Climate Risk and Economics

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Alternative Climate Normals and Impacts to the Energy Industry
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Disclaimer

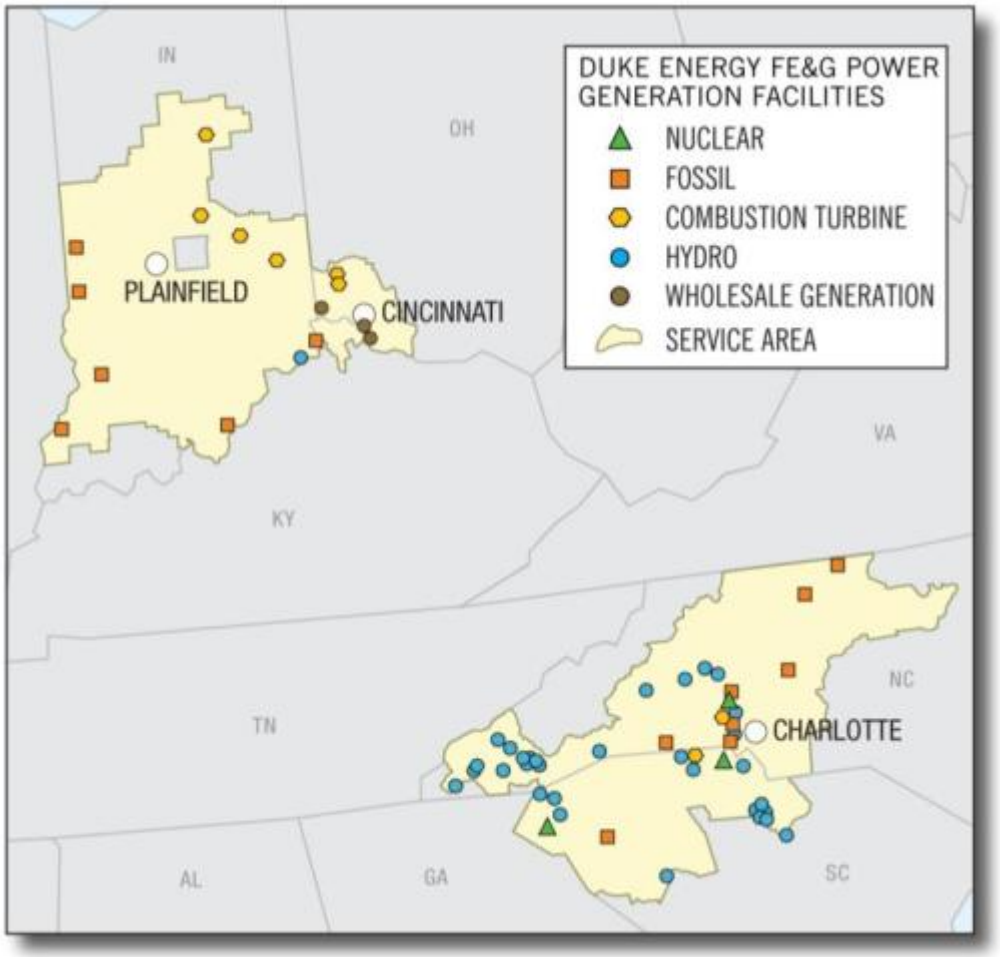
- Speaking for myself – not Duke Energy
- Numbers are, in many cases, approximations. Some data is old.
- Translating from other's work to put forward the generalized views.
- Before citing – go to original sources.

What you're going to hear

- Why we worry about climate?
- How climate risk translates to financial risks (so far, not so much about the weather)
- How policy uncertainty blocks innovation
- The economic arguments in the political discussion

Duke Energy U.S. FRANCHISED ELECTRIC AND GAS

- 5 states: North Carolina, South Carolina, Indiana, Ohio and Kentucky
- 50,000 square miles of service area
- 27,000 MW of regulated generating capacity
- 4.0 million retail electric customers
- 500,000 retail gas customers in the Cincinnati area
- 3rd largest coal consumer & nuclear operator in U.S.

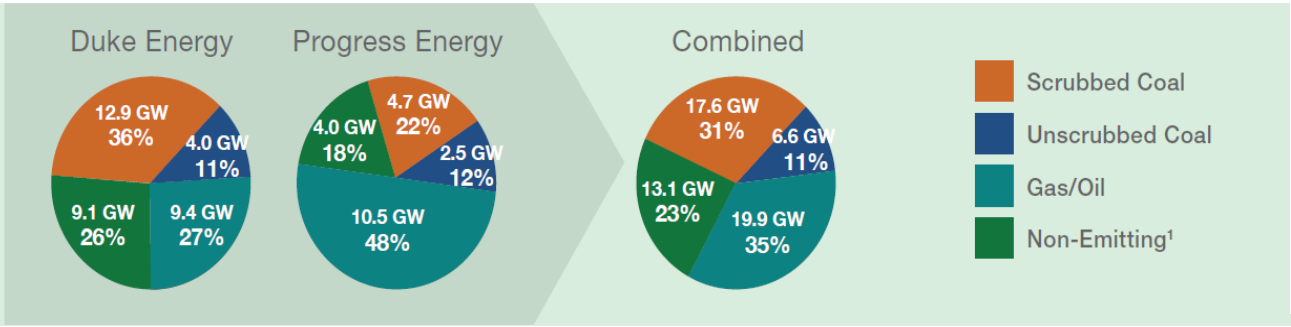


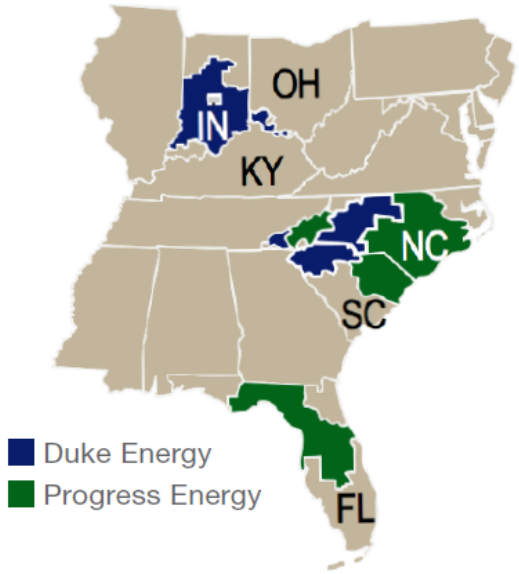
Pending merger with Progress Energy will make us largest utility in U.S. – New Company and New Leadership

U.S. generation well positioned for pending environmental regulations

Mitigate cost increase and strategic execution risks in era of major change

Generation Capacity by Technology (GW/%)





[1] Duke Energy: Nuclear (15%), Hydro (9%), Renewables (2%); Progress Energy: Nuclear (17%), Hydro (1%); Combined: Nuclear (16%), Hydro (6%), Renewables (1%)
Note: Generation capacity as of 09/30/10 and excludes purchased power and 4.1 GW of Duke Energy International assets.

