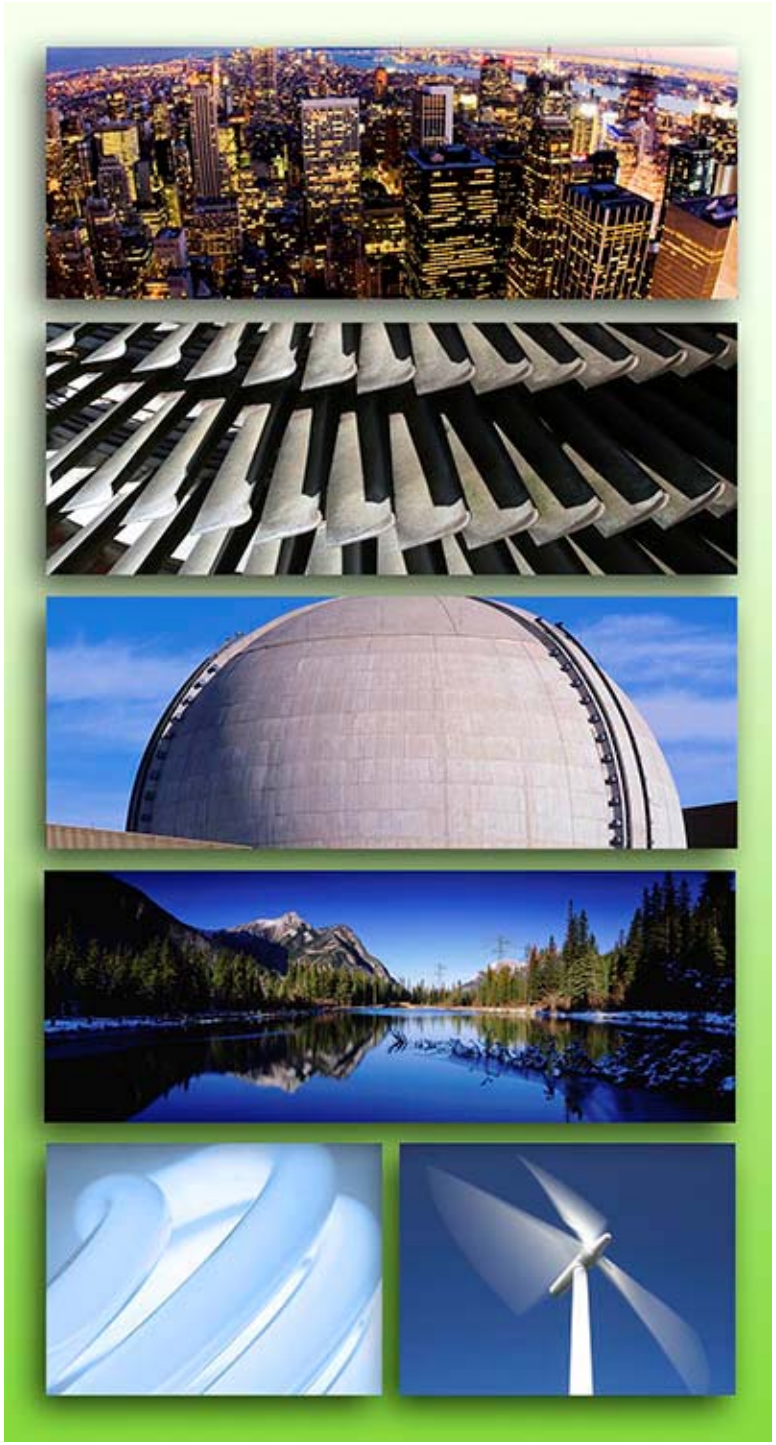

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# Climate Policy Implications and Opportunities for Nuclear Generation

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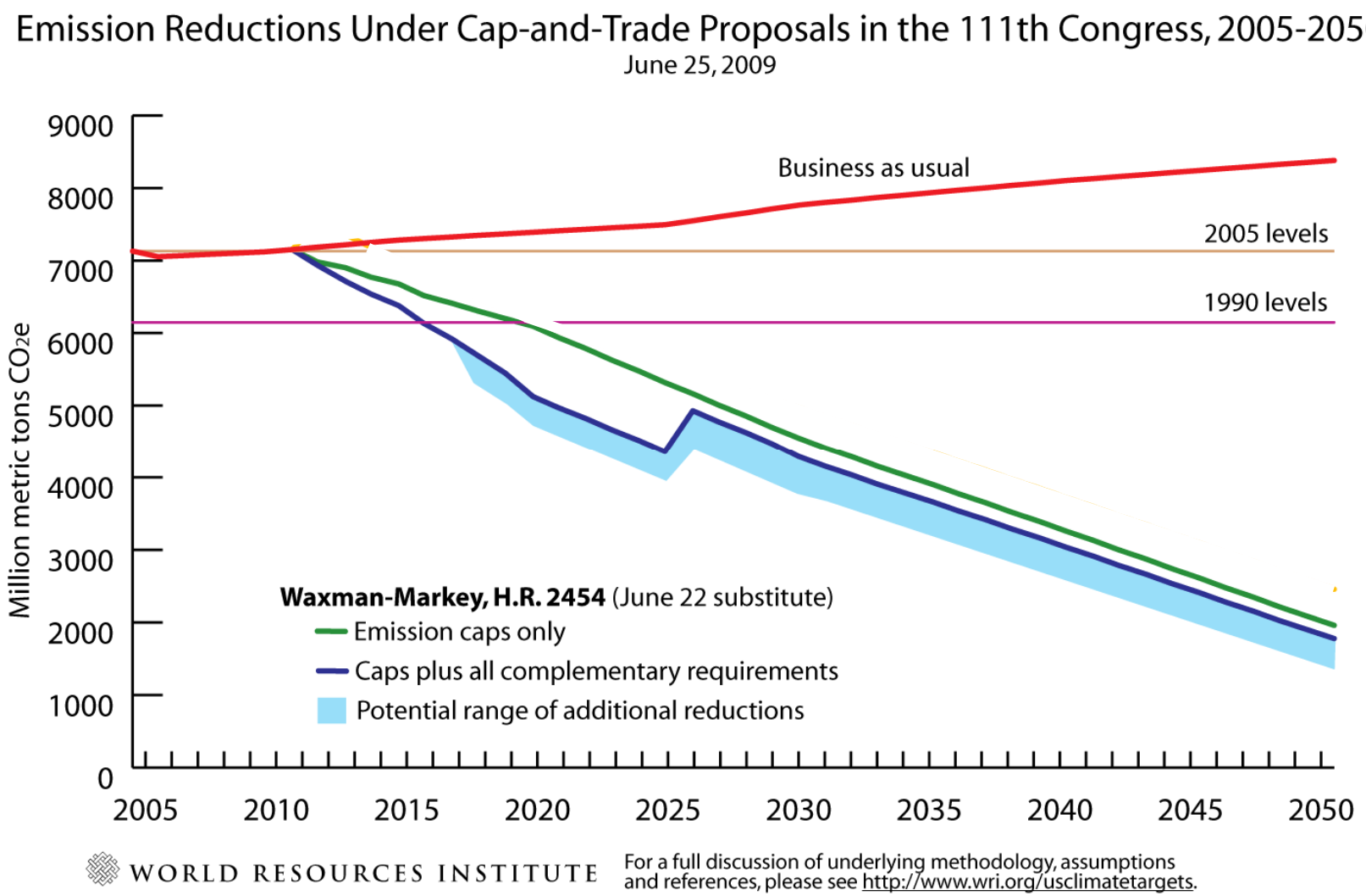
Technical Executive
niemeyer@epri.com, 650-855-2262

