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How Much Does Renewable Energy Really Cost?

Impacts of a National Renewable Energy Standard

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Approach

- Used modified version of NEMS developed for AEO 2001
- Identified modeling issues as reviewer on EIA RPS and power plant multi-pollutant reduction reports
- Identified and made changes to certain renewable energy assumptions based on input from renewable energy experts familiar with NEMS and previous work
  - including DOE, NREL, ORNL, LBL, consultants
- Analyzed national renewable energy standard proposals and other clean energy policies

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Key Renewable Energy Constraints in NEMS

- **Growth rate constraints**
  - **0.5% increase in capital cost for every 1% increase in annual growth rate above 30%**
- **Long-term capital cost multipliers to reflect additional costs of resource degradation, transmission network upgrades, and market factors.**
- **Regional annual build limits for certain resources**
- **Cap on regional penetration of variable output resources (wind and solar) of 15%**
- **Limits on building in one region to serve another**
- **Biomass cofiring in coal plants limited to 5%**

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General technology assumptions

Model modifications - policy cases only

- **Replaced EIA's pessimistic cost and performance assumptions for renewable energy technologies**
- **Used assumptions consistent with the EPRI/DOE and Clean Energy Future Studies**
  - **except for higher initial capital costs for wind and reduced NEMS site-specific capital costs for geothermal**
- **Costs are lower than EIAs for all renewable technologies except biomass gasification**
- **Capital costs hard-wired instead of using EIAs learning function that lowers costs as domestic capacity increases**

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Wind
Model modifications

- **Regional penetration constraint raised from 15% to 30%**
  - **Regions in Germany, Denmark and Spain over 20%**
- **Reclassified windy land area in each region to account for additional siting constraints as more wind is developed**
  - **35% reduction in mountainous region potential**
  - **17% reduction in other regions**
  - **Original data already excludes 100% of urban and environmentally sensitive land, 50% of forested land, 30% of ag land, 10% of rangeland, and land further than 20 miles from existing transmission lines**
- **Replaced EIA regional capital cost multipliers of up to 3x with maximum increase of 40%**
  - **Included cost of backup power from natural gas CT when regional wind penetration >10%; max. increase of 20% when penetration >20%**
  - **Additional 20% cost increase as best sites are used based on CEF study**
  - **Extra transmission costs already included for wind**

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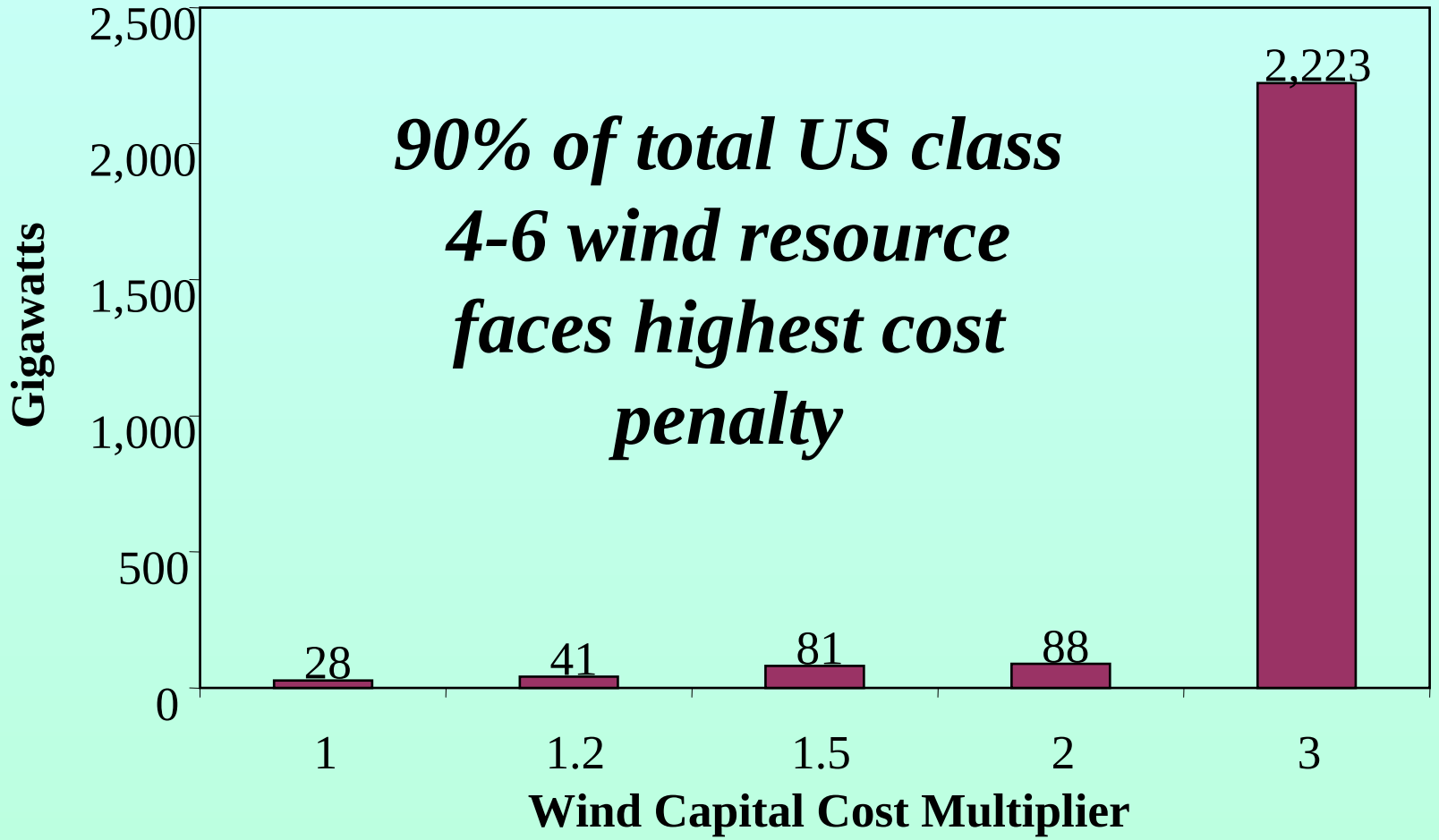
EIA's Wind Capital Cost Multipliers



Source: EIA, "Modeling Costs of U.S. Wind Supply," *Issues in Midterm Analysis and Forecasting*, 1999.

