Synapse
Energy Economics, Inc.

IRP Best Practices
Stakeholder Perspectives

Indiana Utility Regulatory Commission

Emerging Issues in IRP

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Synapse Energy Economics

- Analyzes economic and environmental issues in the electric and natural gas industries
- Founded in 1996
- Staff of 30 engineers, scientists, economists and policy experts in Cambridge, MA
- Focuses on electric industry resource planning and ratemaking. Emphasis on environmental compliance costs, role of efficiency and renewables, design and operation of wholesale electricity markets. Experts in computer simulation modeling of long-term demand, supply and prices.
- Provides reports, testimony, litigation and regulatory support
- Clients include energy offices, utility regulators, consumer advocates, environmental organizations and Federal agencies

Structure

IRP Collaboration Experiences

- Other state mechanisms
- Lessons learned

The Stakeholder Perspective of IRP and CPCN

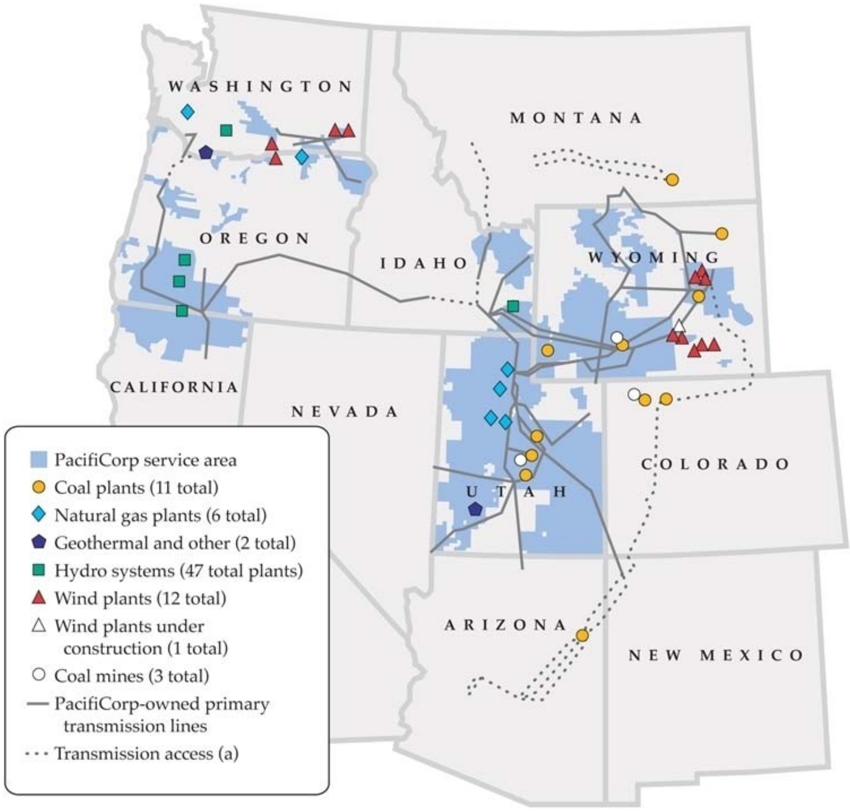
- Purpose of an IRP
- Review of planning assumptions and red flags

Next steps

- Towards a productive collaboration

PacifiCorp (OR, UT, WY, ID, CA, WA)

- Stakeholder process
  - Open to public, staff, consultants
  - Starts one year in advance of triennial IRP, every 3 weeks
  - Meeting content driven by agenda and stakeholder interests
- Responsiveness
  - Comments on meetings summarized and distributed
  - Post-publication formal comment / reply comment
  - Formal oversight in Oregon only
- Docketed proceeding in Oregon with discovery



Hawaii Electric Company (HECO)

- Stakeholder process
  - Commission assigns independent evaluator
  - Open to public, staff, consultants
  - Starts one year in advance of triennial IRP, monthly
  - Evaluator presents recommendation to Commission
- Responsiveness
  - Comments and replies posted to evaluator's website
  - Evaluator keeps Company appraised of current status
  - Formal oversight through evaluator
- Discovery through evaluator

Tennessee Valley Authority (TVA)

- Stakeholder process
  - TVA-selected stakeholder groups
  - Starts one year in advance of triennial IRP, monthly meetings
  - Meeting content driven by agenda and stakeholder interests
- Responsiveness
  - Meeting minutes summarized and distributed
  - No formal reply process
  - No formal oversight
- No discovery process
  - FOIAs processed after 6+ months

Nebraska Public Power District (NPPD)

- Stakeholder process
  - No formal process, no oversight
  - Interaction with Company starts after IRP submission
- Responsiveness
  - Company reviews comments, submits off-year IRP update responsive to comments
  - Comments on IRP update incorporated into next IRP, iterative but post-hoc
- Company offered some confidential information via NDAs

Alaska Regional IRP

- Unique circumstance: state mandated & sponsored (AK Energy Authority)
  - To promote cooperation between linked coops
  - Recommendations only, no mandate
  - Guides AK state spending on infrastructure
- Stakeholder process
  - Open to utilities, public, agencies, & consultants
  - Ran for 5 months by B&V
  - Meetings every two weeks
  - Generally used public data only
  - Agenda driven through stakeholders
- Responsiveness
  - B&V responded via comments
- No formal discovery process.
- Little utility buy-in on process or outcome.

