Electric Utility Risks and Risk Management

Energy Finance 2015

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Synapse Energy Economics

- Founded in 1996 by CEO Bruce Biewald
- Leader for public interest and government clients in providing rigorous analysis of the electric power sector
- Staff of 30 includes experts in energy and environmental economics and environmental compliance
- Developer of tools to assist in Clean Power Plan analysis, including:
  - Avoided Emissions and Generation Tool (AVERT)
  - Coal Asset Valuation Tool (CAVT)
  - CO_2 Price Forecast
  - Clean Power Plan Planning Tool (CP3T)

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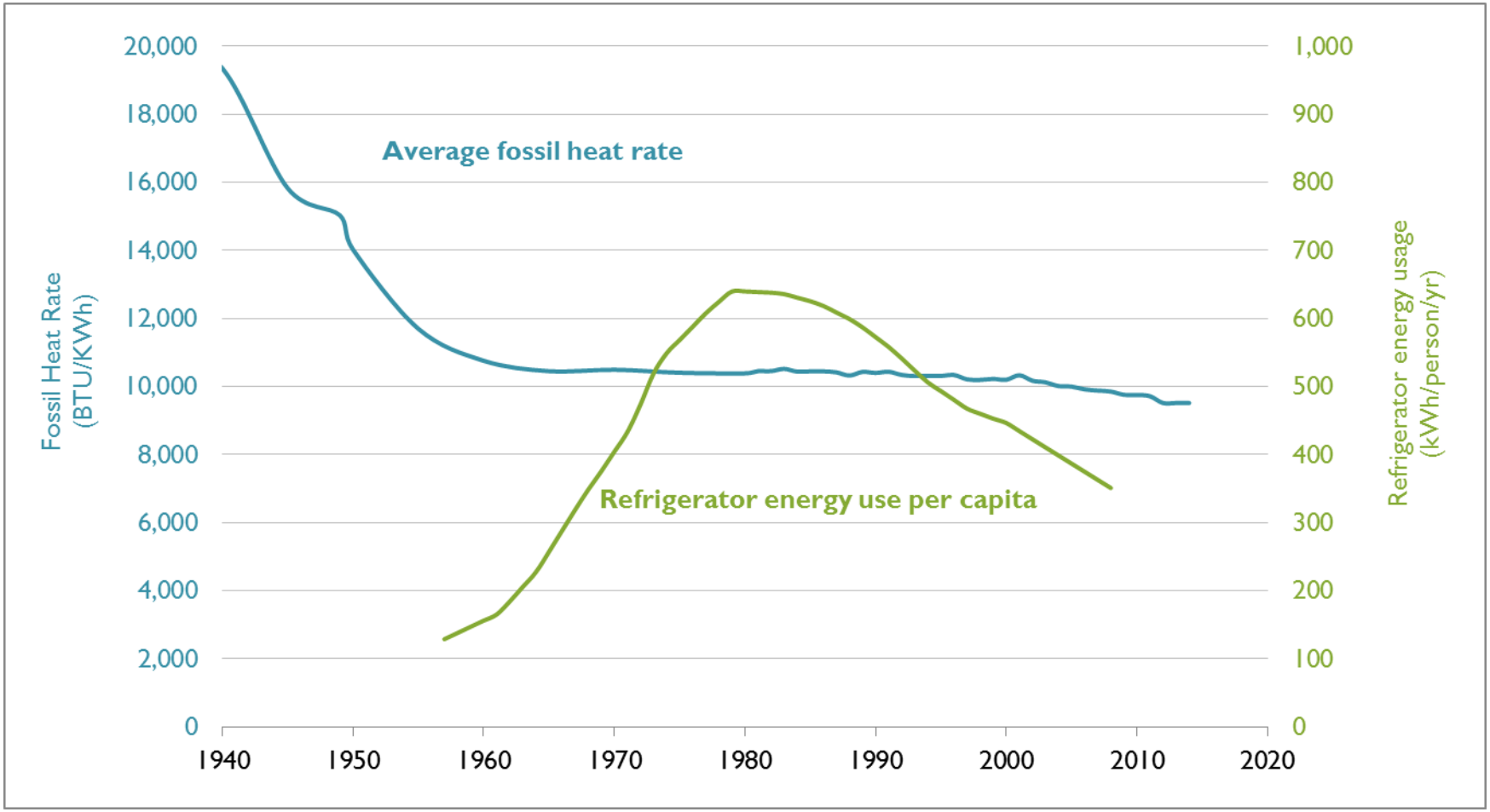
1. Electricity trends
2. Managing risks to customers and environment
3. Managing risks to shareholders
4. “Death Spiral” risk management
5. Tools

Electricity Trends

Supply side vs. demand side efficiency



Sources: Fossil average heat rate pre-1949 from: Phillips, Jeffrey. 2012. "Coal Power Generation For The 21St Century: This Is Not Your Father's Coal Power Plant." Presentation, EPRI, Bismark Energy Conference; Post 1949: EIA.gov. 2015. "Annual Energy Review - Energy Information Administration." http://www.eia.gov/totalenergy/data/annual Refrigerator energy use: Deumling, R. 2004."Thinking outside the refrigerator: Shutting down power plants with NAECA?" Available at: http://aceee.org/files/proceedings/2004/data/papers/SS04_Panel11_Paper02.pdf; and Deumling, R. 2008. "Public Policies, Private Choices: Consumer Desire And The Practice Of Energy Efficiency." Available at: http://eetd.lbl.gov/sites/all/files/deumling_lbnl_slides.5.27.08-web.pdf.

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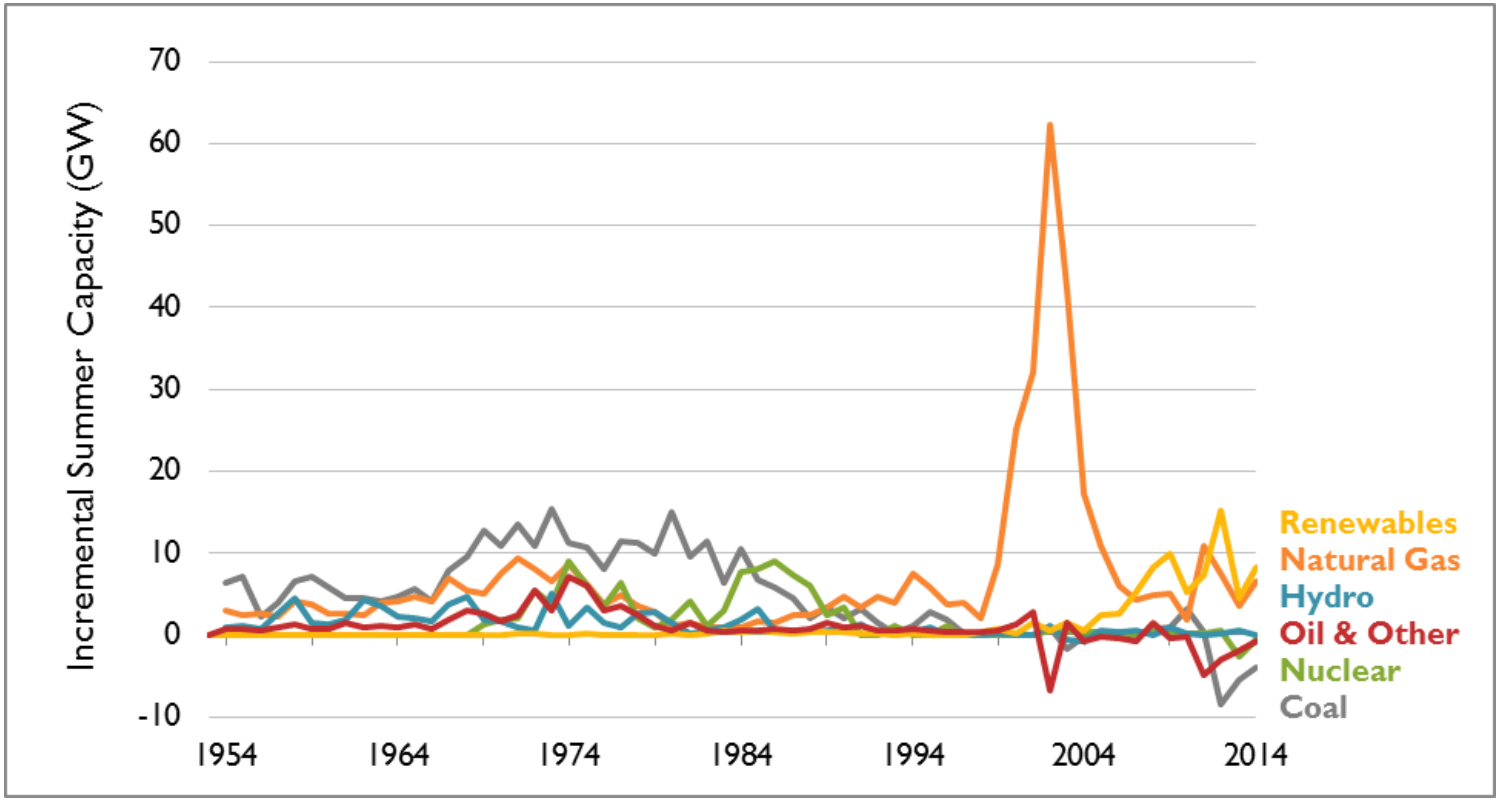
Incremental capacity additions, 1954-2014



