



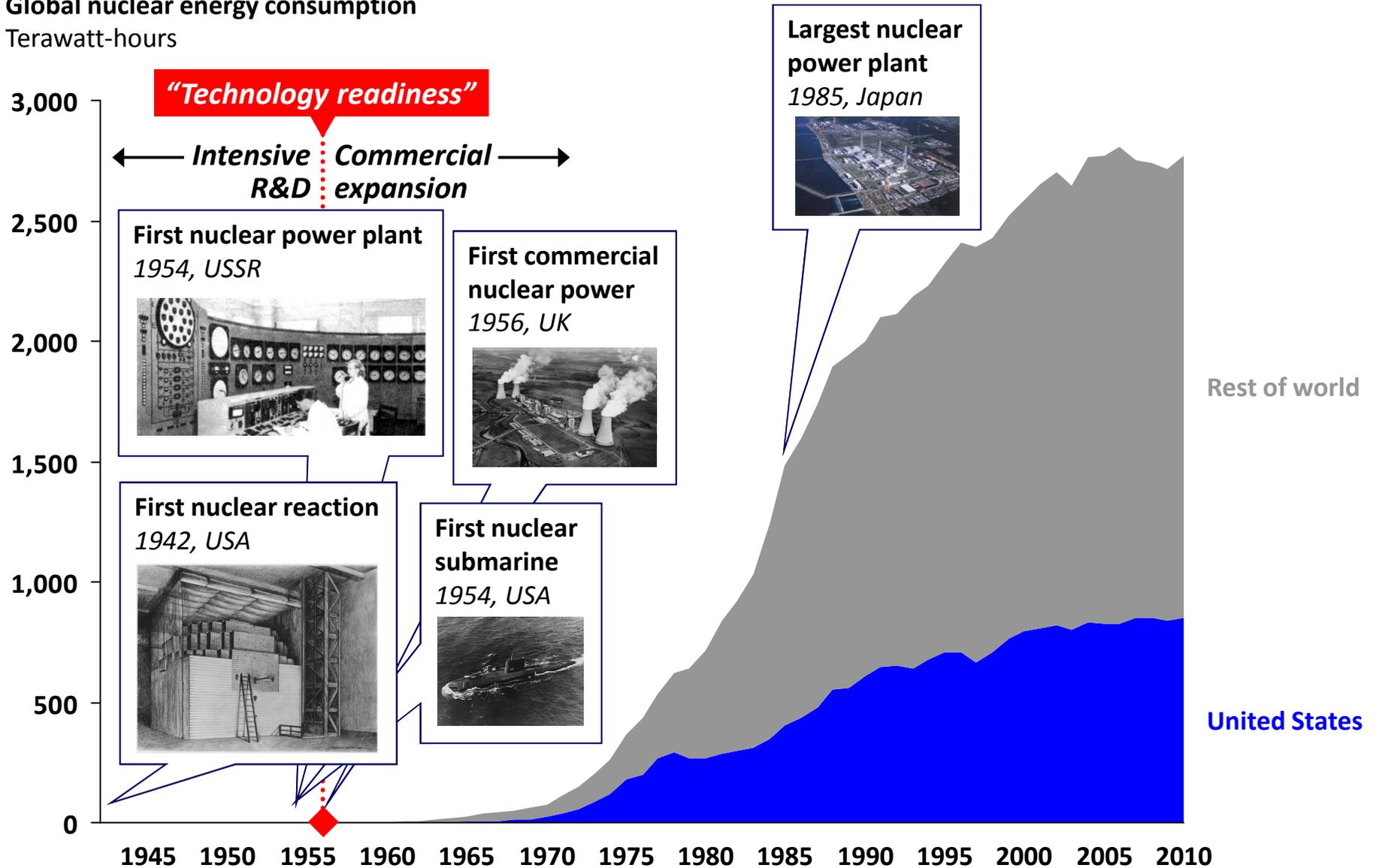
**Defense Energy Security Caucus Briefing  
Washington, DC  
December 6, 2011**

## What we're going to talk about

- The existing pool of liquid energy sources is facing increasing competition, primarily driven by non-OECD demand, which is going to create a gap by 2030
- Filling this gap will require all available options, but very little has been done outside of searching for new oil fields or incrementally improving upon mature technologies
- New energy technologies must be sufficiently researched and developed to an inflection point of “**technology readiness**” before they can be deployed at large, meaningful scale
- Energy technologies must be **technologically ready** by 2020 in order to be implemented at scale by 2030, requiring investment *today*
- The policy goal of the United States should be to enlarge the pool of resources used for liquid fuels
- Military leadership is critical in bringing our drop in fuels to commercialization
- Government intervention is necessary now to ensure that the United States wins the technology race for renewable petroleum drop-in liquid fuels

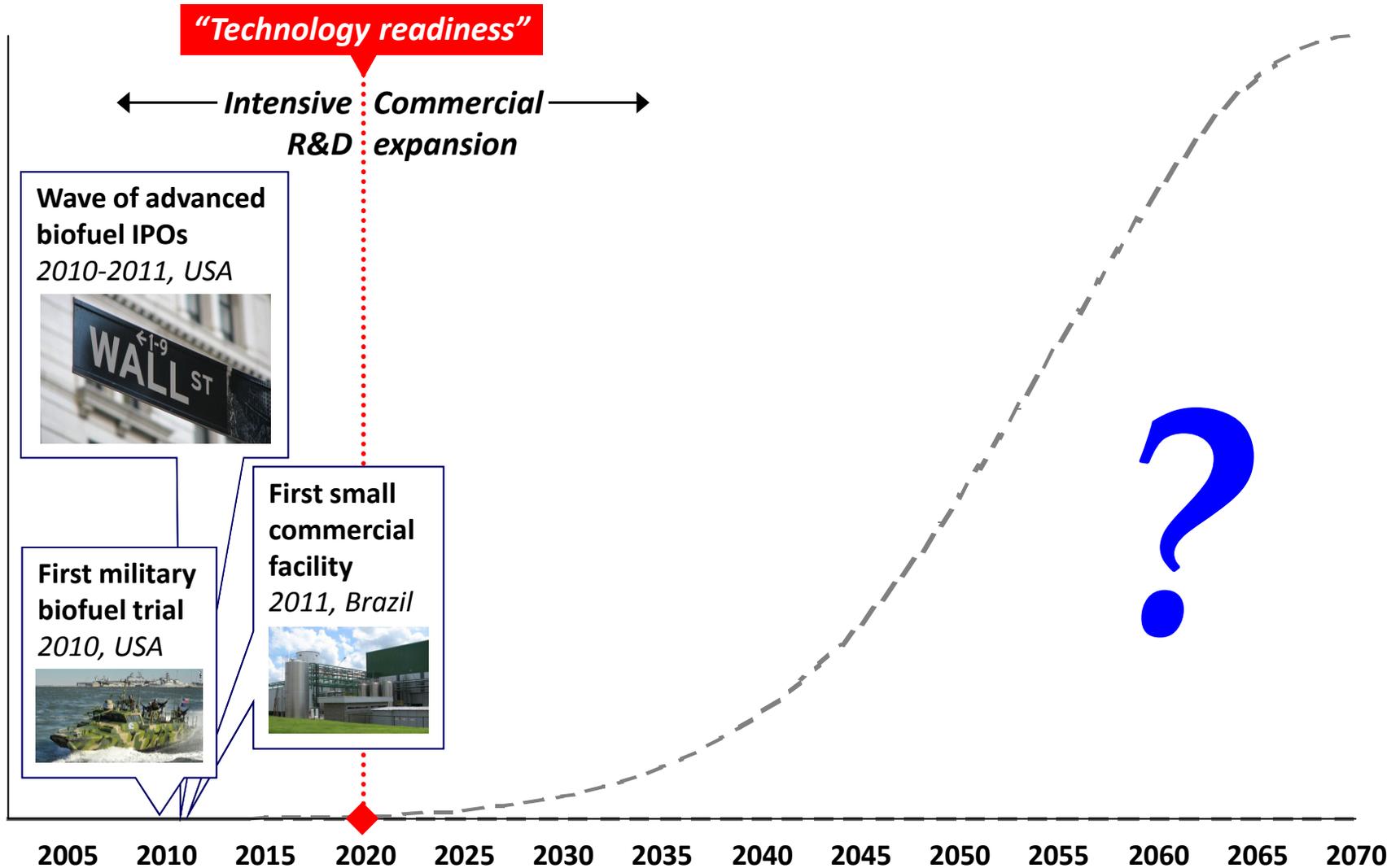
# Sixty years ago we were in the midst of a transformative energy transition to nuclear power

