James A. Baker III Institute for Public Policy

Consequences of an Emerging U.S. Energy and Climate Policy on the Global Energy Market

Abu Dhabi - March 2, 2010

Potential Impacts Of US Energy, Environmental and Climate Policy On Upstream Oil & Gas Investment

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U.S. Energy & Environmental Policy

Key Drivers of US Gas & Oil Demand

- **Natural Gas**
  - Regulatory Demand
    - EPA Clean Air Act Regulations
    - U.S. Climate Change Legislation/Regulation
    - Renewable Portfolio Standards
  - Supply-Side
    - Expanding Off-shore Leases & Discoveries
    - Shale Gas Development
    - Environmental Constraints
    - Alaska and Canadian Pipelines
- **Oil & Liquid Fuels - Key Issues**
  - Renewable Fuels Standards (RFS)
  - CAFE Standards and vehicle efficiency

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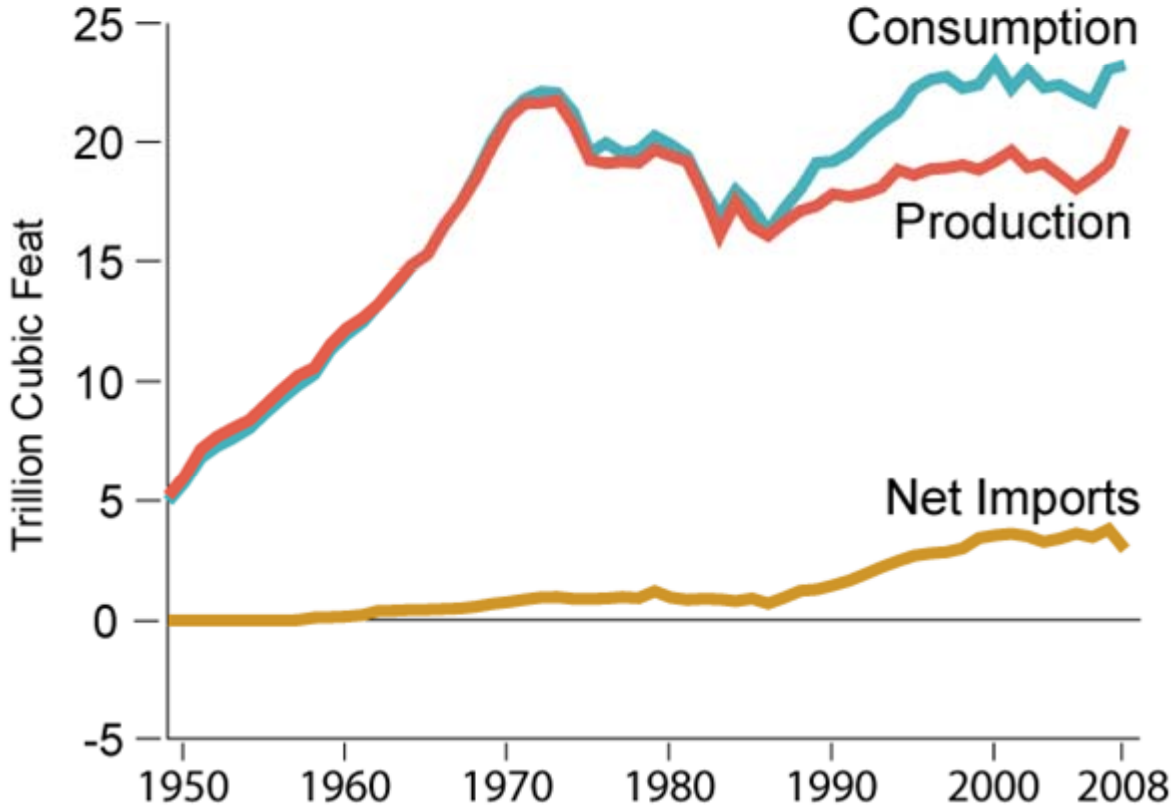
Historic Natural Gas Supply & Demand