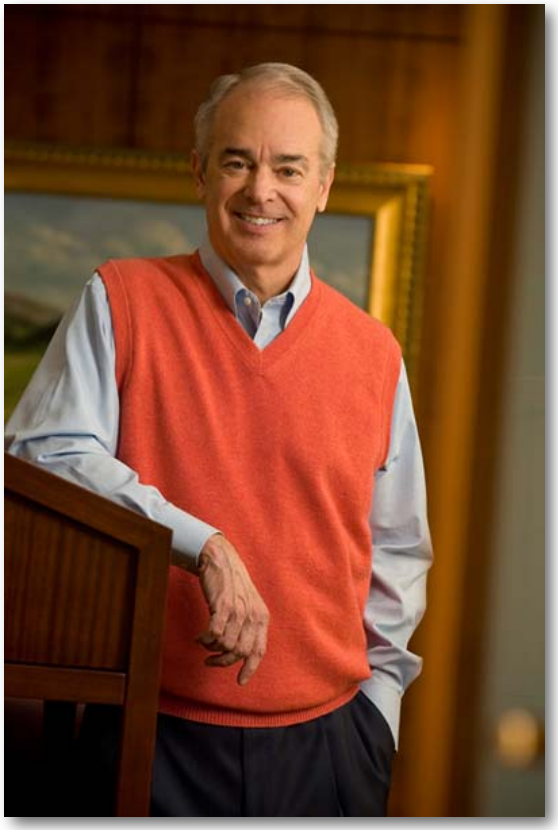
Company Name: Duke Energy Corporation
Corporate Headquarters: Charlotte, N.C.; substantial operations in Raleigh, N.C.
Market Capitalization: $36.5 billion***
Total Assets: $90.6 billion*
Revenues: $22.7 billion**
Customers: 7.1 million electric and 500,000 gas
Generating Capacity: 57,200 megawatts
Service Territory: 104,000 square miles
Executive Chairman: James E. Rogers
President and Chief Executive Officer: William D. Johnson
Board of Directors: The new Duke Energy board will be composed of 18 directors, 11 designated by Duke Energy, including the lead director, and 7 designated by Progress Energy

* As of stock close September 30, 2010
** As of December 31, 2009
*** As of December 31, 2010

Very roughly: 1,000 MW (1 GW) can power 1 million homes

OUR ASPIRATIONS

- Decarbonize our power generation
- Help make our communities the most energy efficient in the world



"These aspirations are grounded in our commitments to provide our customers with clean, affordable and reliable electric and gas services."

Jim Rogers
Chairman, President and CEO

$$$$ Sustainability – A Driver of Business Value $$$$

Unlocks Innovation

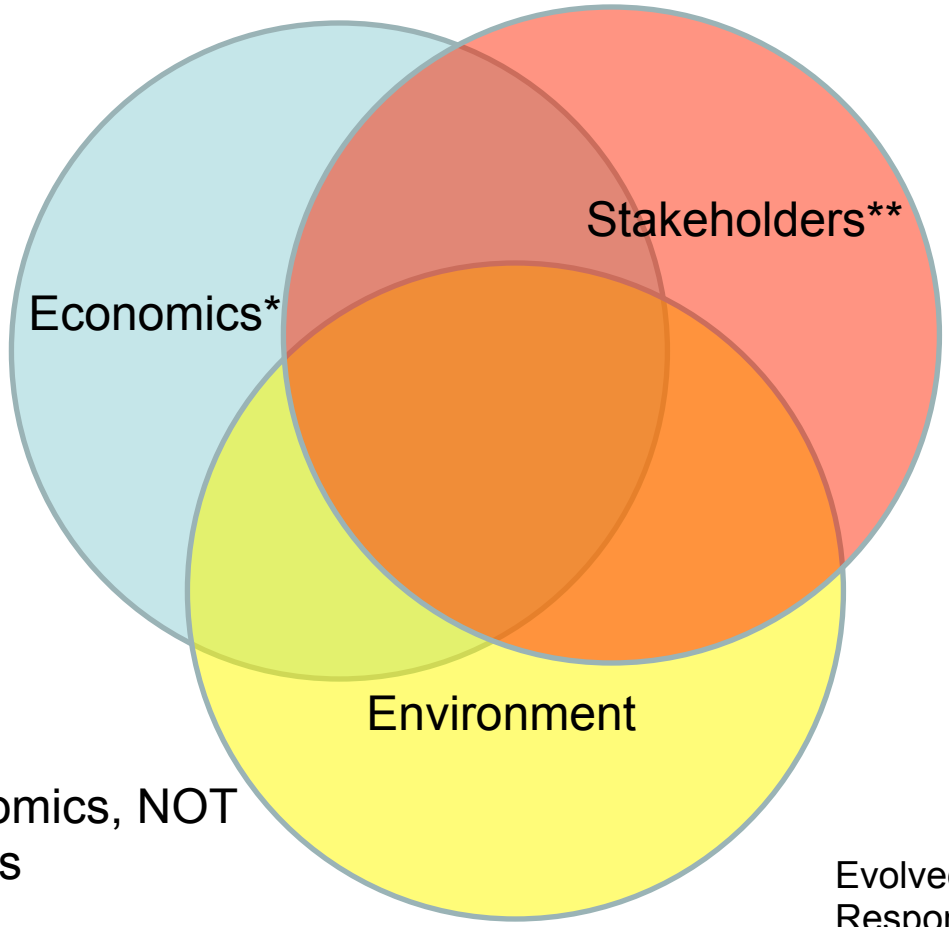
Achieves Bottom Line Results

Builds Positive Relations

Generalized Sustainability Model

If not profitable, not sustainable: how long is management team left in place if can't deliver profits?

++ Tension between short term and long term



*Fiduciary responsibility to shareholders (owners)

**Includes communities in which they operate, customers, suppliers, employees, governments

Environmental Economics, NOT Ecological Economics

Evolved from Corporate Responsibility, to Corporate Social Responsibility and so on.

Sustainability → Risk Management → Value Enhancement

- Risk menu
  - Price risks (prices of inputs and product)
  - Demand risks (how fast local/national economy grows)
  - Technology risks (will new techs cost or work as promised)
  - Policy risks (technology restrictions/preferences, willingness to pay, restrictions on fuels, restrictions on emissions/waste, market structure or rules)
- Duke policy orientation
  - Acknowledge real problems
  - Deep understanding through sound analytics (economics, technology, markets)
  - Engage stakeholders (intelligence gathering/negotiating/informing)
  - Attempt to resolve or narrow policy uncertainty
    - Solves the problem (delayed decisions = prolonged risks)
    - Economically centered
    - Politically sustainable – broad agreement from stakeholders

"Environmentally effective, cost effective and fair"

Consistent view of climate science

- (2004) “Although we know there is still much we do not understand, we respect the analyses presented in the report issued by the National Academy of Science in response to questions from the Bush Administration (in *Climate Change Science: An Analysis of Key Questions).* The NAS assessment states:
  1. The earth is warming;
  2. It will continue to do so; and
  3. Human activity is likely contributing to this warming. “

  Source: http://www.duke-energy.com/pdfs/air_issues.pdf

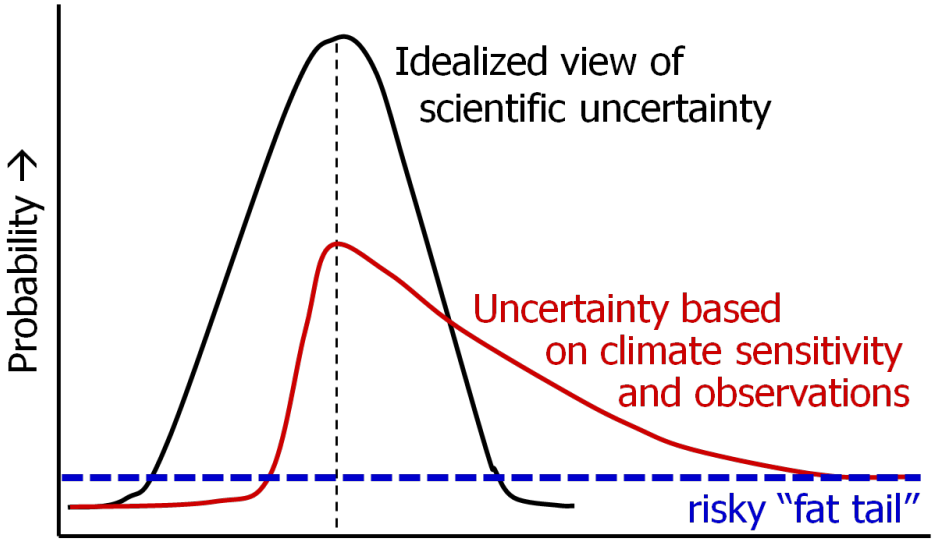
- (2008) “We do not claim to be experts on the science of climate change but we take our cue from the peer reviewed science as synthesized and reported by the IPCC. We acknowledge that climate change is occurring and that human interaction with the environment is responsible for much of it. We also acknowledge a responsibility to engage our policymakers in a solution-oriented approach as quickly as possible.”