**Nuclear Sector Council Meeting**
Orlando, Florida
January 28, 2010

# Today's Discussion

- Climate policy presents challenges and opportunities
- Electric sector will be driven to replace coal emissions
- Nuclear/CCS Coal/Renewables will compete to be part of the solution

# All U.S. Policy Proposals Require Rapid and Dramatic Cuts in $CO_2$ Emissions





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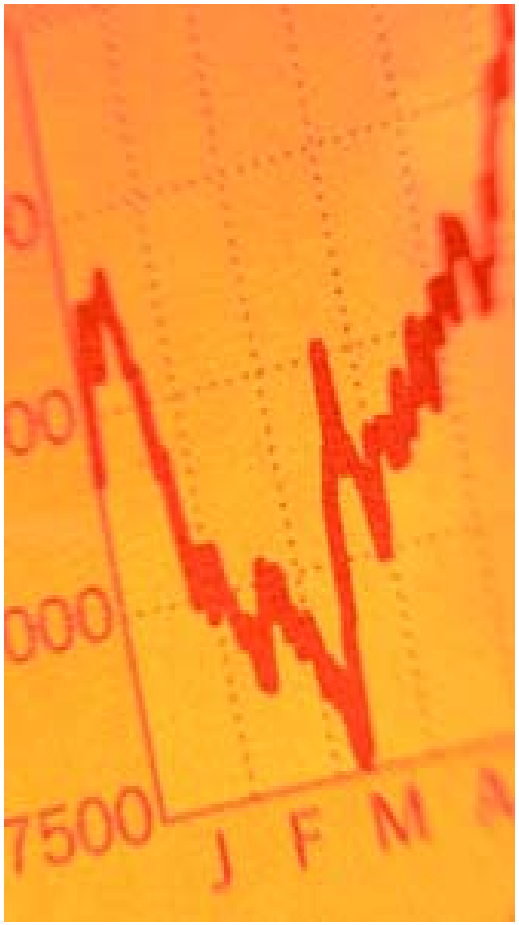
# All Proposals Based on $CO_2$ "Cap-and-Trade"

- A market-based pollution reduction program
  - Imposes a fixed "cap" on annual $CO_2$ emissions
  - Allocates $CO_2$ emission "allowances" equal to the emissions cap (e.g., auction, grandfathering, other)
- "Covered" entities must submit allowances (or qualifying *offsets*) equal to $CO_2$ emissions for a "compliance period"
  - Reduce emissions and/or buy allowances or offsets
  - Allowances & offsets can be bought, sold and traded in the market
- Examples of existing cap-and-trade programs:
  - U.S. $SO_2$ ("Acid Rain") program (Title IV 1990 CAA)
  - Northeast $NO_x$ Budget Program
- Result is a price on $CO_2$

# What Will Drive $CO_2$ Price?

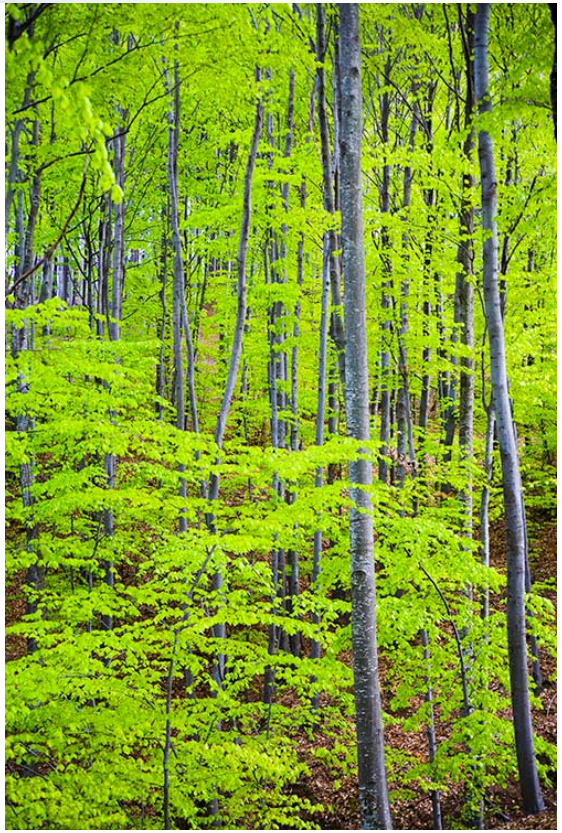



- $CO_2$ prices must rise high enough to force emissions below the cap
- $CO_2$ allowance prices will be "high" ($\geq$ \$30/t$CO_2$) in early years of a new $CO_2$ cap-and-trade program ***unless…***
  - "Safety valve," "price collar," or other price-control mechanism(s)
  - Massive GHG reductions by other regulated sectors (unlikely), or….

**– Abundant offsets are available**

# Example Offset Project Types

- Forests
  - Afforestation / Reforestation
  - Reduced emissions from deforestation and degradation (REDD)
- Soil Carbon and Agriculture
  - Conservation tillage practices
  - Reduced nitrogen fertilizer
- Methane ($CH_4$) Destruction
  - Animal waste digesters
  - Landfill gas
  - Coal-mine methane
  - Natural-gas system fugitives
- Energy Efficiency and Renewables
  - *Domestic* EE & renewable projects are not offset projects. They reduce electric-sector $CO_2$ emissions included under the "economy-wide" cap
  - *International* EE & renewable projects may be offsets if they are implemented in sectors and locations *without* a $CO_2$ cap.