Source: EIA 860, 2001-2014

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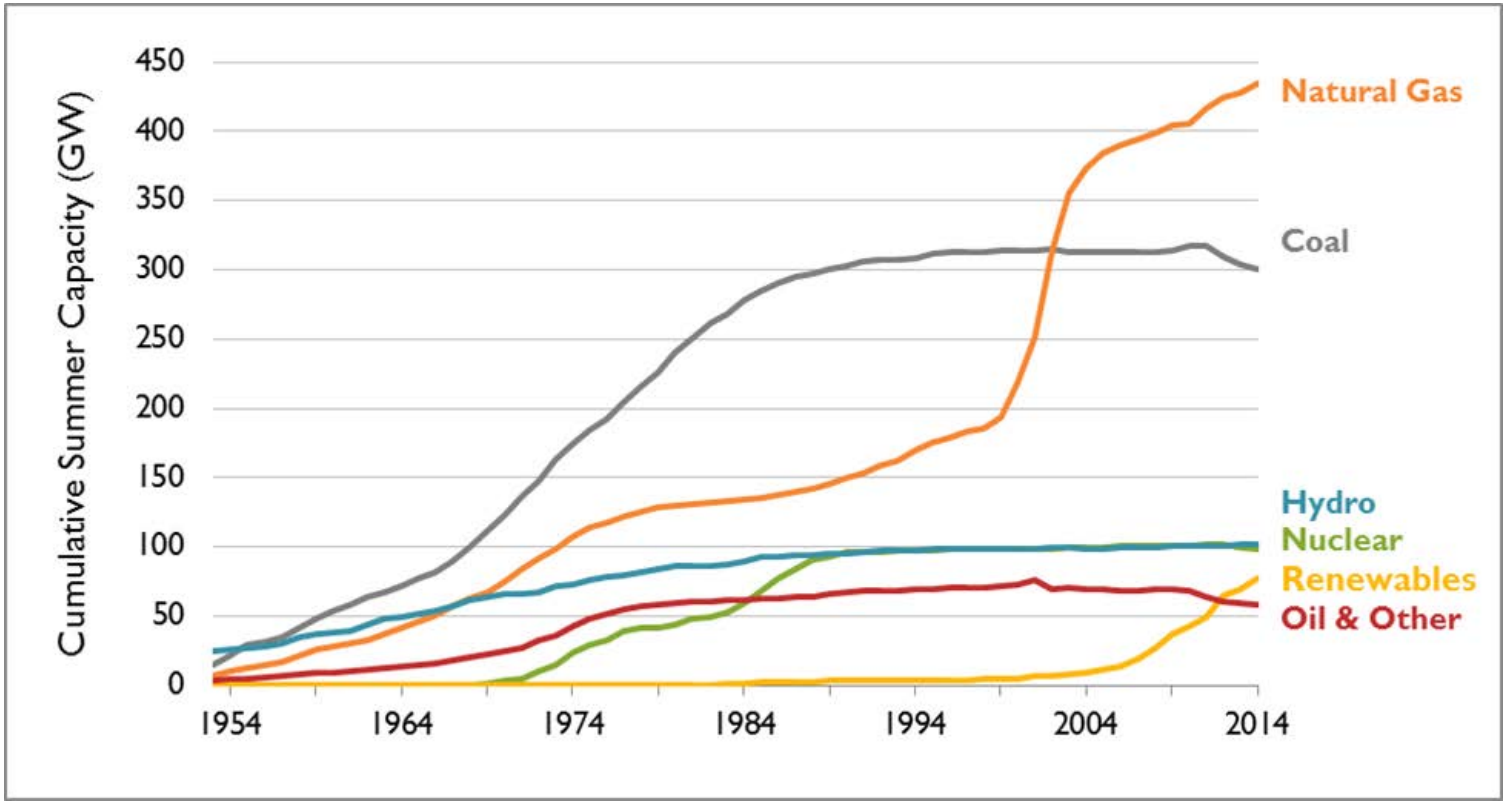
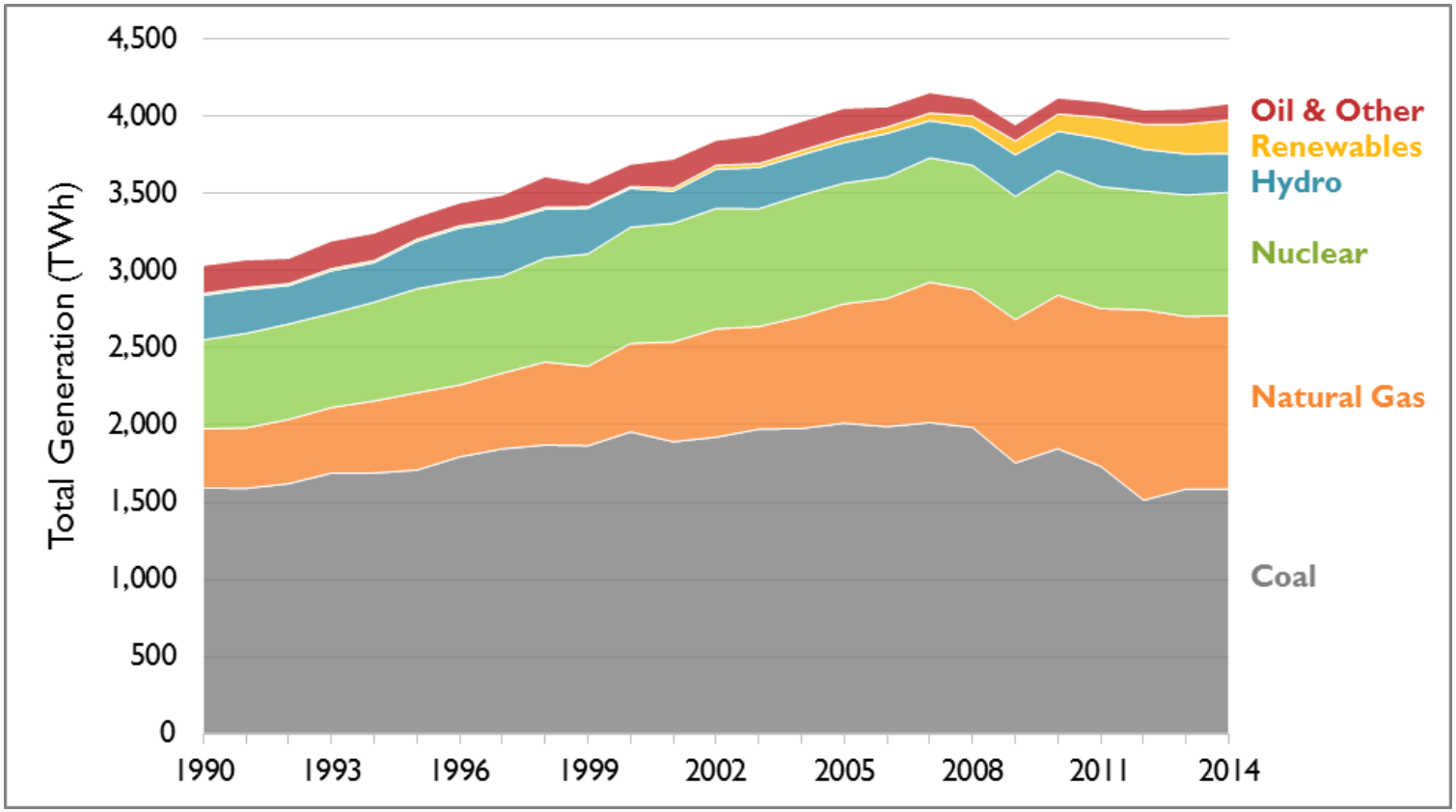
Cumulative capacity installed, 1954-2014