  Source: http://www.duke-energy.com/pdfs/Report-to-Shareholders-on-Climate-Change.pdf (2008)

- Our filters:
  - Who speaks for “science?”
  - How is science formulated? What does “consensus” mean when discussing science?
  - We know, from experience, many energy “experts” who talk nonsense.

Climate Risk Has Yet to Evaporate

- Scientific community has not abandoned theory of climate change
- Underlying physics seldom challenged
- Uncertainty and debate on range of impacts



Cartoon from Jay Gulledge at C2ES

Ronald Prinn, global warming, MIT, MITâ€™s Center for Global Change Science

- Just beginning to assess near term risk to Duke Energy physical assets

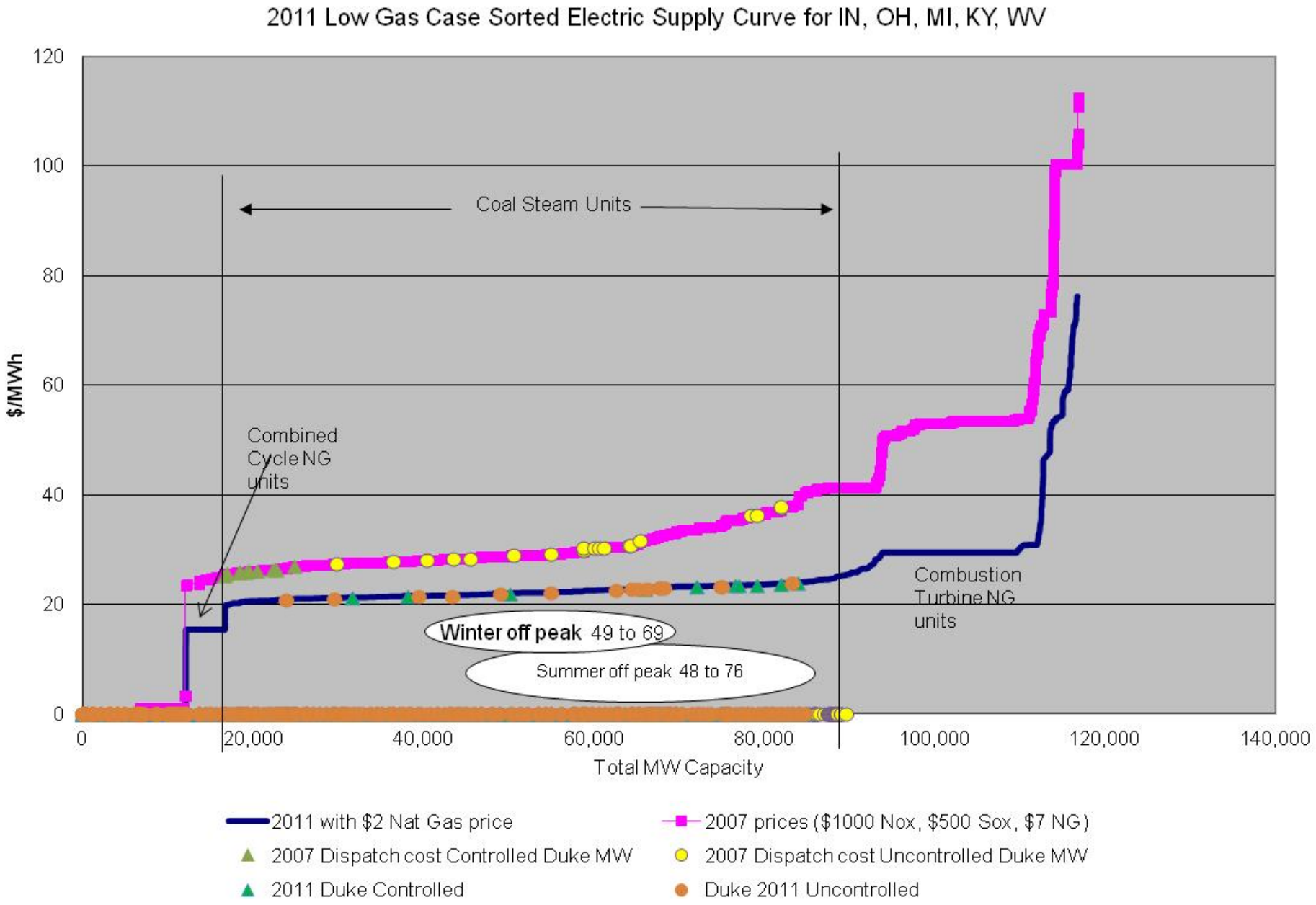
Therefore, Climate Policy and Financial Risk Remain

- As long as science unwavering and weather doesn't cooperate, issue unlikely to go away
- Taboo on climate policy talk does not eliminate firms' economic risk
- Future GHG restrictions within vague timeframe are highly plausible
- Market based policies lowest economic cost & most efficient – likely default (after everything else tried)
  - Buzz about carbon tax to address budget problems
- Ongoing source of significant financial risks in large, long lived capital investments

An Immediate Issue -- U.S. Generation Fleet Aging
Entering new big investment cycle

- About 500,000 MW of electric generation plants in the U.S., about 300,000 MW fueled with coal
- Most of the largest plants built between 1960 and 1980
  - Many already have pollution controls
  - However, about 100,000 MW lack significant pollution controls
    - Many are pre-1960 vintage
    - Responsible for largest share of criteria pollutants (SO_2, NOx, mercury)
- Likely to retire 30,000 to 60,000 MW between now and 2015
- Must replace this and invest for growing demand – what tech to deploy?

