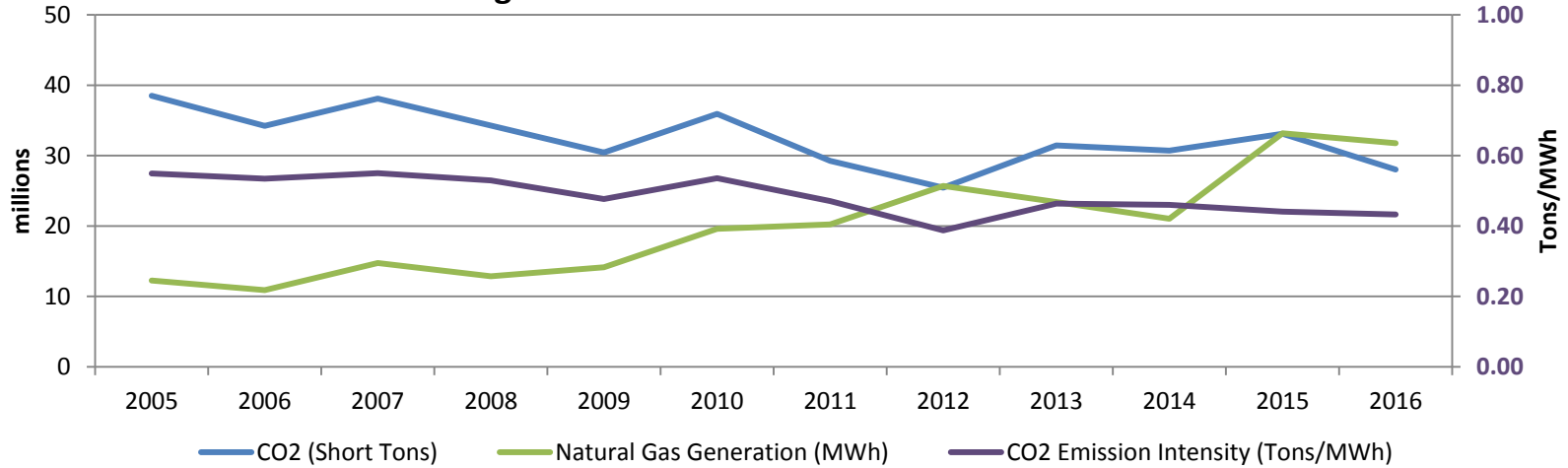


Markets and Power Sector Emission Reductions

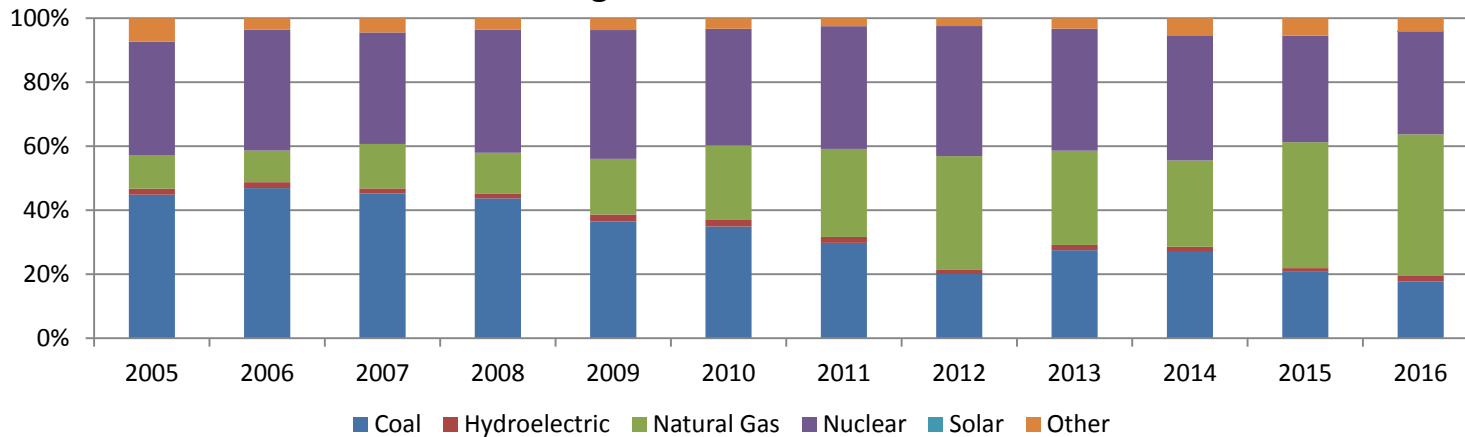
Erica Bowman
Chief Economist
American Petroleum Institute
February 28, 2017