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Biomass
Model modifications

- **Increased cofiring from a max of 5% per region with no capital costs to up to 10% with capital costs of $200/kW**
- **Removed regional capital cost multipliers of up to 100% for new gasification plants as more biomass is used**
- **Reduced forestry residues by half to provide extra margin against using unsustainable sources**
- **Excluded 5 percent of C&D debris, on top of existing 75% exclusion, to provide extra margin against using contaminated materials**
- **Removed regional annual build limits**

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Geothermal
Model modifications

- **Removed site specific capital cost multipliers as successive amounts of the resource is developed**

- **Reduced capital costs for power plants by 25%, field costs by 12%, and drilling costs by 15% to reflect current technology.**
  - **Source: Dan Entingh, PERI.**

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Unchanged EIA conservative assumptions

- **EIA underestimates potential contribution of state renewables policies**
  - **UCS: 12,700 MW of new renewables by 2012 vs. EIA 7,500 MW by 2020**
- **No extension/expansion of the federal Production Tax Credit**
  - **More renewable planned additions would likely lower the cost of meeting the RPS**
- **EIA limits renewables that can be built in one region to serve another**
  - **constrains wind development in the Plains states**
- **EIA excludes class 3 wind resources**
  - **constrains potential future wind development in eastern US**
- **EIA reduced geothermal technical potential by over 40%**
- **EIA underestimates future volatility in natural gas prices**
- **No growth rate or siting penalties applied to new gas & coal plants**

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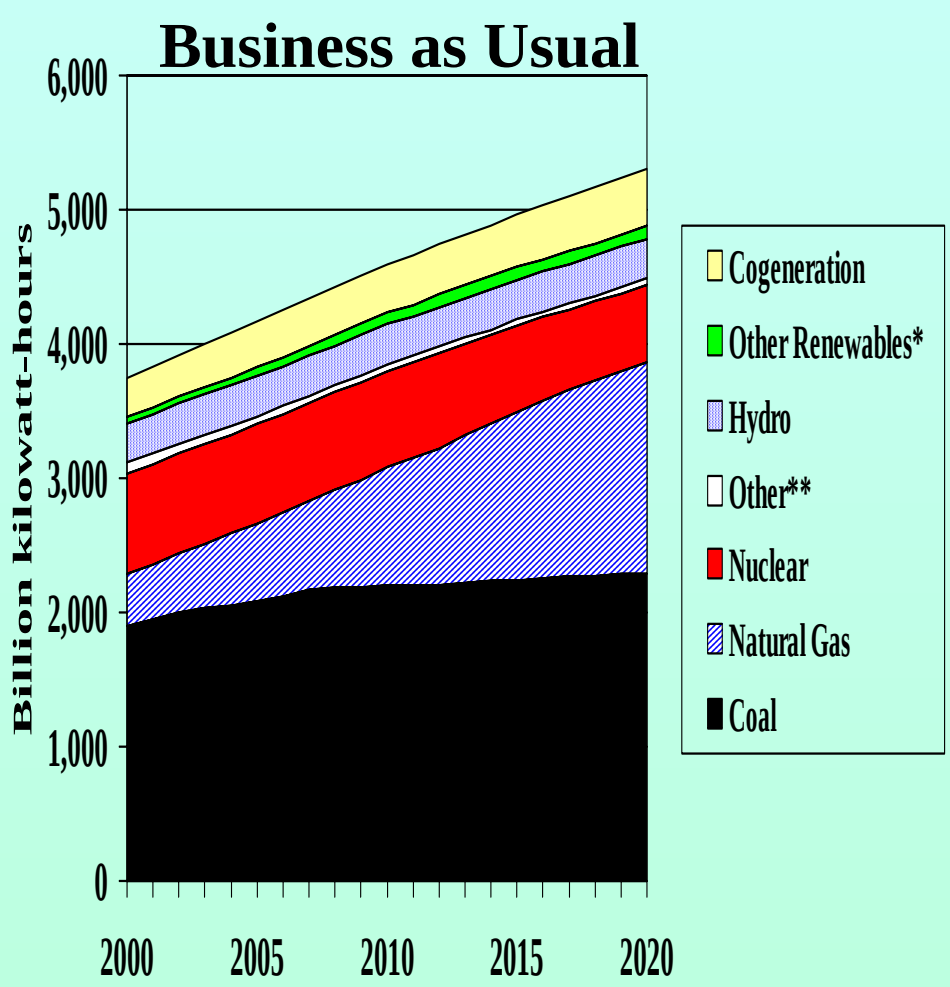
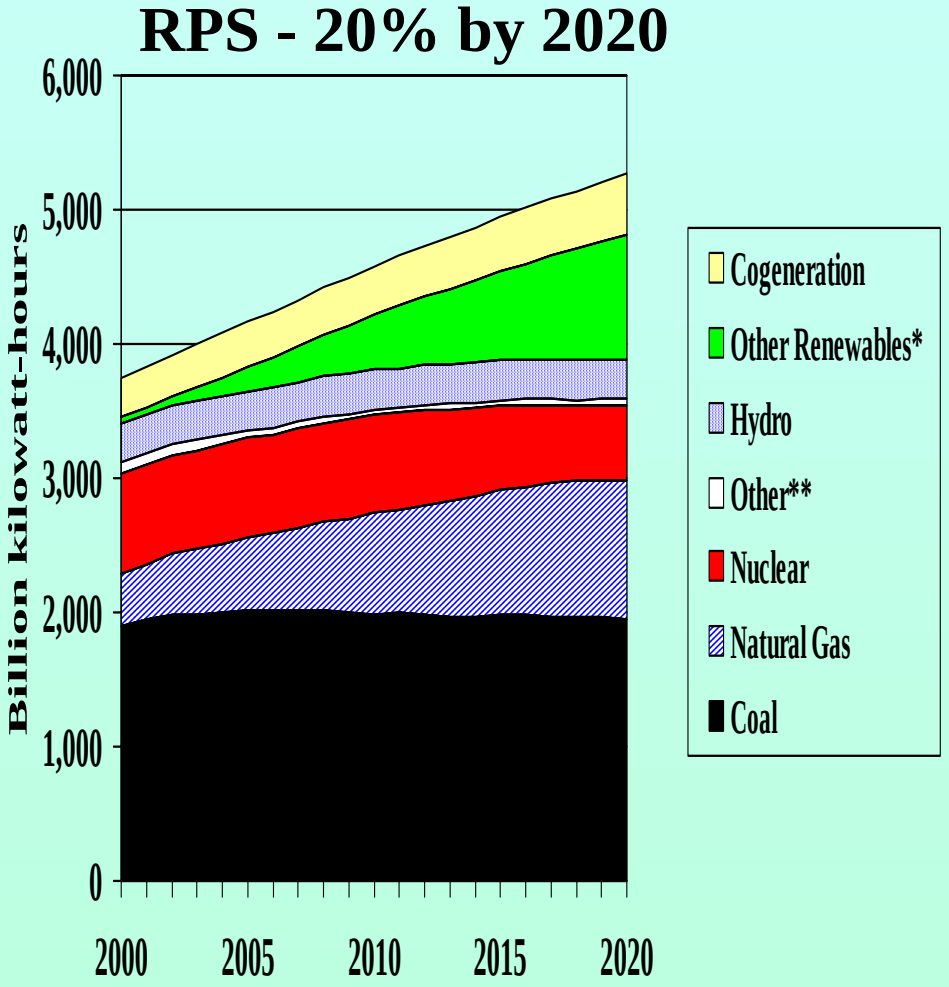
UCS: Impact of 20% RPS on electricity mix





Source: UCS, *Renewing Where We Live*, 2002

***Includes wind, solar, geothermal, biomass, and landfill gas.**
****Includes oil, municipal solid waste, and other wastes.**

