Managing Natural Gas Price Volatility and Escalation:
The Value of Renewable Energy

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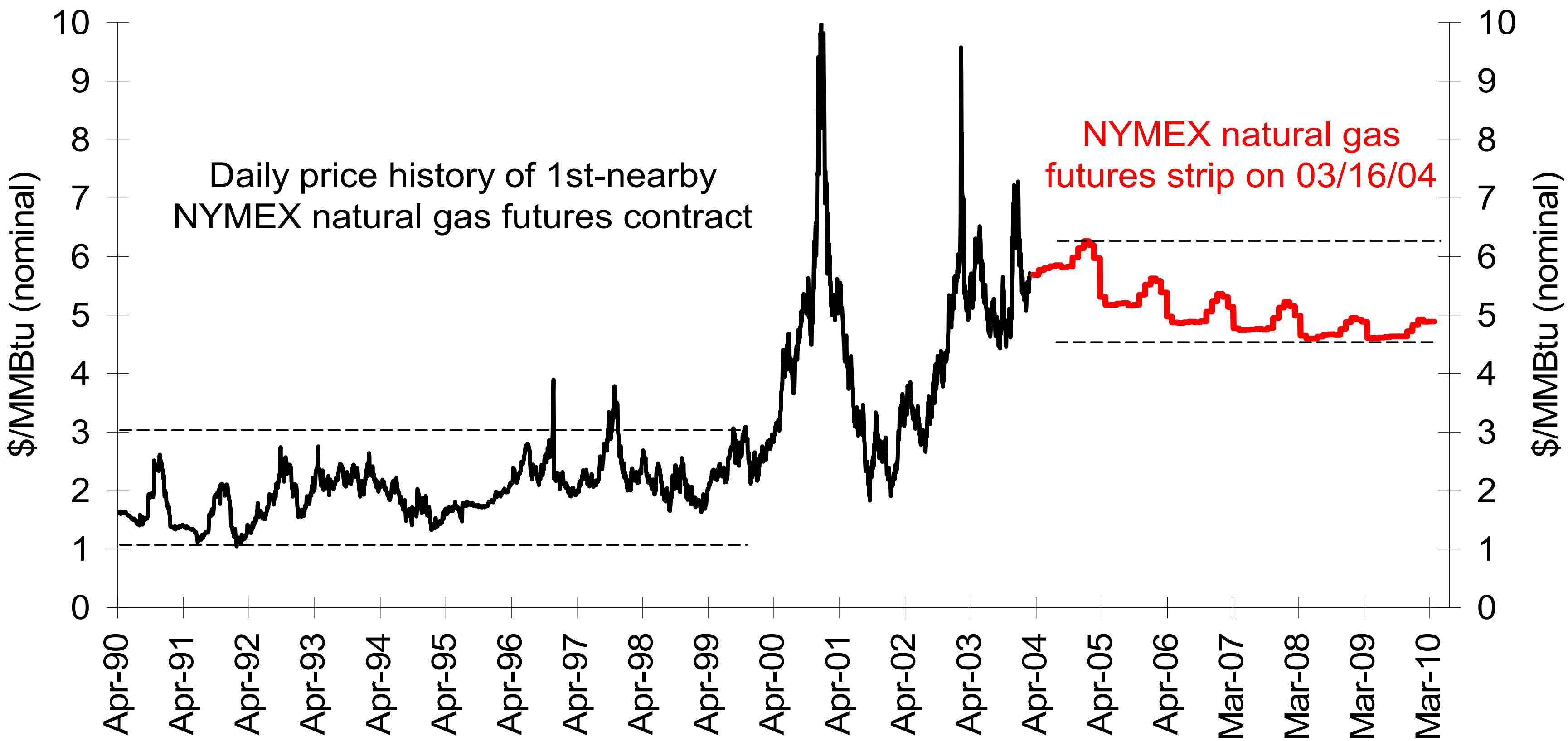
Overview

- Renewable energy (RE) provides a hedge against volatile and escalating gas prices:
  1) **Mitigates Fuel Price Risk:** Long-term contracts for RE are typically offered on a fixed-price basis, unlike gas-fired generation contracts
  2) **Reduces Natural Gas Prices:** Increased RE reduces natural gas demand, and consequently puts downward pressure on gas prices
- Presentation includes an overview of natural gas price uncertainty, and discusses research on both of these possible benefits

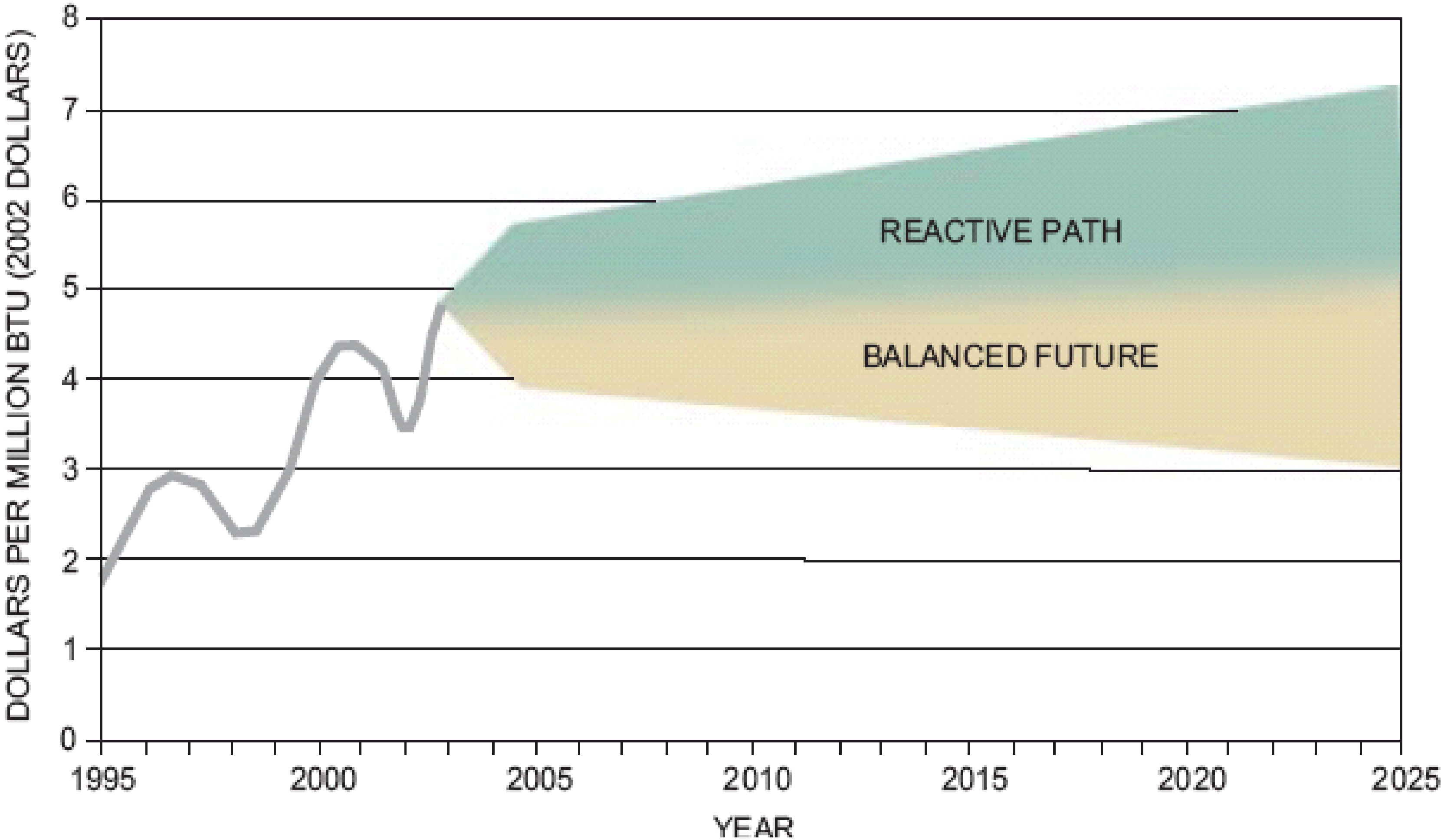
Natural Gas Prices Are High and Volatile