Source: EIA 860, 2001-2014

Annual electric generation, 1990-2014



Source: EIA 923, 1990-2014

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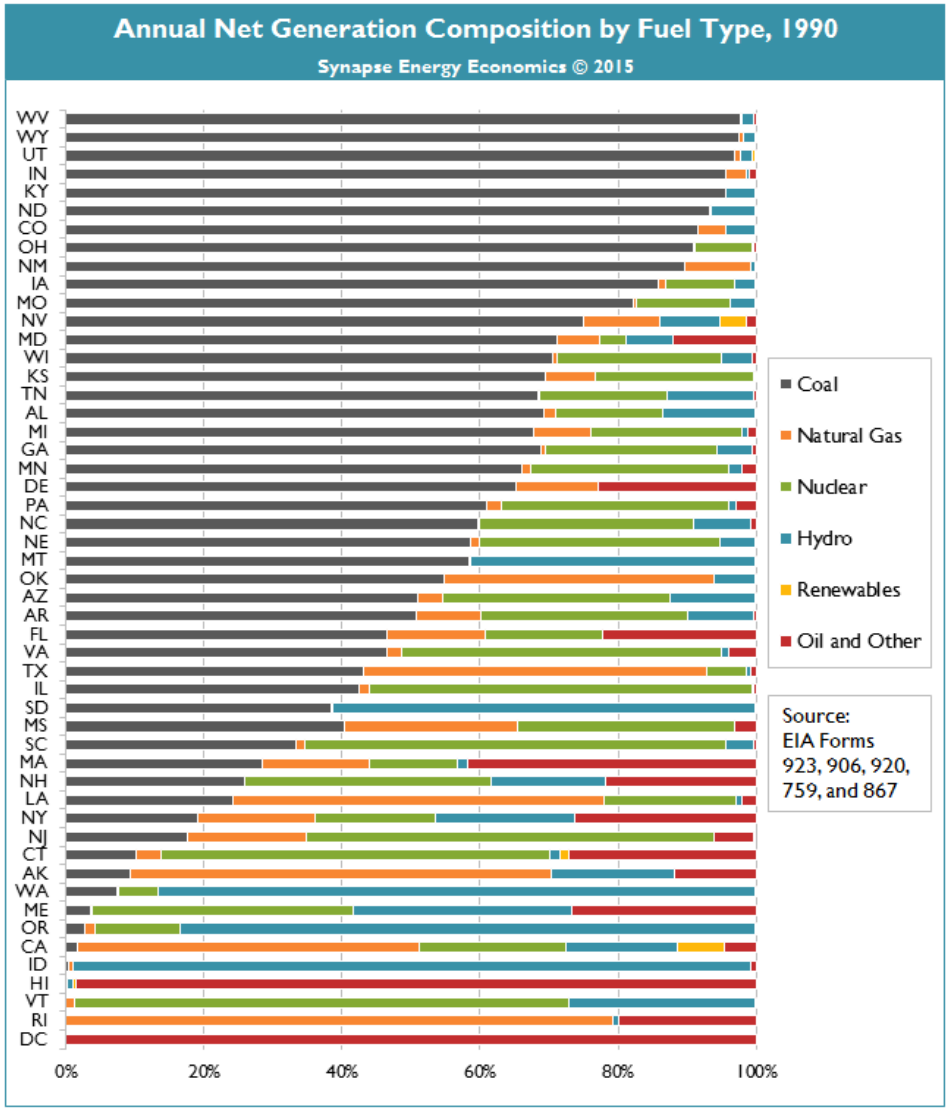
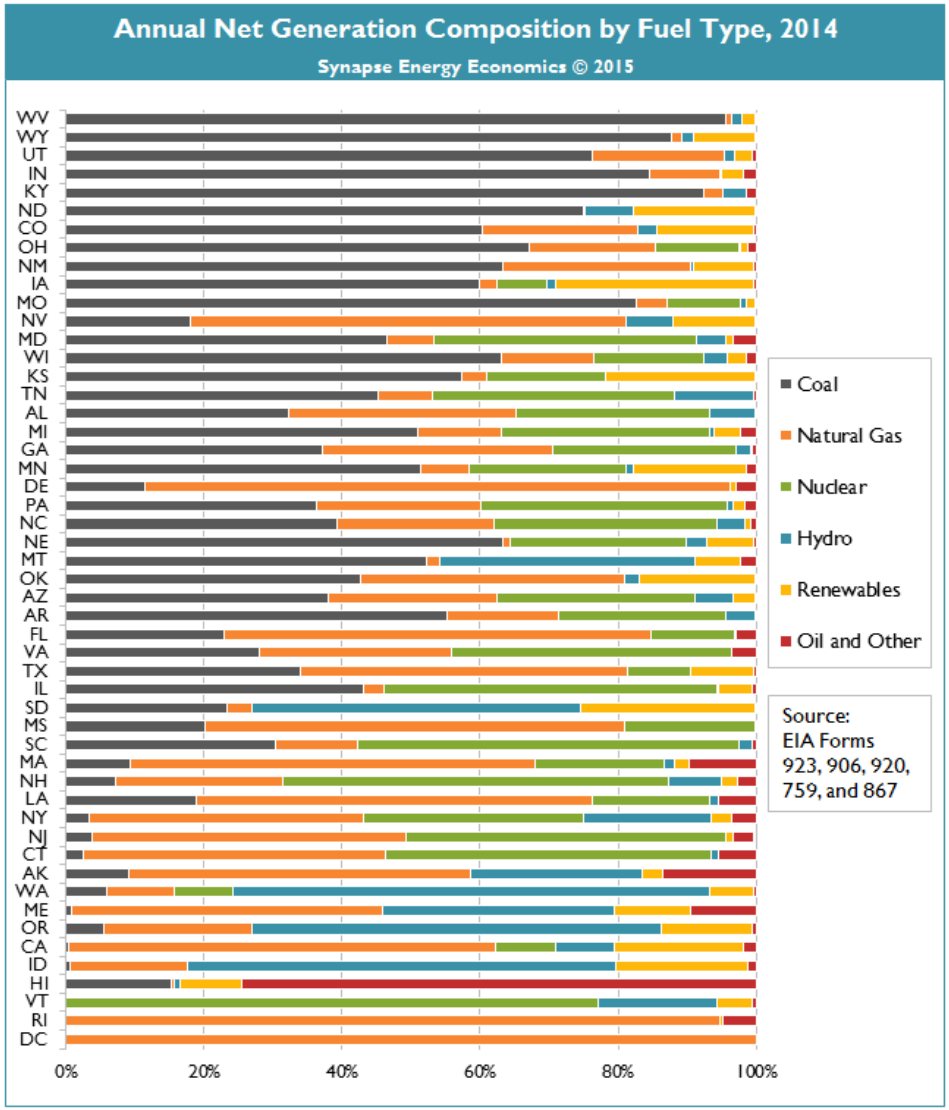
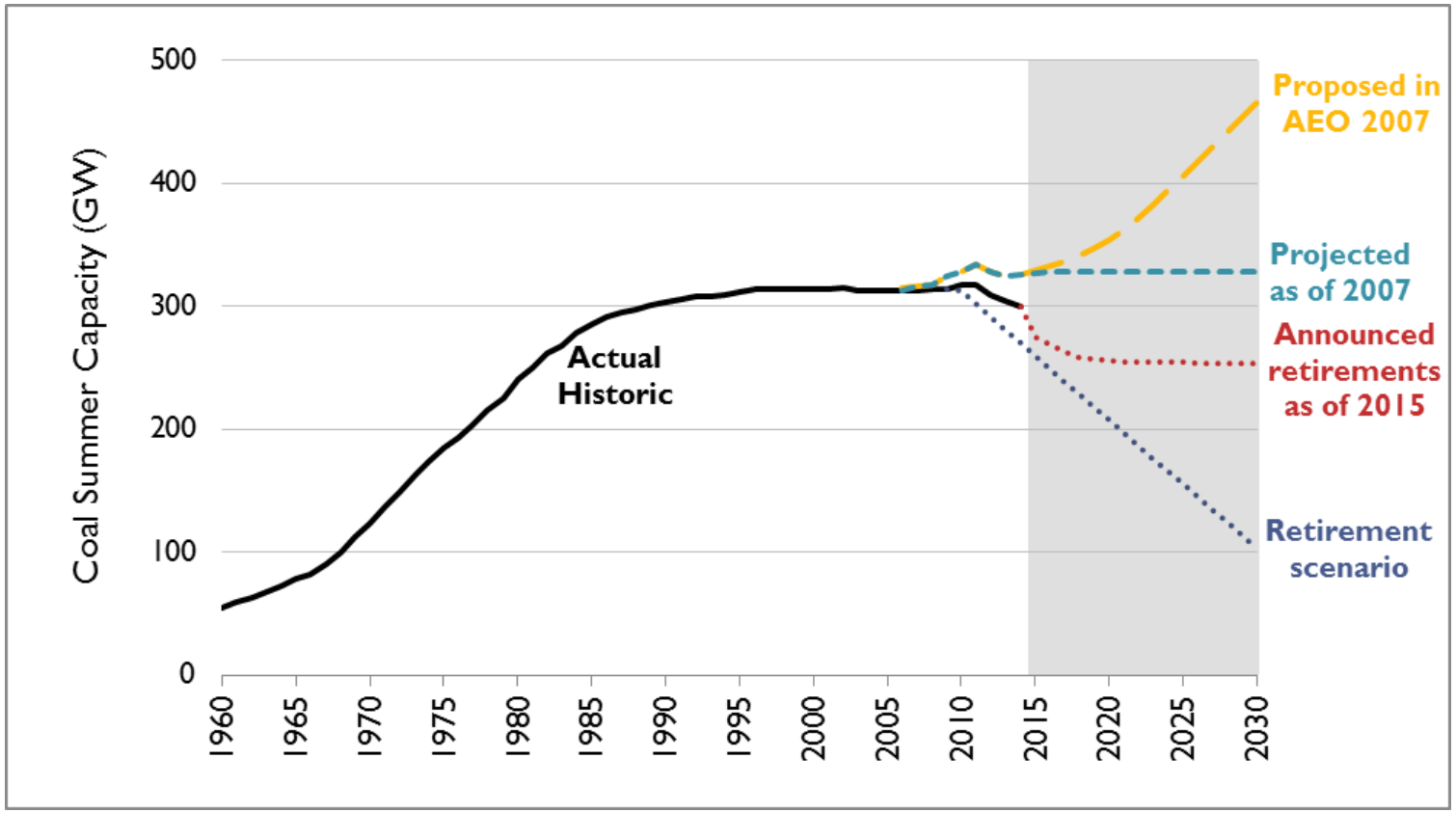
Percentage of net generation by fuel type, 1990



Percentage of net generation by fuel type, 2014



Coal capacity



"Actual Historic" from EIA 860 2013
"Proposed in AEO 2007" from AEO 2007
"Projected as of 2007" from EIA 860 2007
"Announced retirements as of 2015" from EIA 860 2013 and Synapse research
"Retirement scenario" projects all coal to retire by 2040 per REeDS model run

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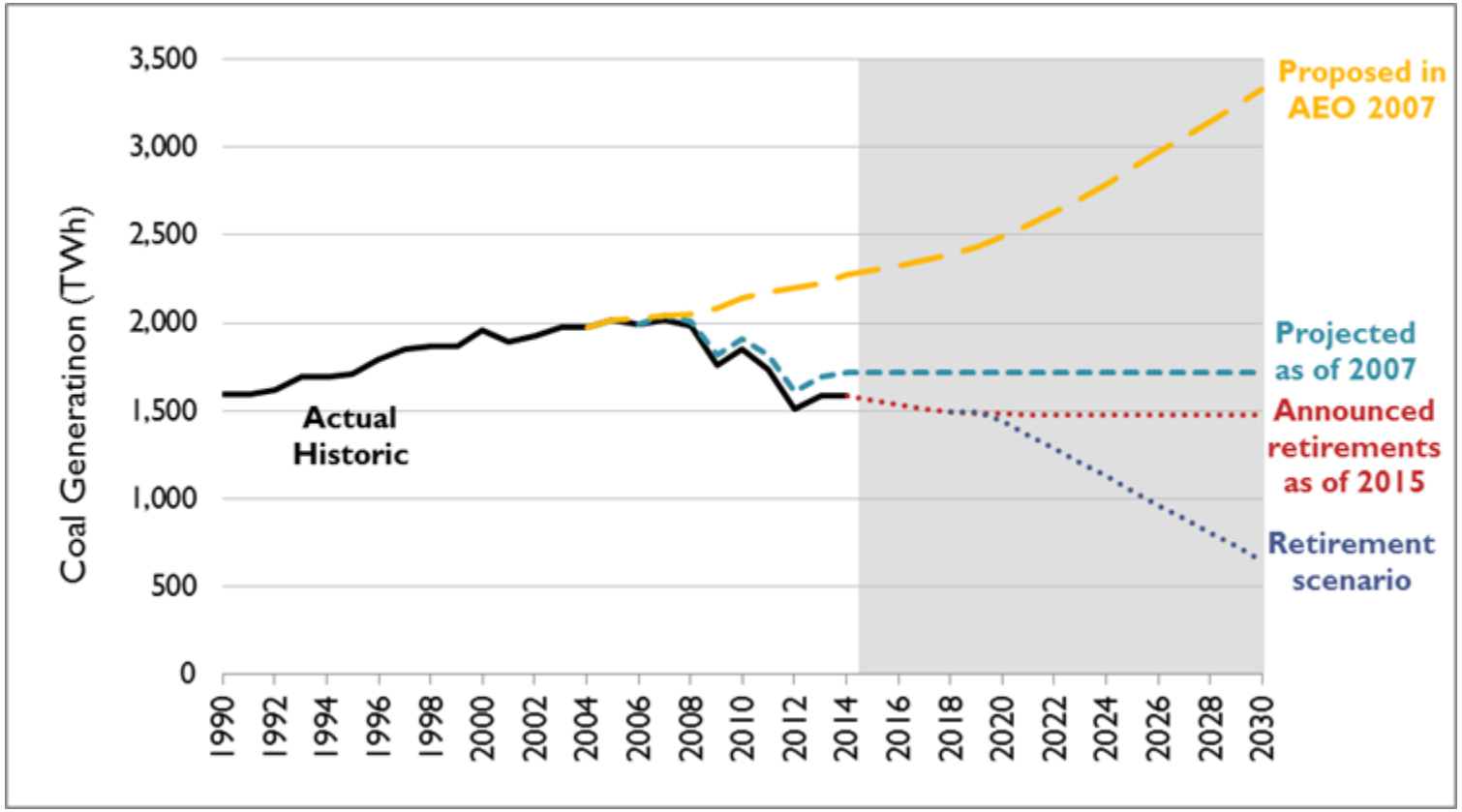
Coal generation



"Actual Historic" from EIA 923 2014
"Proposed in AEO 2007" from AEO 2007
"Projected as of 2007" from EIA 860 2007, using capacity factors from EIA 923 2014
"Announced retirements as of 2015" from EIA 860 2013 and Synapse research
"Retirement scenario" projects all coal to retire by 2040 per REeDS model run