2009 Supply & Demand

- Production: 20.76 Tcf
- Consumption: 22.59 Tcf
- Net Imports: 2.76 Tcf

U.S. Reserves

- Proved Reserves:
  ≈ 238 Tcf
- Technically recoverable:
  ≈ 1,536 Tcf

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U.S. Natural Gas Use is Expanding

Electric Power Generation: Driving consumption

Natural Gas Use, 2003-2008

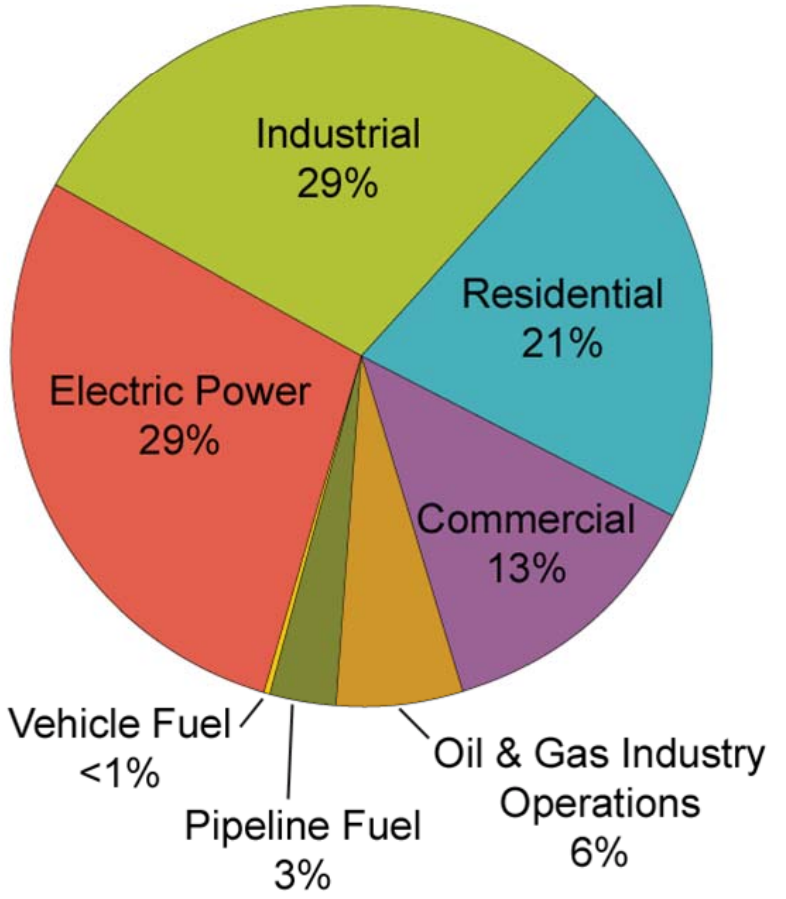
- All Sectors ≈ 4% increase
  - 2003: 22.2 Tcf - 2009: 22.8 Tcf
- Electric Power ≈ **17.5%** increase
  - 2003: 5.1 Tcf - 2009: 6.9 Tcf

Natural Gas Forecast, 2010-2035

- All Sectors ≈ 10.7% increase
  - 2010: 22.5 Tcf - 2035: 24.9 Tcf
- Electric Power ≈ 12% increase
  - 2010: 6.6 Tcf - 2035: 7.42 Tcf

- Sector percentages relatively unchanged through 2035
- Regulatory environment may increase role of gas-generated electric power.