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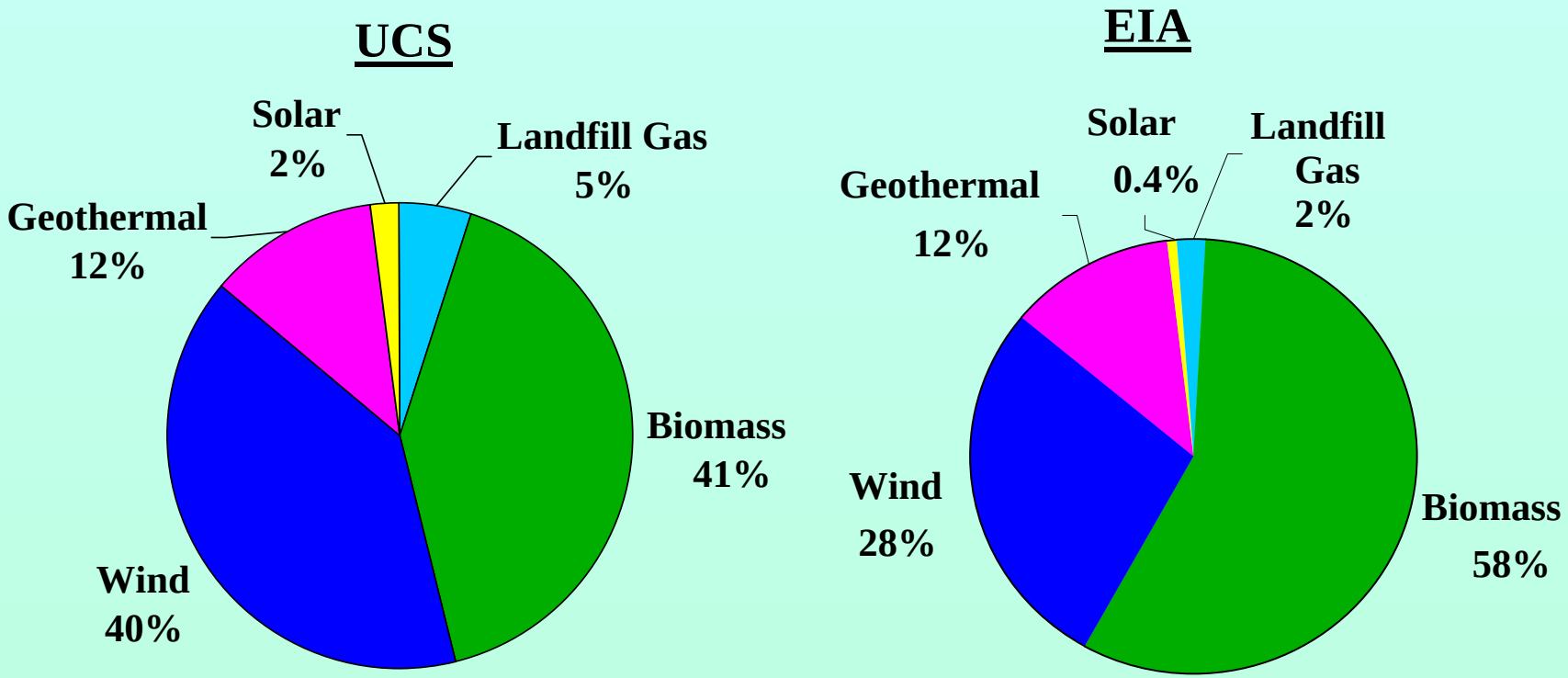
Renewable Energy Mix in 2020 under 20% RPS



Sources: UCS, *Renewing Where We Live*, 2002 **EIA, *Strategies for Reducing Multiple Emissions from Electric Power Plants*, July 2001**

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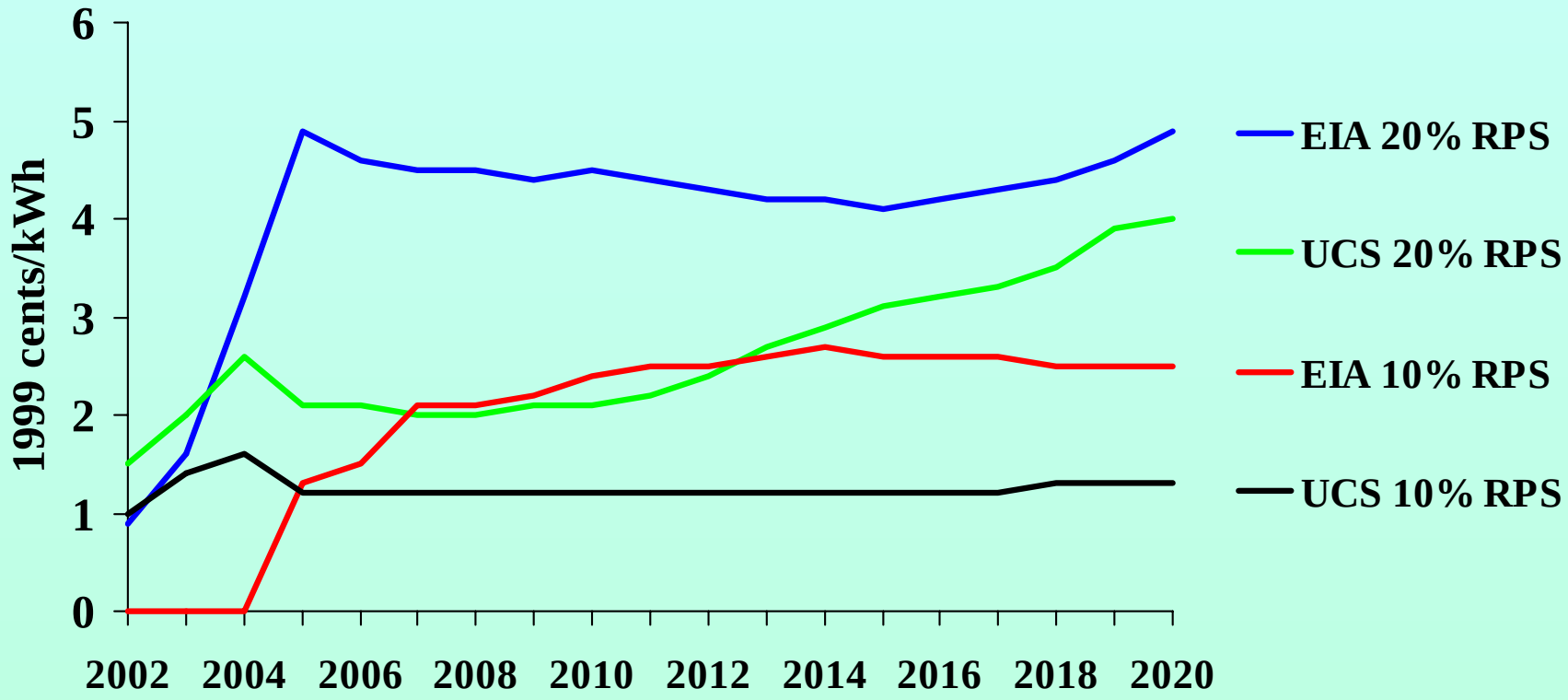
Renewable Energy Credit Prices



Source: UCS, *Renewing Where We Live*, 2002;EIA, *Strategies for Reducing Multiple Emissions from Electric Power Plants*, July 2001

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EIA overstates electricity production cost increase of RPS

- **EIA claims 20% RPS by 2020 would increase electricity production costs by $118 billion over next 18 years**
- **Costs are not discounted**
- **Includes 100% of capital cost in year plants are built. Costs should be annualized over 20-30 year period to be consistent with annual fuel cost reductions**
- **Doesn't include additional fossil fuel savings after 2020**
- **RPS reduces windfall profits to coal and gas plants**
- **Impact on consumer costs more important**