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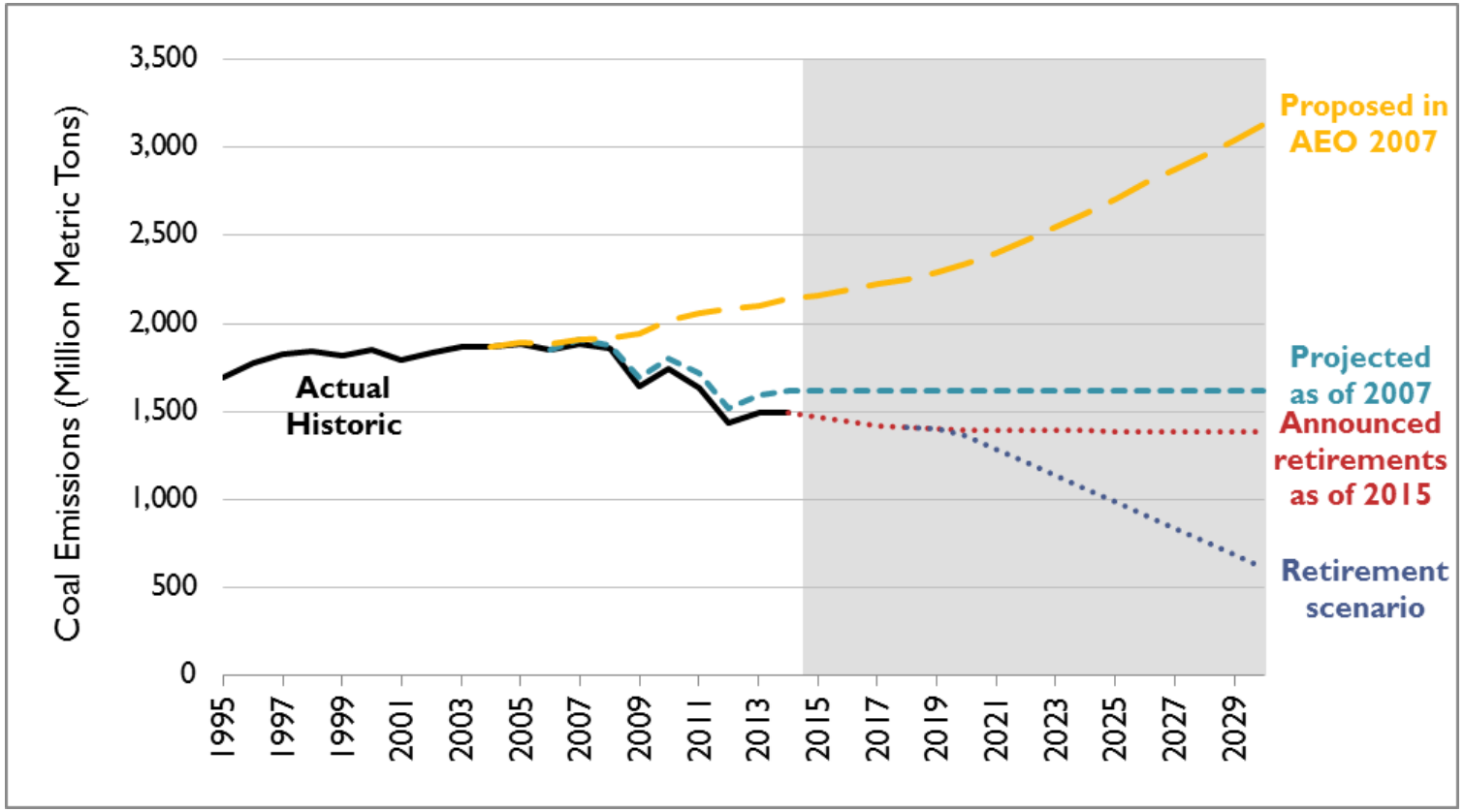
Coal CO_2 emissions



"Actual Historic" from EPA AMP 2014
"Proposed in AEO 2007" from AEO 2007, using emission rates from EPA AMP 2014
"Projected as of 2007" from EIA 860 2007, using emission rates from EPA AMP 2014
"Announced retirements as of 2015" from EIA 860 2013 and Synapse research
"Retirement scenario" projects all coal to retire by 2040

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Assumptions

Trend	Capacity	Generation	Emission Rates
Actual	Actual data	Actual data	Actual data
Proposed in AEO 2007	AEO 2007 assumptions for 2007-2030	AEO 2007 assumptions for 2007-2030	Nationwide averages for 2007-2014, 2014 Nationwide average for 2015-2030
Projected as of 2007	EIA 860 projections for specific, named units expected to be built	Nationwide averages for 2007-2014, 2014 Nationwide average for 2015-2030	Nationwide averages for 2007-2014, 2014 Nationwide average for 2015-2030
Announced retirements as of 2015	Synapse research	Unit-specific averages for retiring units, 2014 Nationwide average for remaining units	2014 nationwide average for 2015-2030
Retirement scenario	All coal retired by 2040	Modeled in ReEDS	2014 nationwide average for 2015-2030

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Managing risks to customers and environment

Major electric system uncertainties

- Demand forecast uncertainty
- Construction cost uncertainty for various resources
- Fuel price
- Environmental regulation uncertainty

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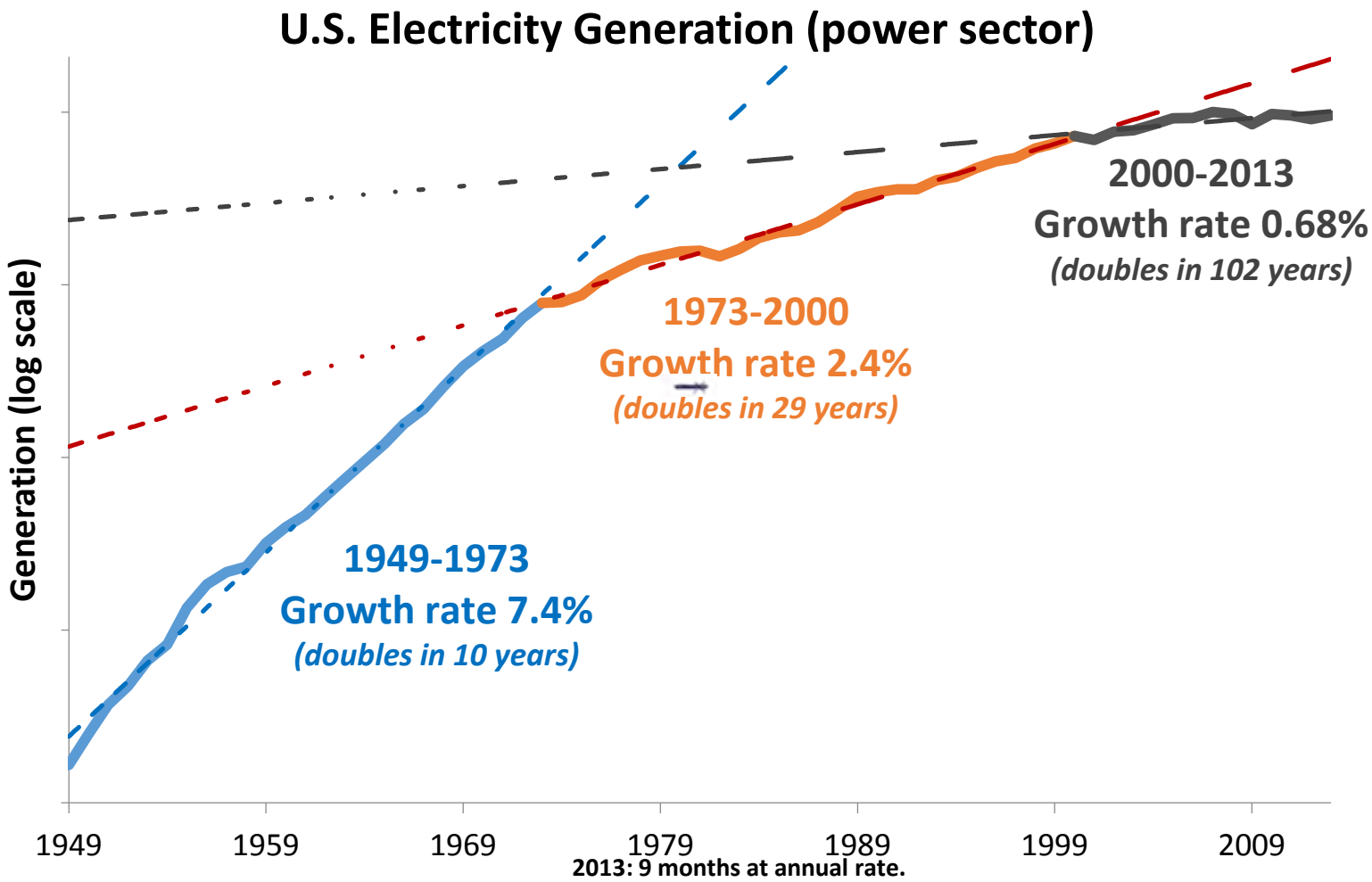
Demand forecast uncertainty



Source: EIA, http://www.eia.gov/electricity/data.cfm#generation, Tables 7.2b, 8.2b

Construction cost uncertainty

Uncertainty in capital costs for large projects:

Edward Merrow

"Understanding the Outcomes of Megaprojects"

- **Scope**: Poor project definition is the source for most faulty cost estimates
- For long projects, **economic assumptions** are crucial; a small error in the assumed inflation rate can result in large changes in expenditures
- **Project execution**: can lead to higher costs than necessary, but rarely the primary source of cost growth

Also: Project proponents are the worst entities to objectively estimate costs and assess cost overrun risks.

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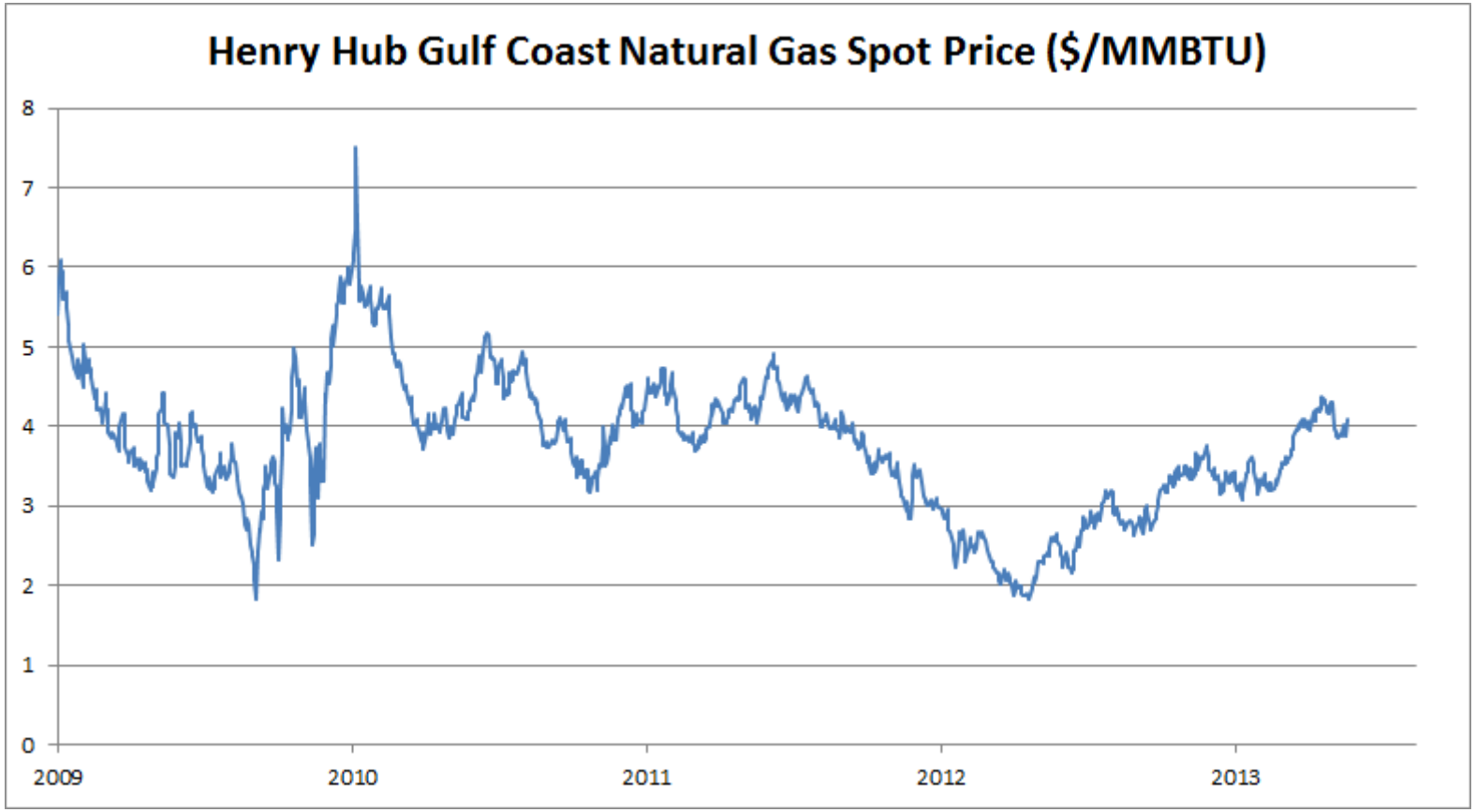
Fuel price volatility