VA Market-Driven Emission Reductions

Virginia: Generation and CO2 Emissions

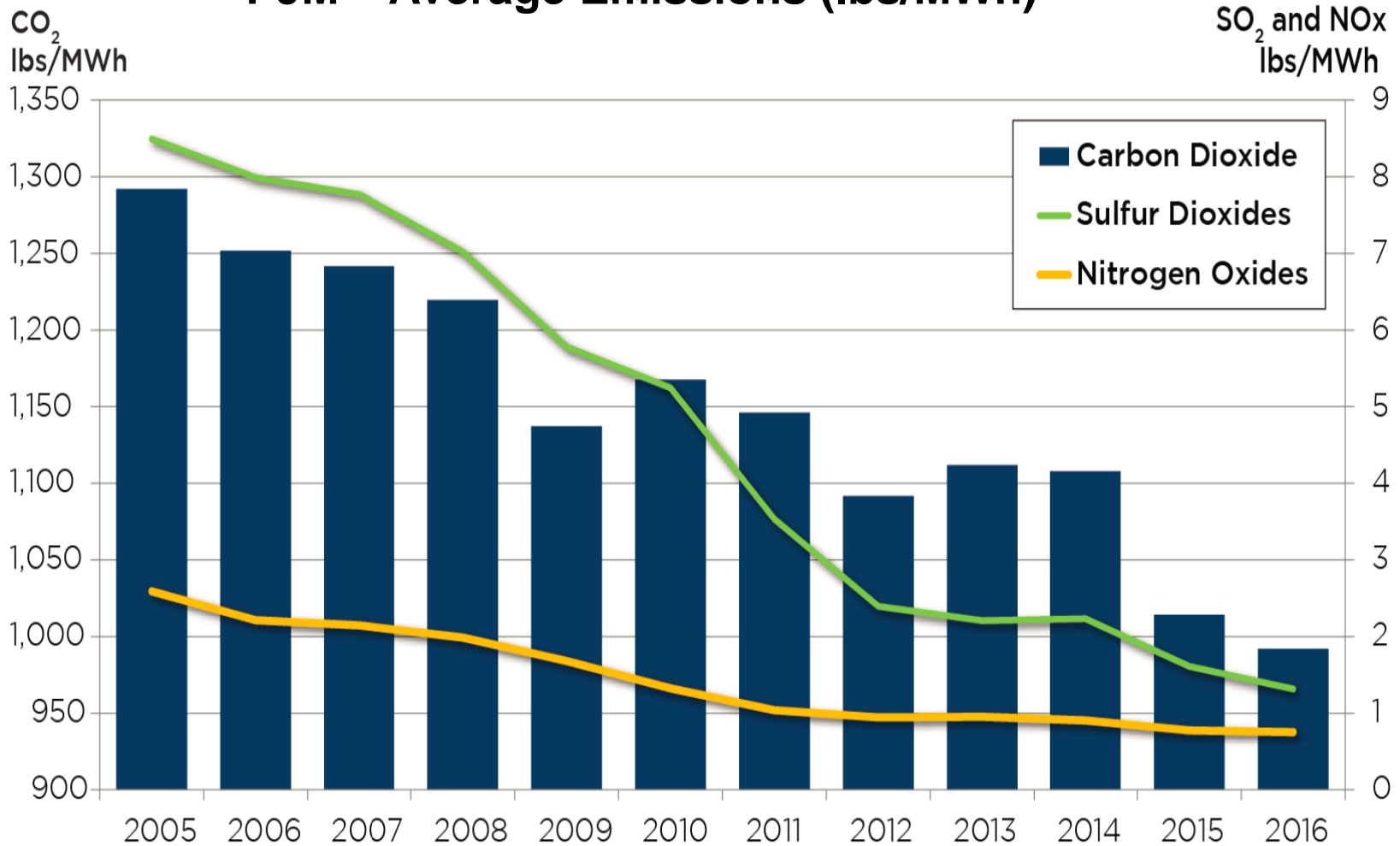


Virginia: Generation Mix



Regional Market-Driven Emission Reductions

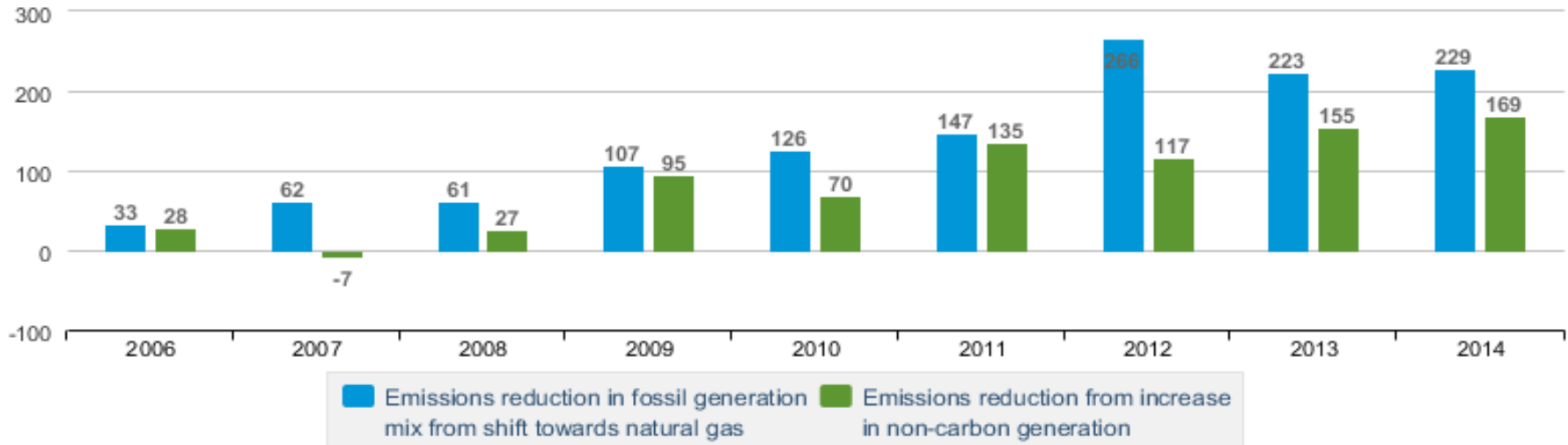
PJM – Average Emissions (lbs/MWh)



National-level emission reductions

CO2 emission reductions by source relative to 2005 generation fuel mix

million metric tons of carbon dioxide



Source: U.S. Energy Information Administration, *October 2015 Monthly Energy Review*, Table 12.6 Carbon dioxide emissions from energy consumption: electric power sector

Table 7.2b Electricity net generation: electric power sector

From 2004 to 2014, includes an estimate of distributed solar generation from the National Energy Modeling System,

Table 16. Renewable Energy Generating Capacity and Generation,



✓ CO2 emissions from power generation are at 25-year lows.