# Electric Sector is Major Source of $CO_2$ Emissions and Abatement

Electric sector's share of national total (2006)

- 33% of total GHGs
- 39% of total $CO_2$

Shares within the electric sector $CO_2$

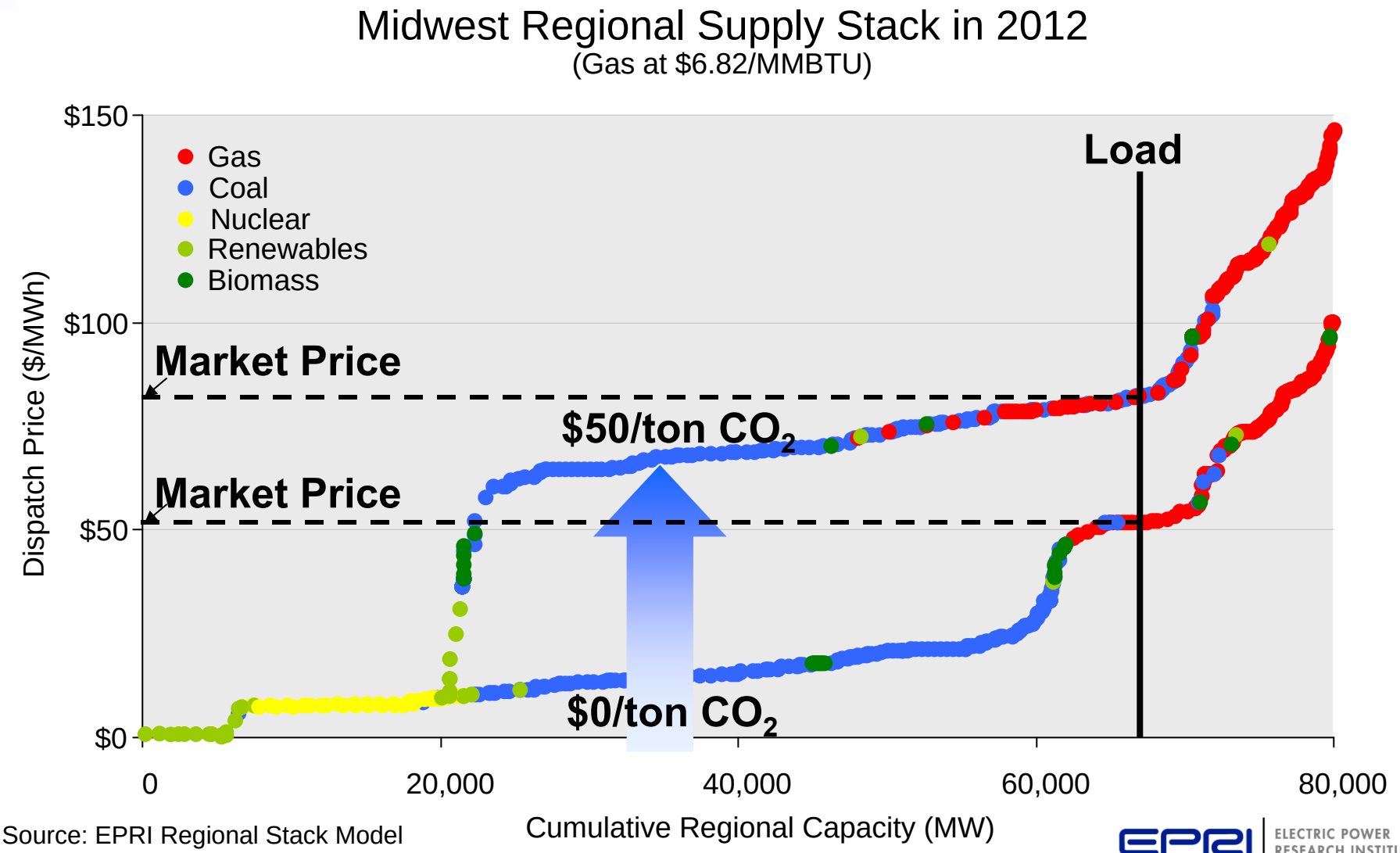
- 15% from natural gas ($6/MMBtu)
- **83% from coal ($1.5/MMBtu)**

**Coal displacement primary source of abatement economy-wide and its cost drives $CO_2$ price**

# $CO_2$ Policy Can Have a Dramatic Impact on Generation Costs, Power Prices, and Cash Flows

- Each dollar of $CO_2$ value boosts fossil dispatch costs
  - ~ $1.00/MWh for coal-fired generation
  - ~ $0.40/MWh for gas-fired CC
  - ~ $0.60/MWh for gas-fired CT/boiler
- But higher dispatch costs mean **higher power prices**
- Net impact on cash flow depends on net balance of cost impacts against net revenue impacts from a $CO_2$ price