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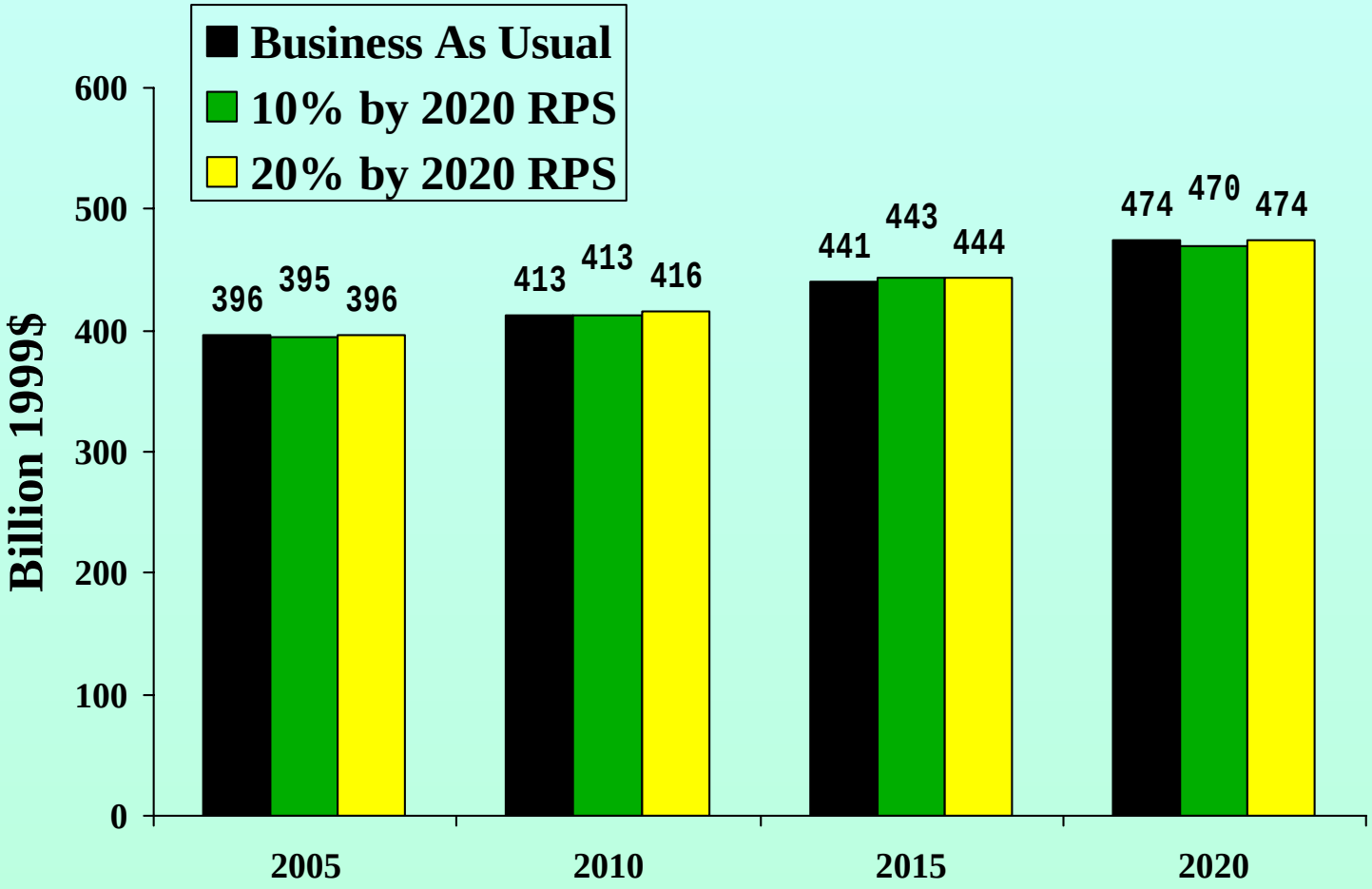
EIA: RPS is Affordable

Total Consumer Energy Bills (excluding transportation)



Source: EIA, *Strategies for Reducing Multiple Emissions from Electric Power Plants*, July 2001, Table E3.

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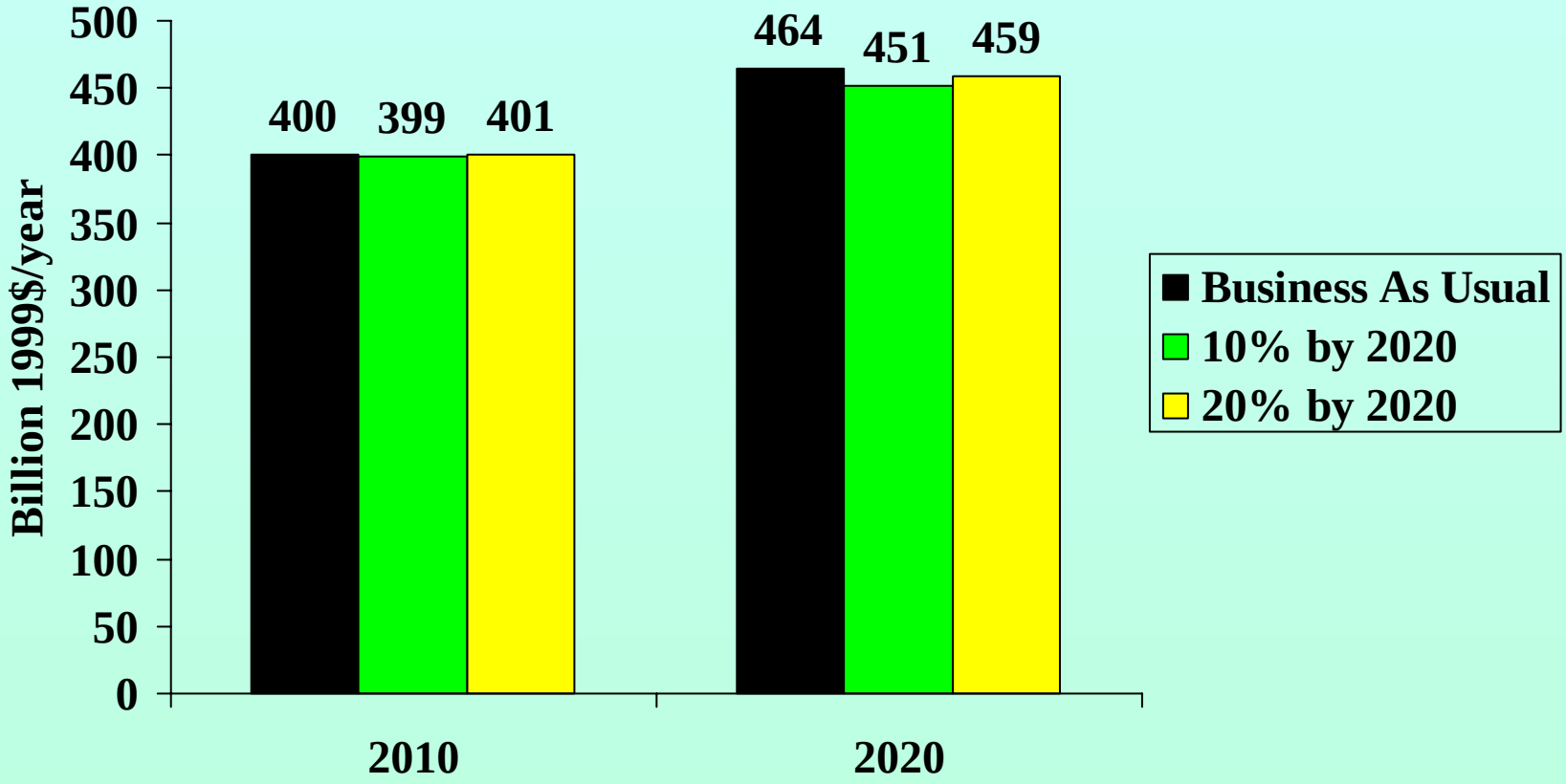
UCS: RPS is Affordable