Natural Gas Use by Sector



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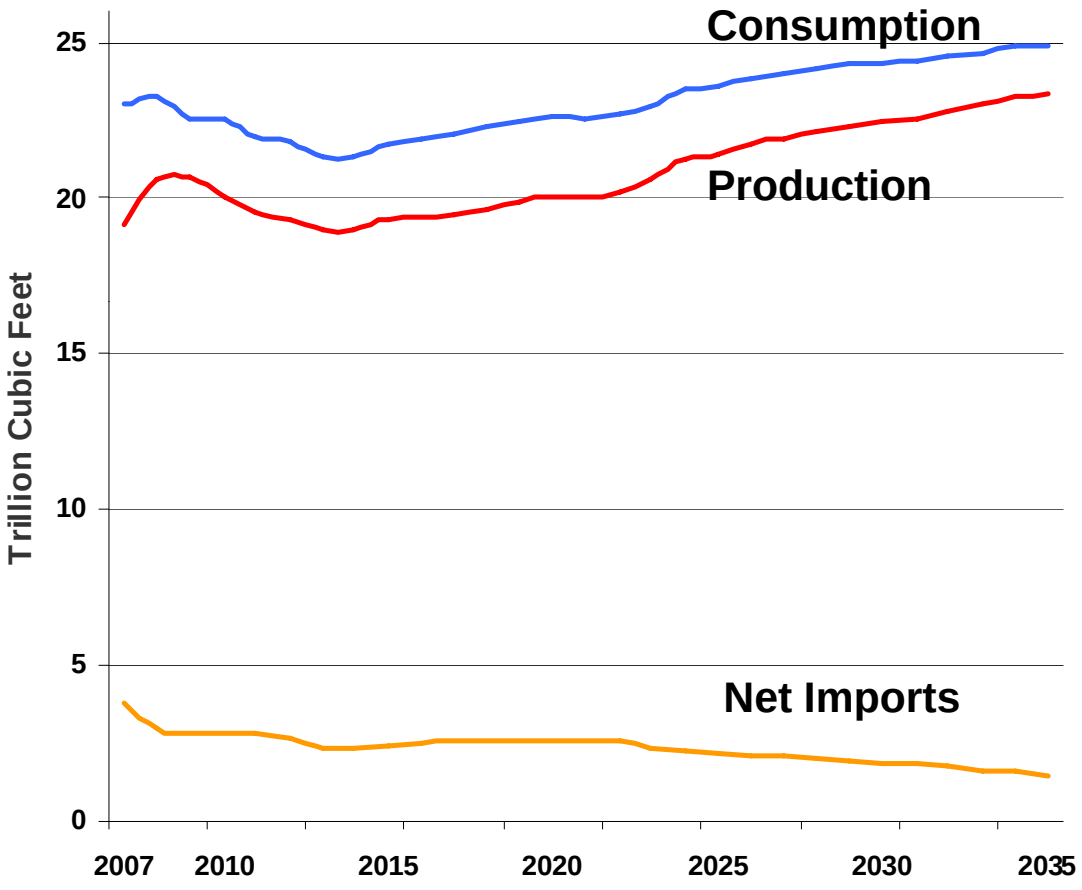
Natural Gas Forecast

2010-2035 Reference Case Scenario



Key Observations:

- Predicted decline through 2014
- Moderate upward trend after 2015
- U.S. shale development lowers prices and drives consumption
- Falling net imports:
  - Shale price pressure
  - Expected Alaskan pipeline
  - LNG project delays
- Reference case assumes no regulatory change
- New regulations are likely to alter trends