Global nuclear energy consumption  
Terawatt-hours

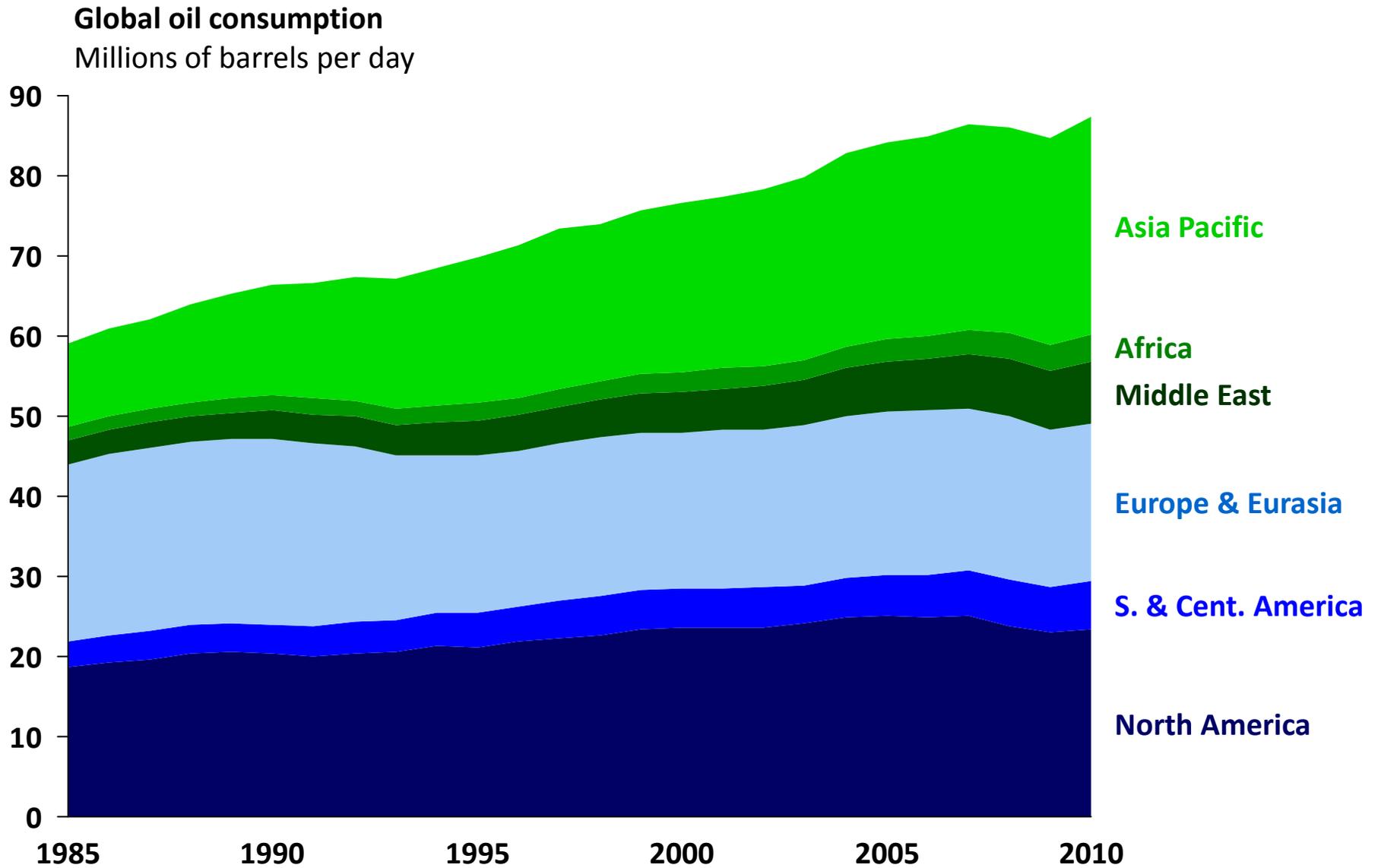


# Today we are pushing to reach technology readiness for renewable petroleum drop-in fuels by 2020

Global renewable petroleum drop-in fuel consumption



## Demand for oil has risen steadily, despite sluggish economic growth over the past few years



**Demand will continue to grow; China's desire to reach 'energy parity' will alone have a massive effect, not including other developing nations**