Source: NYMEX

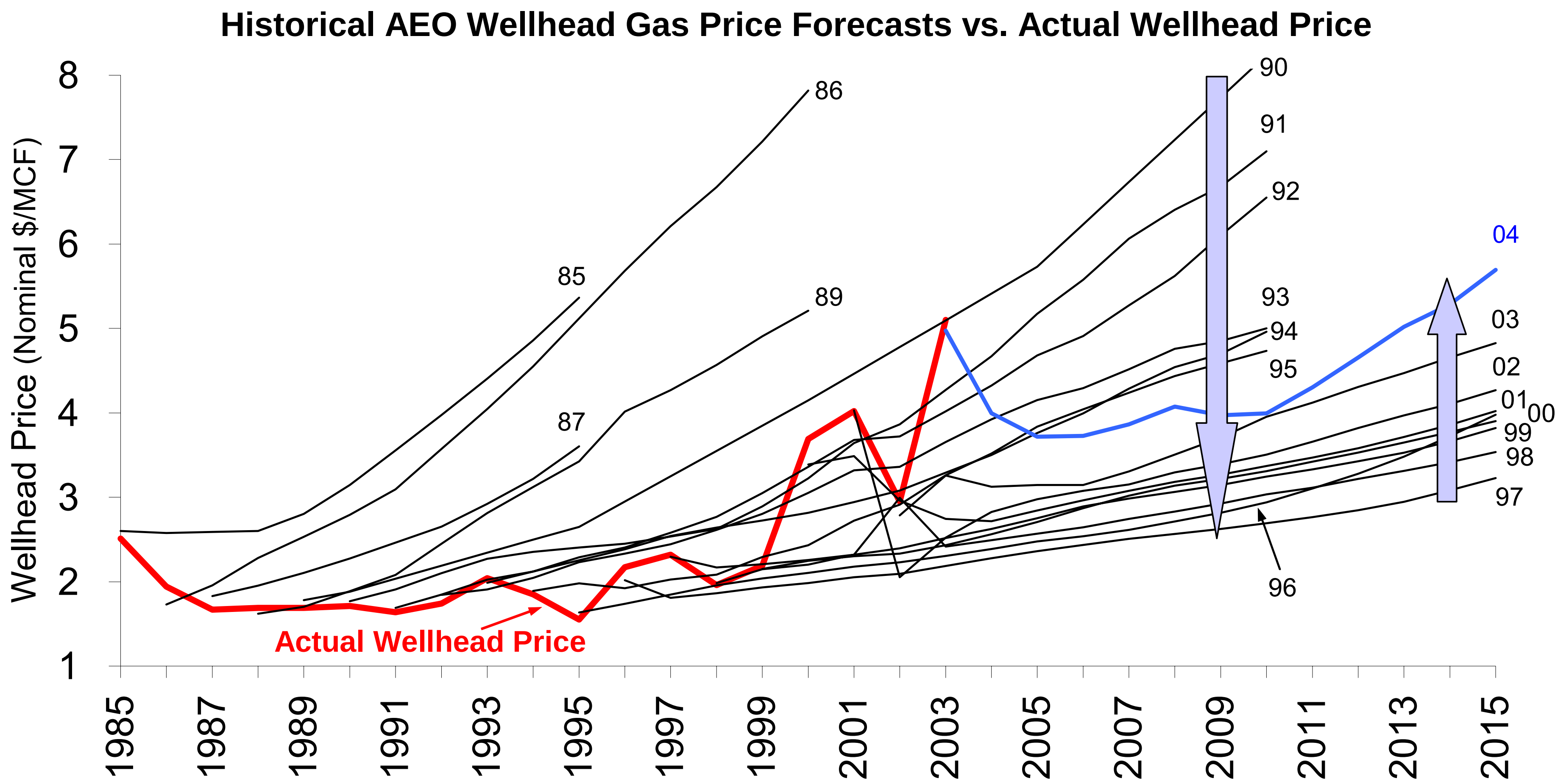
Gas fuel costs account for half of the total cost of new natural gas-fired generation, and gas-fired generation often sets the market clearing price in wholesale electricity markets

Natural Gas Price Forecasts Show a Broad Range of Possible Outcomes



Source: National Petroleum Council, 2003

…But Be Wary of Price Forecasts…



Source: EIA

The Value of Fixed-Price RE Contracts

- Renewable energy can provide a physical hedge against volatile gas prices
  - Renewable energy typically offered at fixed prices for lengthy contract durations (>10 yrs)
  - Gas-fired generation often offered on a long-term indexed or tolling basis, or sold in short-term volatile markets
- Customers or policymakers that value price stability may prefer fixed-price over variable-price arrangements
- RE is not unique in providing price stability: gas generators can hedge using fixed-price gas futures, forwards, and swaps, though perhaps not for same duration as RE

LBNL's *Accounting for Fuel Price Risk…*

Question: How to compare the levelized cost of fixed-price renewable to variable-price gas-fired generation?