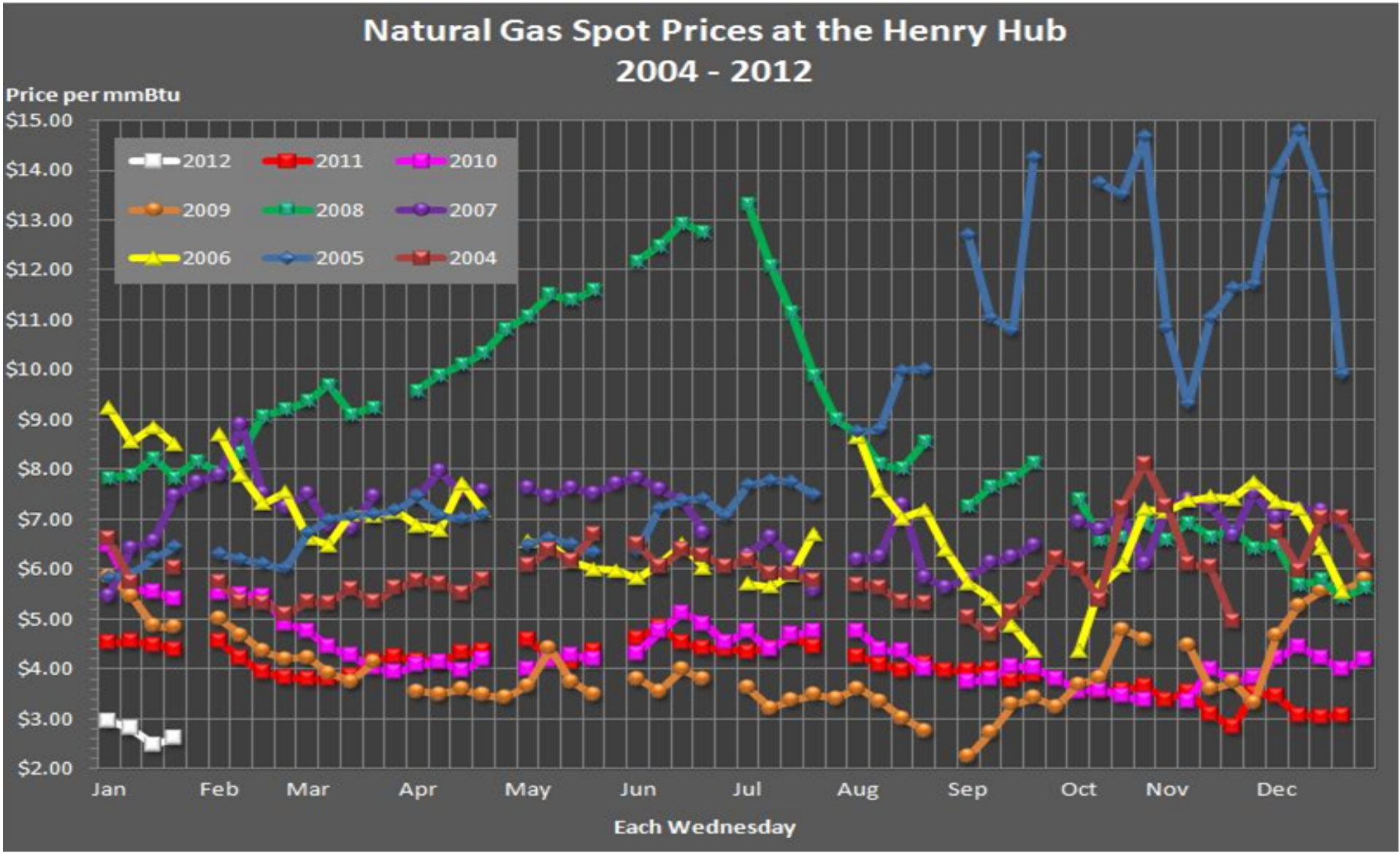
2011 Curve with $2 Natural Gas --



Electric Utilities' Challenge – How rationalize to stakeholders particular technology choices?

- Many still incorporate CO2 price in investment plans
  - Large uncertainty around when, how much and how fast prices will change
    - Difficult to explain – why not higher or lower, sooner or later?
  - Negative hit to coal – few new plant announcements
  - Fuzziness of "when and how much" increases difficulty for many in explaining aggressive investment in advanced techs (nuclear, CCS or renewables)
    - challenge for regulators and investors [aggressive = 15+ new nuclear units for the U.S. by 2025]
- Faced with this uncertainty, option to delay investment increases in value – will defer investment as long as possible
- If must add capacity will minimize capital at risk and opt for lowest Cap-ex – Combined Cycle Natural Gas
  - If shale gas solves past problems of price volatility, good bet! If not …

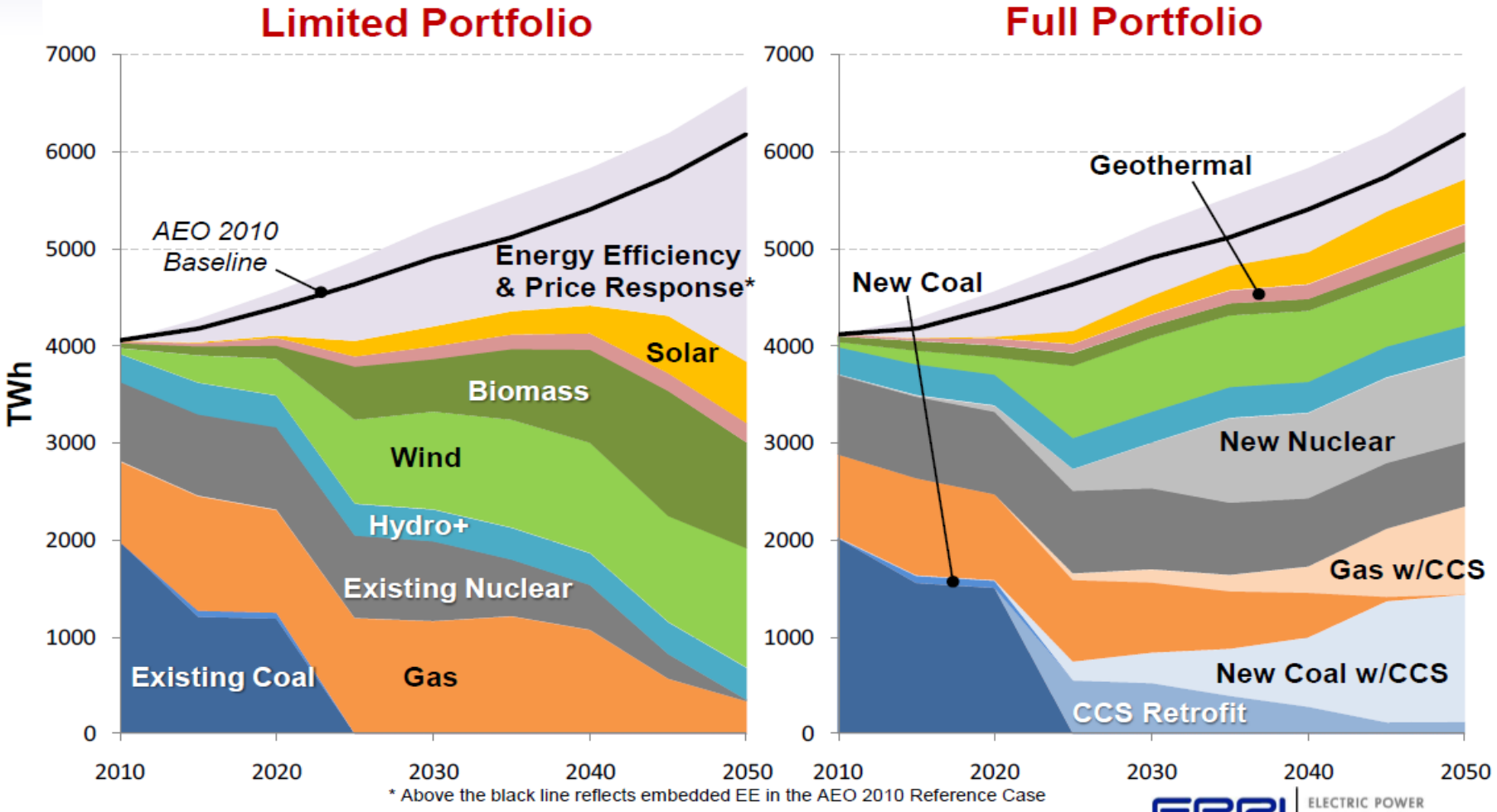
Natural Gas Prices move!