**United States**

**Population: 308 MM**

**GDP per capita: \$47,100**

**Oil use: 19.2 MBD**

**Oil use (per 1,000): 62 bpd**

**Poland**

**Population: 38 MM**

**GDP per capita: \$18,800**

**Oil use: 0.55 MBD**

**Oil use (per 1,000): 15 bpd**

**China**

**Population: 1,330 MM**

**GDP per capita: \$7,500**

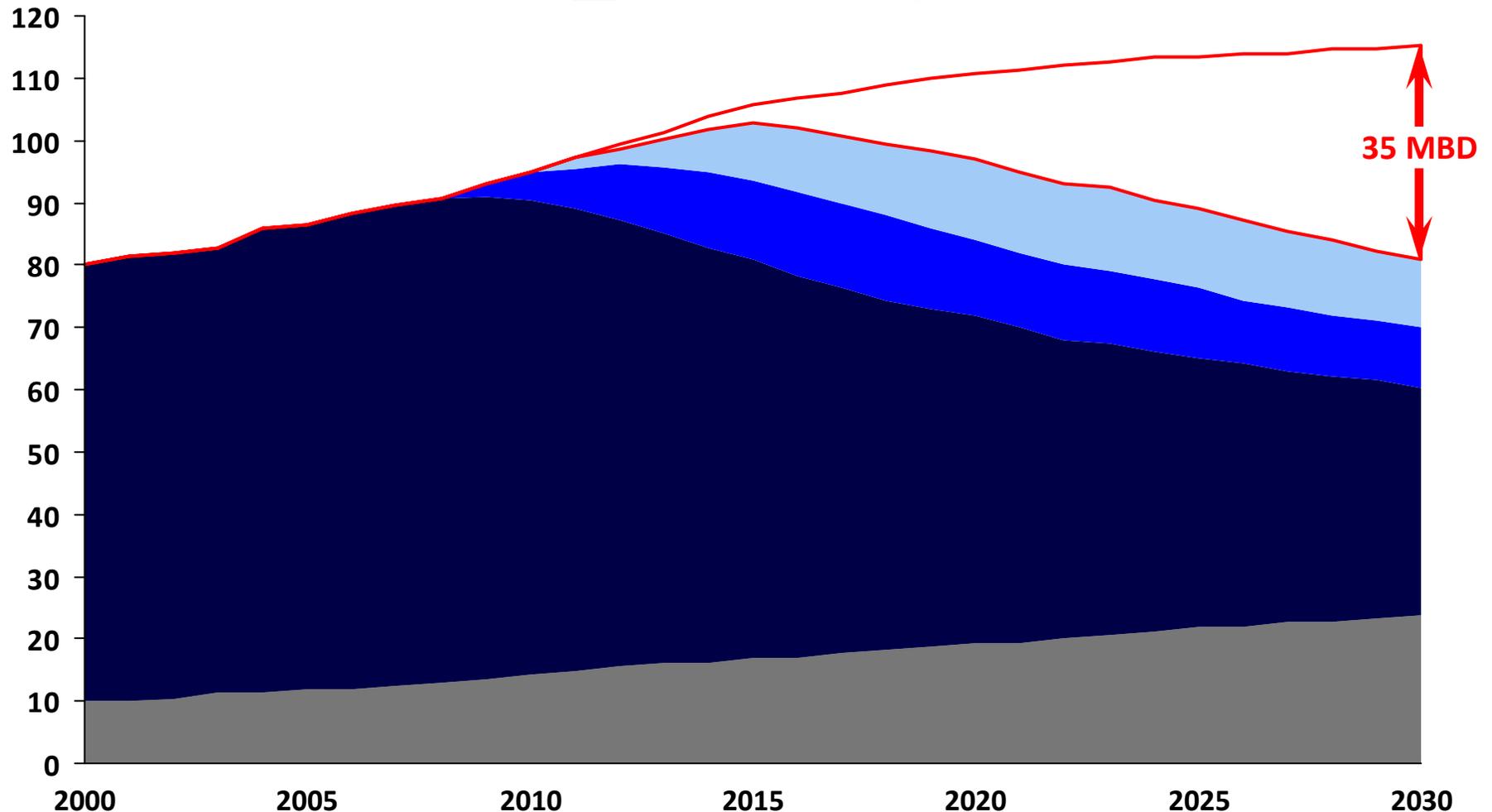
**Oil use: 8.3 MBD**

**Oil use (per 1,000): 6.2 bpd**

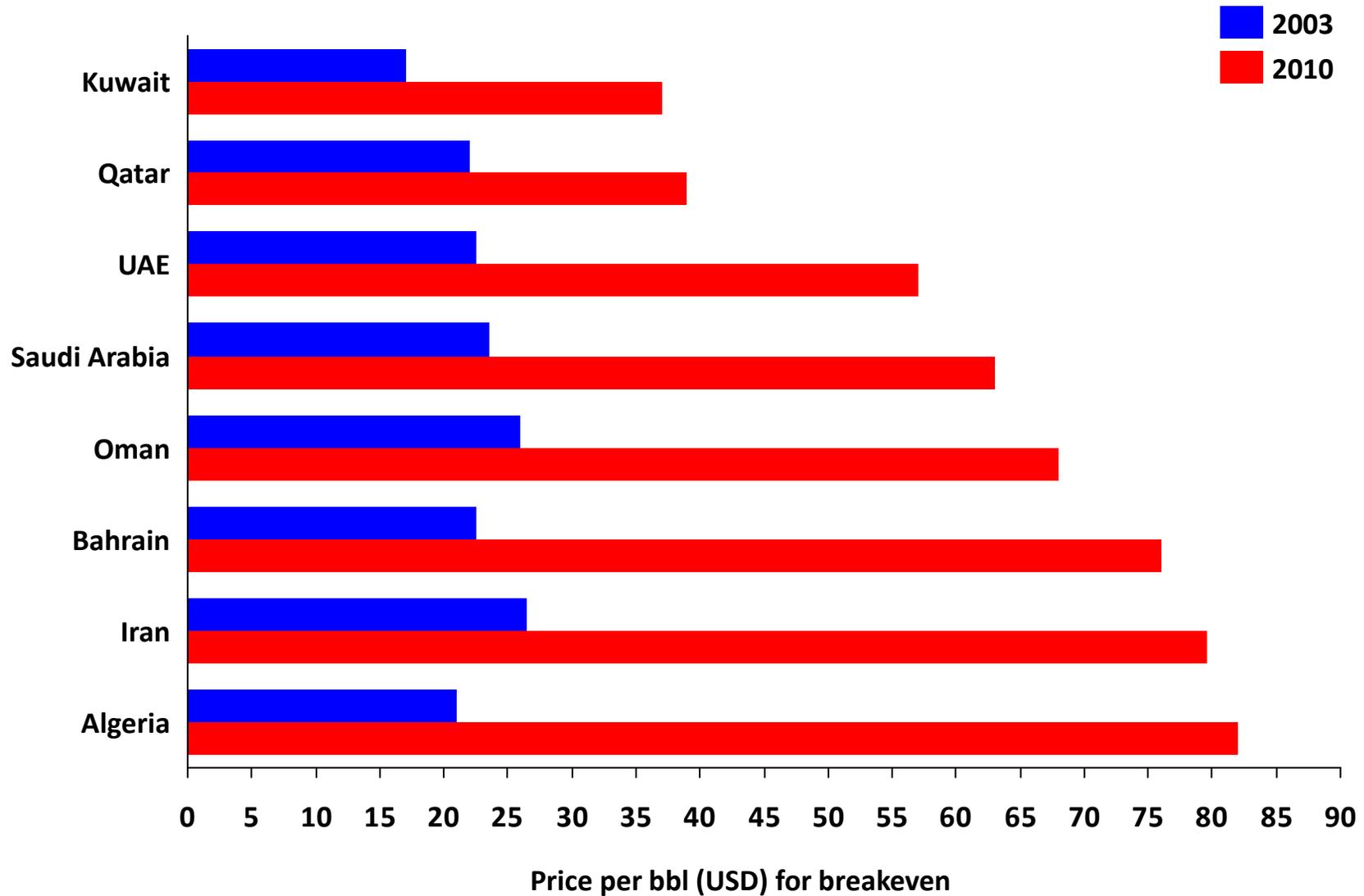
# CERA estimates that by 2030, the world will demand 35 million barrels per day of liquids from unidentified sources—an “oil gap” that must be filled

Global oil supply outlook (as of 2009)  
Million barrels per day (MBD)

- New liquid sources—"oil gap"
- Oil fields in production
- Oil fields under appraisal
- Oil fields under development
- Unconventional liquids



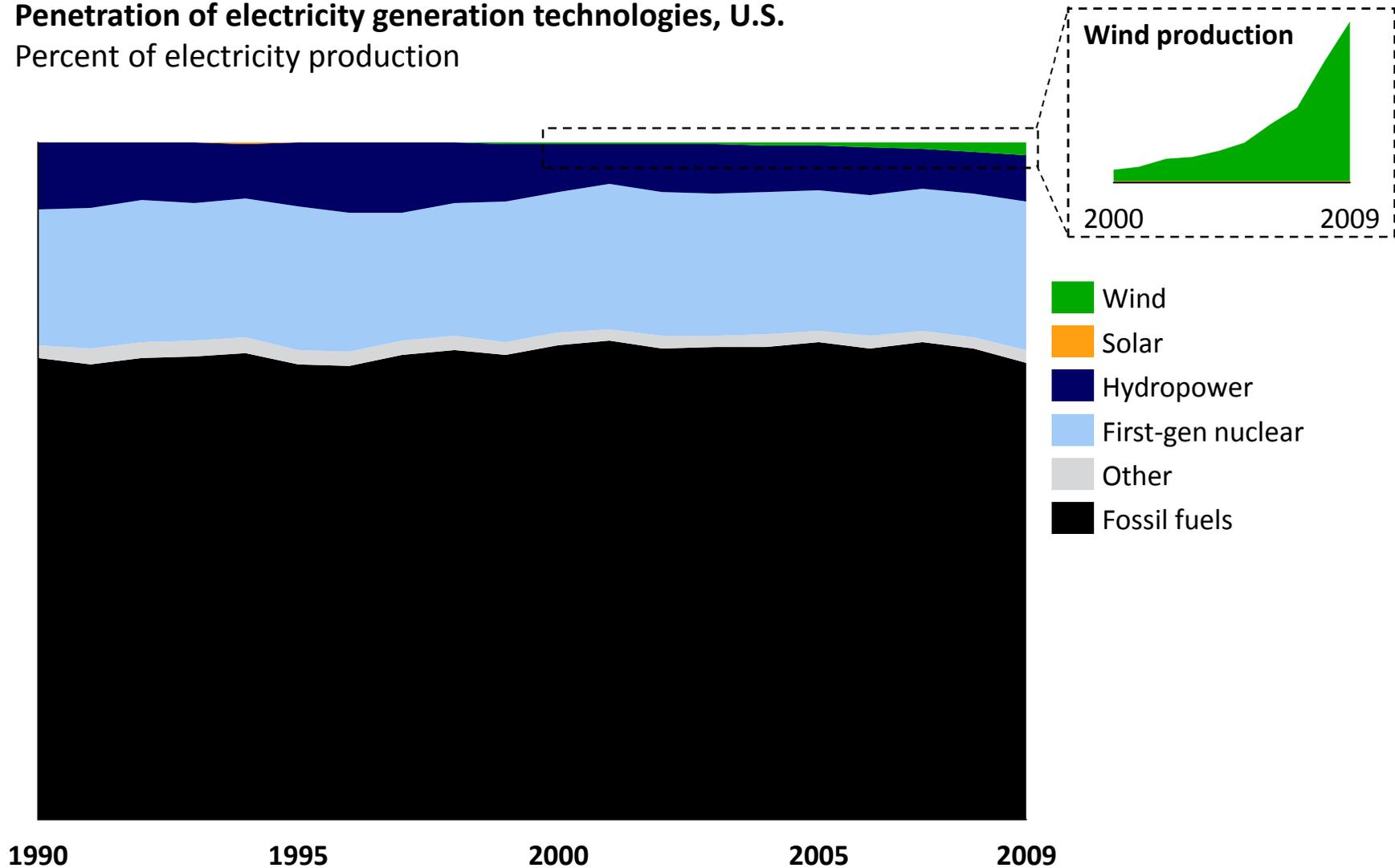
**Even in today's world with no "oil gap," the world is experiencing increased oil prices, due in part to increased breakeven costs for production**