Total Consumer Energy Bills (excluding transportation)



Source: UCS, *Renewing Where We Live*, 2002

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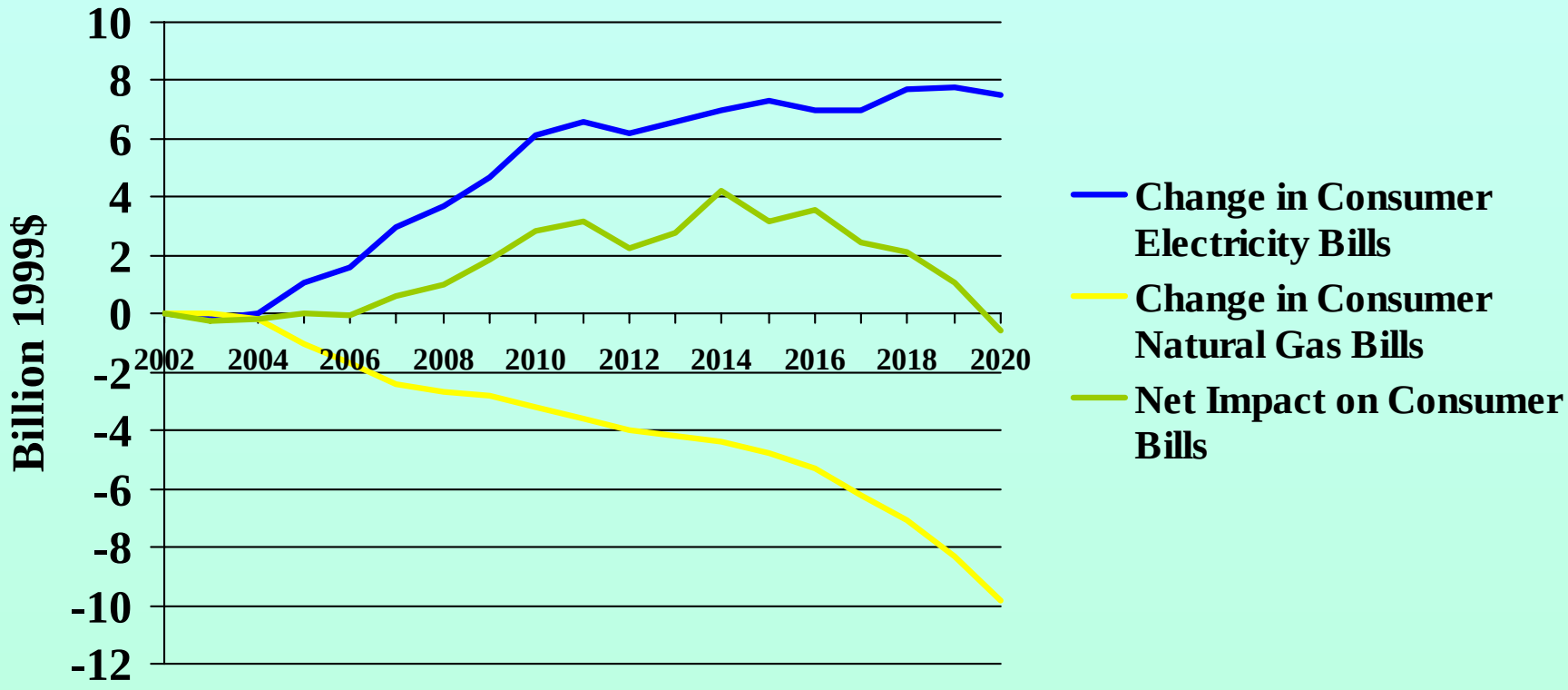
EIA: Change in Consumer Energy Bills Under 20% RPS



Source: EIA, *Strategies for Reducing Multiple Emissions from Electric Power Plants*, July 2001, Tables E2 and E3, not including refinery energy consumption or transportation.

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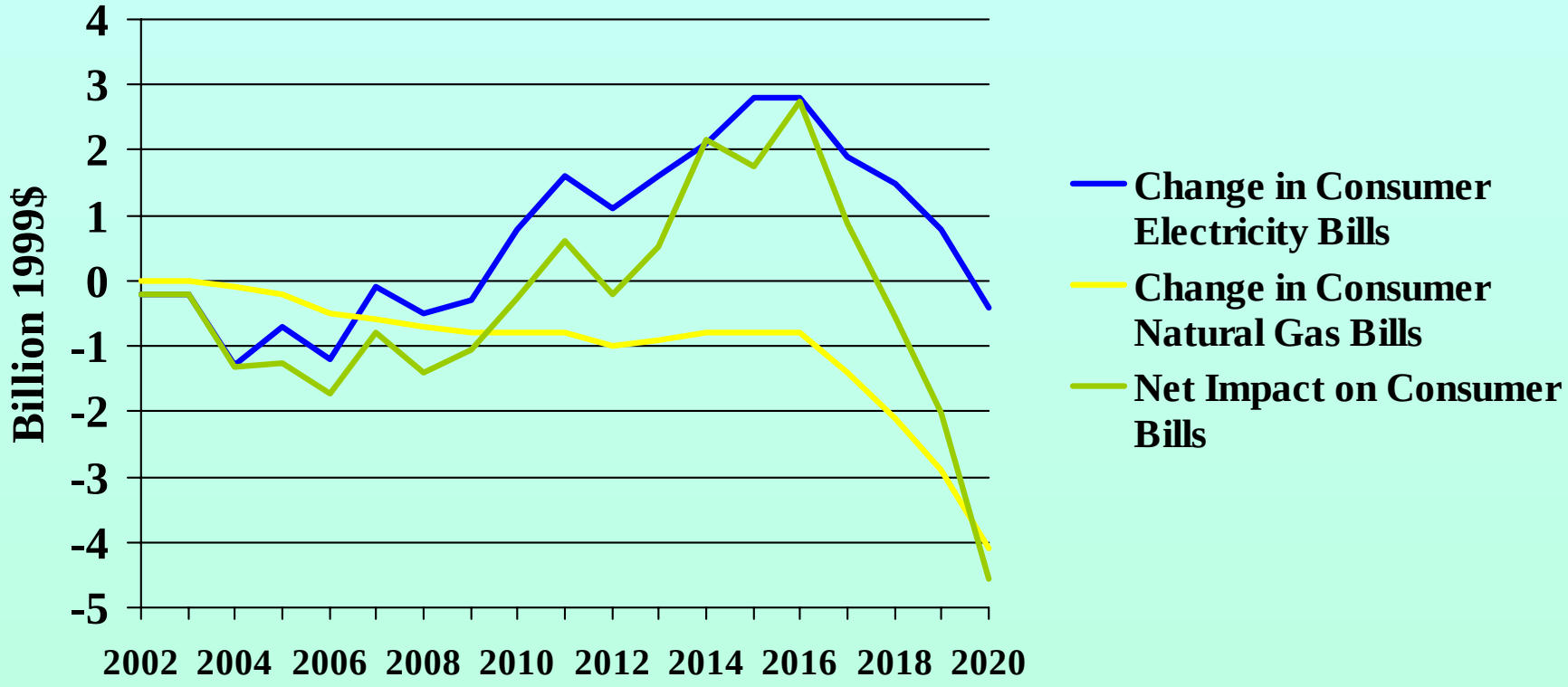
EIA: Change in Consumer Energy Bills Under 10% RPS



Source: EIA, *Strategies for Reducing Multiple Emissions from Electric Power Plants*, July 2001, Tables E2 and E3, not including refinery energy consumption or transportation.

