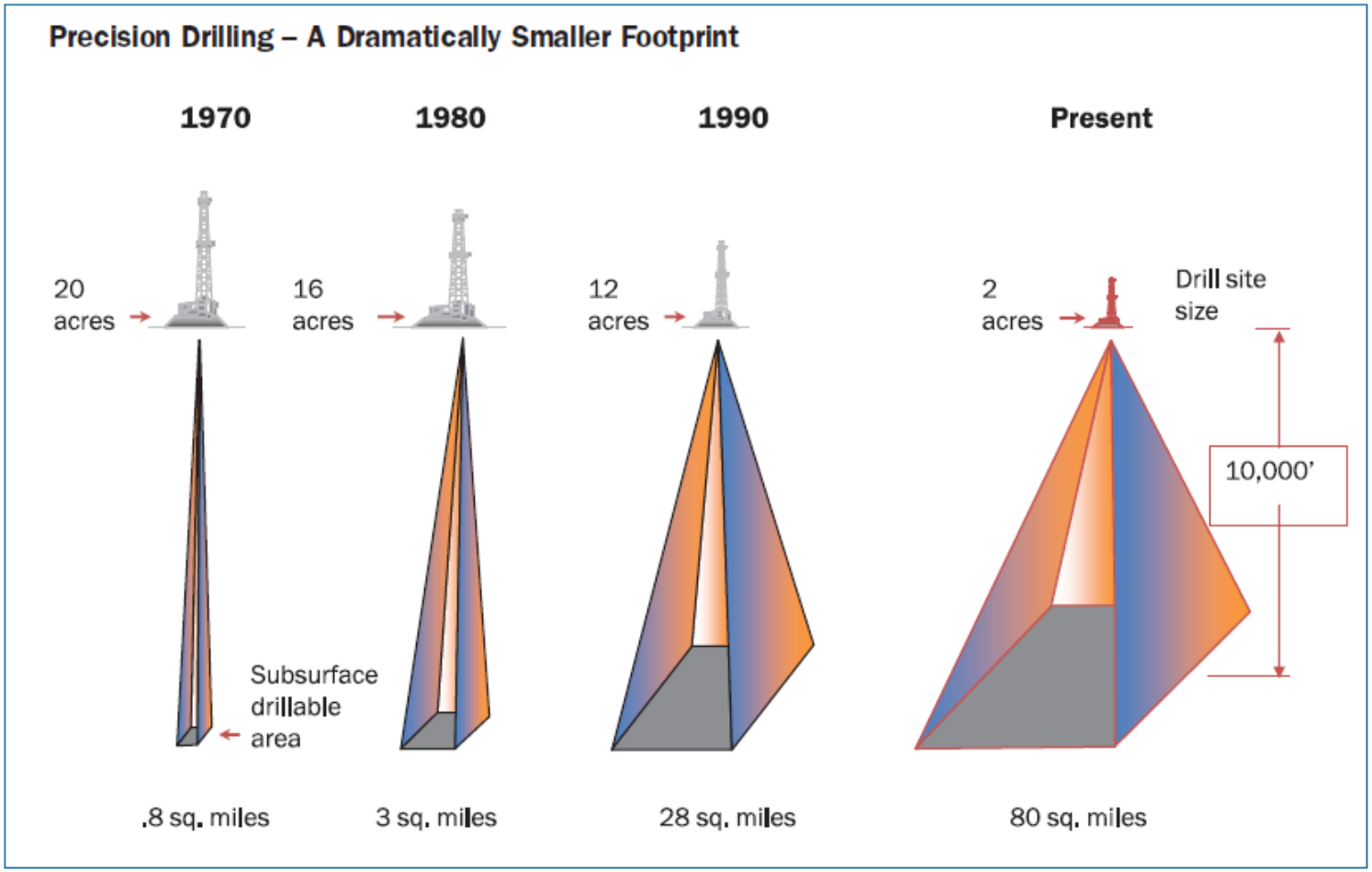


- **Millions of gallons of water used in a frac job require handling, treatment and disposal**

- **Determine Best Practice for Water Management**
  - **Water re-use technologies**
  - **Water treatment technologies**
  - **Alternate Water sources**