Current Practice:  to 

- Cost of renewables is often compared to cost of gas-fired generation based on ***uncertain*** fuel price forecasts

Best Practice:  to 

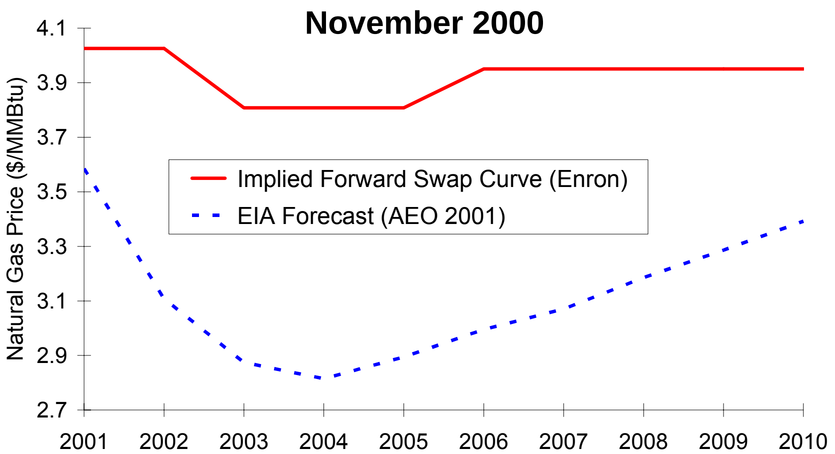
- Cost of renewables should be compared to cost of gas-fired generation based on a ***guaranteed*** fuel price

How do *guaranteed* forward gas prices compare to *uncertain* gas price forecasts?

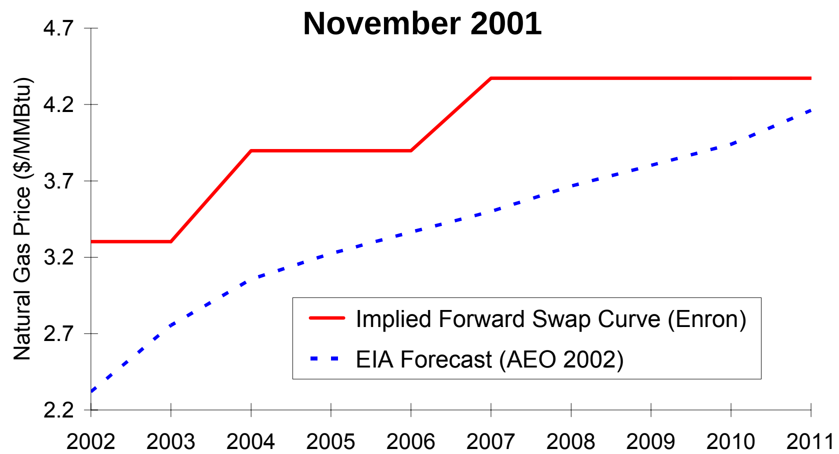
Methodology

- Compared forward market prices for natural gas to long-term spot price gas forecasts
  - **Forward market** data from NYMEX (2002, 2003), Williams/DWR contract (2002), and Enron (2000, 2001), limited to maximum of 10 years
  - **Contemporaneous forecasts** from EIA's AEO reference case (adjusted to delivery point for forwards), and from utility IRP filings
- Limited data availability, especially for long-term forwards, constrains robustness of findings