API Modeling of CPP

- Provides data driven analysis and an understanding of the role natural gas can play in a future generation mix, with or without CO₂ emission limits;
 - Demonstrates the importance of underlying assumptions about the size of the natural gas resource base.
 - Compares the compliance costs of relying on mandated energy efficiency or mandated renewables versus relying on market forces.
- Modeling represents four EPA-defined potential compliance pathways -- federal plan, state rate-based plan, mass based plan on existing sources, and mass-based plan on existing and new sources;
 - Uses the same assumptions and model as EPA with the following exceptions:
 - Considers realistic assumptions about the size of our nation's natural gas resource base;
 - Includes model version updates that reflect changes between the proposed and final CPP rules.

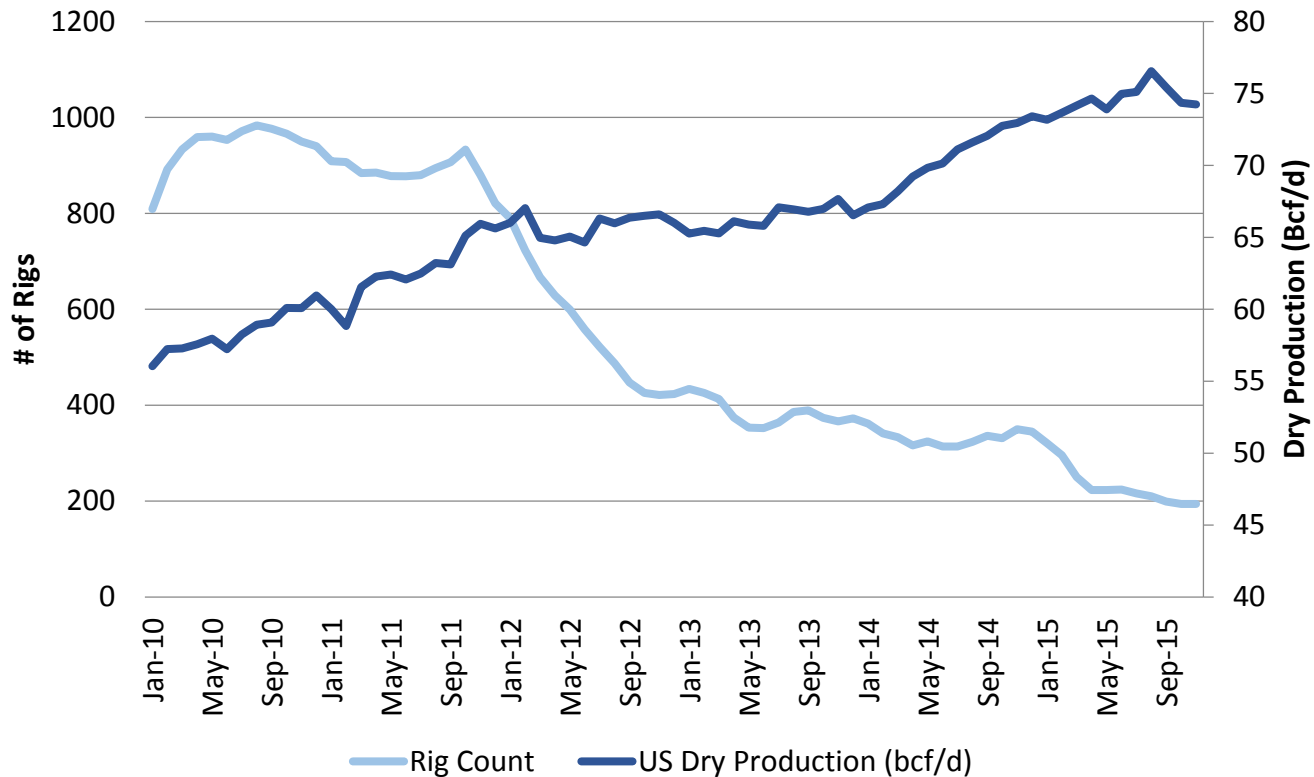
API Methodology & Terminology

- On behalf of API, ICF International (ICF) ran their North American power production-cost model, which solves for the least-cost mix of generation to satisfy a given load while meeting certain constraints or requirements, e.g., emission limits.
- ICF created an API reference case and model runs that include assumptions as defined in EPA's v5.15 Power Sector Modeling Platform and the API-requested natural gas resource reflecting the EIA AEO 2015 High Natural Gas Resource assumption.