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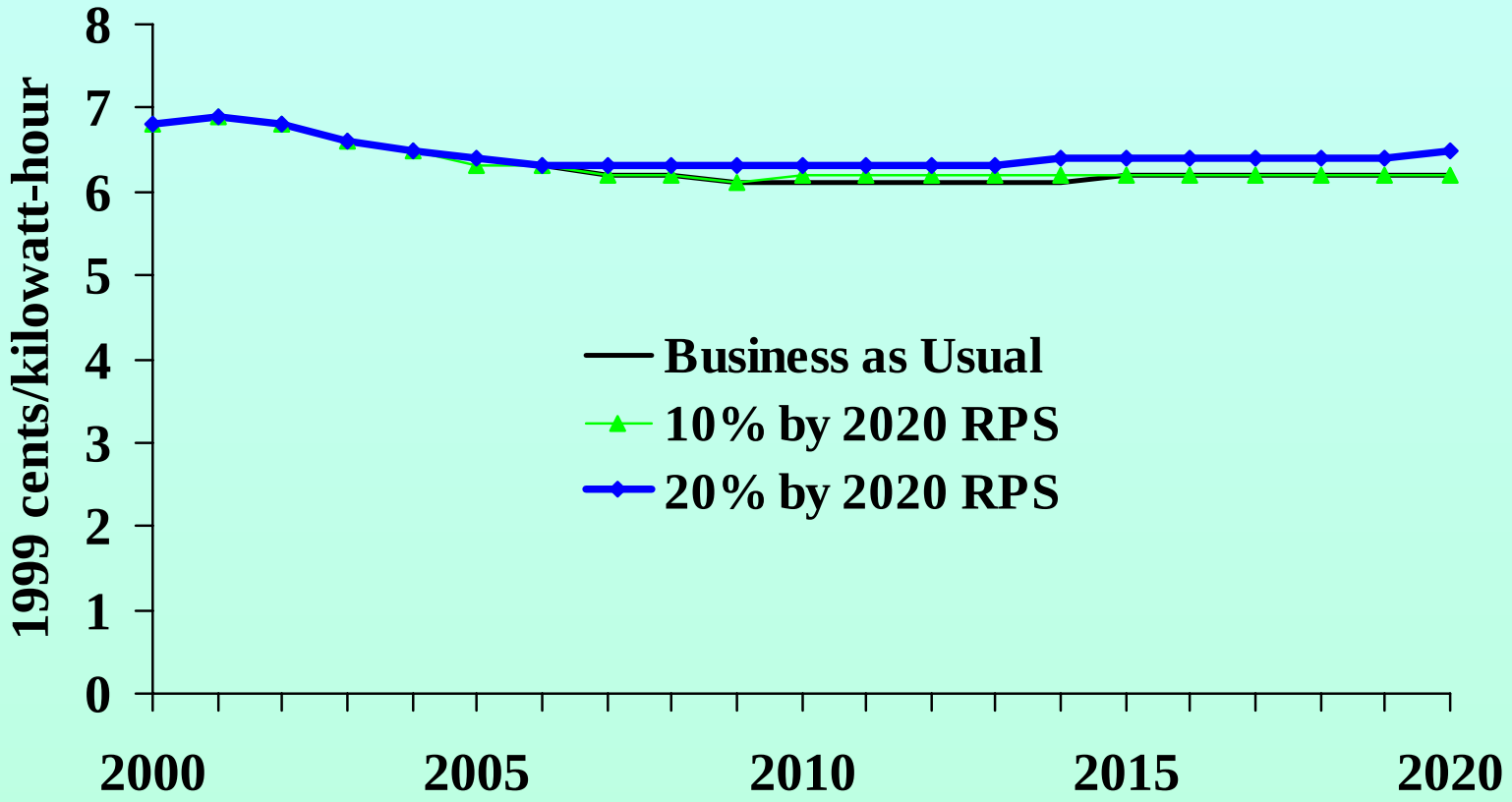
EIA: Average Consumer Electricity Prices Slightly Higher under RPS



Source: EIA, *Strategies for Reducing Multiple Emissions from Electric Power Plants*, July 2001.

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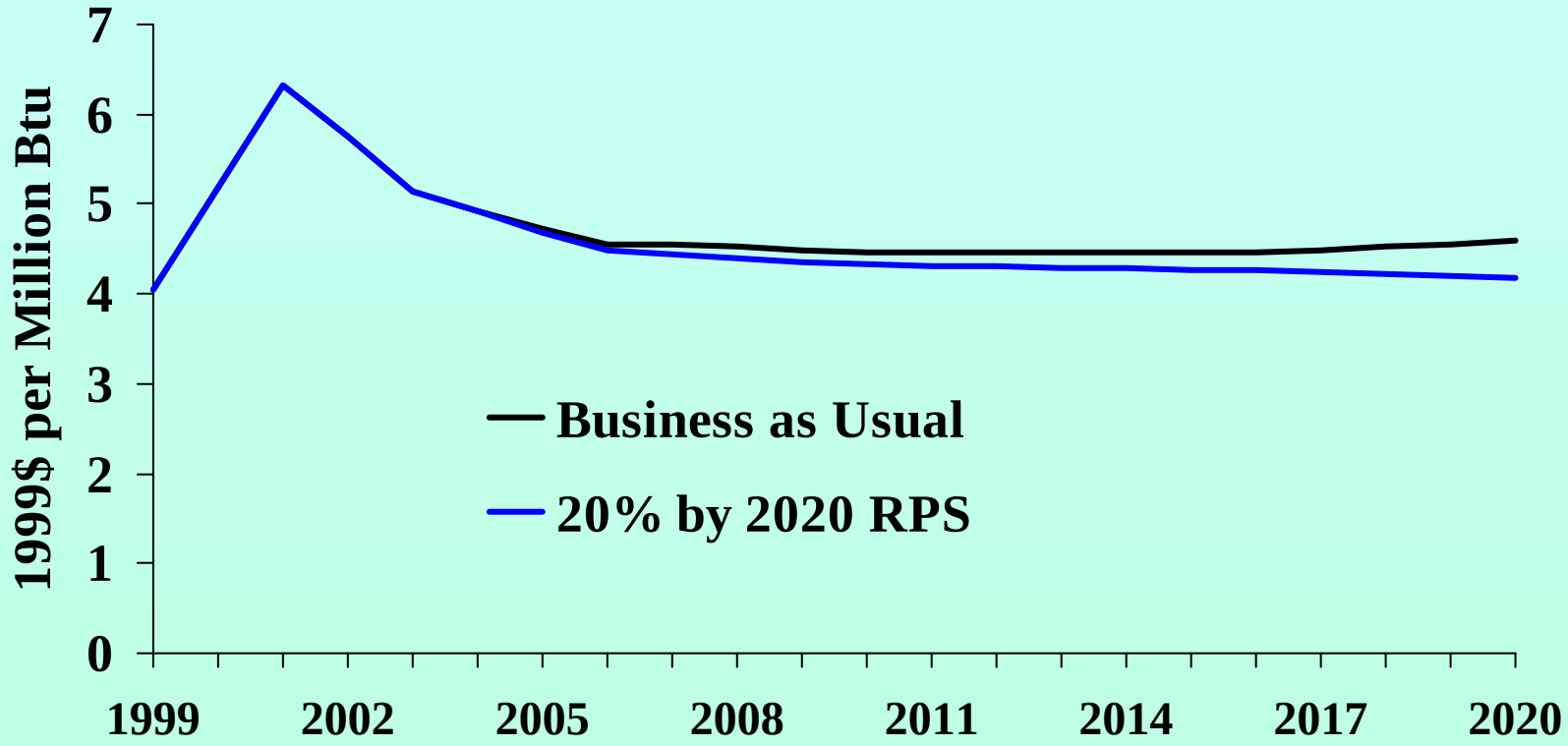
EIA: Average Consumer Natural Gas Prices Lower under RPS