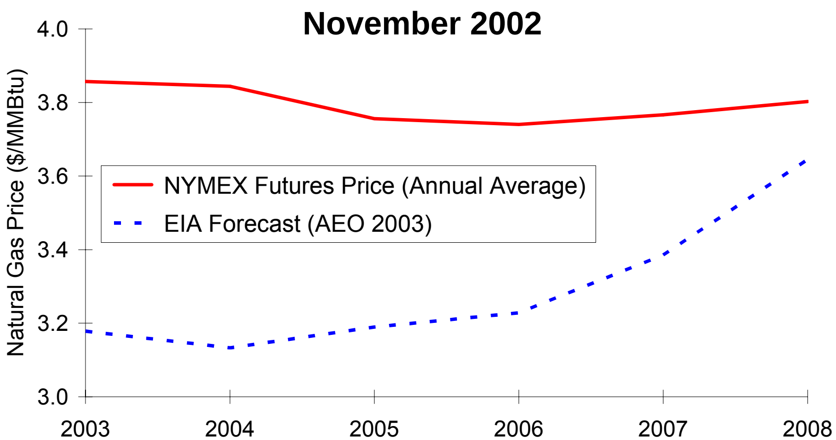
Forward Prices Exceed Price Forecasts



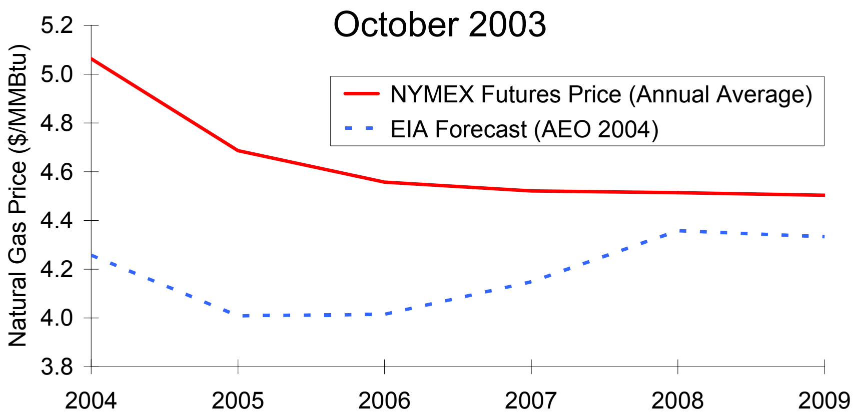
Source: Enron and EIA



Source: Enron and EIA

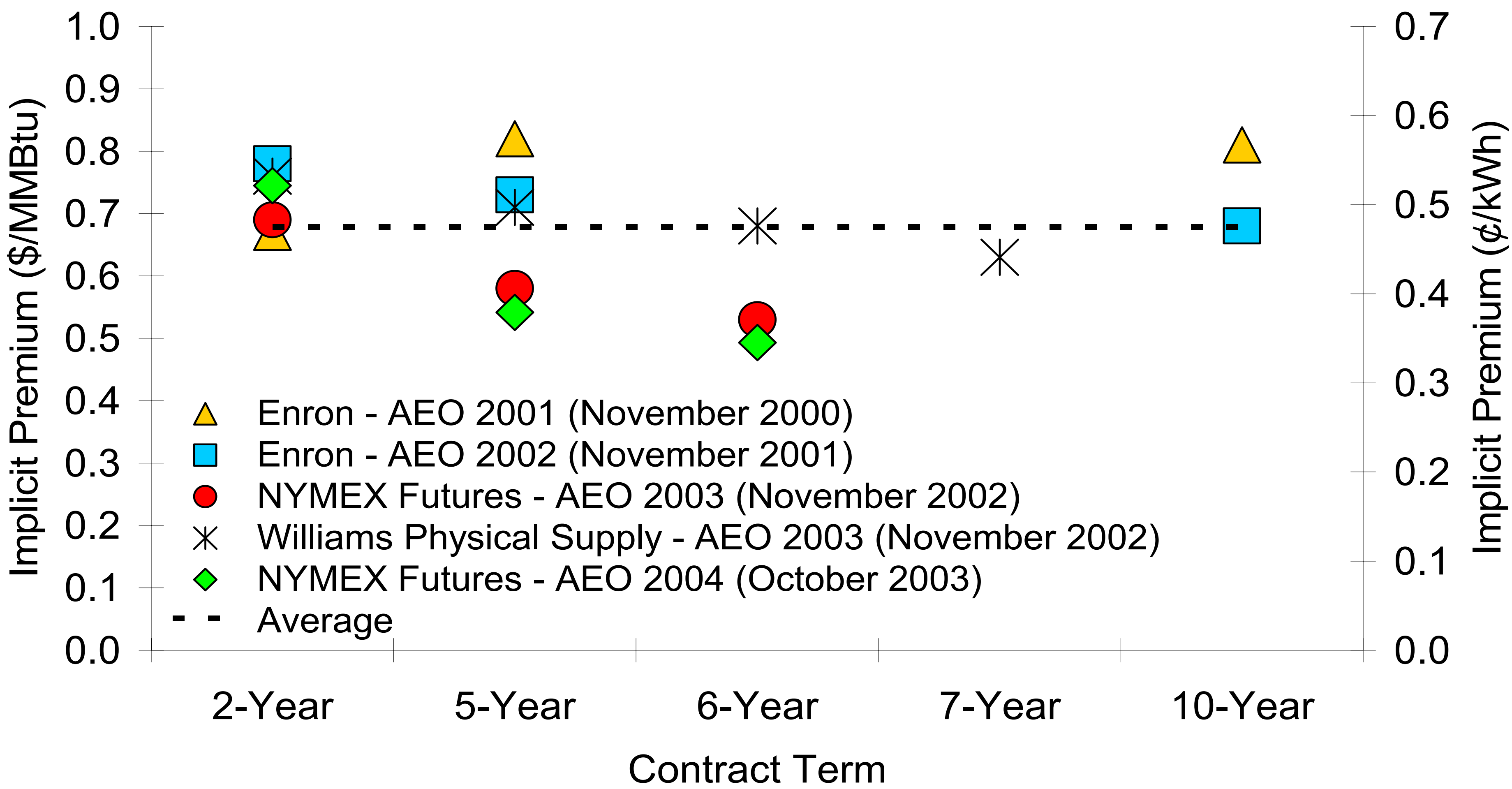


Source: NYMEX and EIA



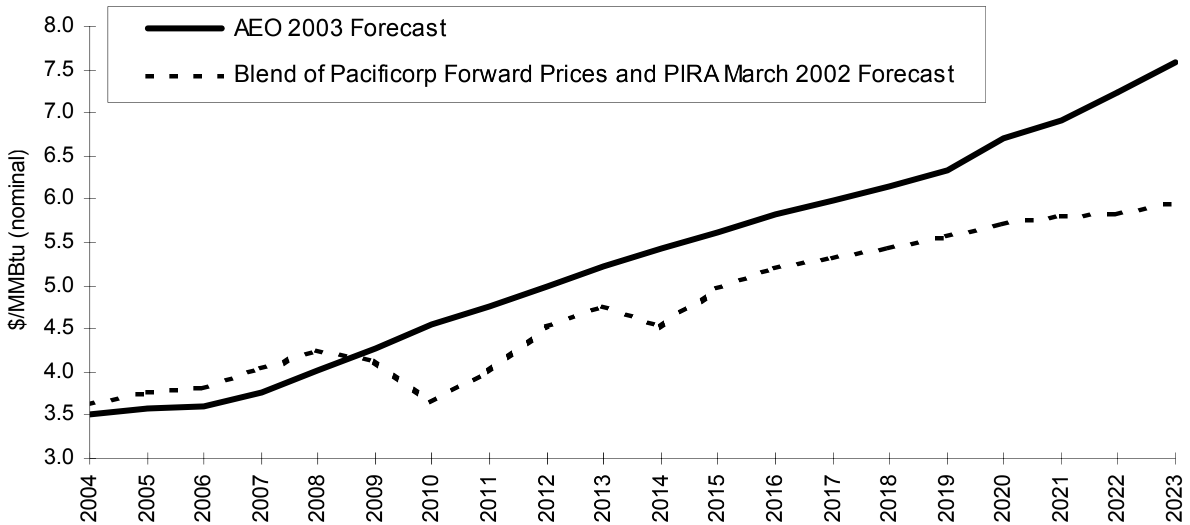
Source: NYMEX and EIA

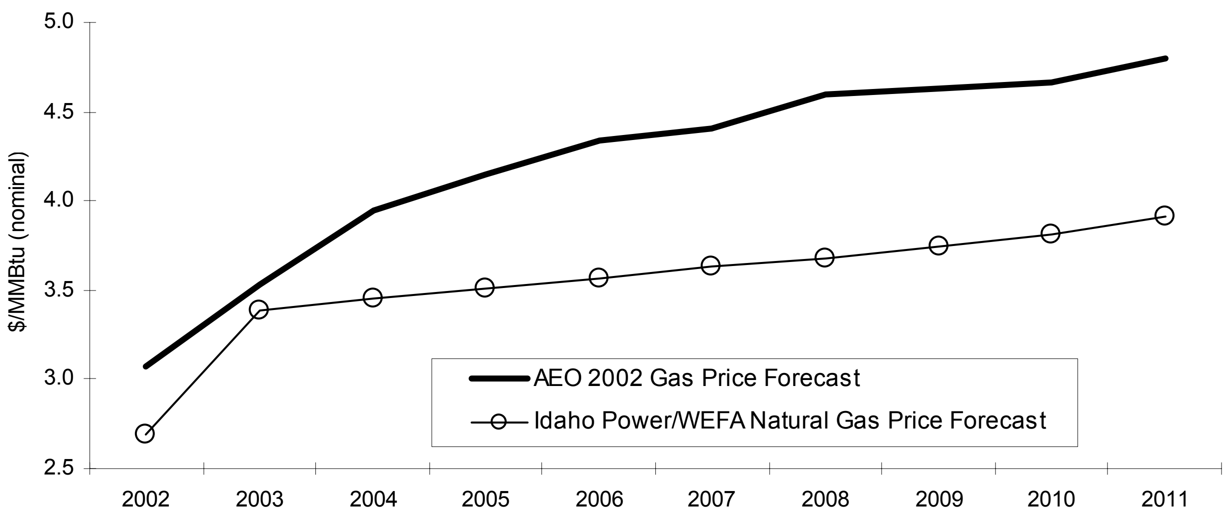
Levelized Premiums Average $0.7/MMBtu



Implicit premium in cents/kWh based on 7000 BTU/kWh heat rate

Gas Price Forecasts in Utility IRPs Have Recently Been Lower than the EIA's





Implications

Over last 4 years, forward gas prices have exceeded EIA reference case forecasts; gas price forecasts used by utilities have been even lower, with a greater "wedge" between forwards and forecasts

Use of gas price forecasts (rather than forwards) over this time period may have "biased" investment decisions towards variable-price gas-fired generation, and away from renewable energy