- **Compliance Pathways:** the EPA-defined options for states to comply with the CPP rule.
- **API-Defined Implementation Choices:**
 - **Market Forces:** Allows the model to solve for the least-cost compliance solution (i.e., generation mix and new capacity additions) to satisfy the constraints in the compliance pathway by not forcing additional mandates beyond those in existing policy.
 - **Increased Energy Efficiency (EE) Mandates:** Assumes reduced load, consistent with the 1% per year compounding load reduction EPA assumed in its Regulatory Impact Analysis and then applies EPA's assumed capital costs for EE to that load. Allows the model to solve for the lowest cost generation mix for remaining load.
 - **Increased Renewable Mandates:** Models a requirement that in-state renewable energy (RE) generation must at least be equal to the EPA-derived state level of renewables used in EPA Best System of Emission Reductions (BSER) standard calculation*.

* Although the EPA BSER calculation was based on renewable capacity operational after 2012, the model allowed any in-state RE generation to satisfy the requirement.

NG Production Efficiency Growing

Indicators of Production Efficiency



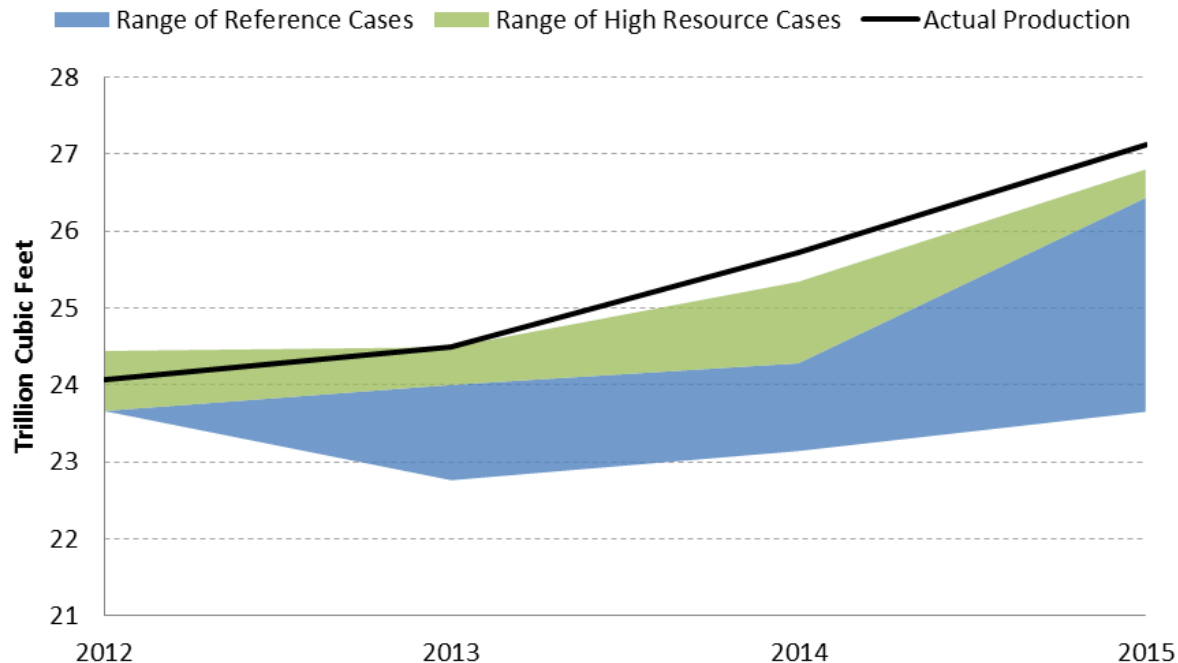
Source: EIA, Baker Hughes

- ✓ *Continued efficiency and technology improvements are unlocking shale gas potential, delivering more gas with fewer rigs and enabling fast supply response to changing demand signals.*