Source: EIA, *Strategies for Reducing Multiple Emissions from Electric Power Plants,* July 2001, Table E3.

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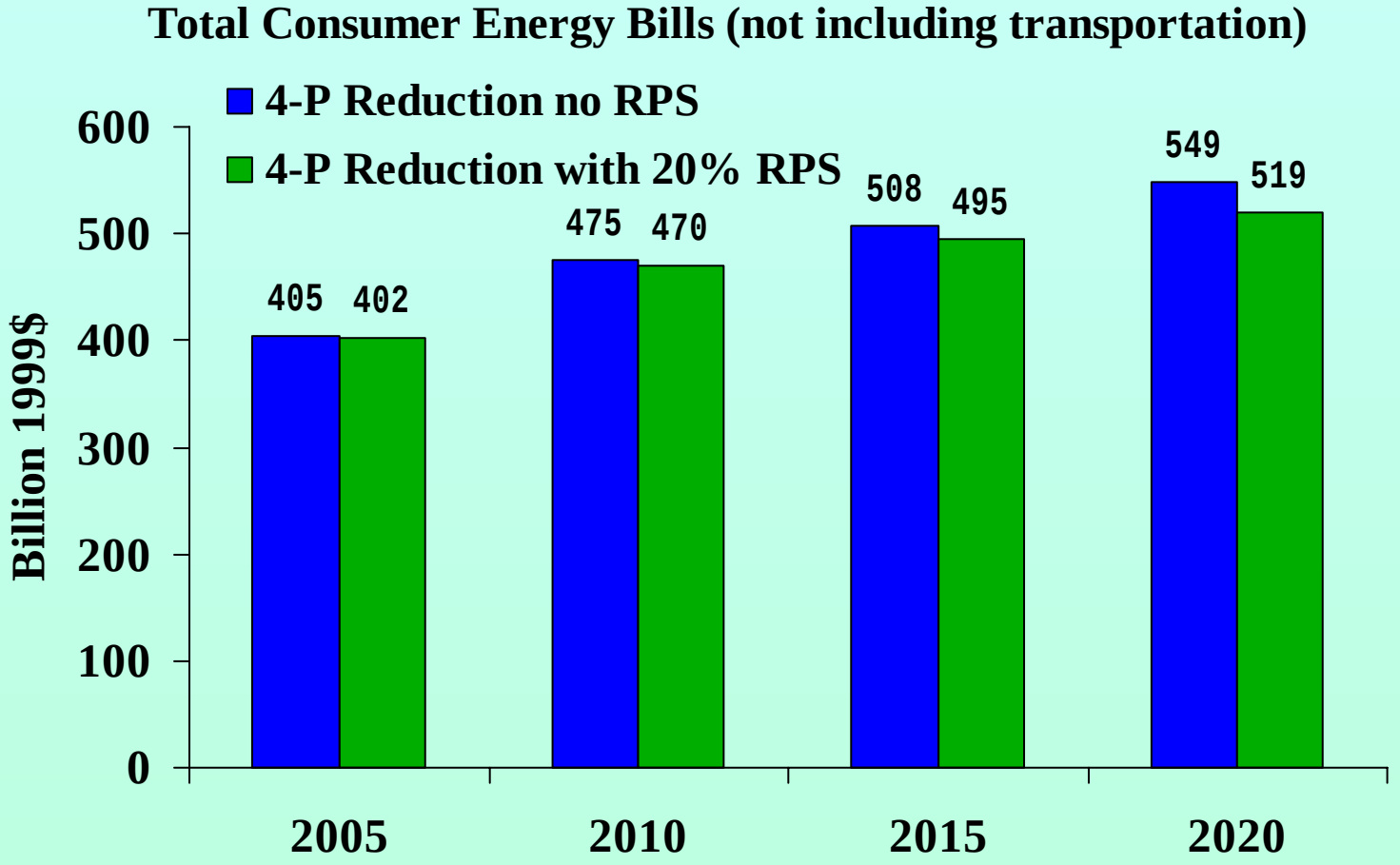
EIA: RPS Lowers Cost of 4-Pollutant Reductions



Source: EIA, *Strategies for Reducing Multiple Emissions from Electric Power Plants*, July 2001, Table H3.