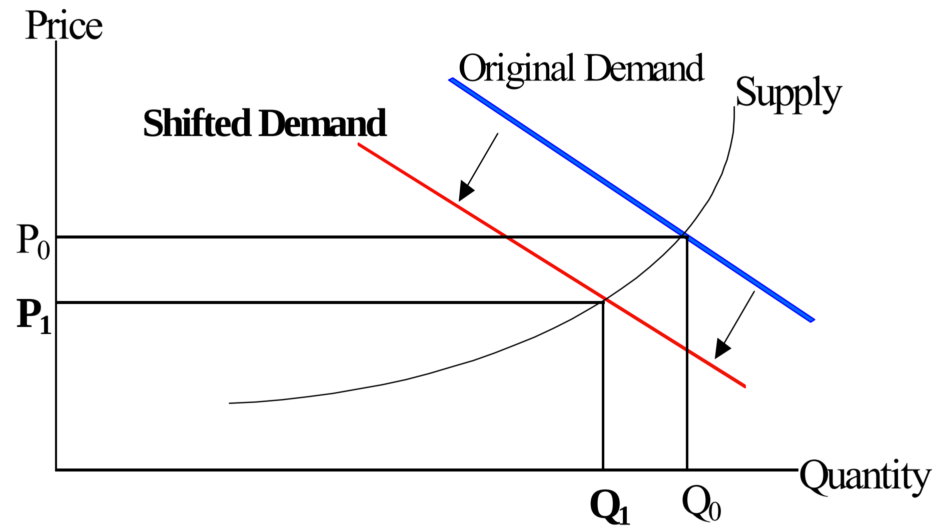
Whether these premiums will continue remains unclear, but does not change the fundamental implication of this work:

When possible, use forward prices, not price forecasts, when comparing the levelized costs of gas-fired and RE generation

For more information:
http://eetd.lbl.gov/ea/EMS/reports/53587.pdf

Renewables May Also Put Downward Pressure on Natural Gas Prices

- **Theory:** Increased use of RE will reduce natural gas demand, placing downward pressure on gas prices



- Magnitude of price reduction depends on the shape of the gas supply curve: impact expected to be larger in the short-term than in the long-term due to short-term supply constraints

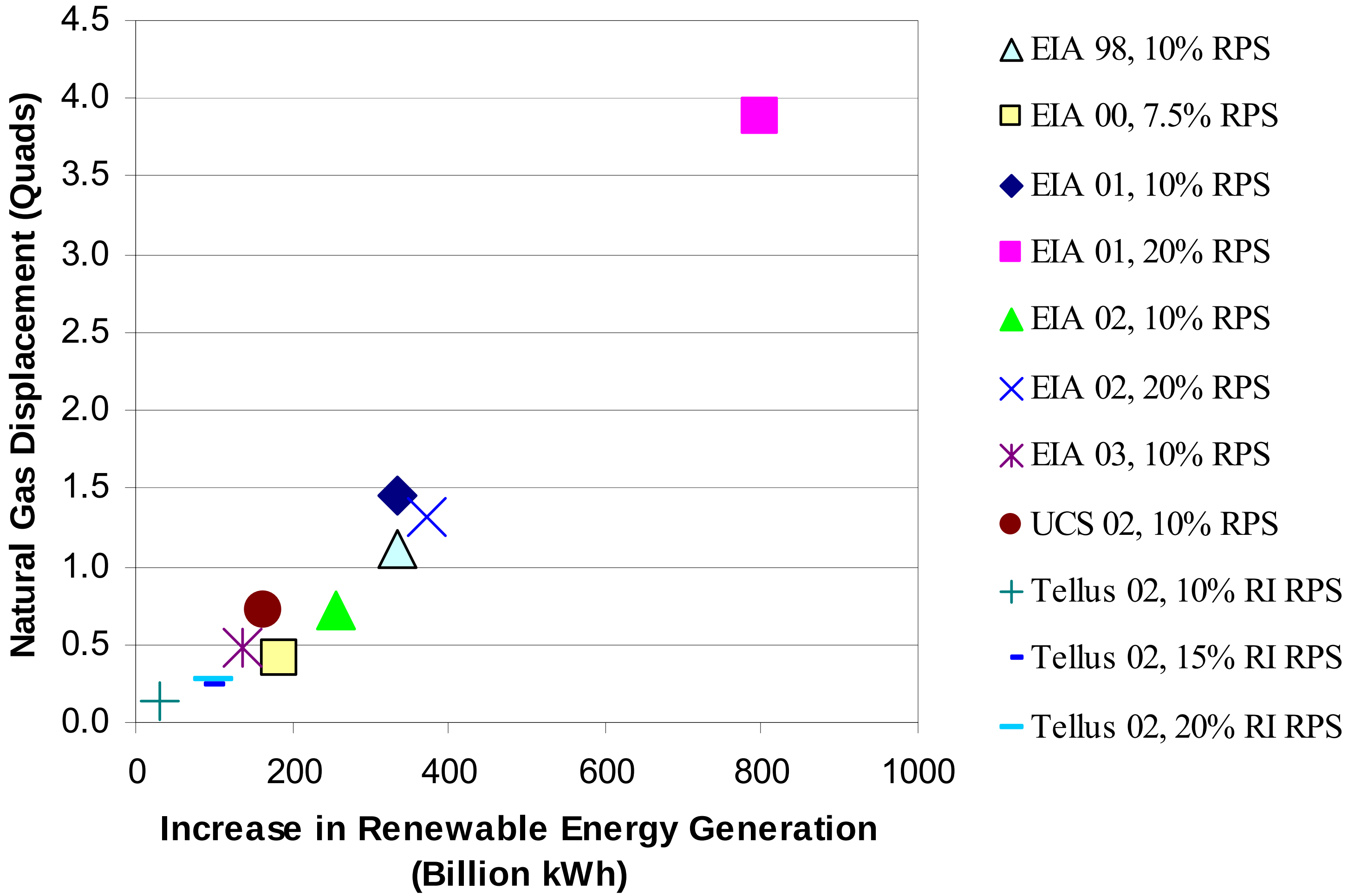
- Price reduction not strictly a gain in net social welfare – it is a gain to gas consumers that comes at the expense of producers; whether such transfers support government intervention is subject to debate