Source: http://www.neo.ne.gov/statshtml/124.htm

Electric Sector Response when CO2 is priced

National Generation Mix: CO_2 Controls



* Above the black line reflects embedded EE in the AEO 2010 Reference Case

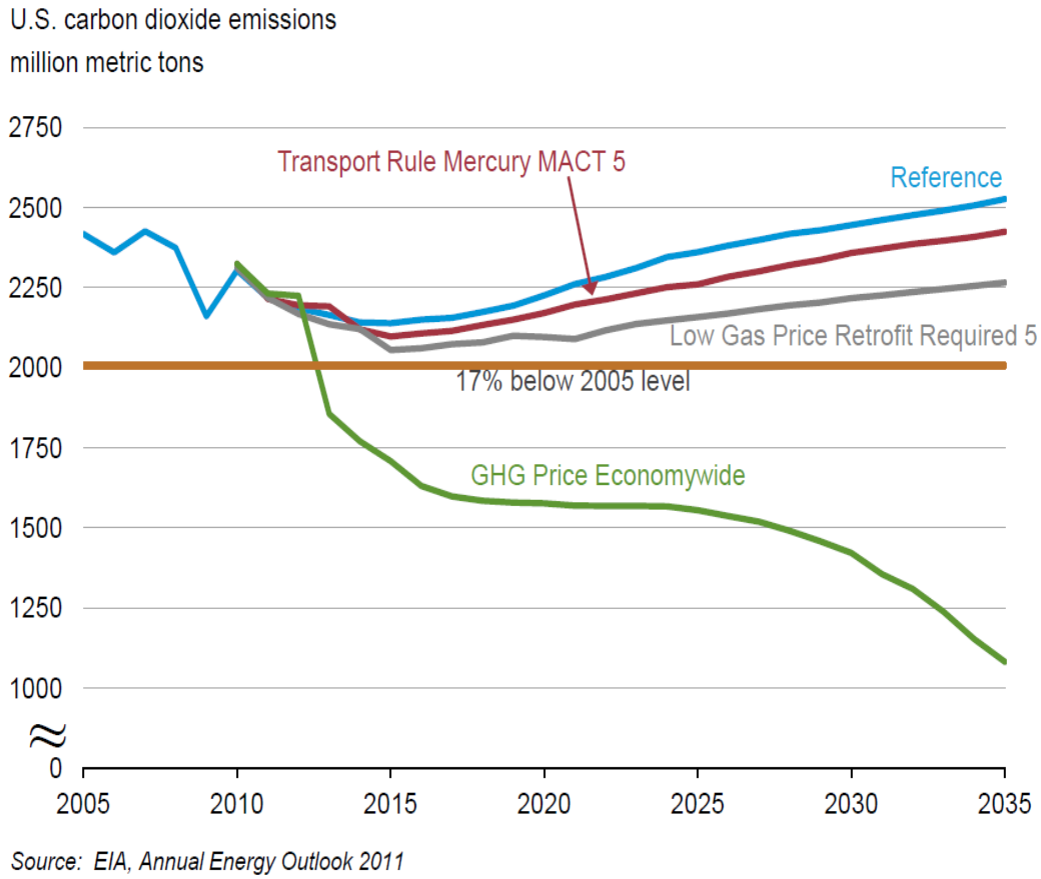
http://mydocs.epri.com/docs/summerseminar11/presentations/01-05_hannegan_epri_prism_v3.pdf

Losing opportunity for Innovation through deployment

- Large scale energy innovation mostly about large scale integration – not iPhones
- Those who spend the money can't grab Intellectual Property value
- Projects to advance technology being sidelined
  - Few able to step out and take multi-billion dollar project risks on nascent technologies
- Rebirth of domestic manufacturing of major nuclear components being deferred or cancelled (some components last made in U.S. in the 1980s)
- Innovation through doing (experience curves) to drive down cost not happening in U.S. – lab based projects insufficient

Electric Sector's CO2 Emissions Already Projected to Decline

(Low Natural Gas Price Scenario used $4)



Source: EIA, Annual Energy Outlook 2011

Crude approximation: Today's natural gas prices have similar dispatch impacts on coal and natural gas fired generators as:

a. $8 natural gas + $60/ ton CO2 price
b. $6 natural gas + $35/ ton CO2 price
c. $4 natural gas + $10/ ton CO2 price

Feared Economic Impacts Prevent Policy Resolution

Not all scientists confine themselves to talking about science – it doesn't take much investment to be smarter than them.

The Sound Bites in the Political Debate

- Opponents: $2.4 trillion tax increase – the total of all estimated energy price increases through 2050, choosing to ignore rebates/tax cuts

The Reality in 2009 with Kerry (Graham) Lieberman draft Senate bill:

- Indiana electricity impact (one of the most coal intensive states): Between 5 and 10% electricity price increase –
  - $6 to $12/month/household or 20 to 40 cents/day
- Gasoline price – 1 penny/gallon for each $/ton CO2, therefore, if assume $20/ton CO2 → 20 cents/gallon.
  - 20 mpg vehicle driven 40 miles/day = 40 cents/day
- Therefore (conservative) impact on pocket is from 60 to 80 cents/day in Indiana

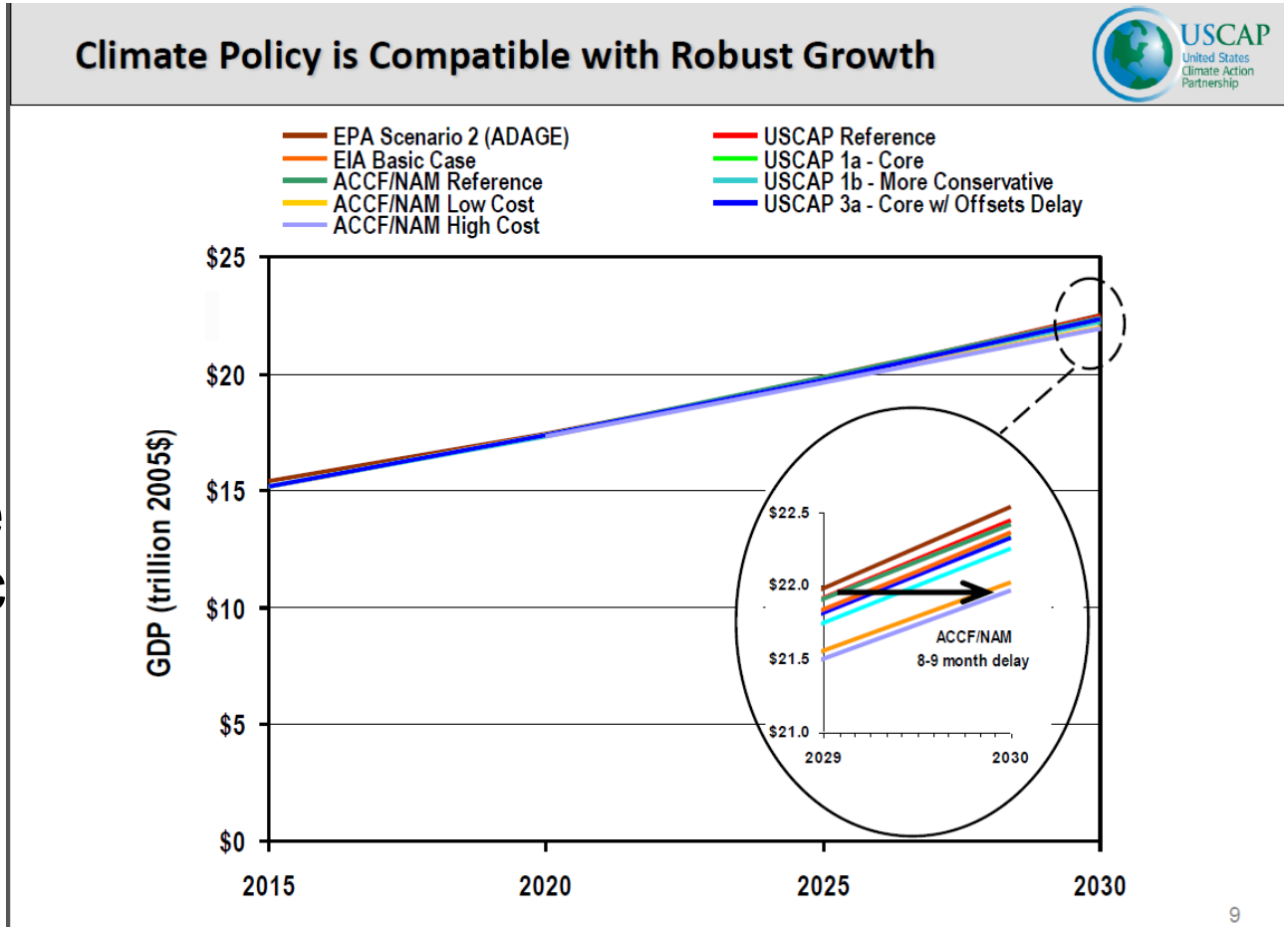
- Real economic costs (Net Present Value of annual reduction from "no policy case") as per EPA analysis of $79 to $146/year/household or 22 to 40 cents/day
  - 2.6 people/household → cost of 8.5 to 15 cents/day/person

Job Killing Machine?

