



Potential Implications of Carbon Regulations on Natural Gas Power Generation

Integrated Energy Policy Report Workshop
California Energy Commission

June 16, 2009

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Overview

- Impacts on natural gas markets and natural gas-fired generation from:
 - Carbon caps
 - Energy efficiency measures
 - Renewable portfolio standards
 - Economic constraints
 - Technologies
 - Electricity generation
 - Carbon capture and storage
 - Residential and commercial fuel switching – electricity to natural gas



Overview (cont.)

- Studies modeling S. 2191 (Lieberman-Warner) scenarios:
 - Energy Information Administration
 - Duke University Climate Change Policy Partnership
- Natural Resources Defense Council scenarios modeling failure to implement any GHG policy
- Studies modeling generic technology, system, policy, and market assumptions:
 - Electric Power Research Institute
 - American Gas Foundation
 - CPUC/Energy Commission



Prevailing Conclusions

- The electric power sector accounts for the vast majority of CO₂ emissions reductions
 - Emissions reductions in residential, commercial, industrial and transportation sectors relatively small
- Total electric generation is reduced; retail prices increase
- Nuclear and coal-fired generation continue to serve most baseload
- Natural gas-fired generation continues to serve marginal load during most hours



Prevailing Conclusions (cont.)

- Prices for natural gas – wellhead, delivered or Henry Hub – increase
- Total coal consumption is significantly reduced
- Timely development of key technologies required to keep energy prices from soaring as carbon caps decrease
 - Some disagreement about which technologies are key, or prospects for timely availability
- Renewables, energy efficiency, demand reduction mitigate energy demand and costs



Differences of Opinion

- Effect of S. 2191 carbon caps on electricity sector natural gas demand and prices:
 - EIA, EPRI, AGF: Caps increase demand and prices
 - Duke: Caps will not significantly increase demand; delivered prices for electricity and industrial sectors increase
- Effect of S. 2191 carbon caps on coal-fired generation:
 - EIA, Duke, CPUC/Energy Commission: Coal-fired generation is reduced significantly
 - EPRI: Coal-fired generation depends on CCS



Differences of Opinion (cont.)

- Effect of S. 2191 carbon caps on natural gas-fired generation:
 - EIA, EPRI, AGF: Natural gas-fired generation replaces proposed nuclear, renewables, or coal+CCS if latter not available
 - Duke: Natural gas-fired generation competes with and substitutes for renewables, not coal