**Let's review an example of where  
we've done an excellent job of  
finding alternatives to fossil fuels...**

# The U.S. has developed and deployed alternative electricity technologies, achieving more than 30% penetration

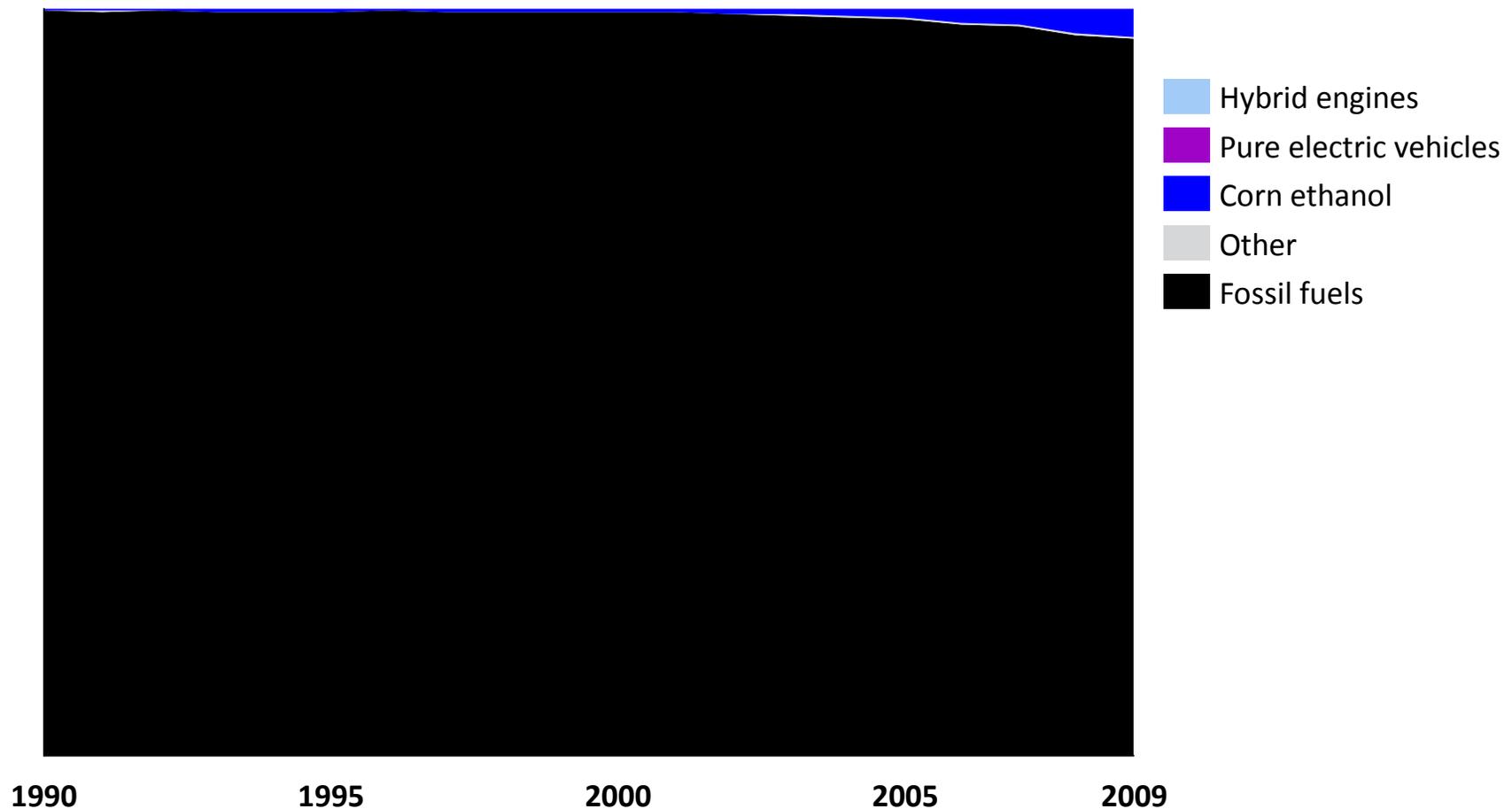
Penetration of electricity generation technologies, U.S.  
Percent of electricity production



**So what's the problem, you ask?**

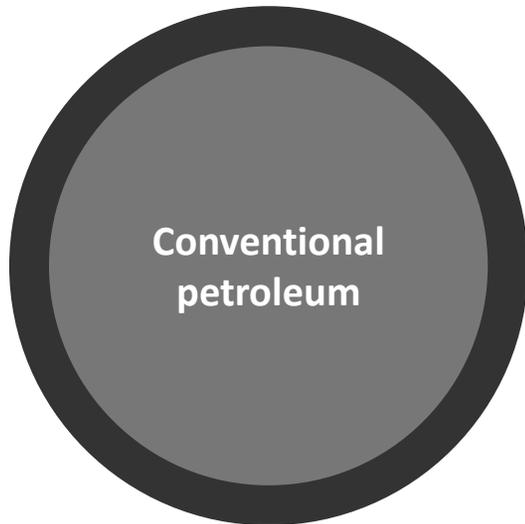
# Unlike electricity, there have been few alternatives developed to date to displace liquid fossil fuels