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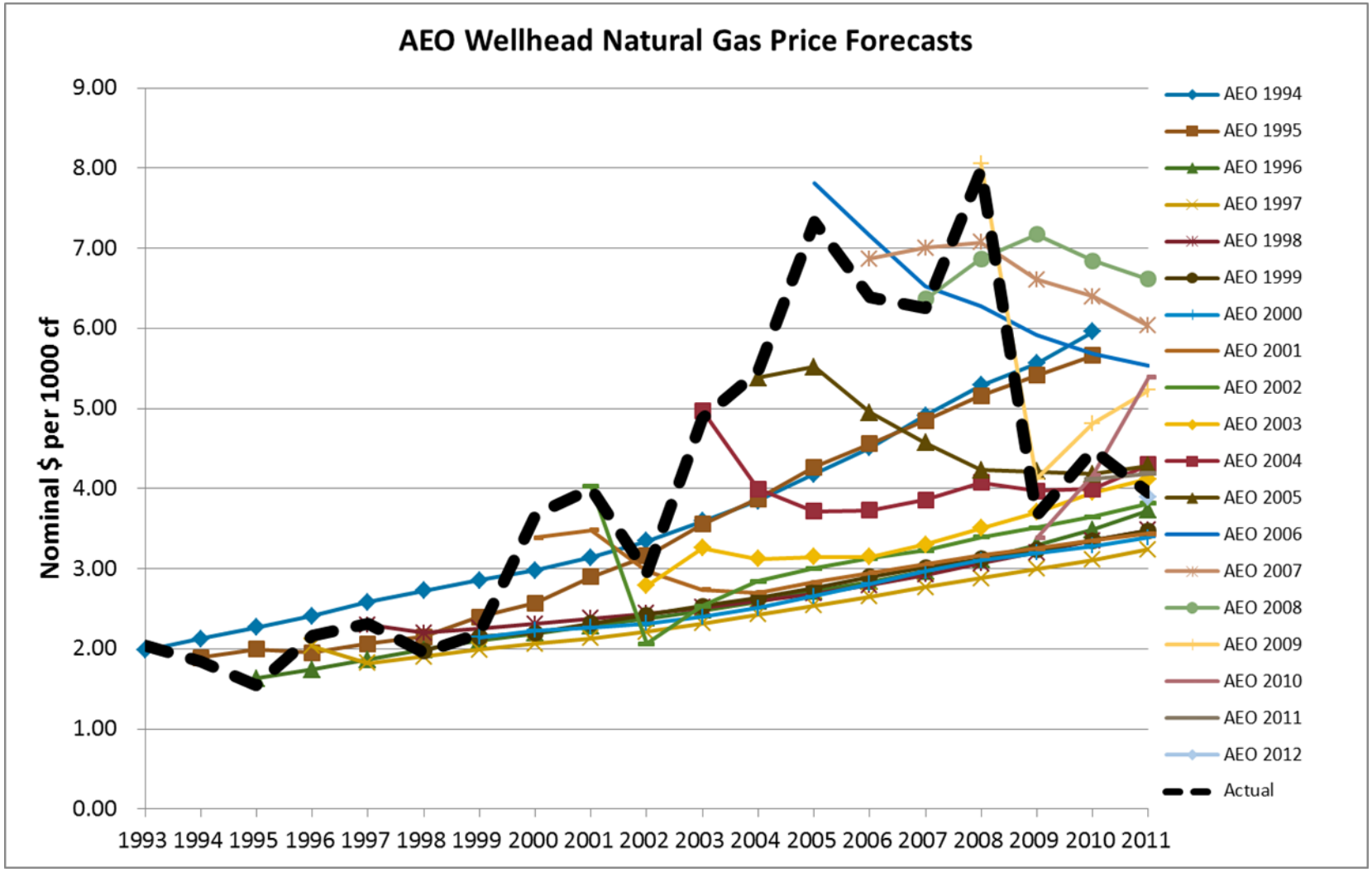
Fuel price uncertainty

How reliable are forecasts?



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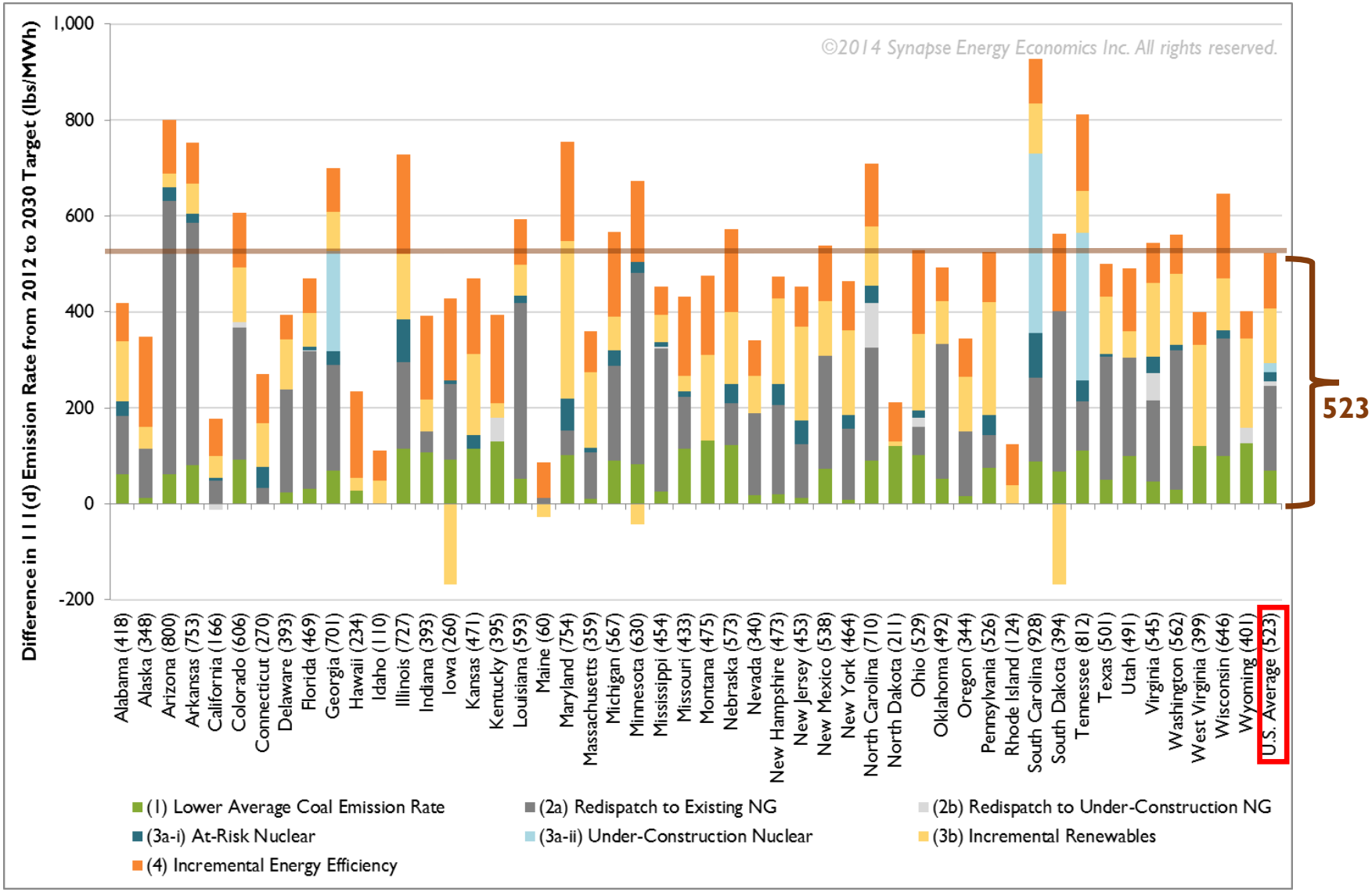
Difference between initial 2012 and target 2030 111(d) emission rates



Dimensions of climate impacts

- Fairly soon, and fairly certain
  - Heat waves, drought, storms, some sea-level rise
  - Agricultural and coastal property losses
  - Bad, but not enough to cause a global crisis?
- Far future
  - Worst impacts will be 100+ years from now
  - Outcomes uncertain due to time span
  - Is discounting meaningful beyond one lifetime?
- Extreme risks
  - We know that we don’t know the exact tipping points
  - “Black swans,” fat-tailed probabilities
  - More research may not resolve uncertainties

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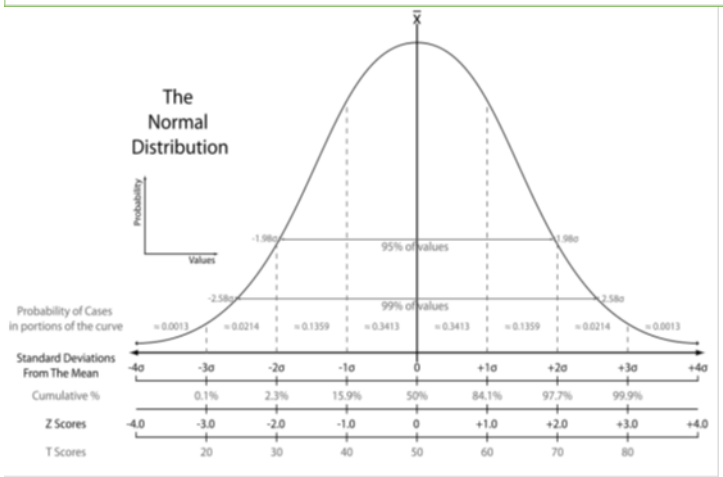
Techniques available to system planners for planning and risk management

- **Sensitivity Analysis**: Develop an optimal "resource plan" for "expected conditions", subject it to various exogenous drivers, and see how the plan performs in those scenarios.
- **Scenario Analysis**: Develop optimal resource plans for a set of different "futures" by selecting resource options based on what is best for each future.
- **Probabilistic Simulations:** Characterize input assumptions as distributions to recognize volatility and/or uncertainty. Could be low/med/high case forecasts of exogenous variables with probabilities attached.