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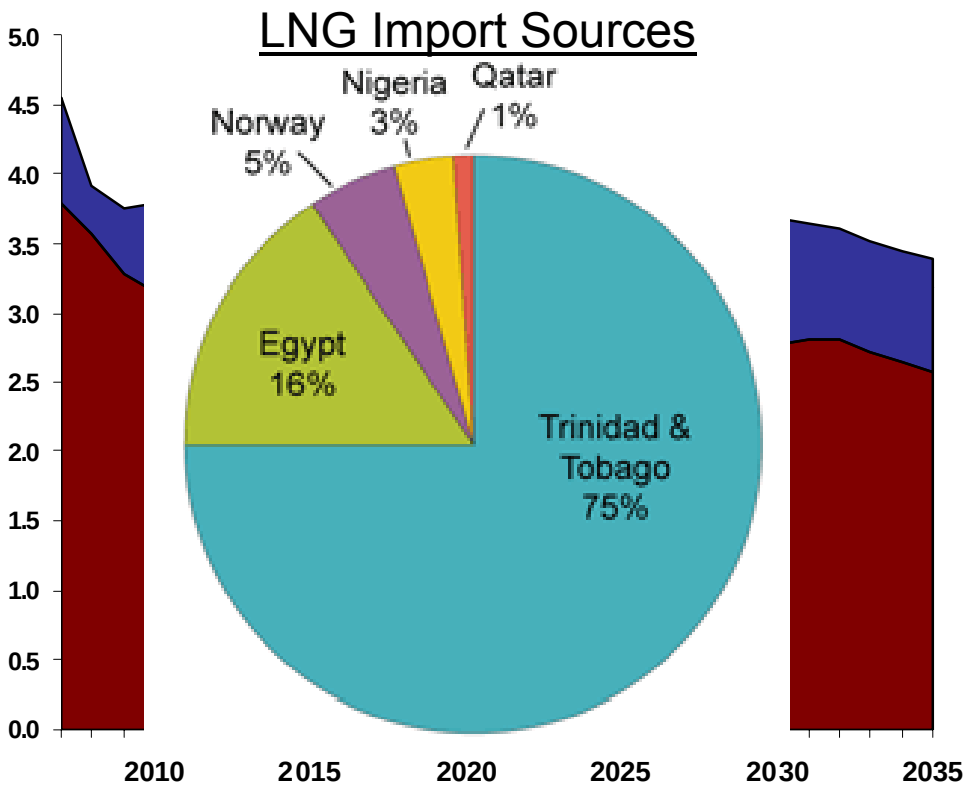
U.S. Natural Gas Import Sources



Pipeline Imports - 2009

- 85% of net imports
- 2.34 Tcf (≈ 12% of consumption)
- Primarily from Canada

LNG Tanker Imports - 2009

- 15% of net imports
- 0.42 Tcf (≈ 1.9% of consumption)
- Primarily from Trinidad and Tobago
- LNG sources and imports increasing

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Gas-Fired Electric Generation Infrastructure

Existing Infrastructure Under-utilized

- **U.S. has more gas-fired electric generating capacity than of any generation other type**
  - Gas-fired capacity: 338 GW - 33% of total
    - Forecast additions of 116 GW by 2035
    - 46% of total capacity increase through 2035
  - Coal-fired capacity: 312 GW - 31% of total
    - Planned additions of 31 GW by 2035
    - 12% of total capacity increase through 2035
- **Gas-fired generating capacity is under-utilized**
  - Gas-fired utilization ≈ 41%
  - Compare with ≈ 73% for coal-fired plants

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Demand Driver - Pending EPA Regulations