- High energy prices per se don't harm an economy – how explain economic performance of Germany where electricity nearly 3x U.S. prices? Gasoline 2x U.S.
- Steadily rising oil prices from '01 to '07 were driven by robust global economic growth
  - Year on year fuel price increase relatively small – low volatility
  - U.S. economy continued to grow
- However …
  - Research seems to indicate high oil price VOLATILITY can trigger recessions
- Climate legislation recognized this – volatility dampened through
  - Allowance allocations to buffer price impacts
  - Offsets to allow aggressive caps in near term (drafted during relatively high growth)
  - Price floor and ceiling/buffer

Economic Models All Indicate Climate Policy DOES NOT Stop Growth

- USCAP modeled CO2 limits under various scenarios
- Compared to growth projections made by other organizations
- ALL pointed in same direction – economic growth continues
- Any "loss" is small delay of achieving same level of wealth



Source:
http://www.c2es.org/docUploads/USCAP-economic-modeling-slides-12-02-09.pdf
And http://www.c2es.org/uscap/economic-modeling

Economics in the Political Debate

NAM's Analysis of Climate Legislation (House passed version – Senate version was less costly)

NAM examined scenario of slow technology deployment with severely limited offsets– legitimate "worst case" view

- "U.S. jobs decline by 1.8 million under the low cost case and by 2.4 million under the high cost case"
- "would impose a financial cost on households of $118 to $250 by 2020 and $730 to $1,248 by 2030"
- "reduce U.S. Gross Domestic Product (GDP) by between $419 billion and $571 billion by 2030 GDP falls by 1.8% under the low cost case and by 2.4% under the high cost case in 2030."

Figure 2. Loss in Employment

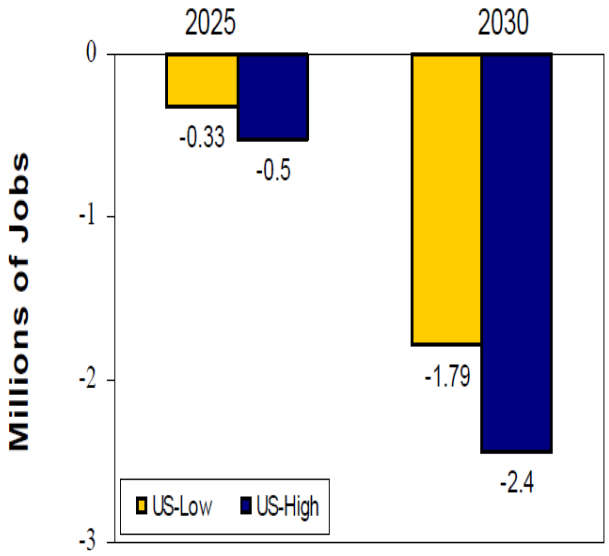


Figure 3. Loss of Disposable Income per Household

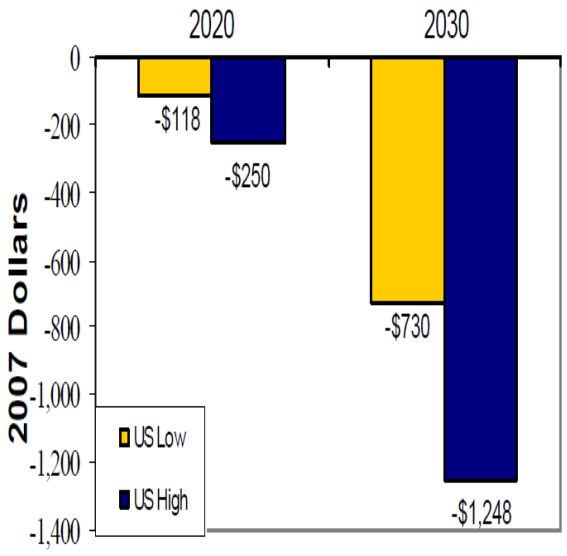
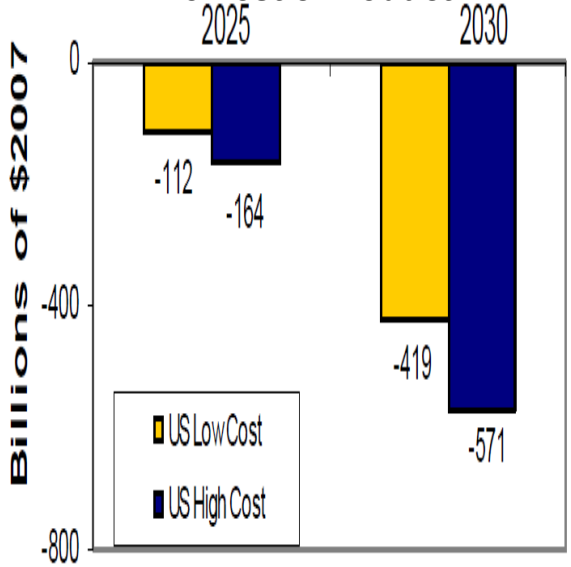