**Penetration of transportation fuel technologies, U.S.**  
Percentage of fuel consumed (or saved), oil equivalent

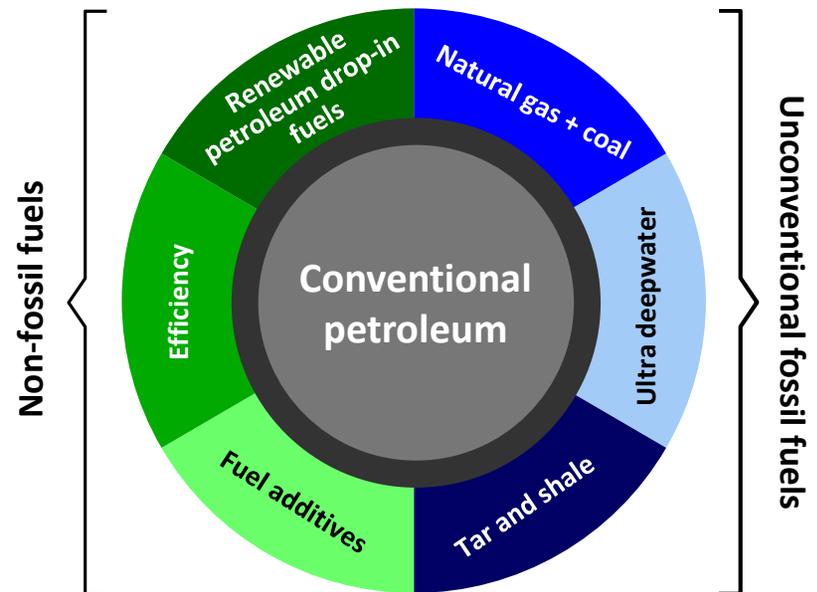


# The world of oil: today versus tomorrow

**2010 demand:  
88 million barrels per day**

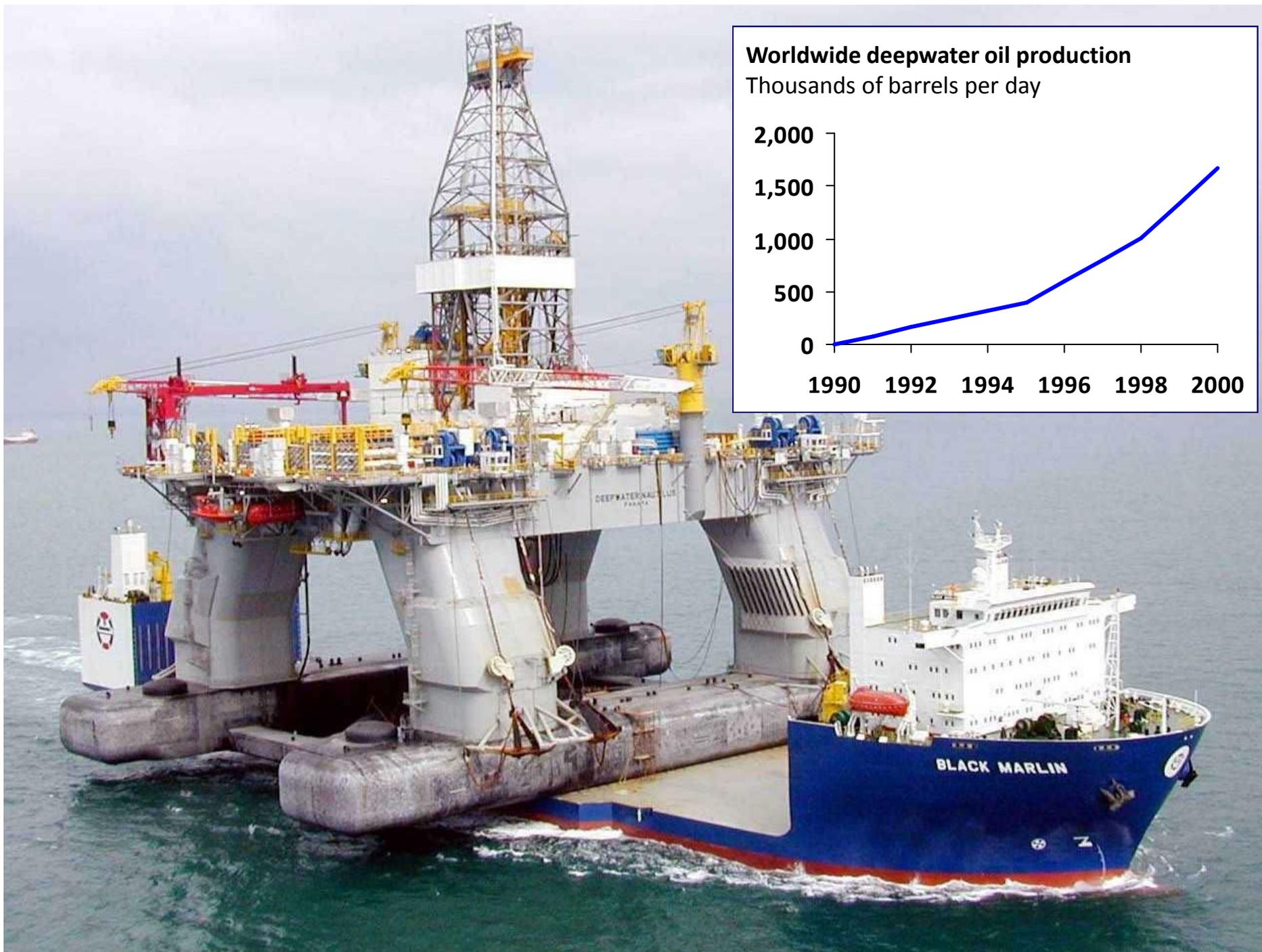
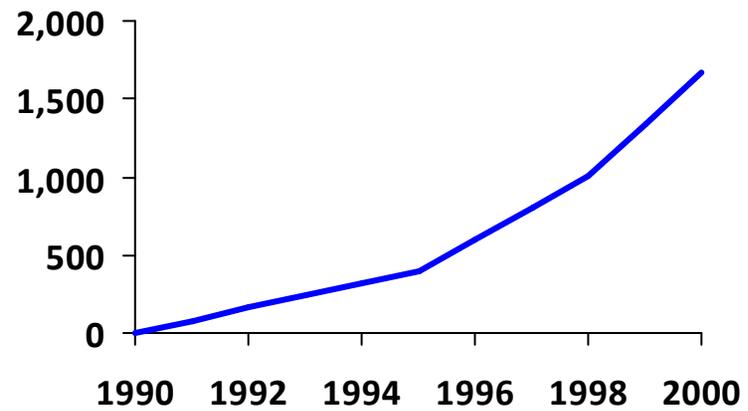