# 2012: $CO_2$ Price Increases Dispatch Costs — Supply Stack Re-Orders to Favor Less Emitting Generation




Source: EPRI Regional Stack Model





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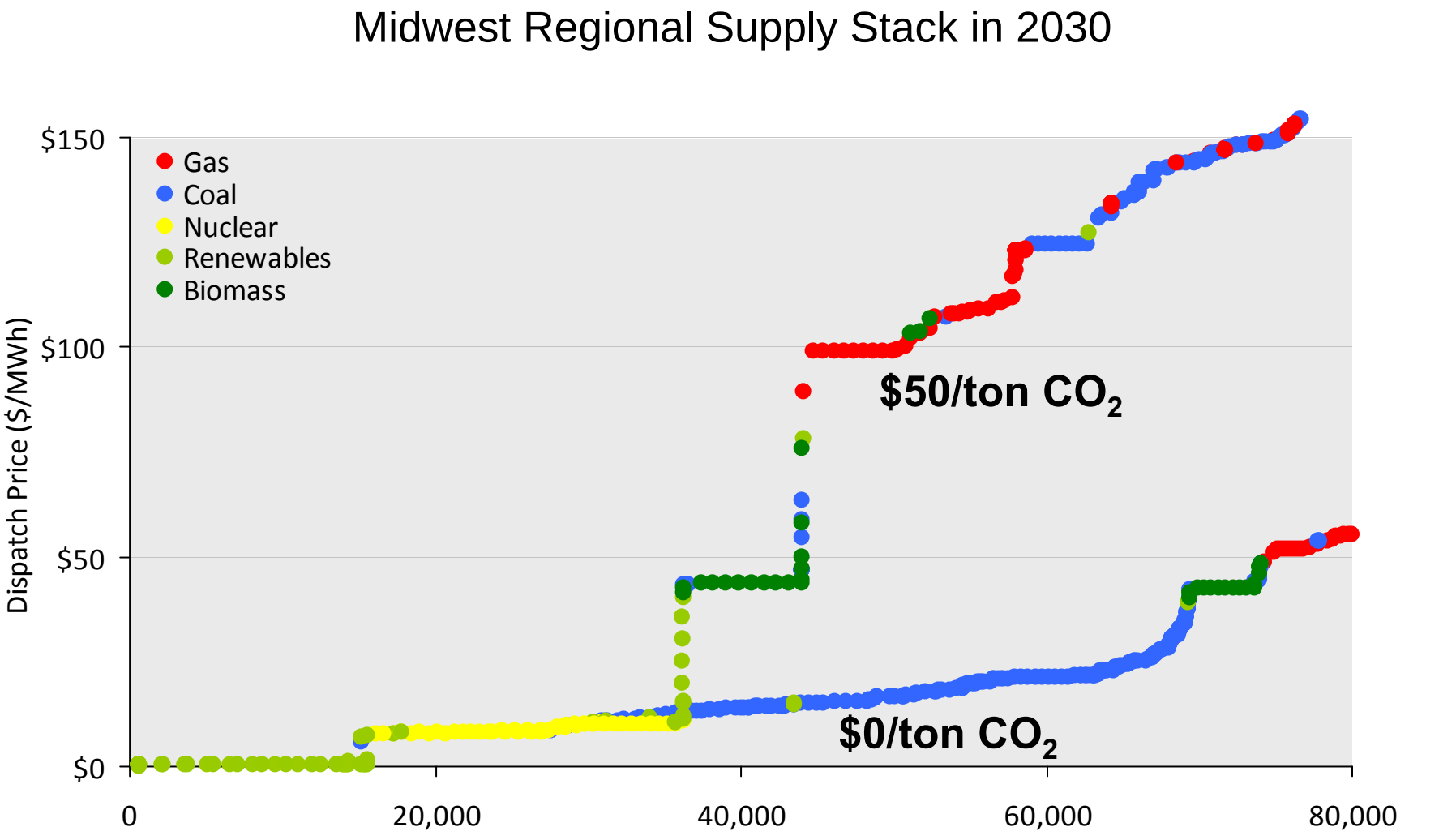
# 2030: Massive Additions of Non-emitting Generation, Much Higher Fossil Dispatch Costs




Source: EPRI Regional Stack Model





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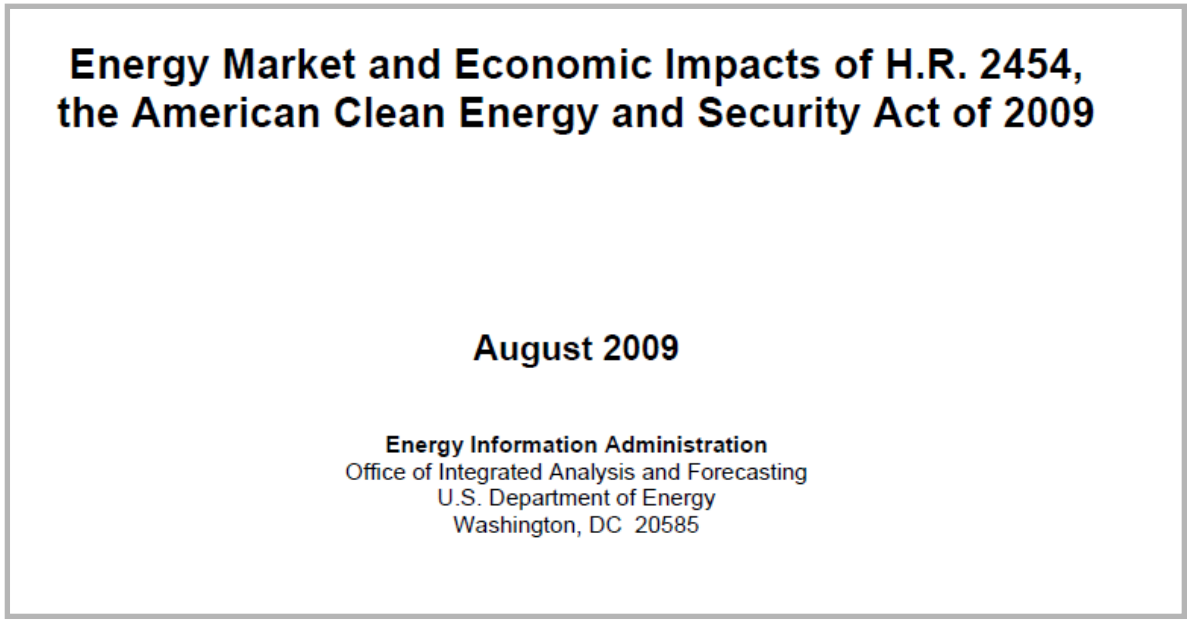
# EIA Analysis of Waxman Markey w. NEMS