Figure 4. Loss in Gross Domestic Product

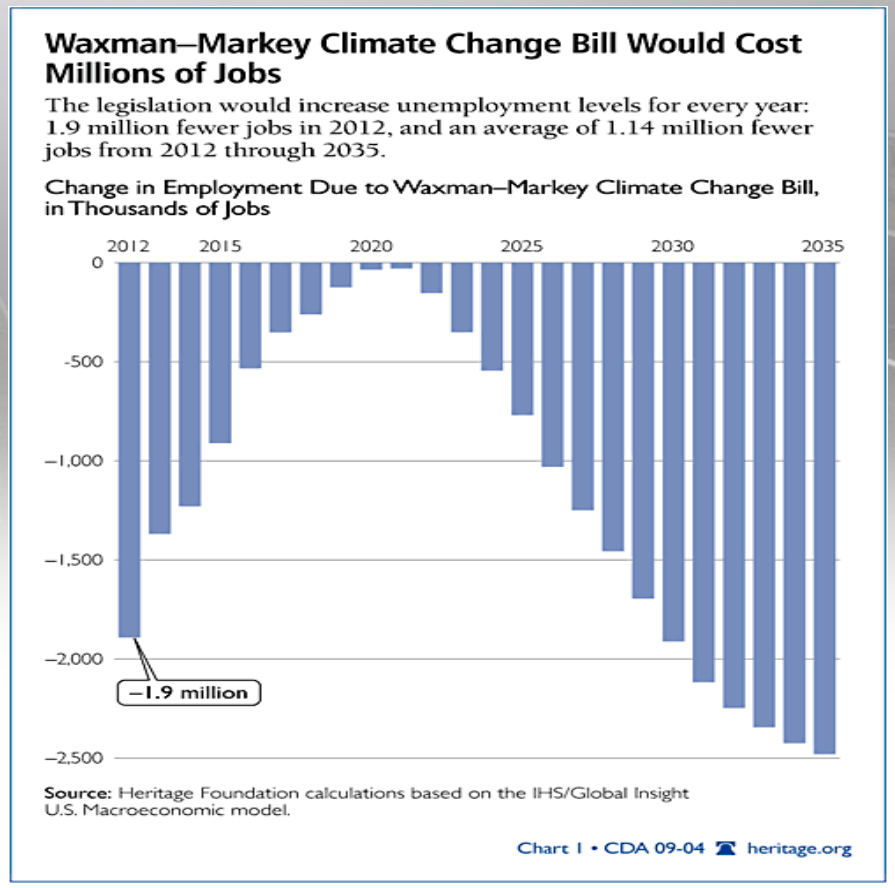


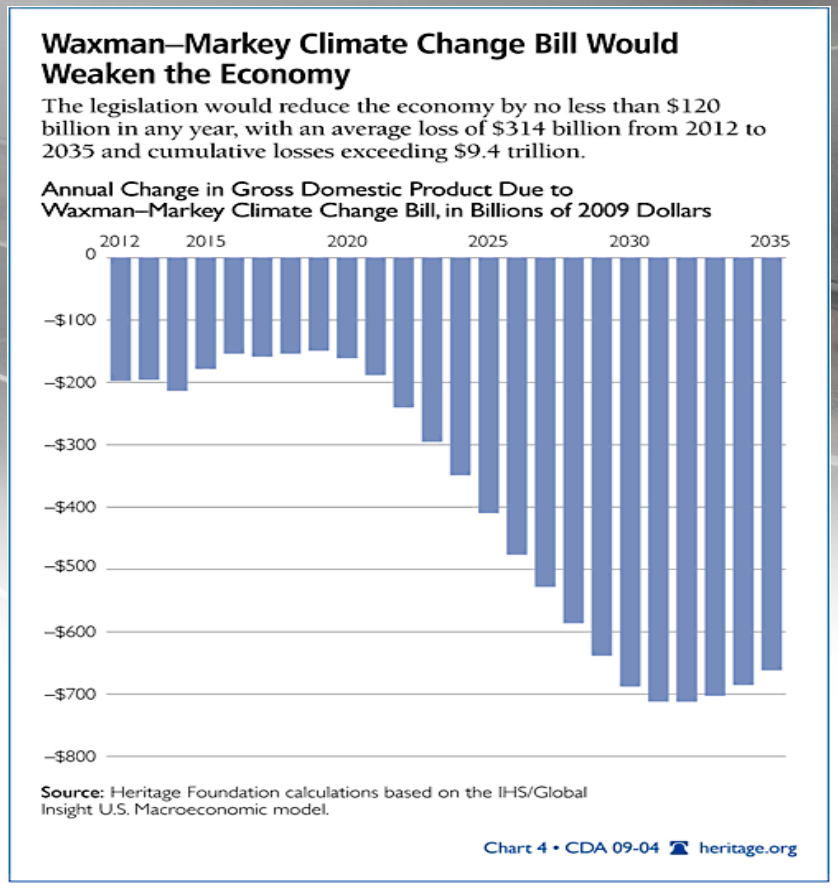
Source: NAM/ACCP Economic Impact of Waxman Markey Bill -- http://www.accf.org/media/docs/nam/2009/National.pdf

Not Bad Enough?

Heritage Foundation's Analysis of House passed climate legislation -- Waxman Markey
Examining scenario of "wheels coming off"

- Ignored cost containment provisions – no offsets, no allocations, no technology, CO2 price constraints ignored
- Very high CO2 prices in first year, resulting in energy price shocks