**2030 demand:  
97-115 million barrels per day**



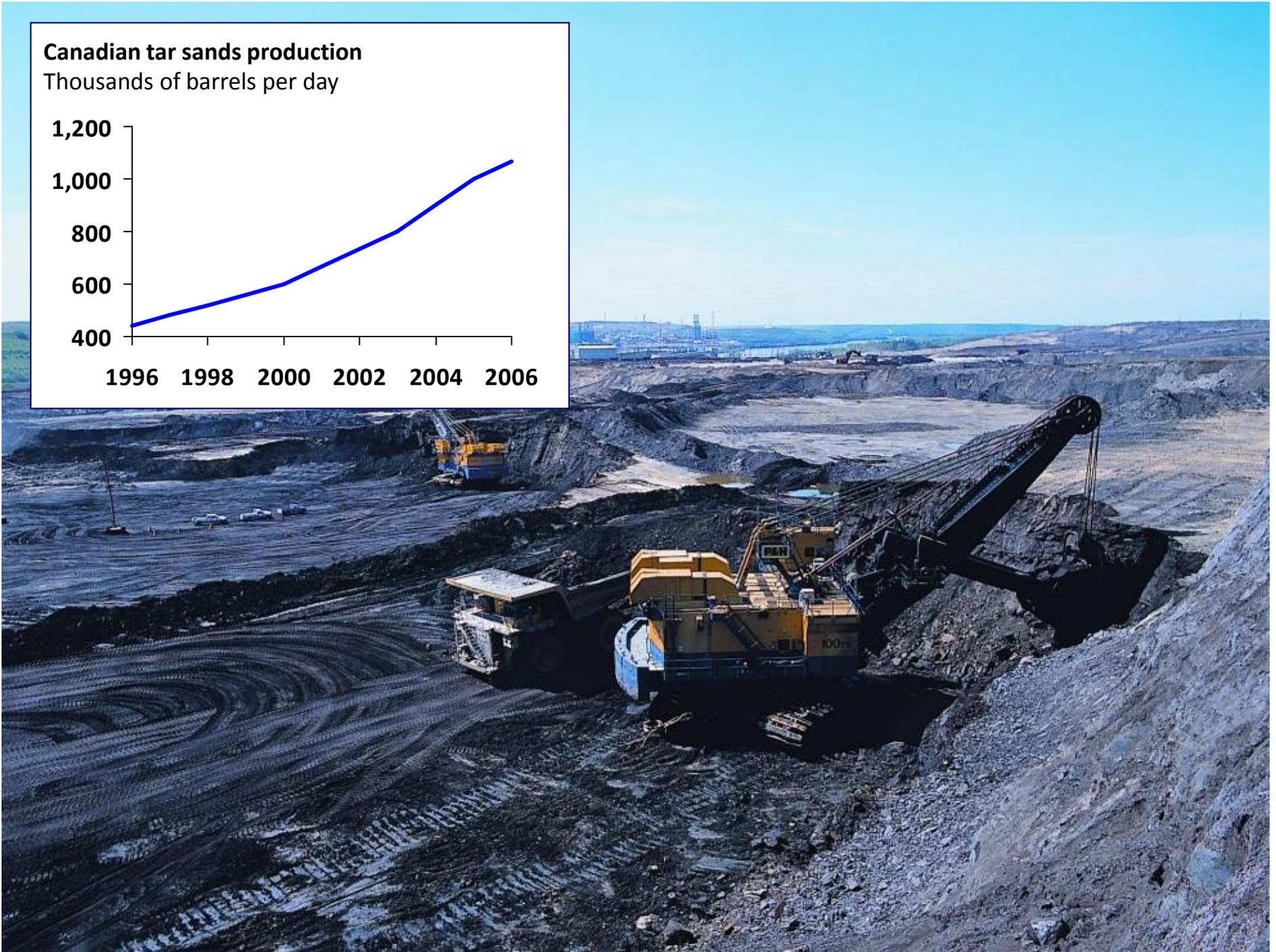
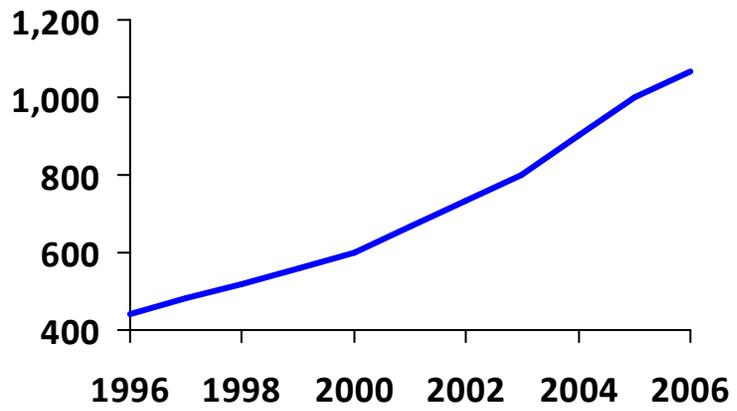
**We're making progress on the right side of the circle...**

**Worldwide deepwater oil production**  
Thousands of barrels per day



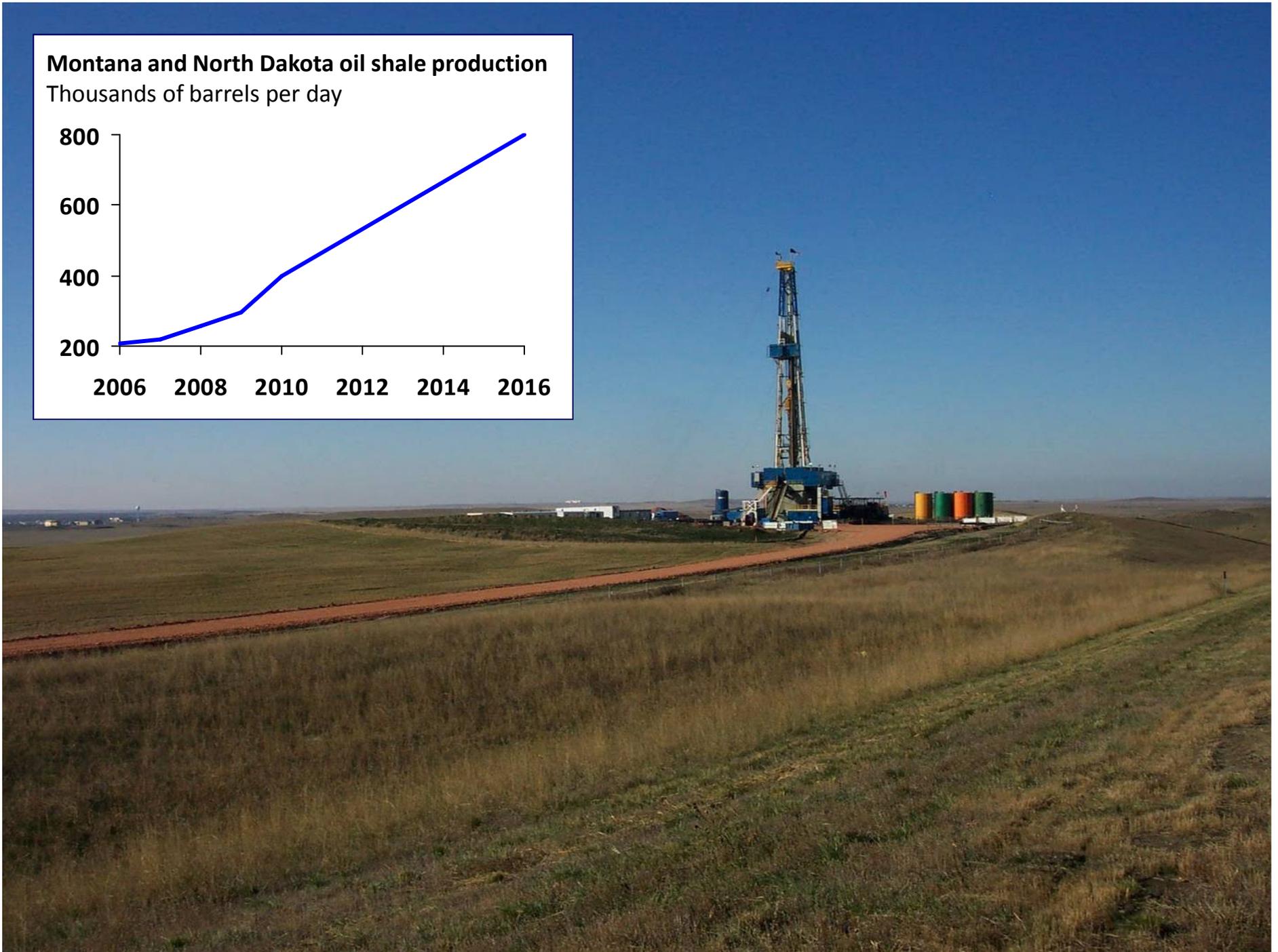
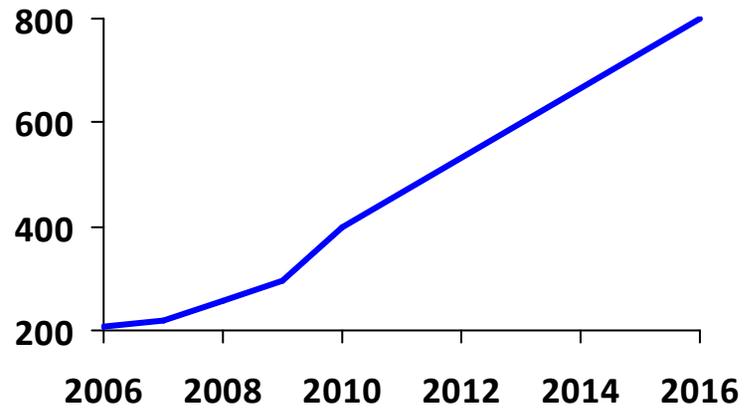
### Canadian tar sands production