**Energy Market and Economic Impacts of H.R. 2454, the American Clean Energy and Security Act of 2009**

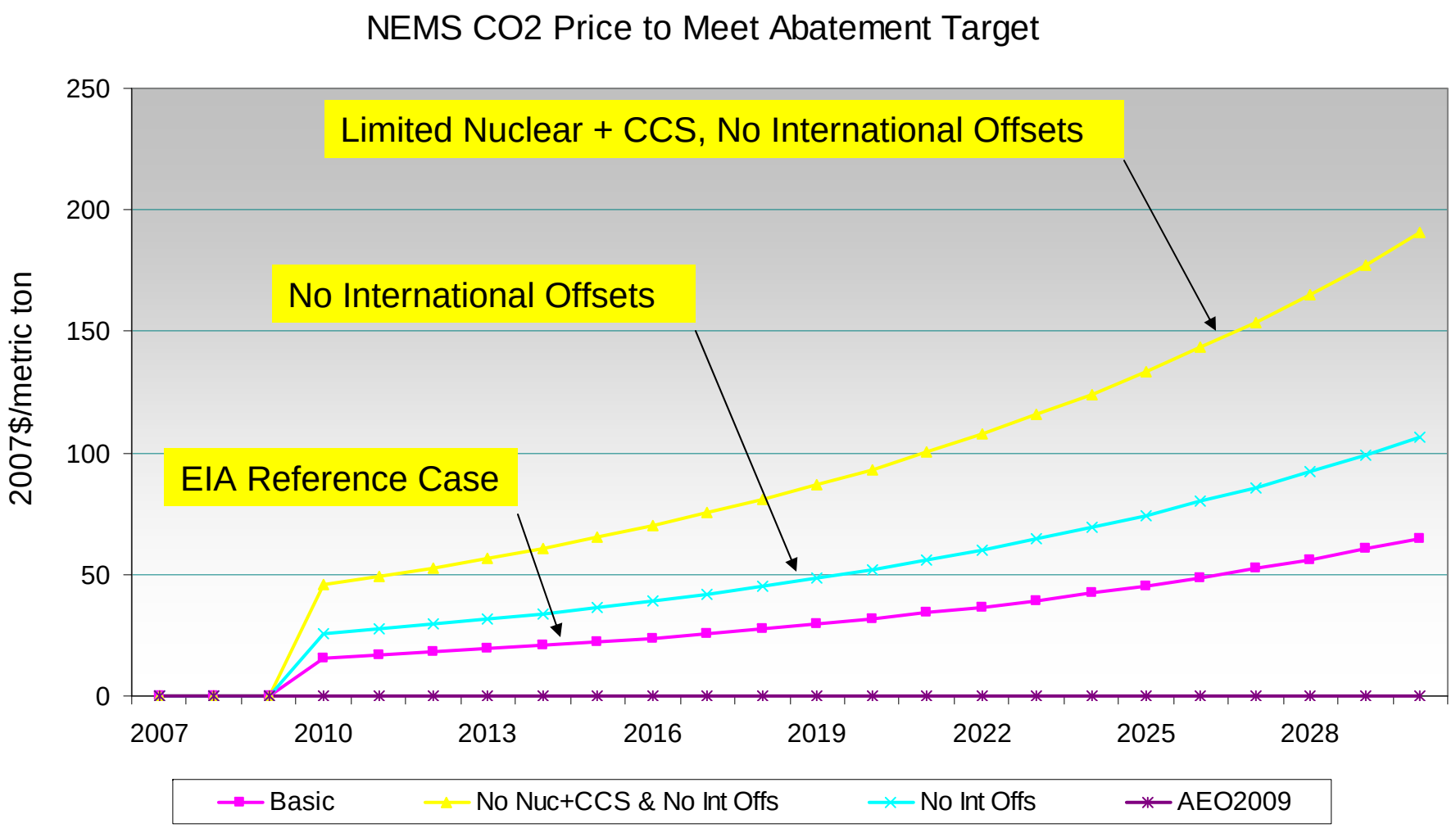
**August 2009**

**Energy Information Administration**
Office of Integrated Analysis and Forecasting
U.S. Department of Energy
Washington, DC 20585

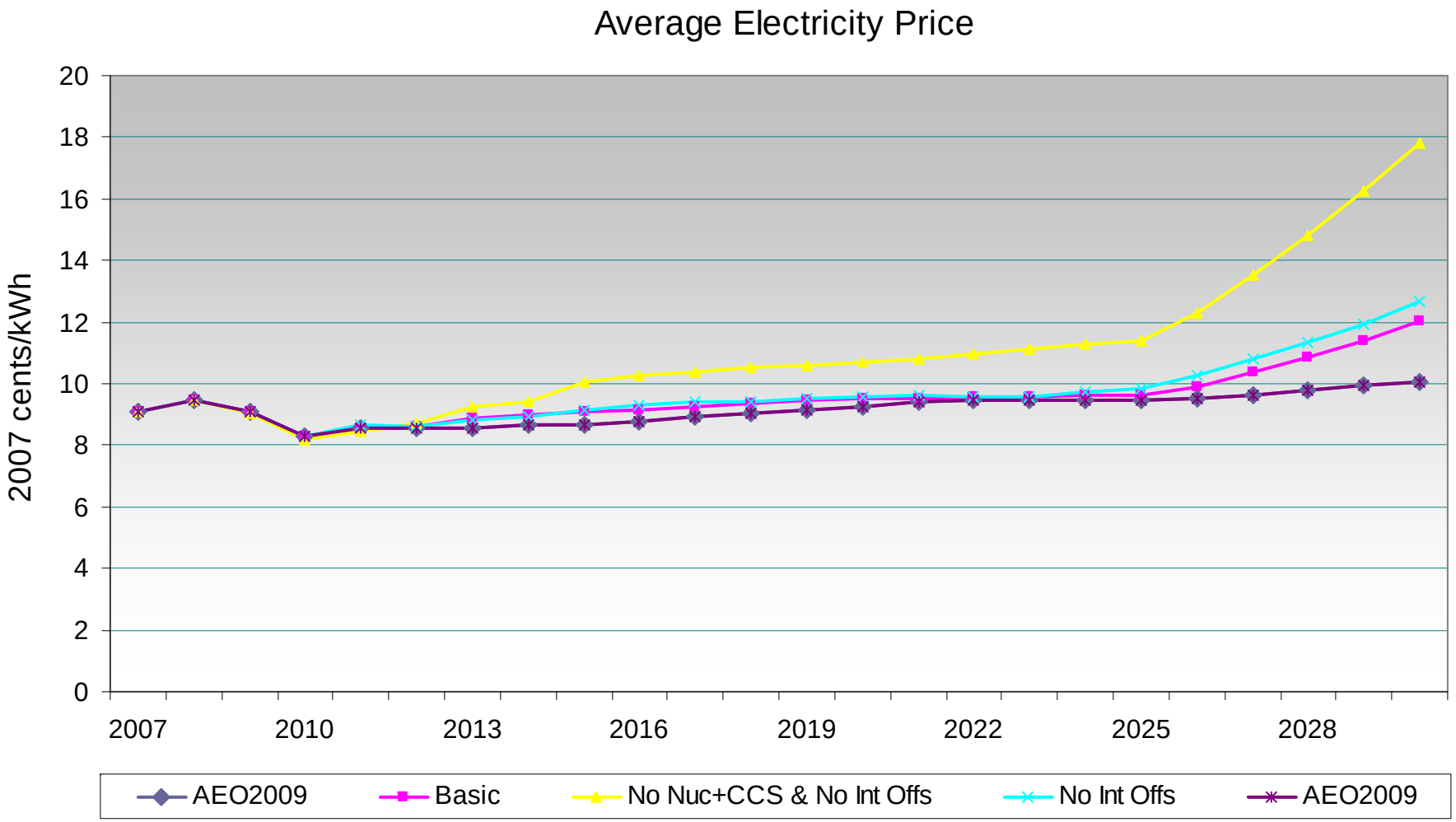
- Based on AEO 2009 w. stimulus (ARRA)
- Covered many policy scenarios and sensitivity cases