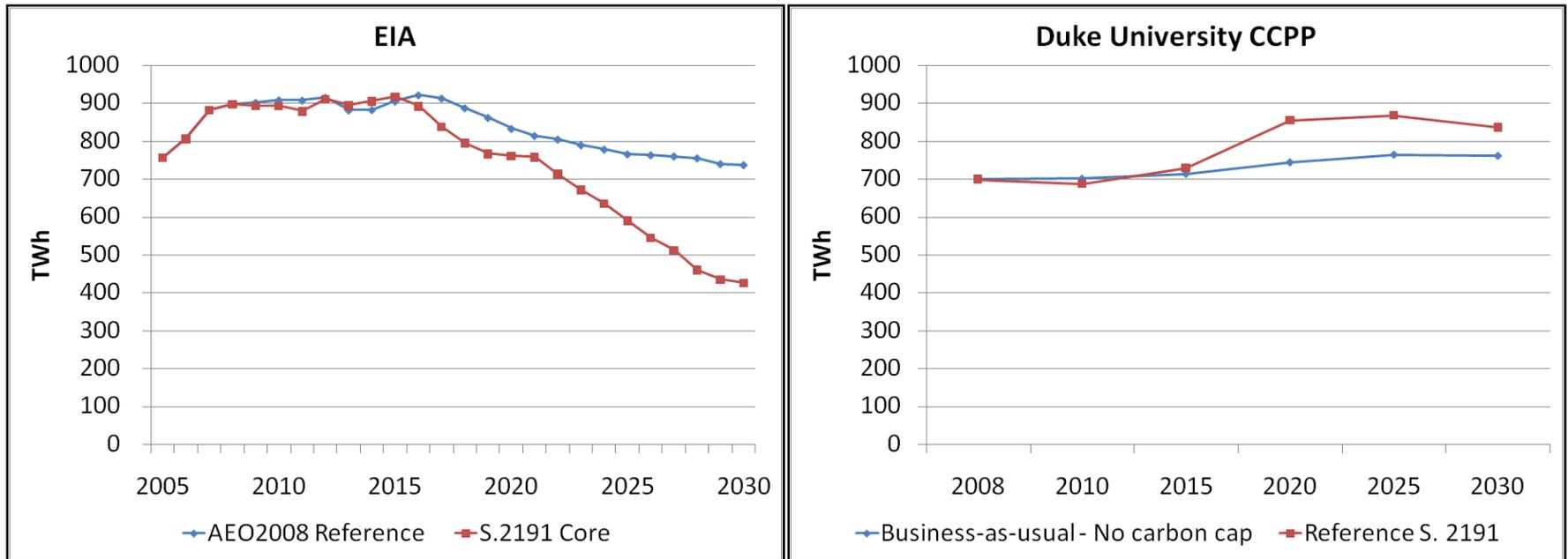


Differences of Opinion (cont.)

- Strategies key to minimizing GHG policy costs:
 - EIA, Duke, EPRI: Nuclear, coal+CCS, IGCC, energy efficiency, wind and biomass
 - AGF: Fuel-switching from electricity to natural gas in residential and commercial applications
 - CPUC/Energy Commission: Renewables and energy efficiency technologies and programs



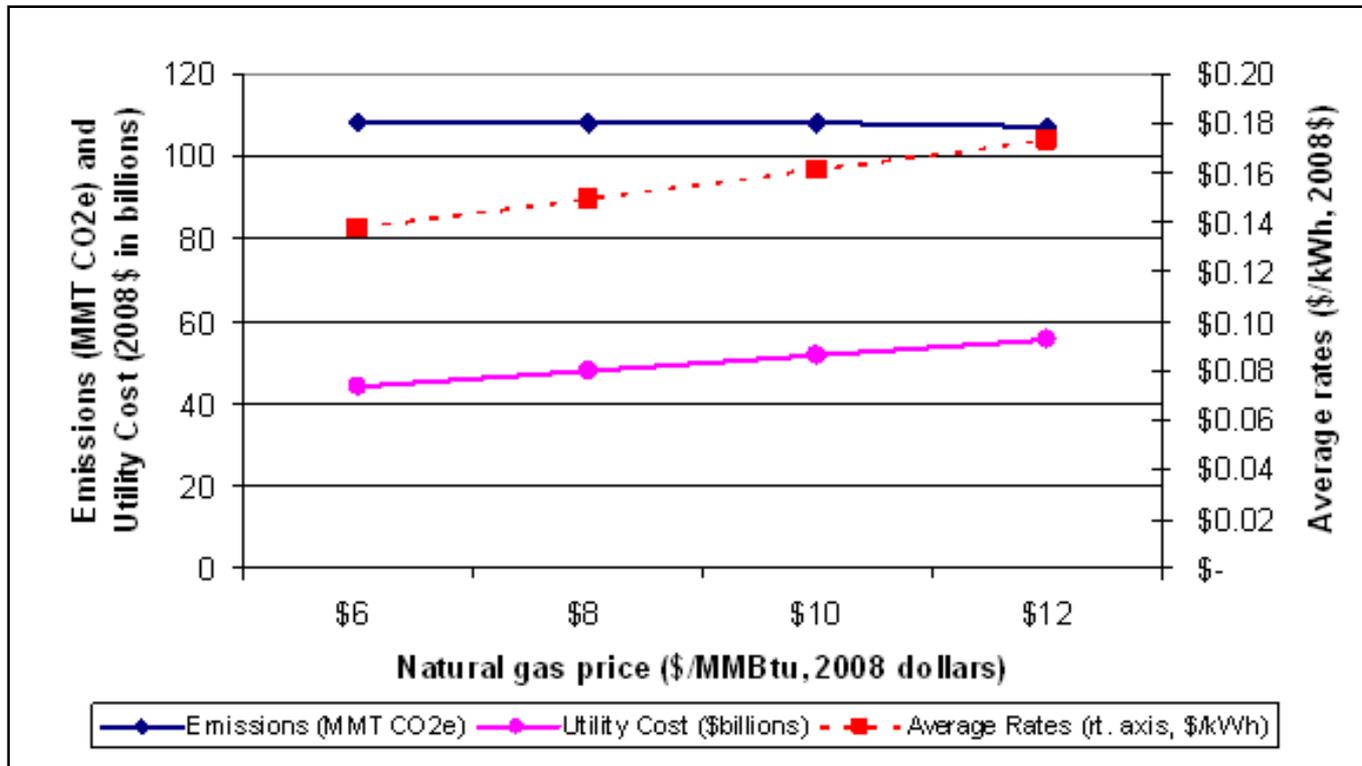
EIA vs. Duke Natural Gas-Fired Generation: Reference Case vs. S. 2191