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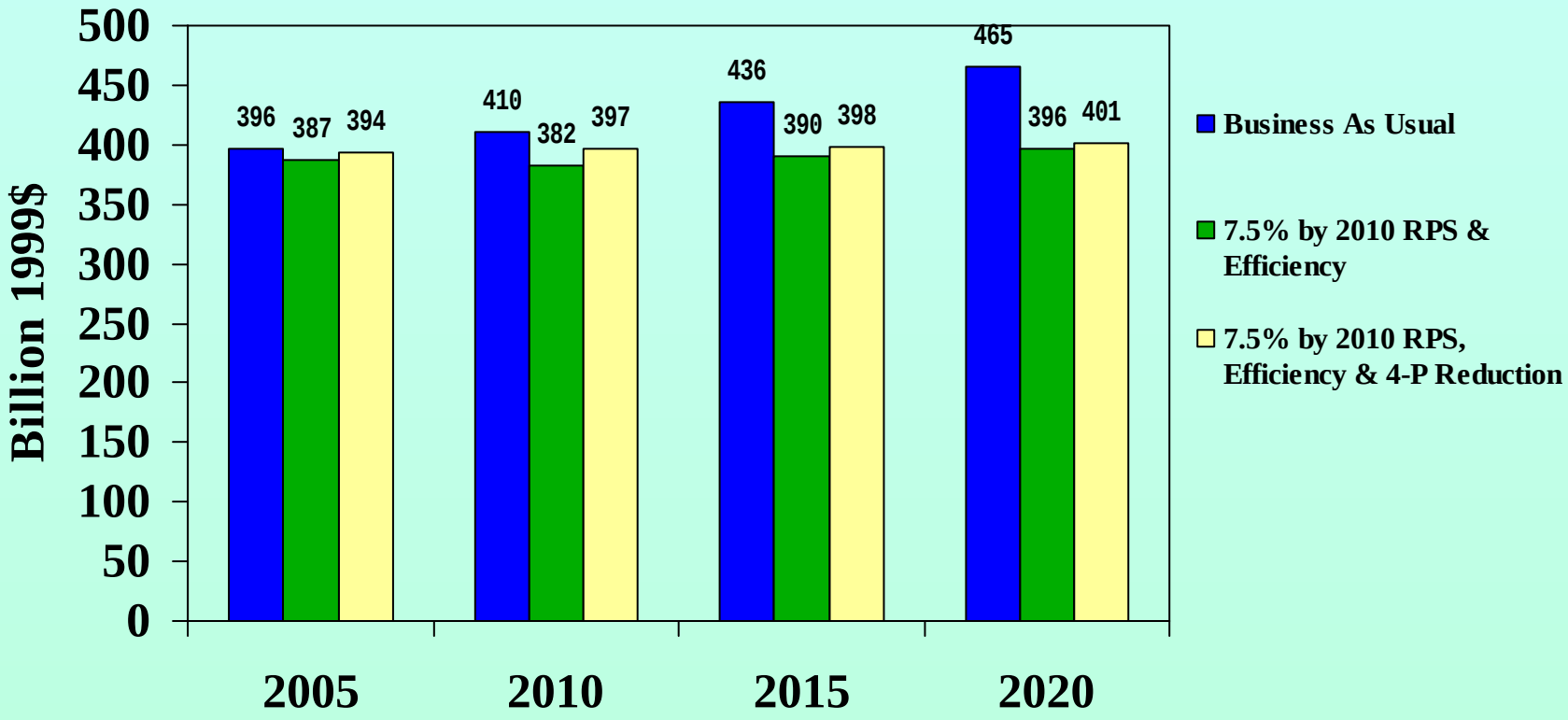
EIA: Combining 4 Pollutant Reductions with an RPS and Efficiency Saves Money

Total Consumer Energy Bills (not including transportation)



Source: EIA, *Strategies for Reducing Multiple Emissions from Electric Power Plants with Advanced Technology Scenarios*, Oct. 2001, Table D3.

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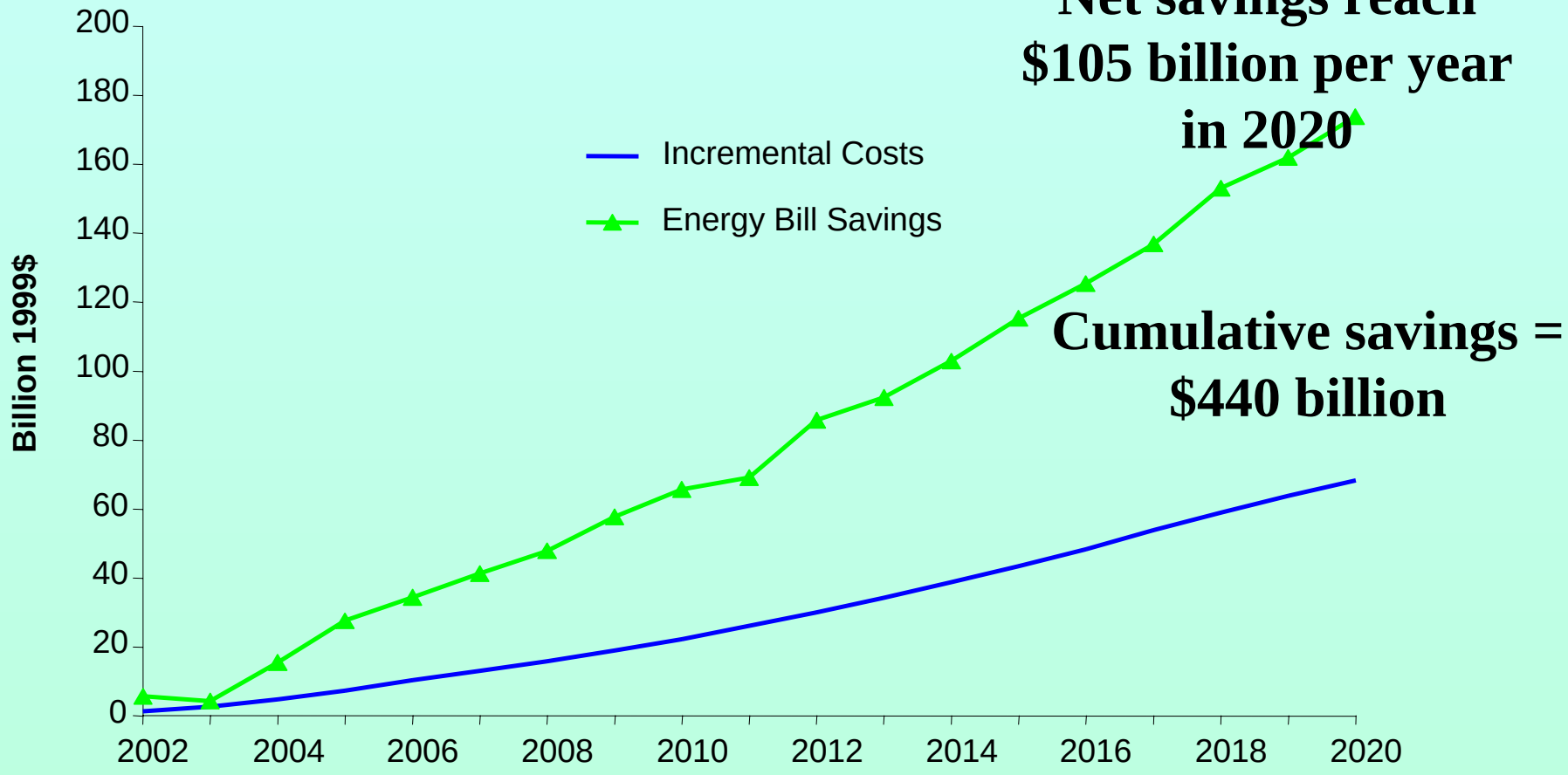
UCS: Combining a 20% RPS with Efficiency Increases Savings

Clean Energy Blueprint



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UCS: Renewing Where We Live
Benefits of 20% RPS

- **Employment**
  - **$80 billion in new investment**
  - **$5 billion in property tax revenues for communities**
  - **$1.2 billion in new income for farmers**
  - **> 80,000 new jobs**
- **Environment**
  - **19% CO_2 reductions by 2020 compared to BAU**
  - **~ 100 million metric tonnes**
  - **Reduction in Nox, Sox, particulates, mercury**
- **Consumers**
  - **Reduce fossil fuel dependence, price volatility, costs**
  - **$4.8 billion energy bill savings through 2020**

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Conclusions

- **EIA/NEMS overstates the costs of increasing renewable energy use**
- **A national RPS is affordable, even using EIAs pessimistic renewable energy assumptions**
- **A RPS provides important energy diversity, security, environmental and rural economic benefits not fully captured by energy markets**
- **National RPS is needed to capture these national benefits**