- Today we focus on results for three scenarios

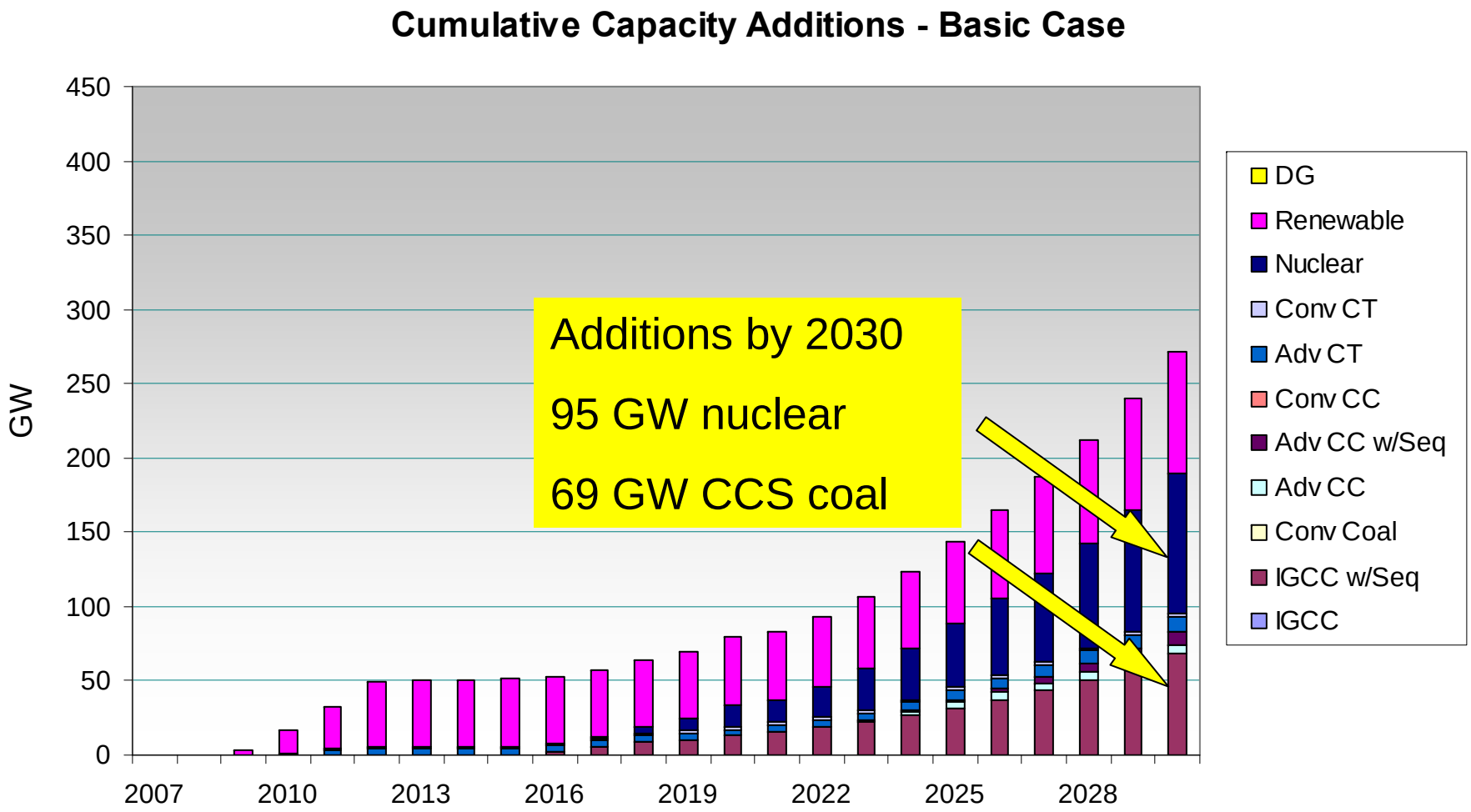
# $CO_2$ Price Paths Highly Sensitive to Scenarios



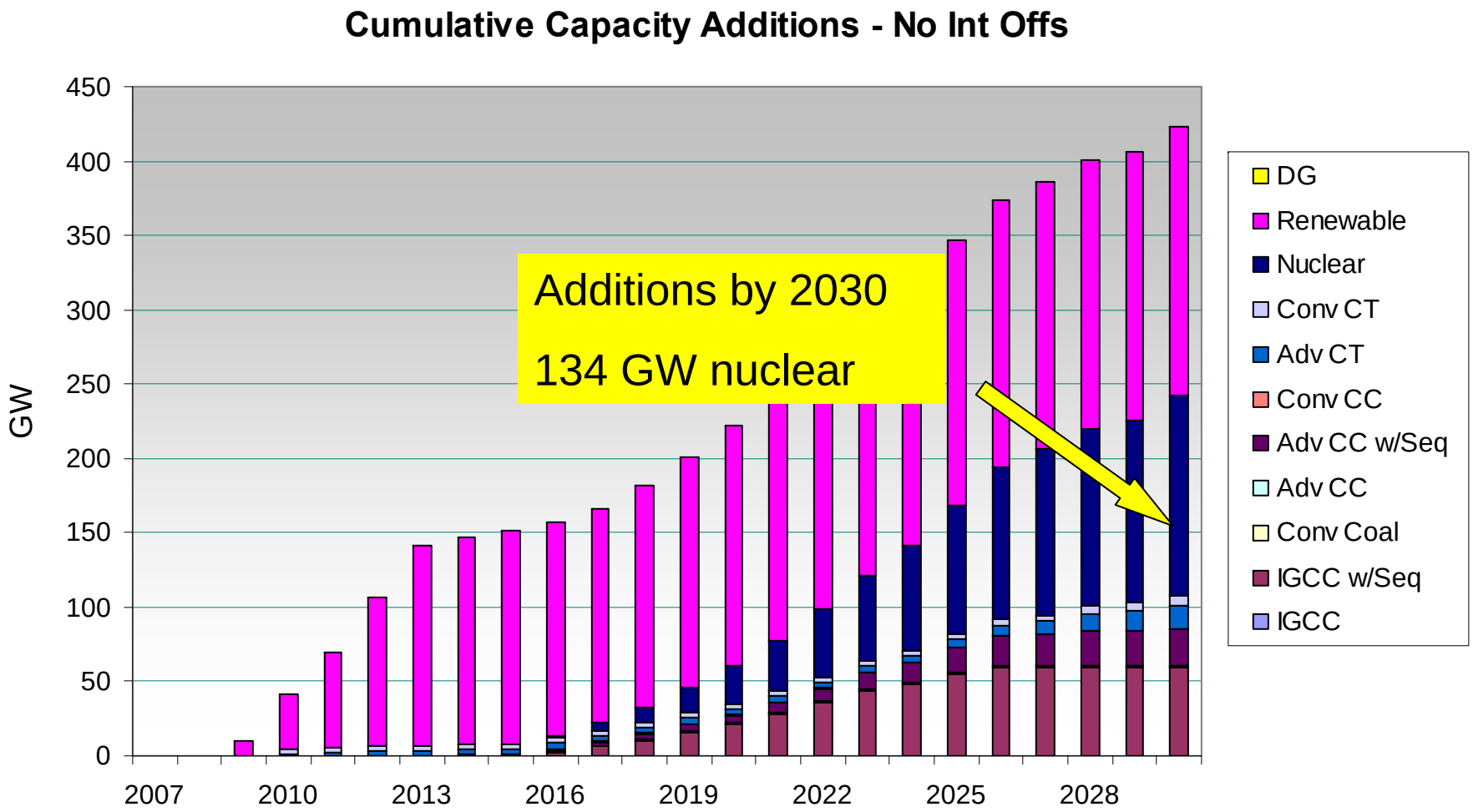
# Electric Consumers See Price Increases, Masked by Allocation of Free Allowances