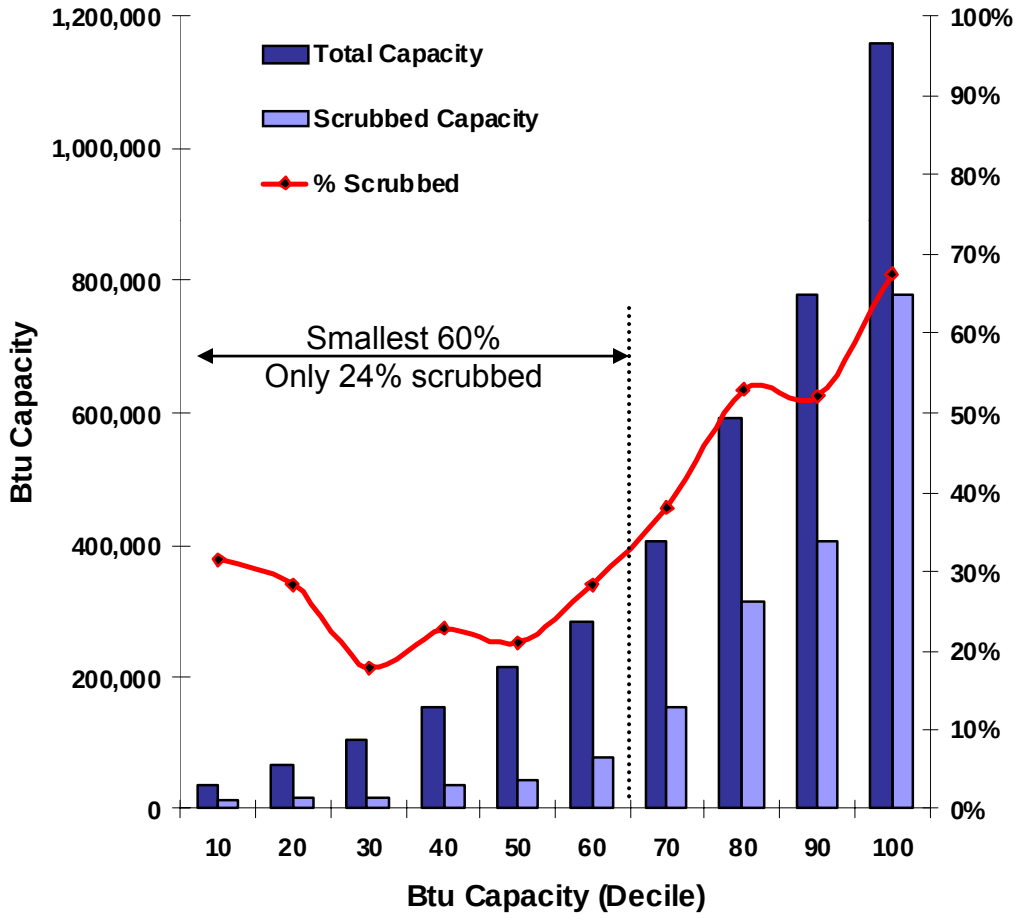
New rules spur demand for natural gas

- **New EPA rules will affect coal-fired power plants**
  - EPA must issue new mercury & acid gas rules by 2011
  - Will require new control requirements
  - All coal-fired power plants must comply, or shut down
- **Small & older coal-fired facilities will shut down**
  - Few have existing controls
  - Control Installation not cost effective
  - Closure will require new replacement capacity
  - Probable 2015-18 implementation timeframe
  - Could affect 17%-28% of coal-fired generating capacity
    - Represents 54-98 GW of capacity

Demand Driver - Pending EPA Regulations

Impact on small coal-fired power plants

Coal-fired Power Plant Scrubber Penetration by Size



Key Observations

- Scrubber installation rate increases with plant size
- Smallest 60% of plants have low scrubber installation rates
- Only about 1/4 of these small plants are scrubbed
- Remaining un-scrubbed plants represent 17% of coal-fired capacity that may be replaced