As close as two of the selected studies come to agreement. EIA *AEO2008* Reference and Duke Business-as-usual baselines both use *AEO2008* assumptions, but Duke adds new unconventional natural gas reserves, restricts LNG imports to a portion of EIA assumptions, allows CCS retrofits to existing power plants, and increases power plant construction costs. Both studies used EIA's NEMS model. Major findings for these studies might disagree with these charts, because the major findings synthesize all scenarios modeled.



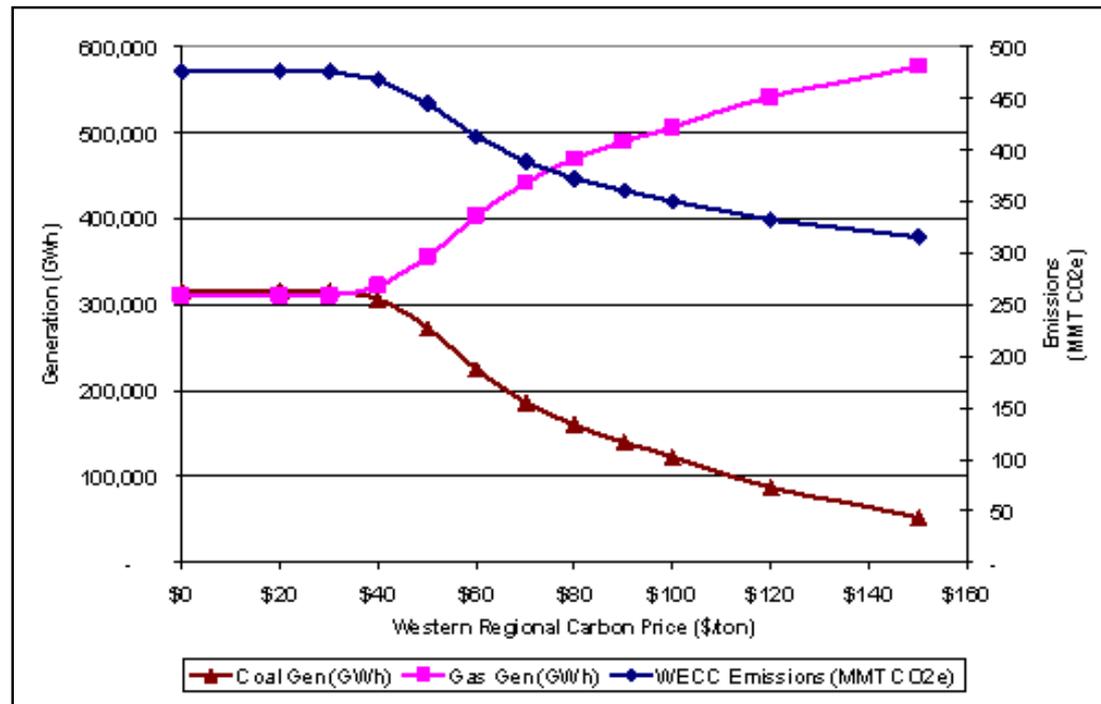
Effect of Natural Gas Prices on Electricity Rates



One of the prevailing conclusions is that carbon caps will increase natural gas prices across the U.S. In California, where the ratio of natural gas- to coal-fired generation is a lot higher, a doubling of natural gas prices increases average electricity rates by about 3.5 cents/kWh. Emissions remain nearly flat because the resource plan assumptions do not include changes in power plant dispatch.