Methodology

- Recent modeling studies have evaluated impact of increased RE and EE deployment on gas prices (most use NEMS)
- Our analysis reviews results of nine of these studies
  - 5 EIA studies of the impact of national RPS proposals
  - 2 UCS studies of the impact of national RPS proposals
  - 1 Tellus study of the impact of New England RPS (focus on RI)
  - 1 ACEEE study of the impact of national RE/EE deployment
- Our Approach
  - review economic theory of the price suppression effect
  - review modeling output to test for model consistency over time, across models, and with economic theory
  - compare results with empirical estimates of supply elasticities
  - determine whether existing models are treating this effect within reason
  - focus on national impacts initially – regional impact analysis up next

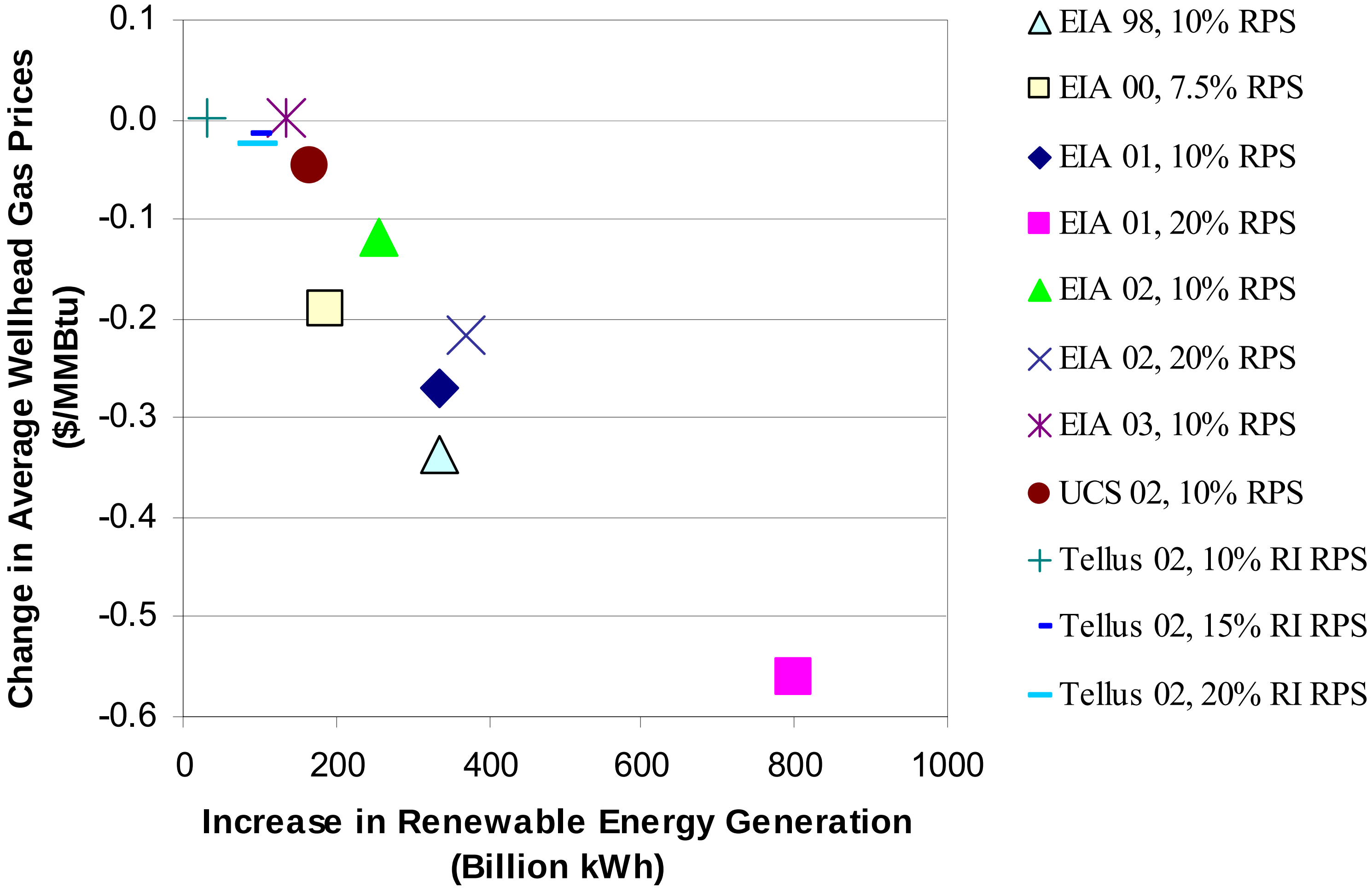
Increased Renewable Energy Penetration Displaces Natural Gas