CO_2 Forecast	Low	Ref	High
Probability	30%	40%	30%



Managing risks to shareholders

Three (conflicting?) perspectives on cost and risk in utility planning

1. **Environment:** lowest societal cost, public health impacts, greenhouse gas emissions
2. **Consumer:** lowest electricity bill, aka present worth of revenue requirements
3. **Shareholder:** highest earnings per share, relatively near-term

- Environmental and consumer interests can conflict, but often align
- Utility management focuses most enthusiastically on managing risk to shareholders
- Manage regulatory risk (especially disallowances)
- Crucial for understanding coal plant retrofit/retire decision-making; and attitudes toward energy efficiency and distributed generation

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Utility ratemaking

- Regulated Monopoly Economics
- Electric utility prices are not set by “the market”. They are set by state public utility commissions in “rate cases”.
- Fuel, O&M, purchased power, and administrative costs are passed through as expenses.
- Power plant investments are put into “ratebase” and recovered over time with an allowed administratively determined return on equity.
- Plant investment that is not prudently incurred should be removed from rates.
- Plant investment that is not “used and useful” should be removed from rates.

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Why is utility planning so bad?

Regular Business	Regulated Monopoly Utility Business
Prices determined by strategy and markets	Prices set by regulators
Cost overruns decrease profits	Cost overruns can increase profits
Manage risk	Manage regulatory risk
Ignore sunk cost	Significant concern about sunk cost recovery

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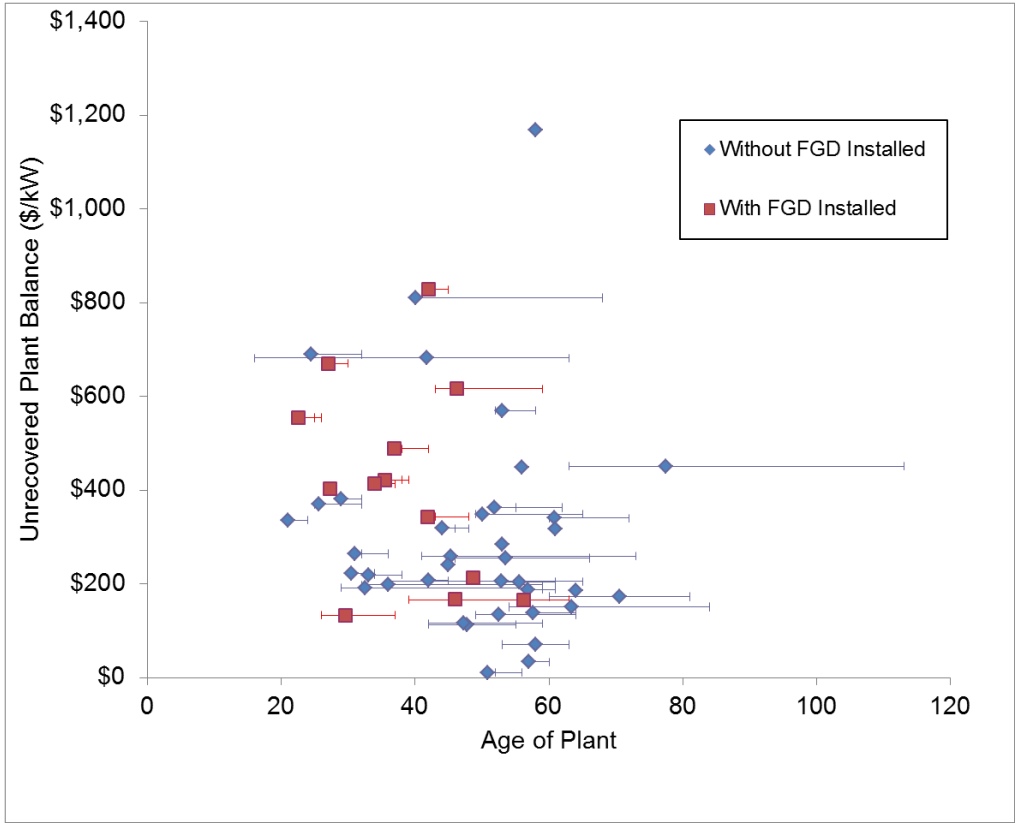
Utility incentives: Old coal plants have significant investment in rate base



Source: Presentation by Bruce Biewald, August 8, 2013, "Synapse 2013 Technical Training. Session 3: Components of Good Planning IRP and CPCN," slide 19.

- Data collected from 52 coal plants owned by 11 utilities
- Average plant age weighted by capacity: ~47 years
- Average plant capacity: ~675 MW
- Average unrecovered plant balance: ~$336/kW
- Average unrecovered balance as a percentage of Total Plant Balance: 50%

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Poor electric system planning practice

- Passive attitude toward information
- Rely on out-of-date construction cost estimates
- Consider only “existing” environmental regulations
- Ignore CO_2 price, or treat it “at the end” as a sensitivity case
- Assume existing plants continue to operate
- Overly constrain alternatives such as renewables and energy efficiency

IMPRUDENT!

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Good electric system planning practice

- Actively seek out relevant information
- Rely on up-to-date and realistic construction cost estimates
- Anticipate reasonably likely future environmental regulations
- Include reasonable CO_2 price forecast in the reference case, and analyze high and low sensitivities
- Evaluate continued operation vs. retirement options for existing plants
- Include full consideration of alternatives

PRUDENT

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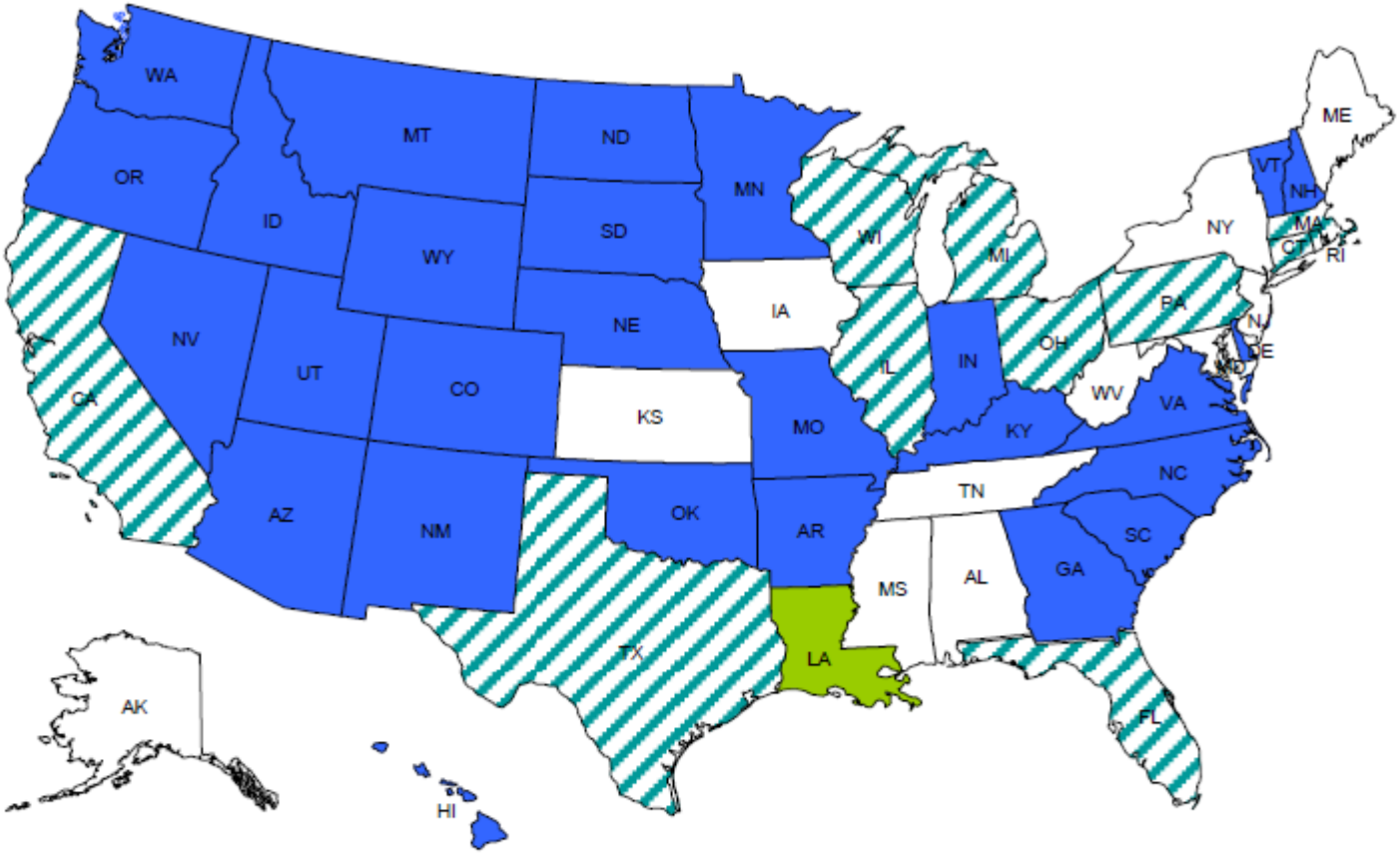
Presence or absence of state IRP rules and procurement plan filing requirements