Thousands of barrels per day



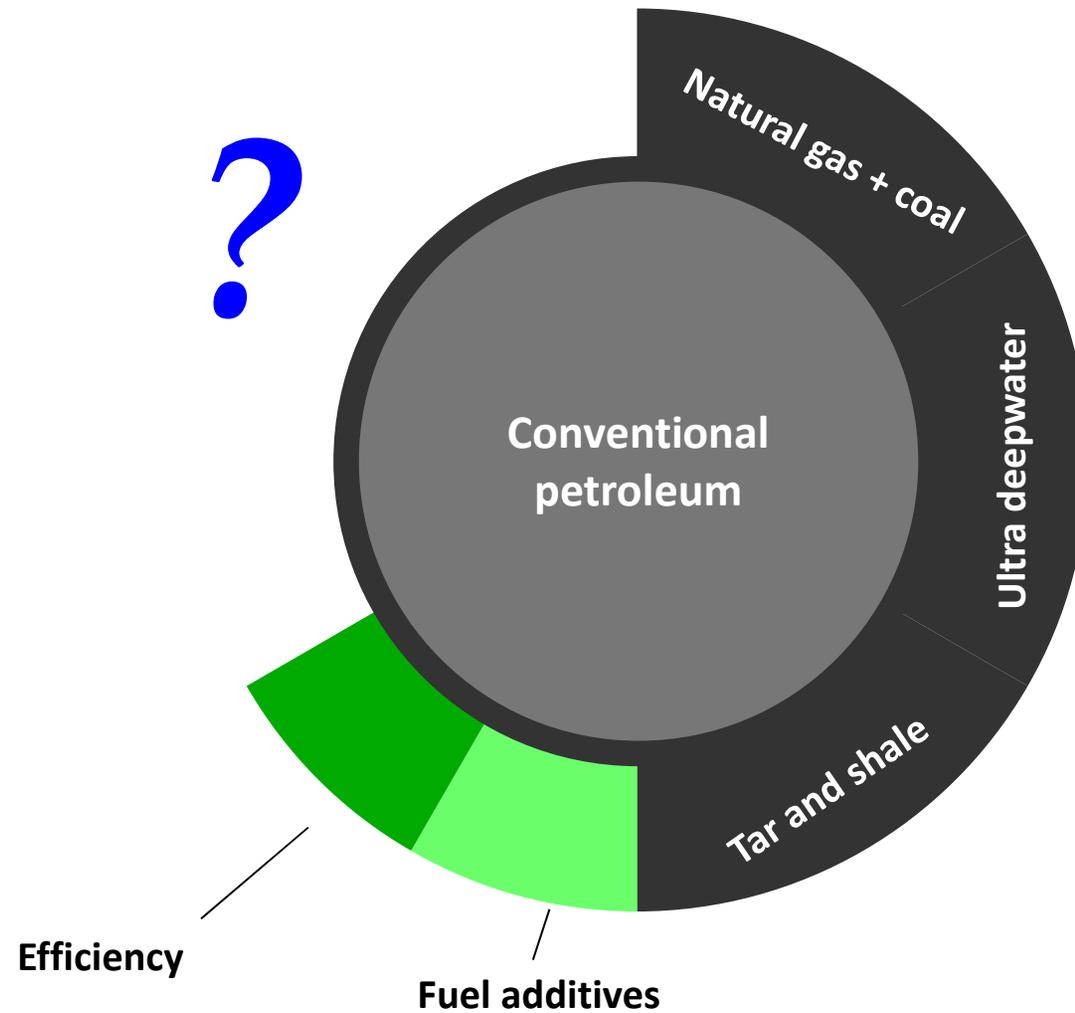
### Montana and North Dakota oil shale production

Thousands of barrels per day



**So how do we address the left side of the circle?**

If fossil fuels, fuel additives, and efficiency gains aren't enough to "fill the oil gap," what else is left?

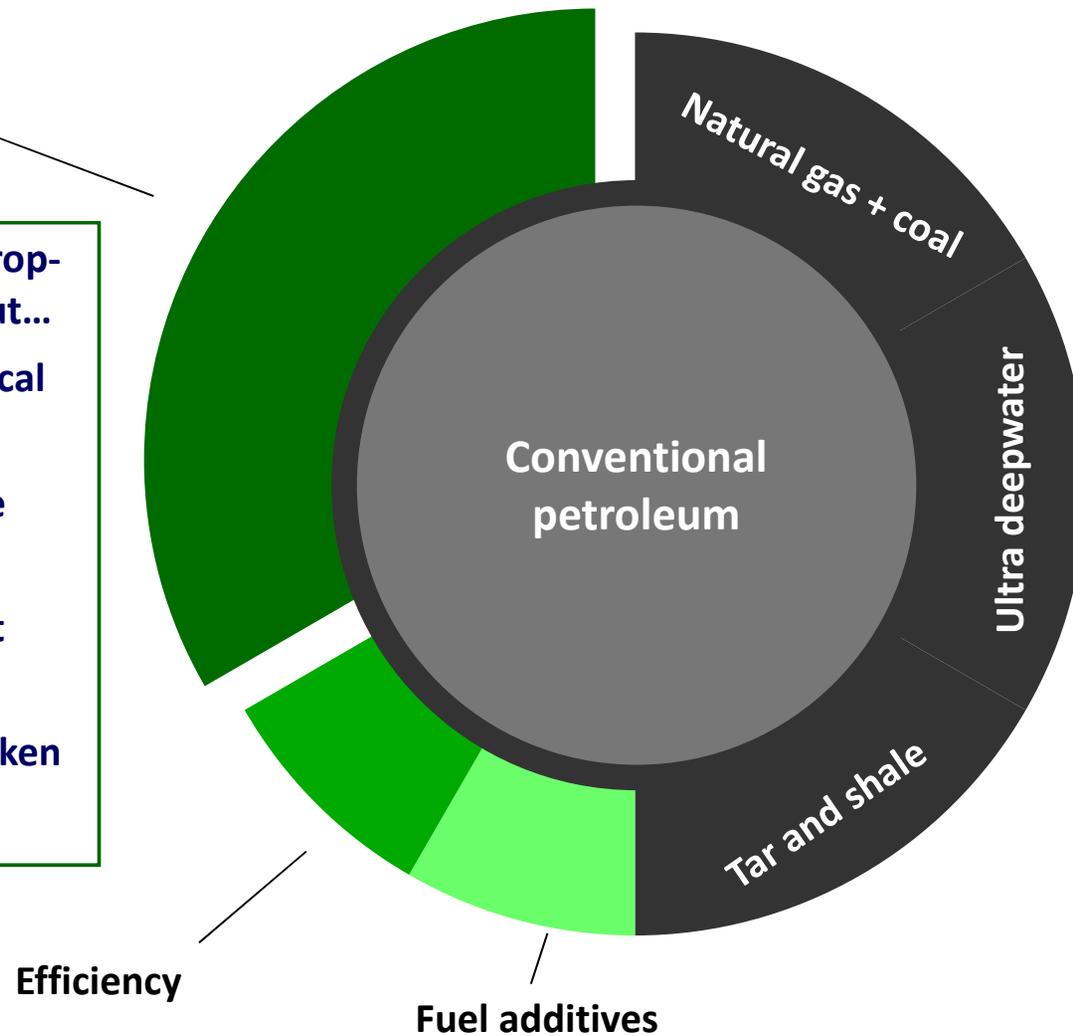


If fossil fuels, fuel additives, and efficiency gains aren't enough to "fill the oil gap," what else is left?

## Renewable petroleum drop-in fuels

Renewable petroleum drop-in fuels are necessary, but...

- They carry large technical risk in development
- Who will refuse to take that risk?
- Who can best take that risk?
- Who has historically taken that risk?