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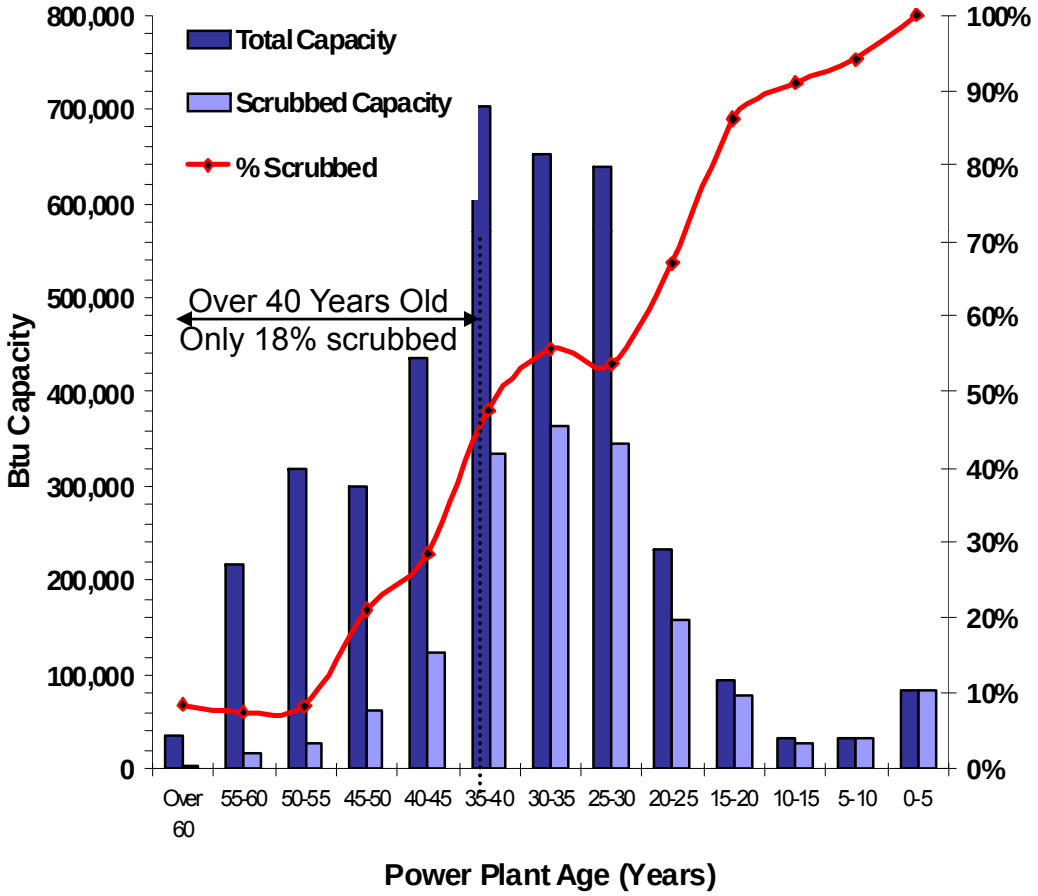
Demand Driver - Pending EPA Regulations

Impact on older coal-fired power plants

Coal-fired Power Plant Scrubber Installations by Age



Key Observations

- Plants over 40 years old have low scrubber installation rates and high heat rates (Btu/MWh)
- Less than 1/5 are scrubbed: 28% of total capacity may be replaced
- New plants approach nearly 100% scrubber installation and are unaffected

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Demand Driver - Renewable Portfolio Standards

Natural gas supports renewable power

- **RPS currently enacted by 31 states**
  - Require a certain percentage of electric generating capacity from renewable resources (10% - 33% range)
    - Phase in over time, typically by 2020-25
  - Natural Gas "peaking" capacity required to fill gaps left by wind, solar, and other renewable projects
    - Uneven distribution by region and gas supply/costs
- **National RPS standard**
  - Likely component of future GHG regulation strategy
  - Current models indicate a relatively flat natural gas consumption at a 15% national RPS
    - Higher standards may require additional peaking capacity

Climate Change & GHG Regulation

Varying effects on demand

- **EPA GHG regulations**
  - BACT determinations & efficiency measures
  - May result in increased gas consumption
    - Difficult to quantify - little consensus on BACT for GHGs
- **Pending legislation may cap carbon emissions**
  - Will add cost to carbon-based fuels
  - Drives down use & construction of coal-fired EGUs
  - Also adds cost to natural gas
  - Natural gas demand likely increases as GHGs are constrained, due to relatively low carbon content of gas

Climate Change & GHG Regulation (cont.)

The natural gas bridge

- **Natural gas will displace coal under cap-and-trade**
  - Gas-fired power plants emit ≈ 37% less CO_2 than coal
  - Existing gas-generating infrastructure under-utilized
  - Coal-fired generation currently less expensive
- **GHG allowance costs make gas competitive**
  - Current Costs:
    - Gas at $6/MMBtu;
    - Coal at $2/MMBtu ($41/ton)
  - At $29 per ton of carbon dioxide gas and coal values merge
  - Predicted CO2 price range for proposed US legislation is estimated to be $30 by 2020, escalating to $60 by 2030*