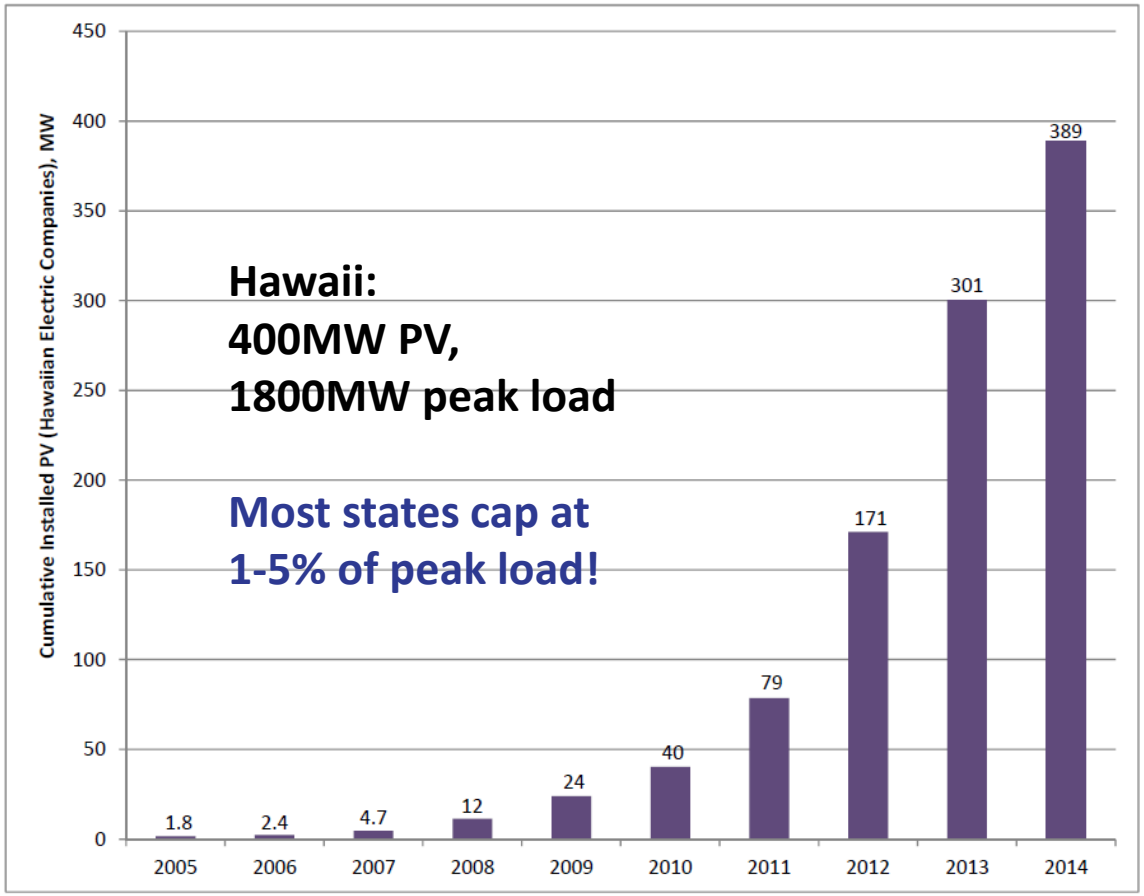


Source: Peterson & Wilson 2011

“Death Spiral” risk management

Will DG create a utility "Death Spiral"?

Increasing PV revenue from traditional utility sources at risk - less so in deregulated states



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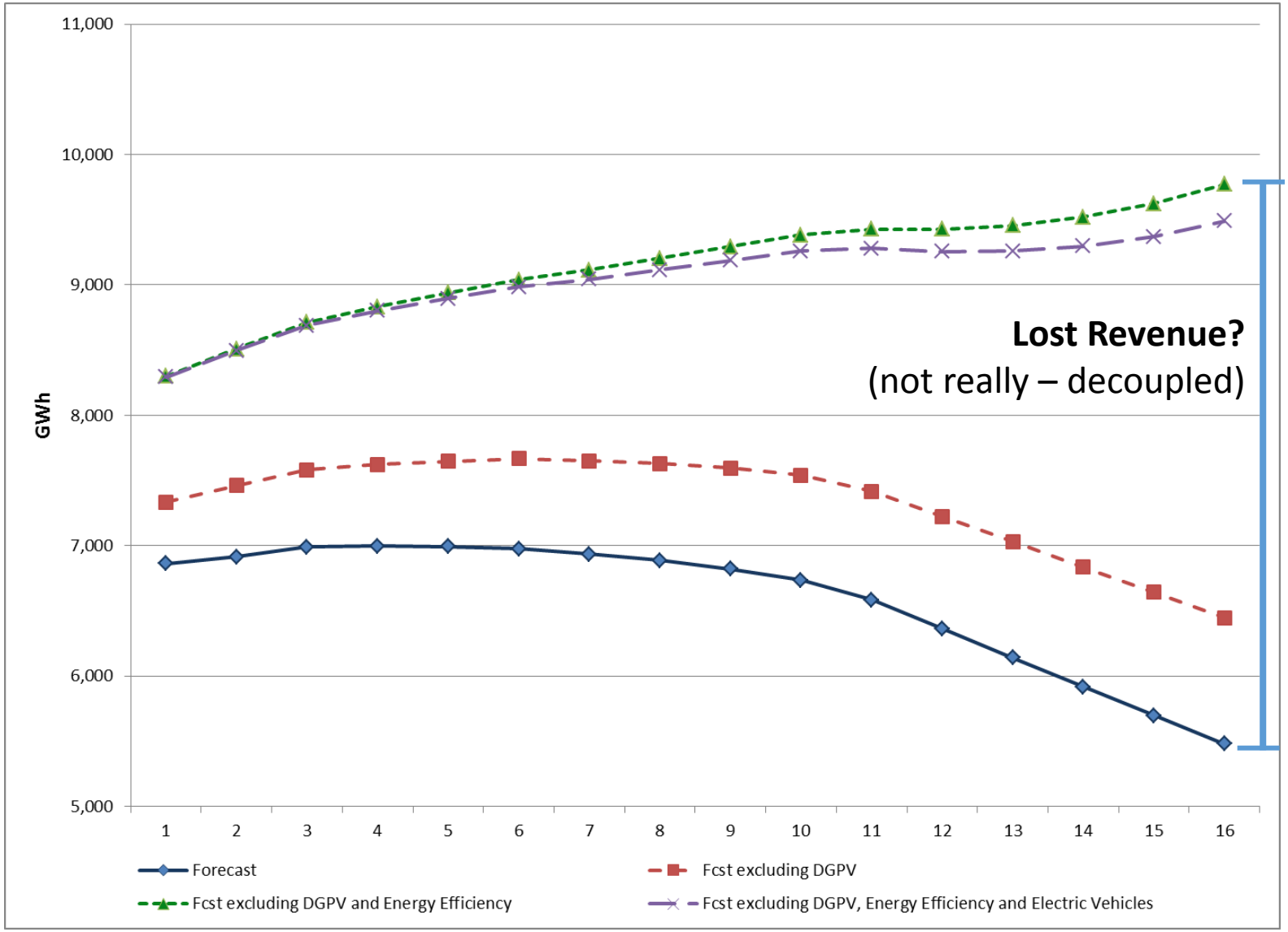
Load forecasting in Hawaii



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DG "Death Spiral" risk management

Today

- Lobbying and PR efforts build regulatory and ratemaking walls
  - Ensuring full cost recovery, regardless of end results
  - Interconnection limits in the name of reliability
- Maintain monopoly in service provision

Tomorrow

- "Utility of the Future" expands business model to take advantage of DG
  - Flexible generation service that embraces solar variability
  - Function as ISO for distributed energy resources
  - Product not purely commodity sales, but "clean" power, installation assistance, and much more

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Tools for planning

What is AVERT?

- AVERT – *Avoided Emissions and Generation Tool*
- AVERT began development in 2012 as EPA began to search for a tool that could provide users with the capability to estimate the changes in generation and emissions at particular generating units due to new renewable energy (RE) and energy efficiency (EE) projects.
- AVERT is now an EPA-approved tool used to translate the energy impacts of EE/RE policies and programs into emission reductions (NO_X, SO_2, CO_2).

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What is AVERT?

AVERT aims to fill the gap between expensive and work-intensive tools (like dispatch models) and the use of generic state-by-state marginal emission rates.

Basic Method

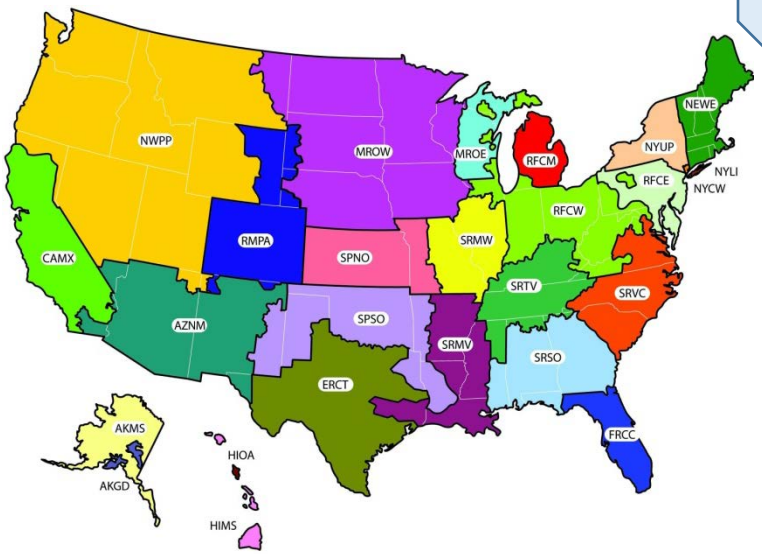
eGRID region non-baseload emission rates

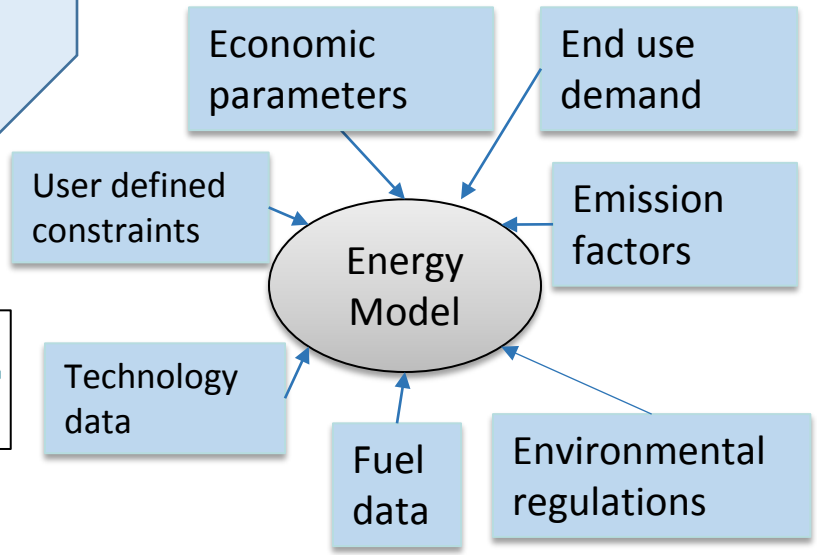
Intermediate Method

Historical hourly emission rates

Sophisticated Method

Energy Modeling





Coal Asset Valuation Tool (CAVT)

- CAVT is a spreadsheet-based database and model.
- It aggregates publicly available data (such as capacity, generated power, and heat rate) on ~1000 non-cogenerating coal units.
- CAVT combines this with publicly available cost methodologies to calculate the cost of complying with environmental regulations.
- It adds in environmental retrofit capital and O&M costs for the year the control is expected to come into effect. The net present value of each unit's lifetime cost is then calculated for 2013 through 2042.
- CAVT then compares these economics with proxy values for energy market prices.