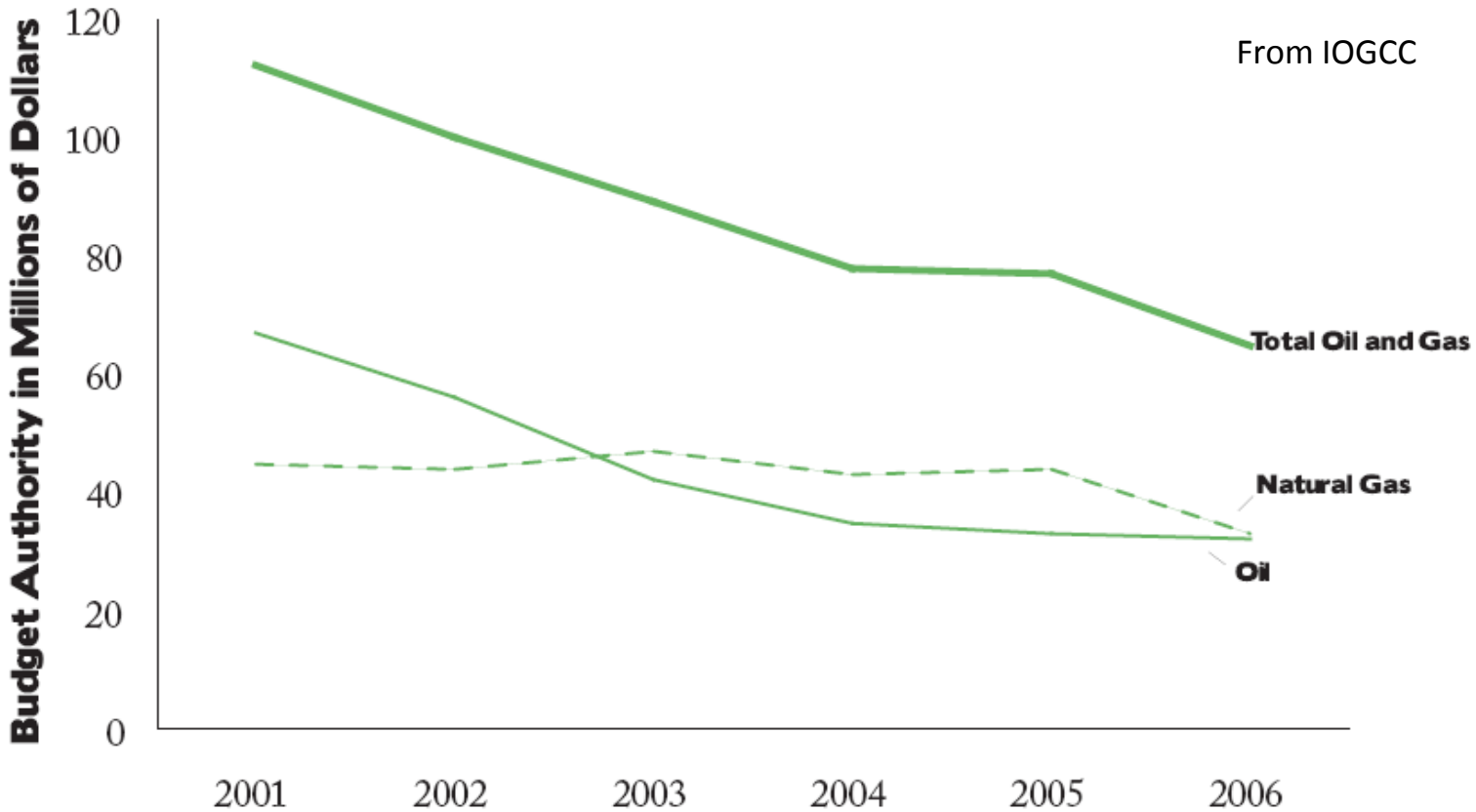
Gas Technology Institute

More subsurface from less surface



Federal R&D Funding Trends

Figure 7: DOE Oil and Gas R&D Budget History



“Do or do not, there is no try.”

Yoda

Looking forward to questions!