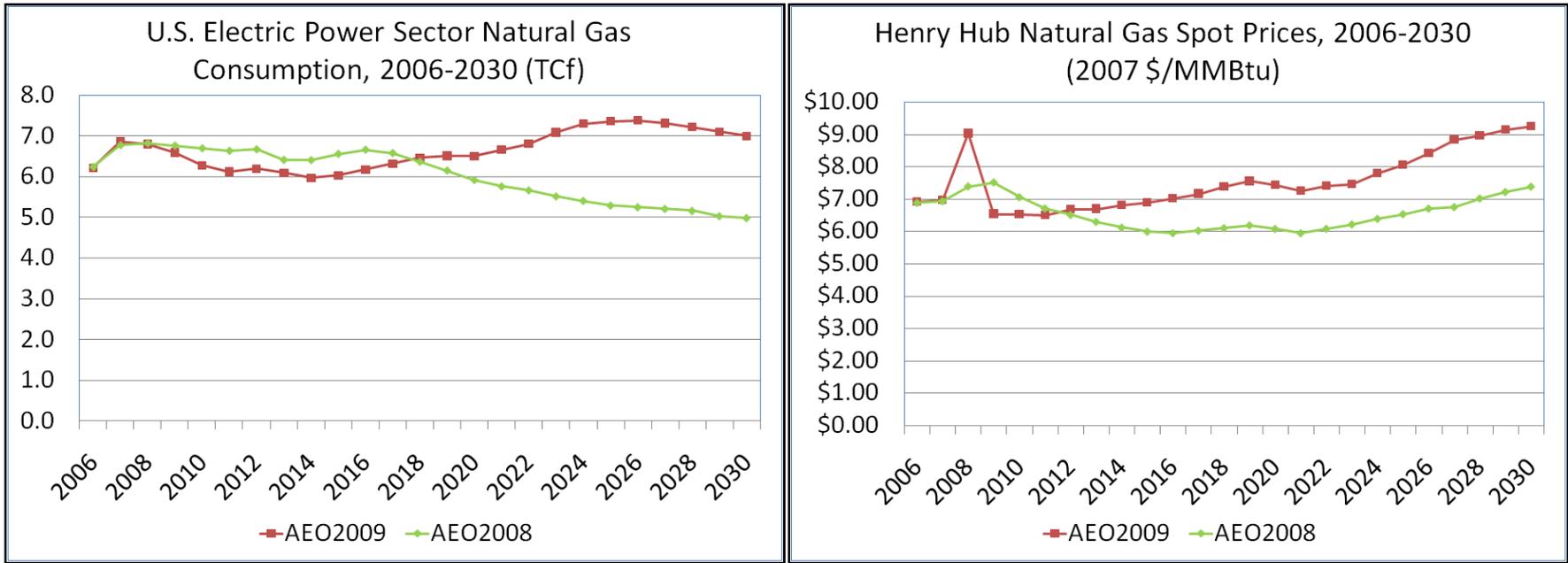
Effect of Carbon Prices on Natural Gas- and Coal-fired Generation and CO₂ Emissions



Another prevailing conclusion of the studies is that total U.S. coal consumption is significantly reduced under carbon caps, due to reduced coal-fired generation. Some studies argue that U.S. natural gas-fired generation does not displace coal as carbon prices increase, but this chart for the year 2020 projects that it will in the WECC, where natural gas is favored much more than in the rest of the U.S.



The Problem with Changing Baselines



Two assumptions that are critical to modeling the performance of GHG regulations – U.S. electric power sector natural gas demand, and Henry Hub natural gas spot prices – are charted here. In the outlying years of the *AEO2009* forecast, demand for natural gas is projected to exceed 7 trillion cubic feet (TCf) – a whopping 2 TCf, or 40 percent increase – over the *AEO2008* forecast. Natural gas prices beginning in 2015 are projected in the *AEO2009* to exceed the same inflation-adjusted prices forecast in the *AEO2008* by \$1/MMBtu, or 17 percent, and in the outlying years the differentials nearly double.



Issues

- Will the federal laws and regulations emphasizing lower carbon emissions result in a switch from coal power generation to natural gas generation?
- Since California receives 87 percent of its natural gas needs from out-of-state, what will be the potential impact on natural gas supplies to California?



Issues (cont.)

- Will an increase in natural gas demand for electricity generation in states that currently use coal have a significant impact on prices that California pays for natural gas?
- Will natural gas demand in California decrease due to the carbon emission concerns associated with natural gas use for electricity generation?



Questions & Comments