Projected Gas Displacement in 2020 Under RPS Studies

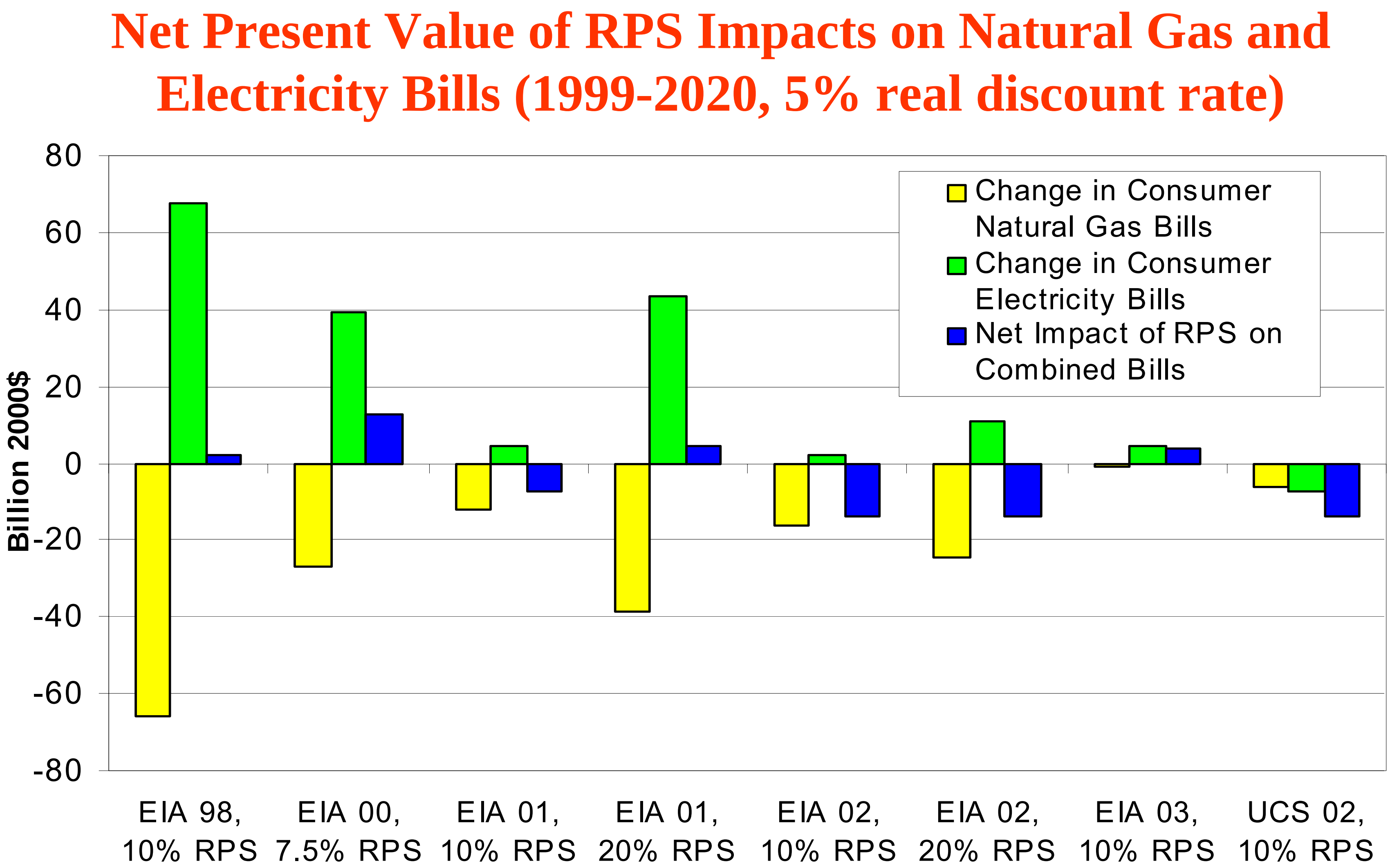


Increased RE Penetration Reduces Natural Gas Wellhead Prices

Projected Gas Wellhead Price Reduction in 2020 Under RPS Studies



Consumer Gas Bill Reductions Substantially Offset Increase in Electricity Bills

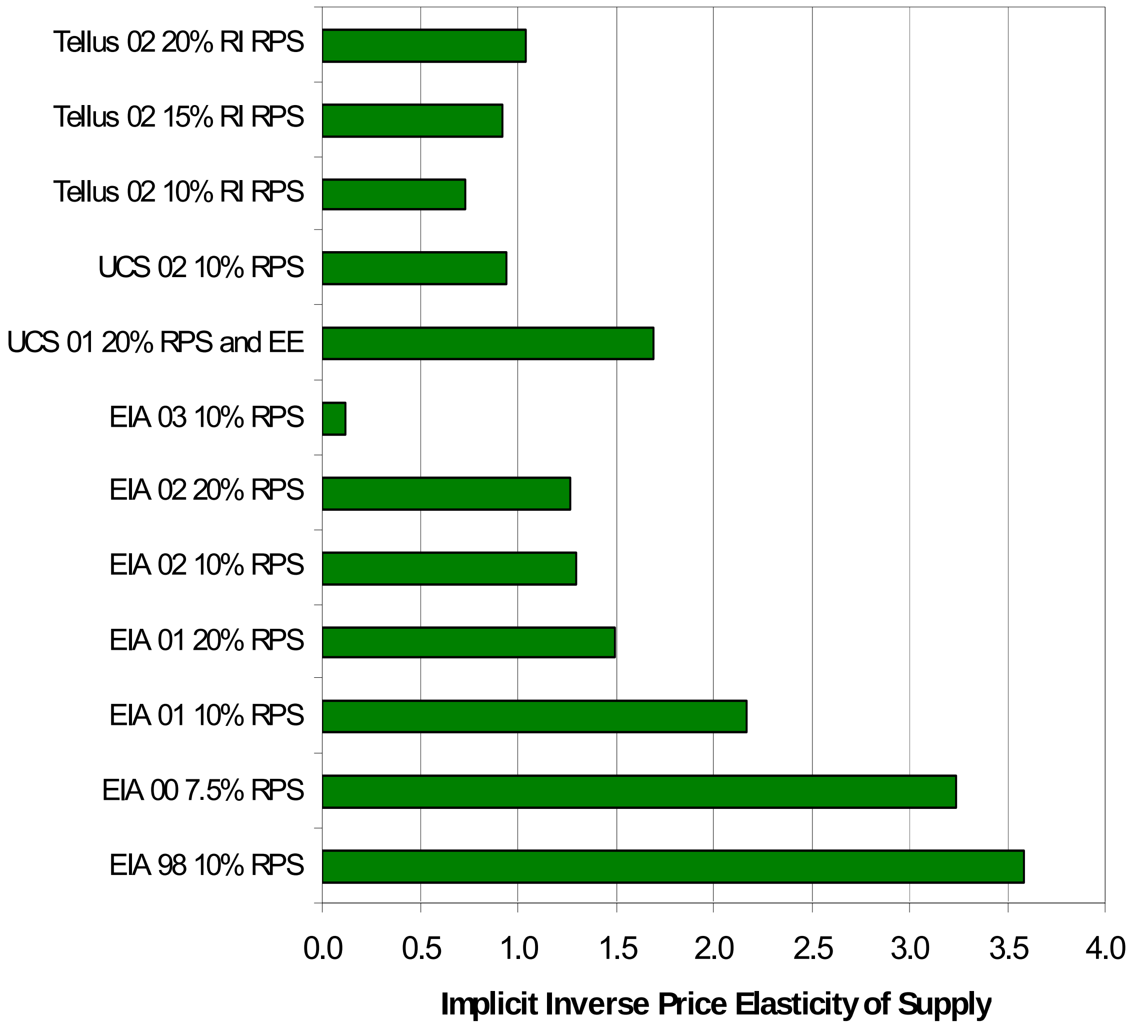


Model Consistency

Inverse price elasticity of supply defined as %ΔP/%ΔQ, and measures shape of gas supply curve