* Source EPA

Supply - Environmental Concerns

Potential constrains on shale gas development

- **Hydraulic fracturing and groundwater concerns**
  - Potential for increased state & federal regulation
  - Increased citizen challenges under NEPA and state laws
- **Pipeline infrastructure development**
  - Environmental concerns and regulatory delay/risk
- **VOC emissions from shale gas facilities**
  - Potential ozone problems may prompt state regulation
- **Potential GHG regulations**
  - Pending EPA regulations may increase costs
  - Legislation covers processing & distribution of natural gas

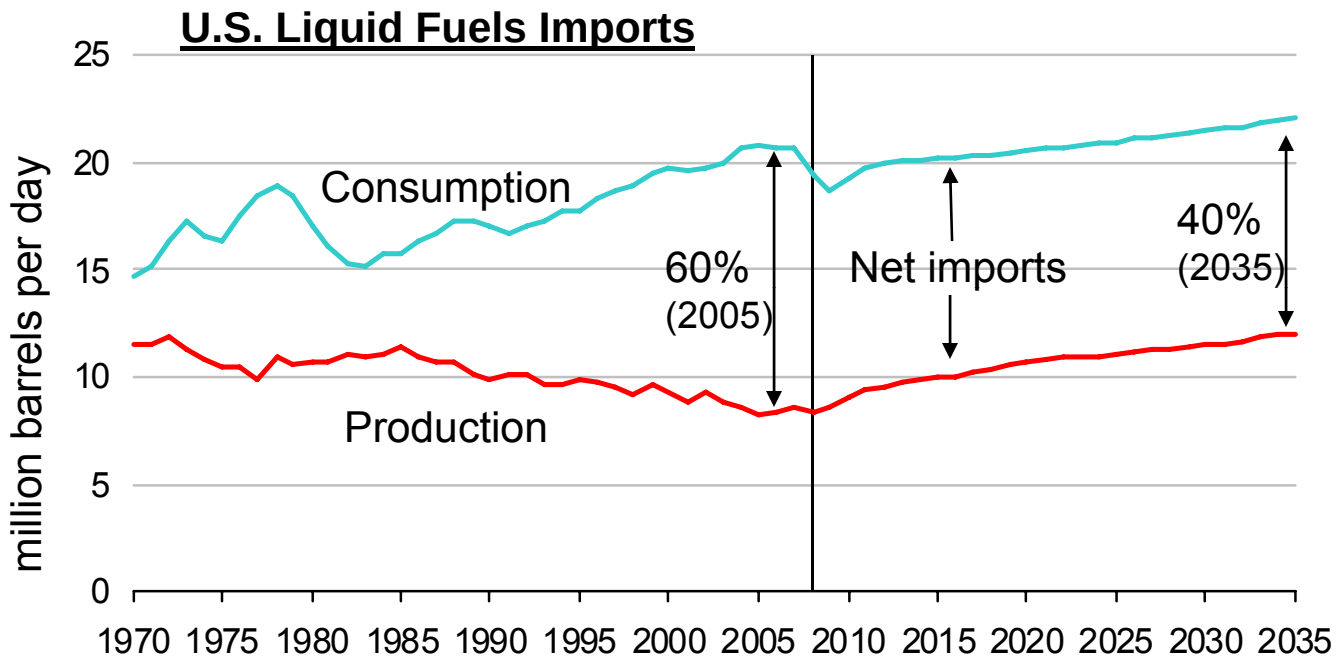
Supply - Regulatory Constraints

- **LNG Infrastructure Development Slows**
  - Timeframe and risks for new projects
  - Long regulatory process, jurisdictional & citizen issues
- **Pipeline Approvals Alter Supply**
  - Alaska: delivery from North Slope to US markets
    - Expected completion by 2023; regulatory uncertainty
  - Canada: Canadian shale gas production expanding
  - Price & supply pressure from domestic shale production will affect imports
- **U.S. Offshore Gas Production Stagnant**
  - Currently focused in Gulf of Mexico
  - Energy & climate legislation to expand opportunities