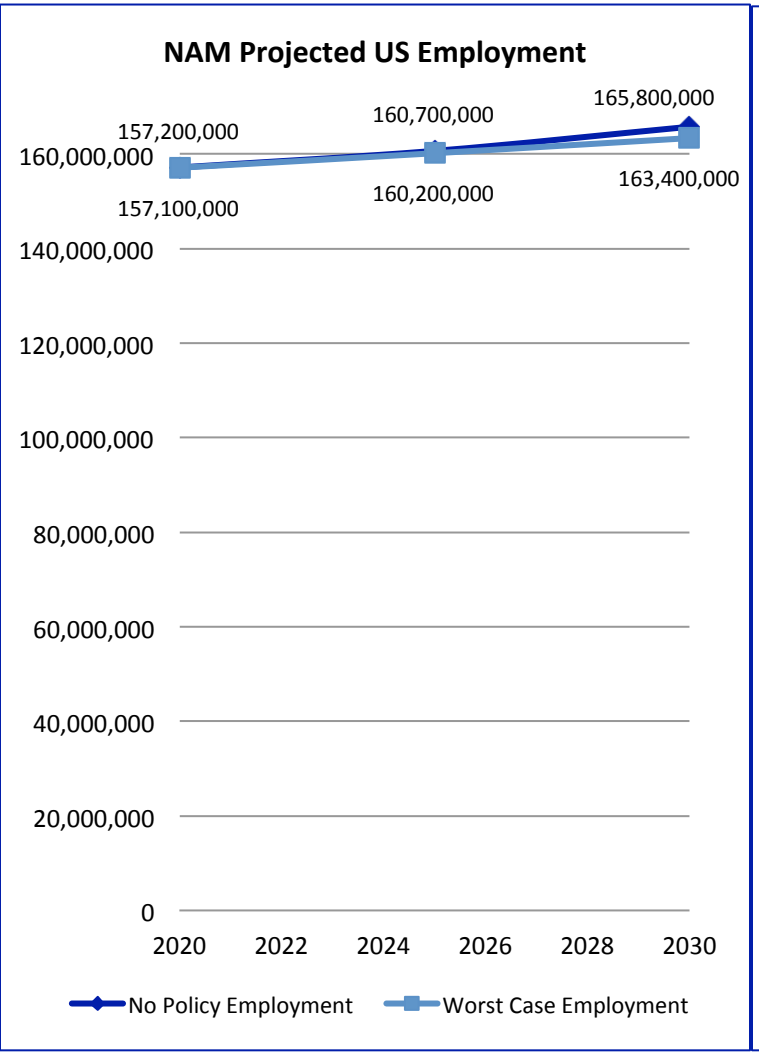


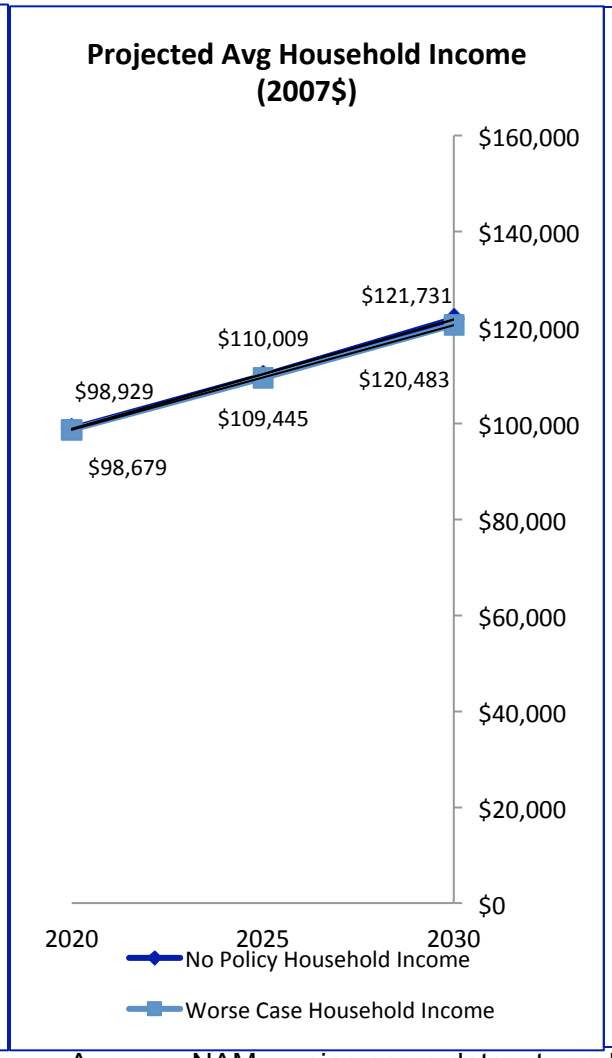


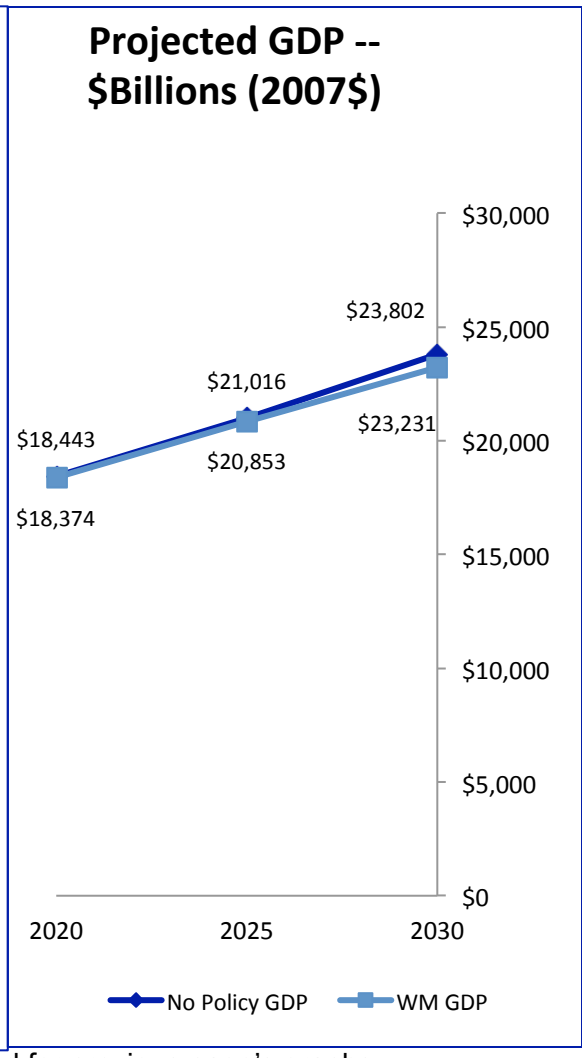
NAM With Context:

Same analysis & model output

Not a matter of "loss" but delay in achieving the same "no policy" numbers – a matter of months.







Answer: NAM – using same dataset used for previous page's graphs.

Source data: http://www.accf.org/media/dynamic/3/media_381.pdf, page 5

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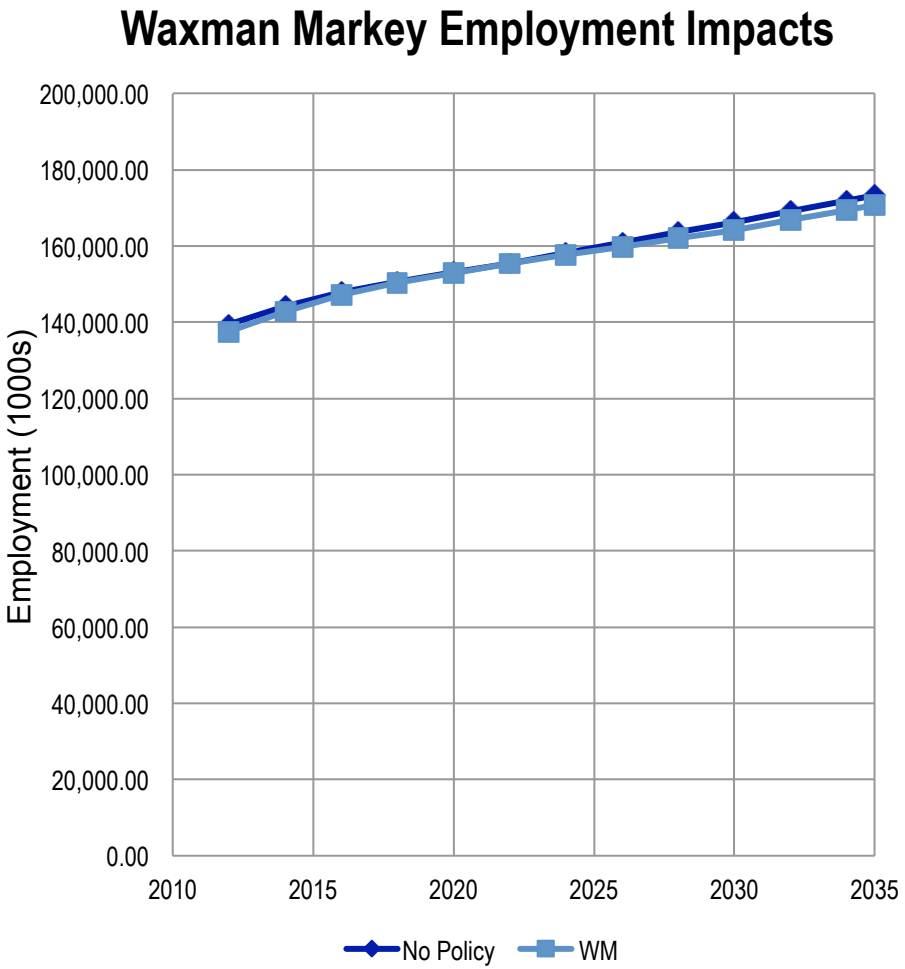
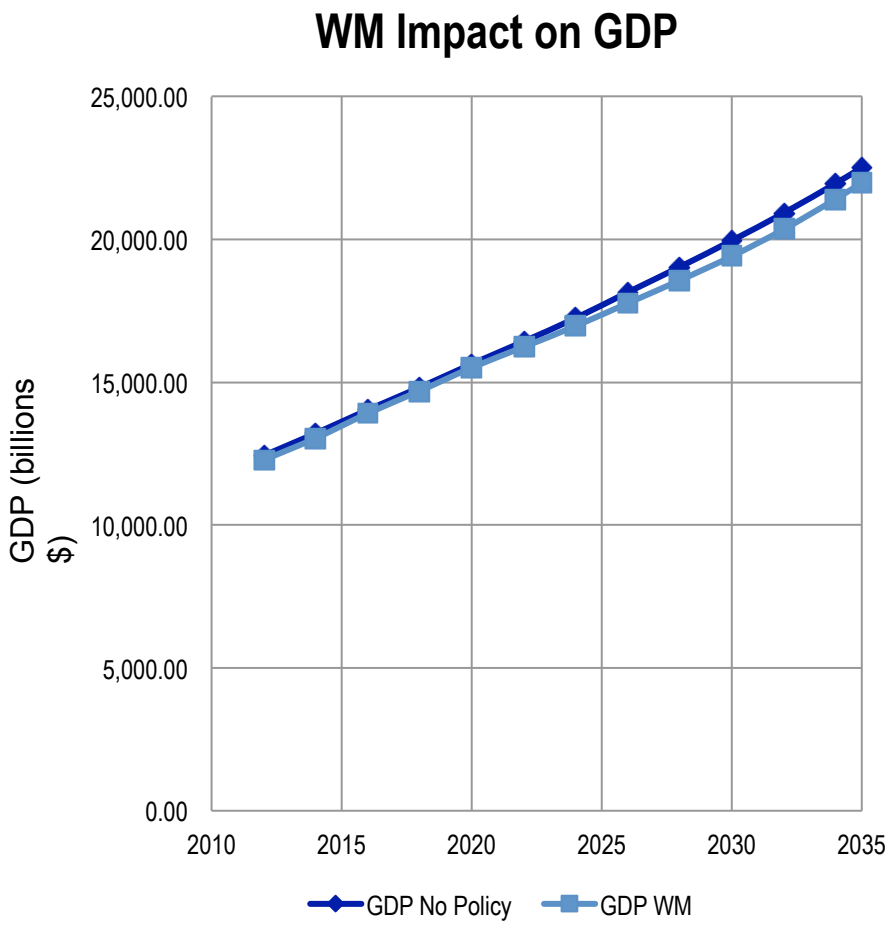
Heritage output with context

Same model runs and output as slide 26





Source for above data: Heritage Foundation analysis of Waxman Markey -- http://www.heritage.org/research/energyandenvironment/images/CDA-waxman-markey-appendix-table-2_1.gif

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Economic takeaways

- Well crafted policy is not “free” but affordable
- ALL models show economic growth continues – projected changes within typical forecast error
- Employment continues to grow – NAM’s own forecast project increase from 157 million to 163 million
- NAM’s household income shows growth from $98.9K to $120K
- NAM’s GDP projection – grows from $18 trillion to $23 trillion

- High energy price volatility is the job killing machine, not the absolute price of energy. Germany.

the forecast …

continued fog

Drive carefully