Long-term avg. inverse elasticity for EIA, UCS, and Tellus varies from less than 0.5 to over 3.5 depending on the study: central tendency 0.75 - 2.5

ACEEE focuses on shorter-term impacts, and shows short-term elasticity of over 15, and medium-term elasticity of ~4



Benchmarking to Other Models, Markets, Data

- Models suggest that **1% drop in gas demand** could lead to **0.75% – 2.5% reduction in long-term wellhead prices**, with some models predicting even larger effects
- These results for NEMS are somewhat consistent with:
  - NEMS AEO economic growth cases
  - Implicit elasticities embedded in a number of other energy models (Stanford EMF 2003)
  - Limited empirical literature on historical elasticities for non-renewable energy commodities
- Central tendency of NEMS output is broadly consistent with limited existing knowledge: **reduction in consumer gas bills due to increased RE could therefore largely offset expected incremental cost of RE to consumers**

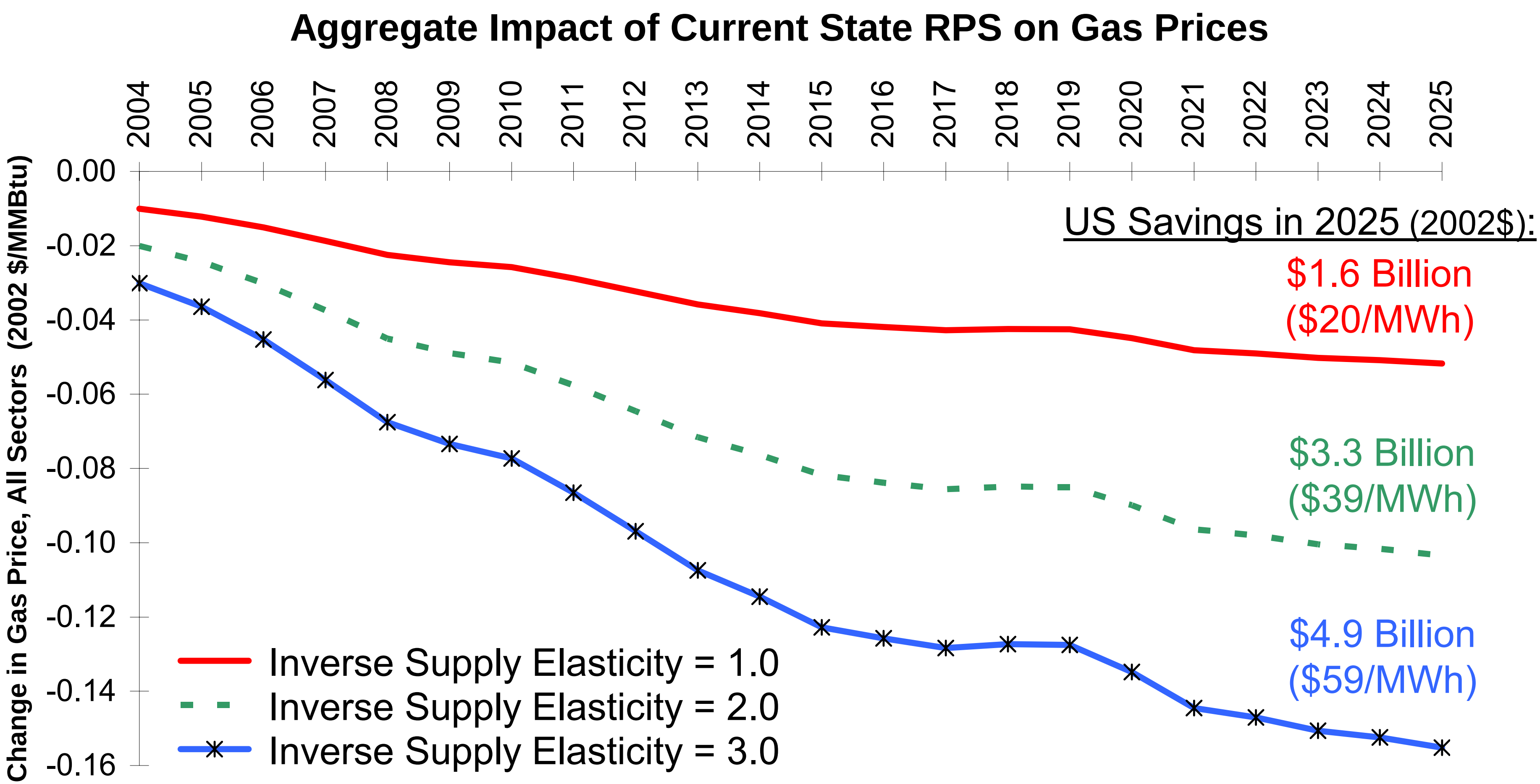
Simplified Method – Inputs

Despite central tendency, variation in implicit elasticities across models and years, combined with dismal historical ability to predict gas prices and uncertainty in shape of supply curve, imply that little weight should be placed on any *single* model result

"Model" results, without having to run the model!

- Gas Displacement (1 MWh RE = 0.6 MWh Gas-fired)
- Heat Rate of Displaced Gas-Fired (7,500 Btu/kWh)
- US Gas Consumption Forecast (from AEO)
- Inverse Elasticity of Supply (range from +1 to +3)
- US Gas Wellhead Price Forecast (from AEO)
- Wellhead to Delivered Prices (1:1)

Example Results: Impact of Existing State RPS Policies, ~16,000 MW of New RE



Conclusions

- Gas prices are high, volatile, unpredictable
- Diversification with renewable energy can help hedge these risks over the medium to long term
- Cost of renewables is steady, predictable
  - Achieving similar gas price stability with futures, forwards, or swaps has cost ~$0.7/MMBtu over last 4 years relative to EIA reference case, suggesting that reference case is either out-of-tune with the market or there is a cost to hedging gas price risk
- RE reduces gas consumption *and prices*
  - Modeling studies imply that a 1% drop in gas demand leads to a long-term 0.75% - 2.5% drop in gas prices on average (and possibly a larger near-term drop)
  - Increased consumer electricity prices due to additional RE predicted to be greatly offset by reduced consumer gas bills

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Reports available at:

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