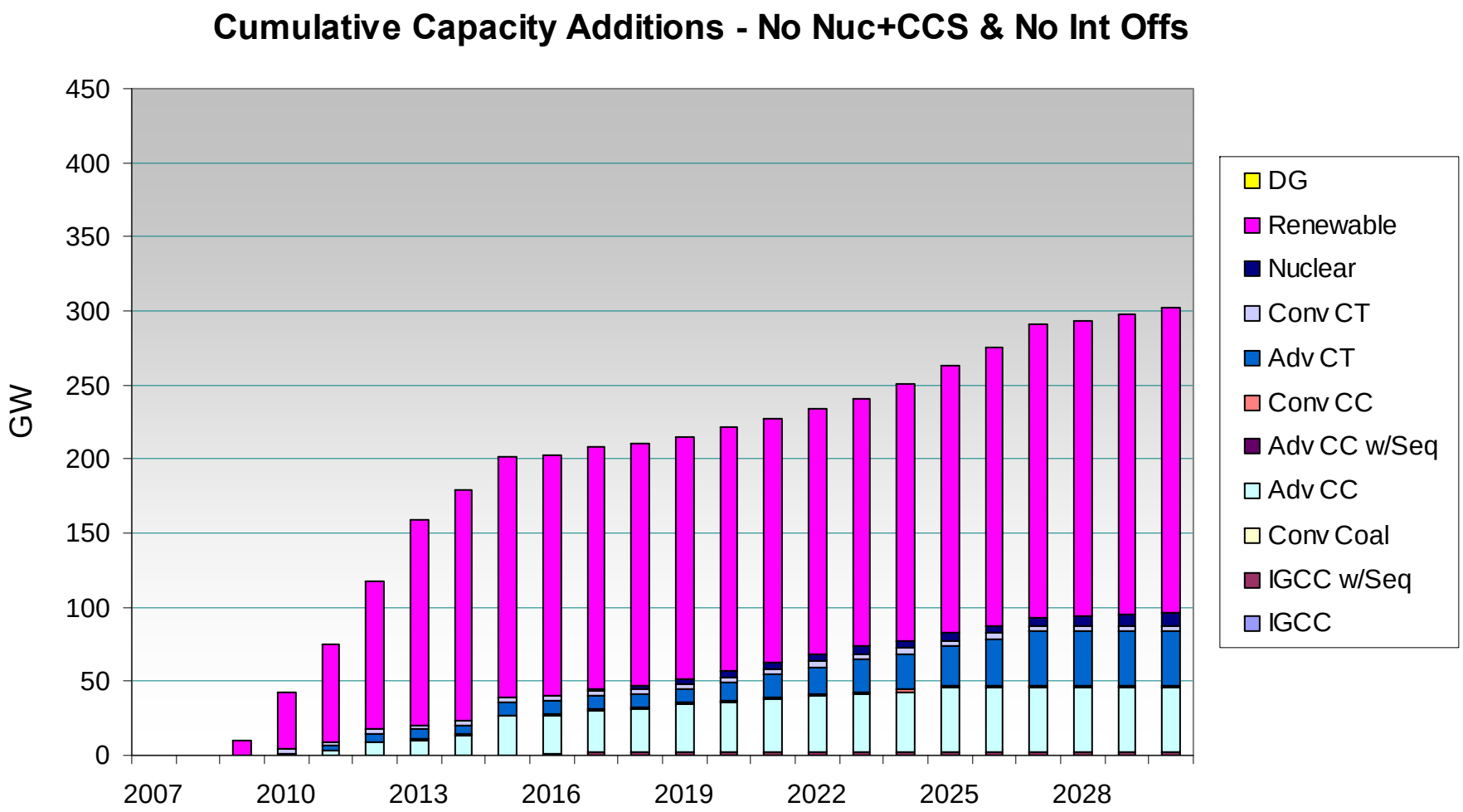
# Cumulative Capacity Additions – Basic Case



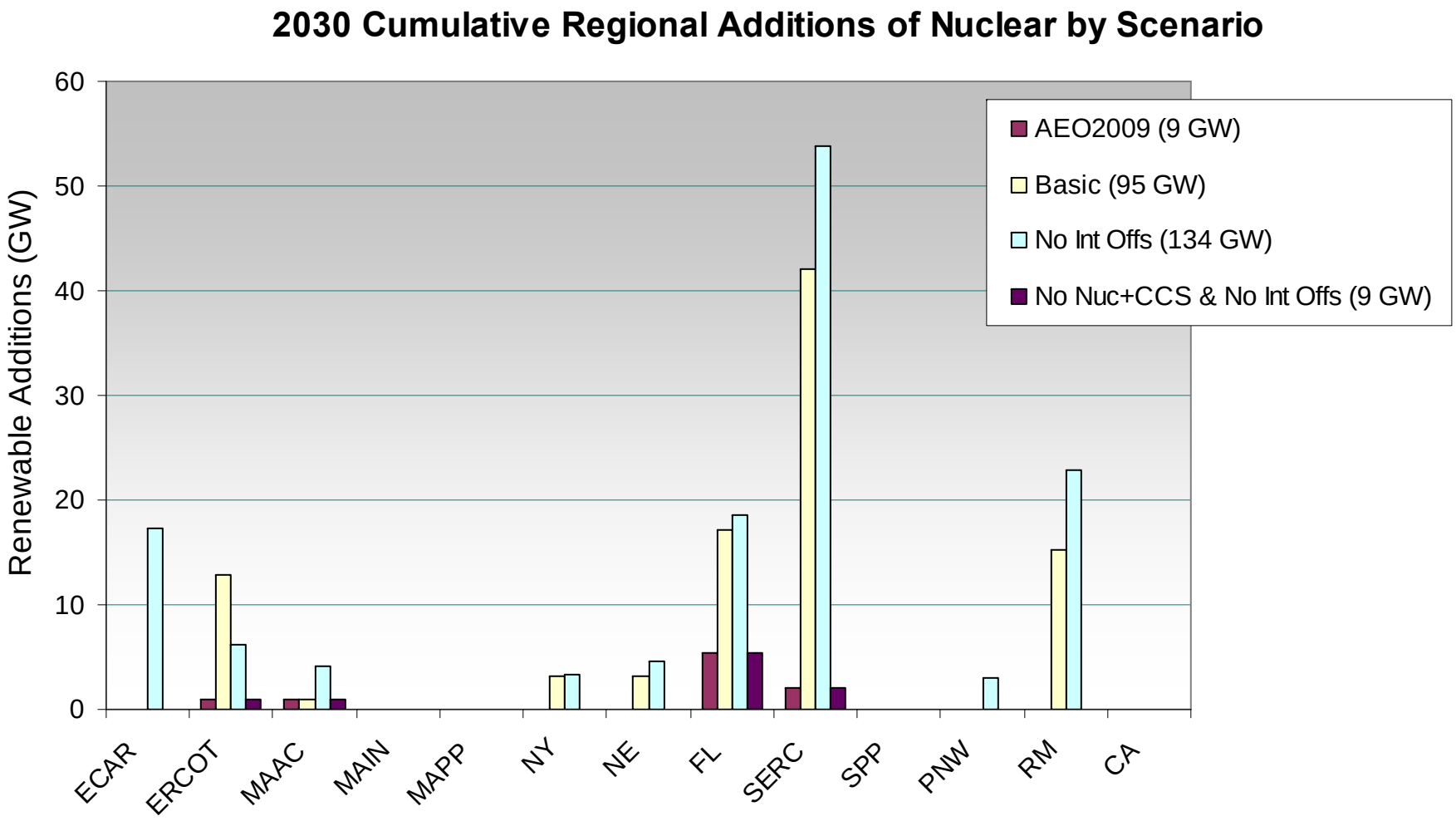
# Cumulative Capacity Additions – No International Offsets Case