Production Exceeds Expectations: Demonstrates High Resource Reality

U.S. Dry Natural Gas Production

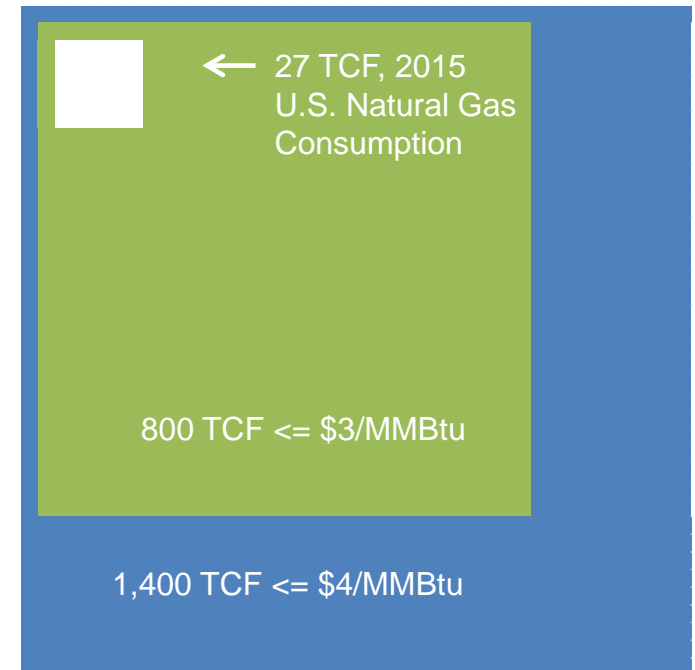
EIA AEO 2012-2015 Projections & Actuals



- ✓ *North America is in a high resource reality.*
- ✓ *Even though production projections increased in each subsequent AEO, actual production continues to exceed even EIA high oil and gas resource projections.*

IHS Study bolsters resource outlook

- The IHS supply study, ***Shale Gas Reloaded: The Evolving View of North American Natural Gas Resources and Costs***, concludes that in the U.S. Lower 48 and Canada:
 - Approximately 1,400 TCF of natural gas is recoverable at a current Henry Hub break-even price of \$4/MMBtu or less (in real terms), a 66 percent increase over 2010 estimates.
 - More than 800 TCF can be produced at a current break-even price of \$3/MMBtu or less.