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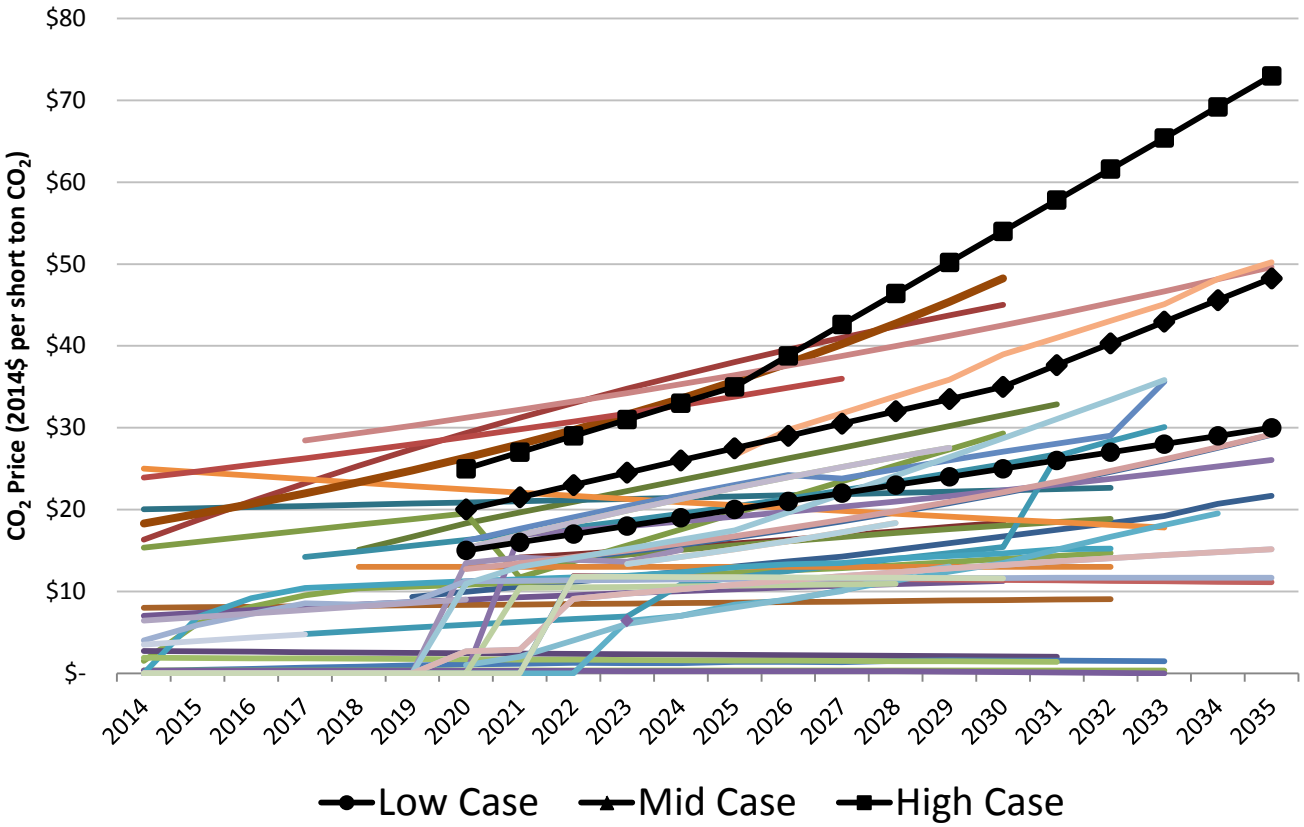
Synapse 2015 CO_2 Price Forecast and Utility Reference Cases



Luckow P., E. Stanton, S. Fields, B. Biewald, S. Jackson, J. Fisher, R. Wilson. "2015 Carbon Dioxide Price Forecast." Synapse Energy Economics. http://www.synapse-energy.com/project/synapse-carbon-dioxide-price-forecast

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Overview of Clean Power Plan Planning Tool (CP3T)

- Synapse has developed a user-friendly Excel-based spreadsheet tool based on the unit-specific data assembled by EPA to create their 111(d) building blocks.
- You can adjust fossil unit capacity factors, renewable energy and energy efficiency projections, unit retirements, and 111(b) unit additions for each state. You can compare the differences in generation, capacity, emissions, emission rates, and costs between their created scenarios and the EPA base case.
- CP3T is released under a free, open-source model using a Creative Commons "share and adapt" license. This allows anyone to obtain a copy of CP3T and use it within the framework and caveats Synapse provides.
- CP3T is available at cp3t.org.

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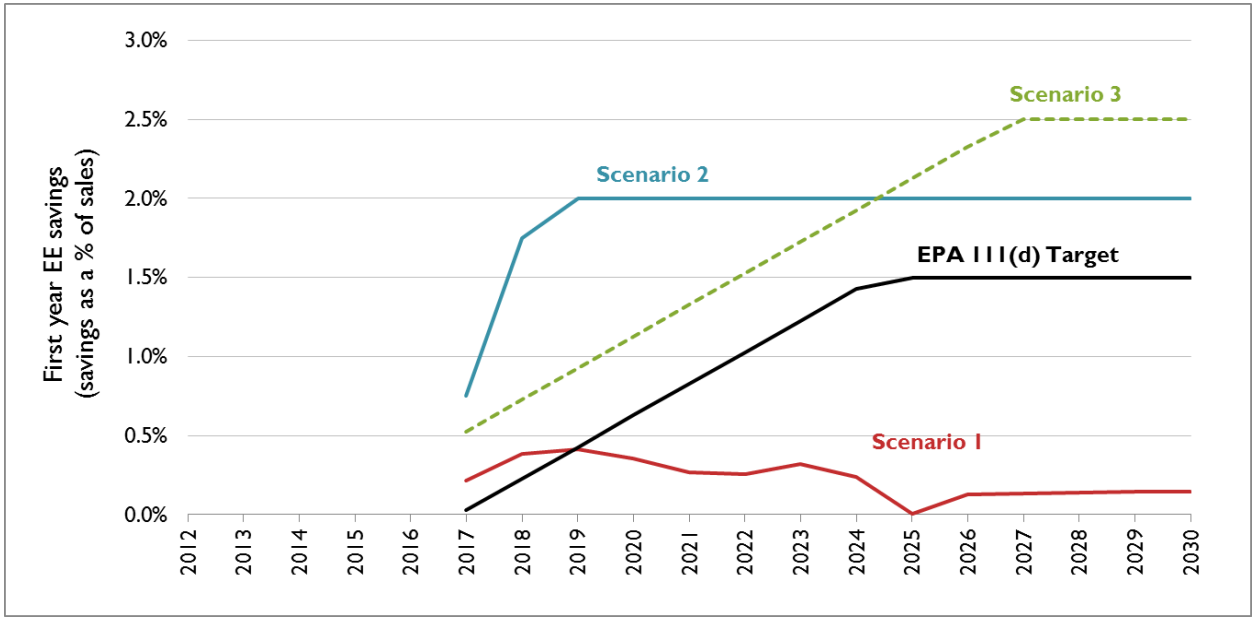
CP3T analysis:
Impact of EE on 111(d) compliance



Source: EPA Technical Support document data file: GHG Abatement – Scenario 1; Synapse webinar on scenario analysis of 111(d) compliance in Virginia.2014.

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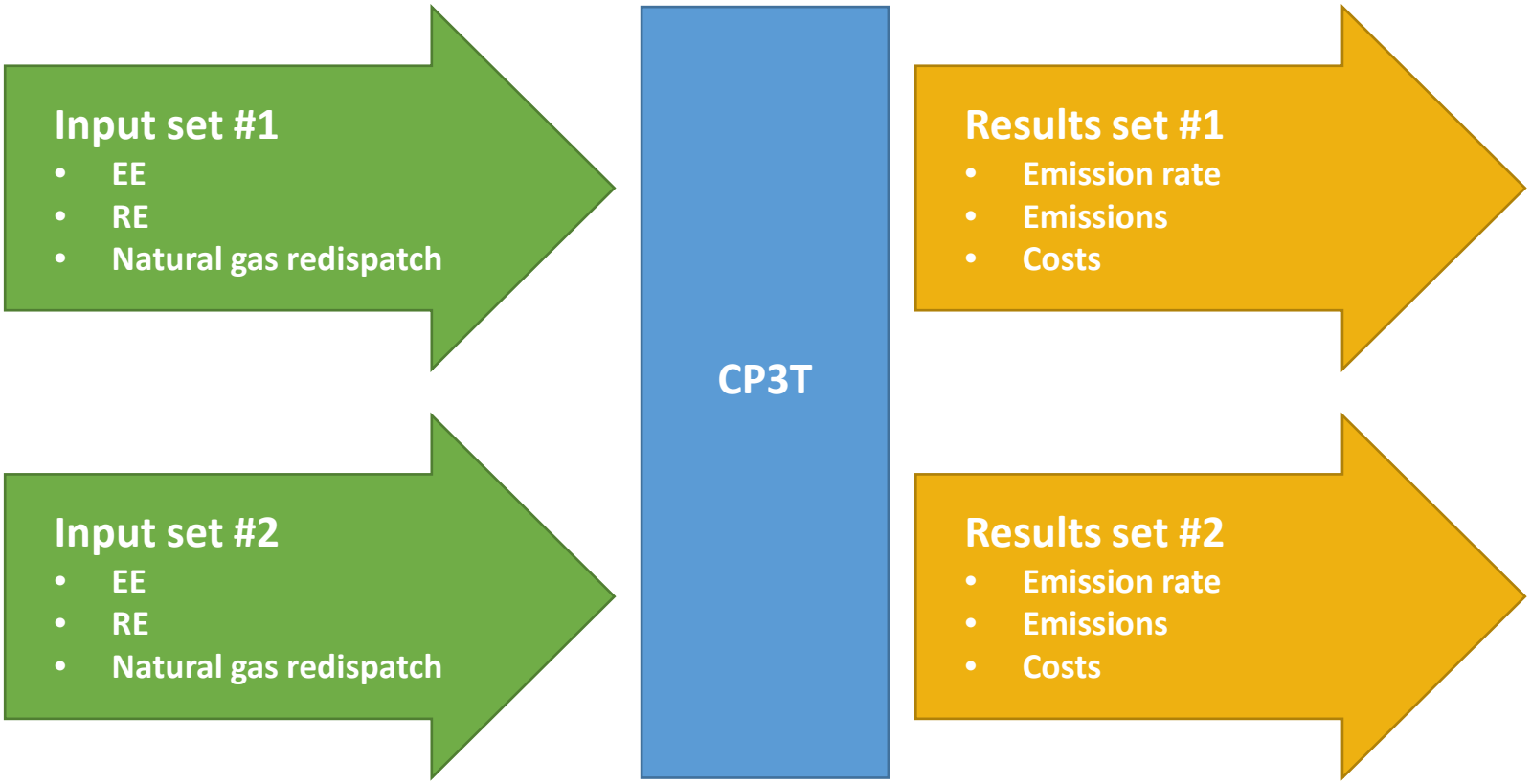
Introduction to scenario analysis

- Strength of CP3T is its ability to easily set up different scenarios
- These allow you to compare the impact on results of choosing different inputs



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Conclusion

1. **Electricity trends:**

   Things (usually) change very gradually with the electric industry.

2. **Managing risks to customers and environment:**

   Advocates focus on this.

   Emphasize good planning.

3. **Managing risks to shareholders:**

   Utilities focus on this.

   Advocates should understand major drivers.

4. **"Death Spiral" risk management:**

   Entrenchment vs. progress

5. **Tools:**

   Some open source tools are available.

   Use them!

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