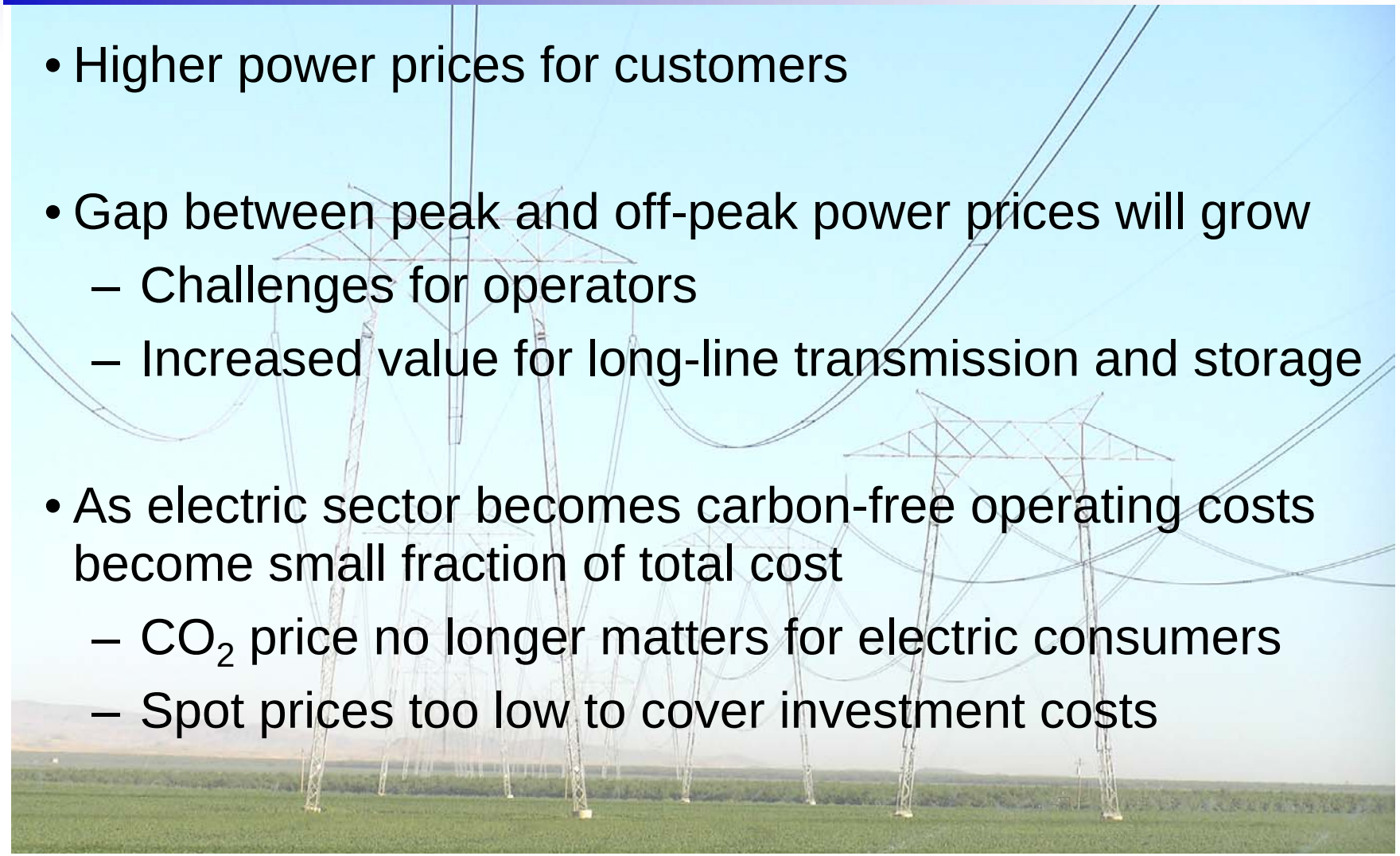
# Cumulative Capacity Additions – No Nuclear or CCS and No International Offsets Case



# Nuclear Additions Concentrated in a Few Regions



# Implications for the Electric Sector



- Higher power prices for customers
- Gap between peak and off-peak power prices will grow
  - Challenges for operators
  - Increased value for long-line transmission and storage
- As electric sector becomes carbon-free operating costs become small fraction of total cost
  - $CO_2$ price no longer matters for electric consumers
  - Spot prices too low to cover investment costs

# The Big Questions

- Will there be a binding societal commitment to drastically cut emissions?
- If so, how big the cuts, and how soon?
  - How stringent the goals
  - How easy the offsets
- Or will the policy be “technology pushing” while debate over science and cost continues?
- What will be the relative successes of non-emitting generation options?
  - Nuclear
  - CCS coal
  - Grid-integrated wind

# Together…Shaping the Future of Electricity