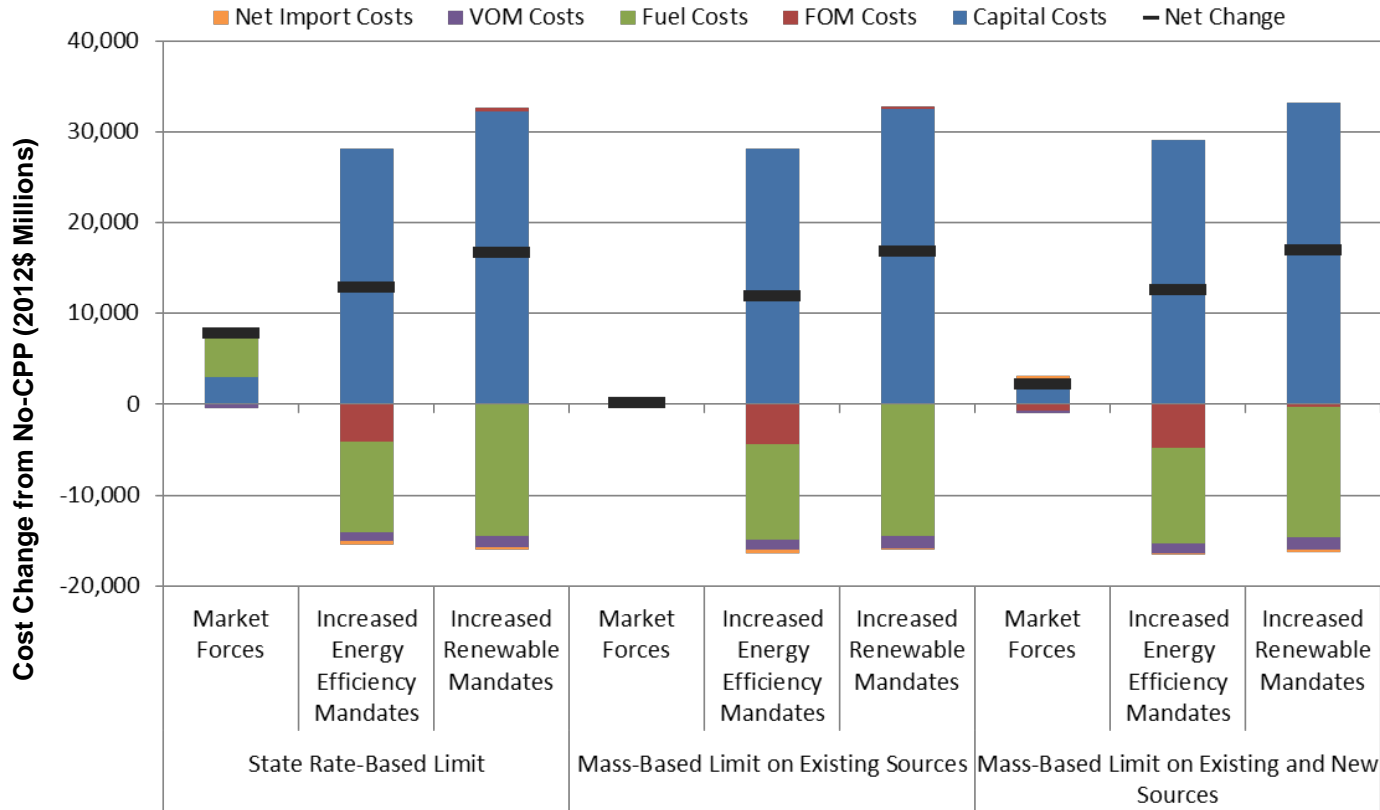
Key Findings

- (1) Natural gas generation in the power sector will drive emission reductions even without the CPP. In fact, modeled 2030 CO₂ emissions under API's reference case¹ are 30% lower than 2005 CO₂ emission levels;
- (2) Total production costs² are lowest when market forces drive the future resource mix to achieve compliance rather than relying on government mandates for energy efficiency or renewables;
- (3) Within each of the EPA-defined compliance pathways, the lowest cost solution to meeting compliance also has the most natural gas generation.

¹ API reference case assumes: No CPP, Business-as-usual load, API natural gas resource assumptions.

² IPM production costs include costs associated with the production of electricity including capital, fixed operating and maintenance, fuel, and variable operating and maintenance costs.

API Results: U.S. Net Cost Change and Cost Change by Production Cost Component in 2030



Because natural gas is so affordable:

- Reductions in fuel costs in the mandated EE and RE cases are more than offset by increased EE & RE capital costs.
- Capacity investments and generation shifts in the API reference scenario result in greater emission reductions than required by the CPP Mass-Based Limit on Existing Sources, therefore the market forces implementation case shows no cost change.

✓ *Market forces, not mandates, lead to lowest cost compliance: Costs are higher for implementation choices that mandate RE or EE.*