U.S. Demand for Oil and Liquid Fuels

- **Existing Regulatory Drivers**
  - Renewable Fuels Standards (RFS)
    - Displaces 13.6 billion gallons of petroleum-based fuels by 2023
    - Biofuels supply increases with new and existing incentives
  - CAFE Standards and vehicle efficiency
    - New standards require 40% efficiency gains by 2016
    - Eliminates need for an estimated 1.8 billion barrels of oil
- **Projections - next 25 years**
  - U.S. oil use remains near present level through 2035
  - Growth in demand met primarily by biofuels
  - Electric vehicle in-roads could affect gasoline demand

U.S. Imports Decline from 2005-2035



- 2009: Imports = 54% of total U.S. liquids fuels
- 2010: Share of imports declines to 45%
- 2035: Continued decline, to a projected 40%

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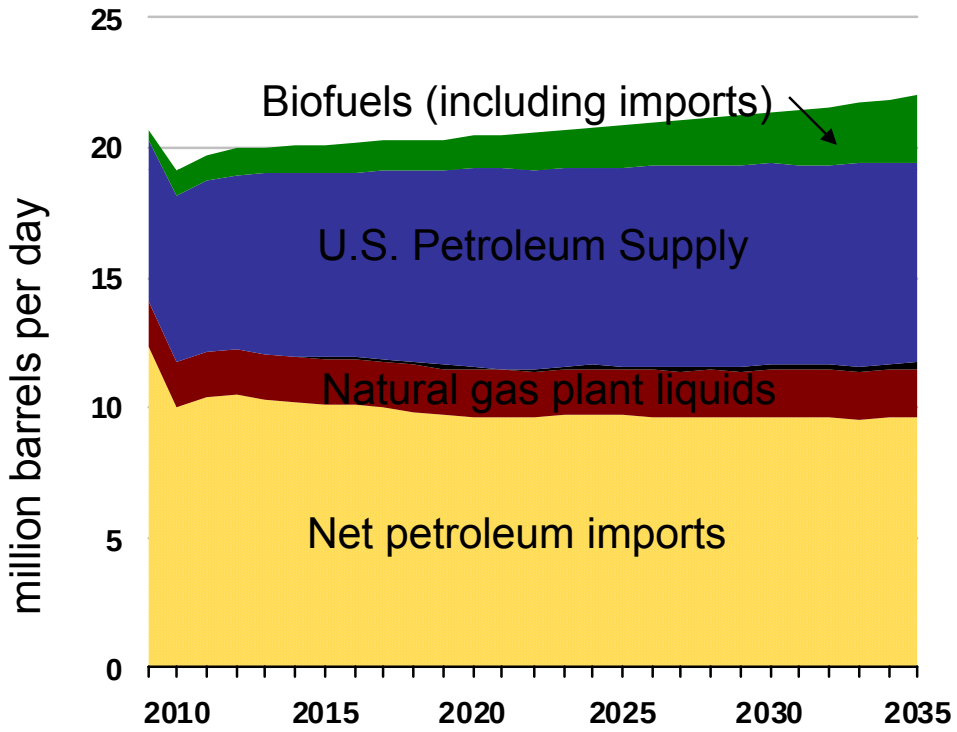
Biofuels Meet New Demand

Federal programs increase supply

Liquid Fuels Consumption



Key Observations:

- Biofuels are a priority for President Obama
- Biofuels Working Group evaluating mechanisms to increase production
- Current incentives & programs also expected to increase biofuel production
- Proposed USDA rule will provide financing to biofuel facilities

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Concluding Remarks

- **Natural Gas**
  - Low cost and regulatory compliance drive demand
    - New Clean Air Act rules, GHG regulation, RPS
  - Shale gas represents greatest domestic growth
    - Environmental and regulatory issues may constrain development
  - Imports will continue to play a secondary role
- **Oil & Liquid Fuels**
  - Consumption of petroleum-based liquids nearly flat
  - Biofuel consumption accounts for most growth
    - Federal RFS, efficiency, GHG concerns
  - Continued decline in imported volume
    - Overall expenditures back to 2008 levels by 2035

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