# Renewable petroleum drop-in fuels must be technically ready by 2020



**“Technology readiness” (*now through 2020*)**



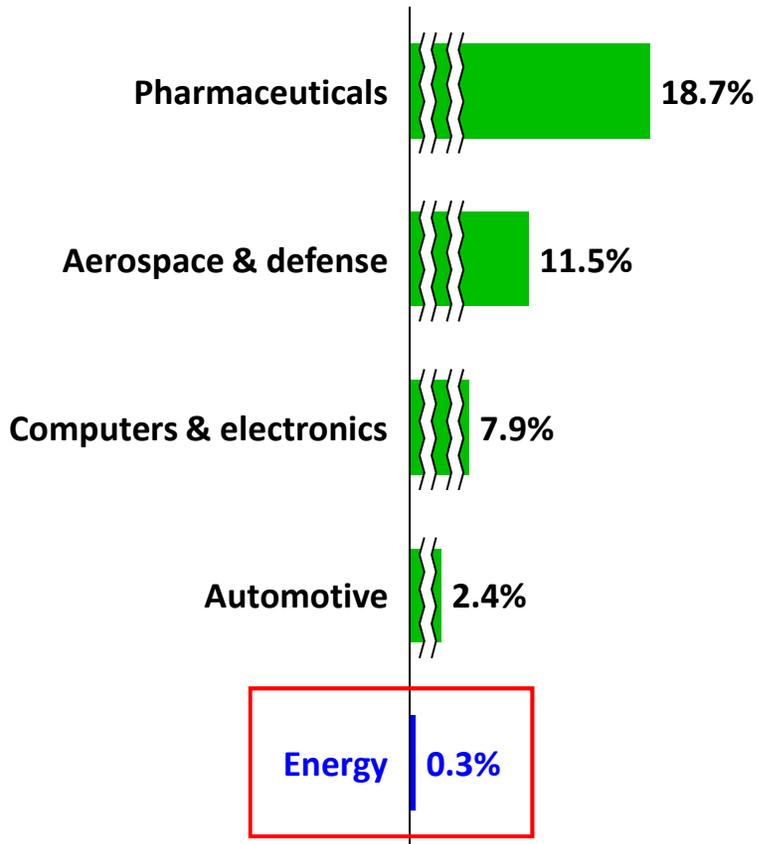
**Political and social will plus discipline (*now through 2030*)**



**Massive capital deployment (*2020 through 2030*)**

# Is enough being done today to solve this problem?

**Combined U.S. public and private R&D spending in major technology-dependent sectors**  
Spending as share of total U.S. sales



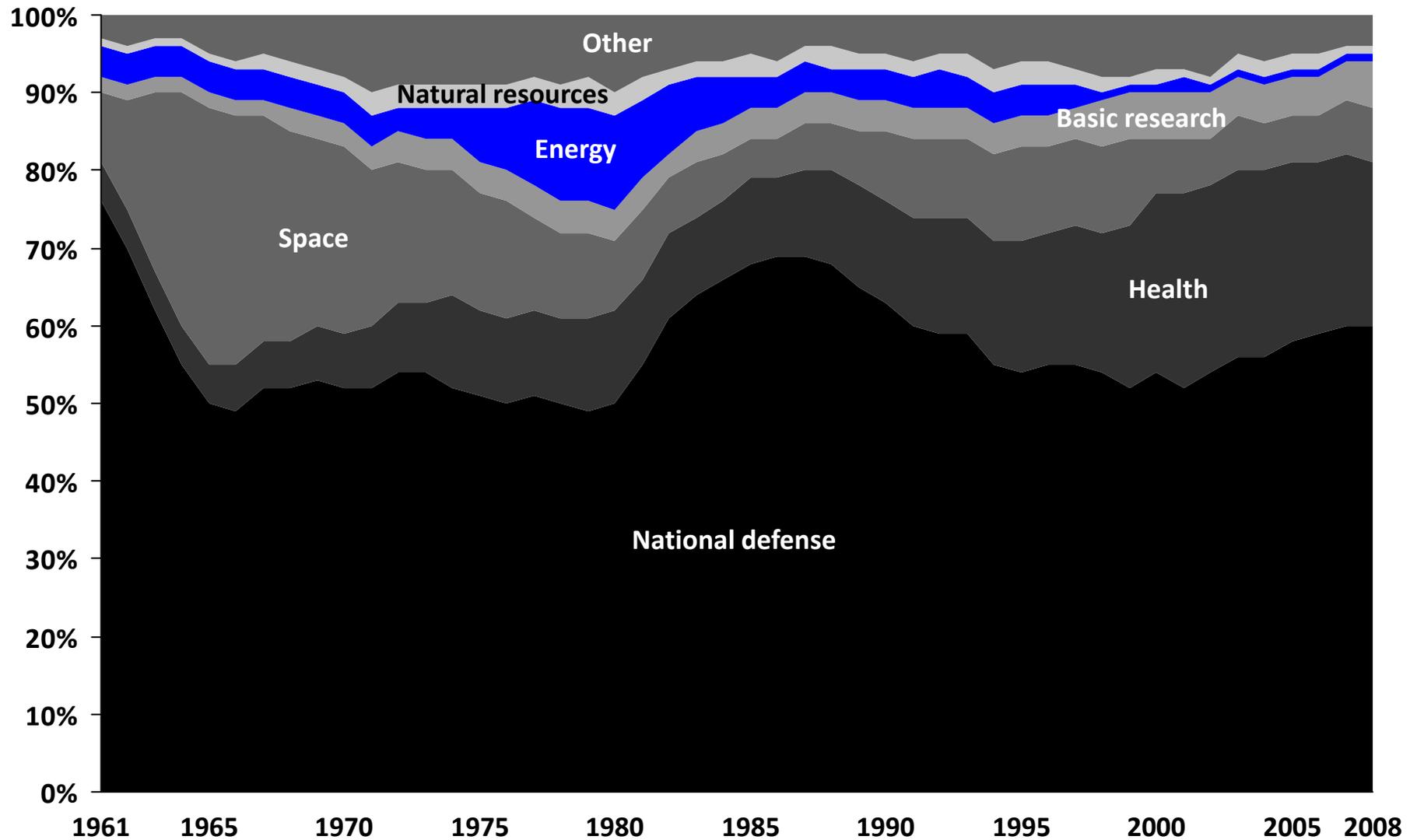
**2010 U.S. federal budget (\$3.60 trillion total)**  
Billions of dollars per section

Spending on energy was just \$10.4 billion, including \$5.1 billion for R&D



# How federal investment in energy R&D stacks up

U.S. federal R&D investment by major program area  
Percentage of total federal R&D spending



# The DoD has historically led the way in developing strategically important technologies with the private sector



**Nuclear:** the Navy, develops nuclear propulsion in the 1940s and 1950s; this, in turn, enables commercial nuclear power plants.



**Stealth:** the DoD launches a top-secret program with Lockheed to develop a stealth aircraft. The program eventually results in the F-117 Nighthawk.

1900

1925

1950

1975

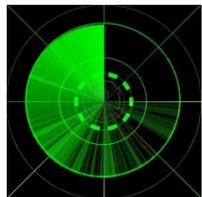
2000



**Oil:** The Navy is an influential early adopter of oil as a transportation fuel



**Internet:** the DoD funds the creation of ARPANET, which becomes the foundation of the Internet.



**Radar:** the U.S. Navy, in collaboration with RCA, develops and produces an early version of Radar during WWII.



**GPS:** the DoD develops a satellite-based positioning system; in the 1990s, the system is made available for civilian use.

# The world needs empowered leaders who will take this problem head on



This is a **global problem**, but it is particularly critical for **countries like the U.S.** that rely heavily on foreign sources of oil



We must **change** the way we deal with energy if we are to solve this problem; the **private sector will not take this technology risk alone**. Today nearly **90% of global clean-energy investment goes to existing technologies**, rather than more innovative alternatives that could offer real solutions to the problem



The world needs:

- **Government leaders** who **prioritize what actually works** in the long run over what is popular, even though the development time *will be* longer than an election cycle
- **Military leaders** who embrace this challenge as a **national security imperative**
- **Business leaders** who see the potential for growth and will **work with the government** to confront the technology challenges
- **Technology leaders** who will devote themselves to bringing promising technologies to fruition

## Summary

- The existing pool of liquid energy sources is facing increasing competition, primarily driven by non-OECD demand, which is going to create a gap by 2030
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