Massachusetts, Connecticut, and Rhode Island

- Deregulated
  - No IRP, but EE spending oversight through advisory council
- Stakeholder process
  - Advisory council membership assigned by legislation
  - Technical consultants hired by state to run process and models
  - Program administrators (i.e. utilities) are *ex officio*
  - Stakeholders vote on plan
- Responsiveness
  - Stakeholders run process completely
  - Final recommendations submitted to Commissions
  - Followed by docketed process to process recommendations
- All data and assumptions available to stakeholders

Lessons Learned

Transparency	• IRP requires stakeholder ability to vet assumptions and audit modeling; major input assumptions may not be sufficient
Accountability	• Commission oversight (direct, staff, or evaluator) ensures all parties act in good faith
Responsiveness	• Stakeholder time, effort, and input has no value if there is no response mechanism.
Adaptability	• Outcome is predetermined if assumptions and process are also predetermined

Purpose of an IRP
The Stakeholder Perspective

- Adaptive management
  - Long-term strategy
  - Short-term actions and adjustments

- Information
  - Put all information on the table
  - Put all parties on the same page, no surprises
  - Vet mechanism for making short and long-term decisions

- An IRP is (usually) not a preapproval

Stakeholder Review of Electric Utility Planning

Synapse represents various stakeholders in IRP, CPCNs, pre-approvals and other planning cases.

What triggers an in-depth review?

Elements that:

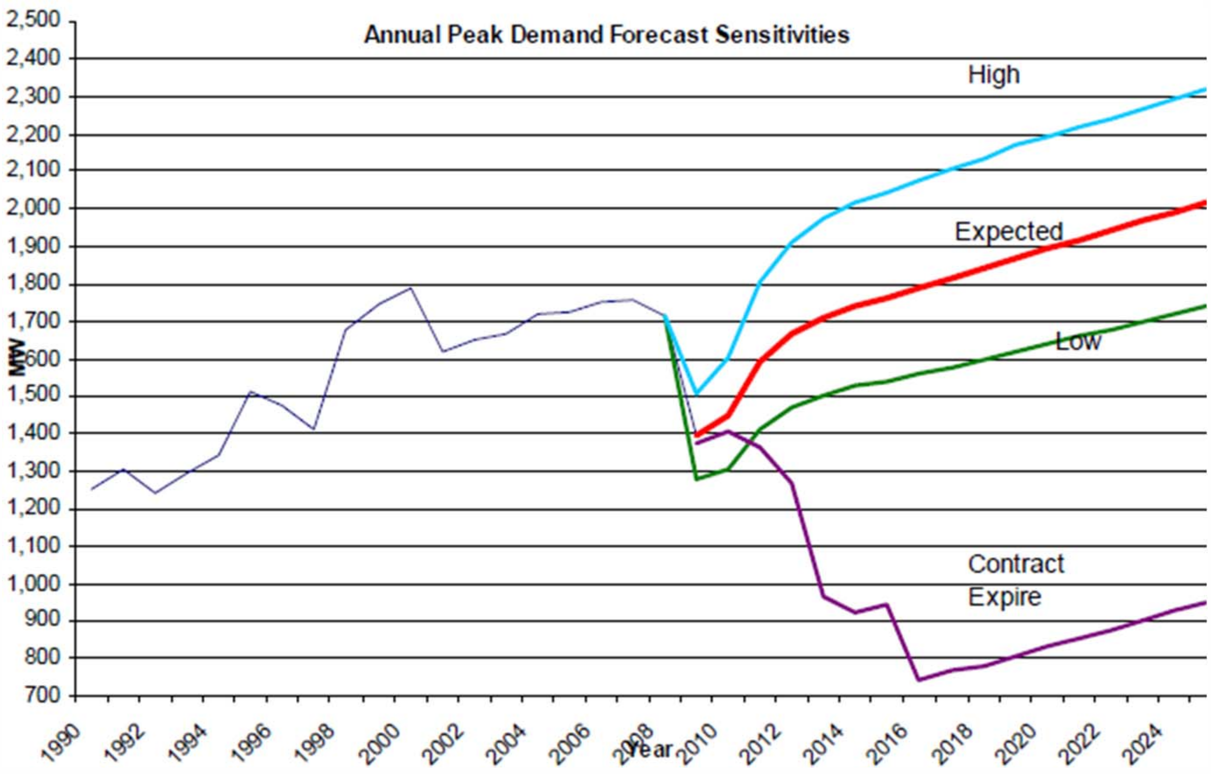
- can affect a planning outcome,
- are complex or non-intuitive, or
- novel.

Load Forecast

How vulnerable is the utility to the departure of a major customer?

Death spiral: Rates go up, major customers depart. Utility has to raise rates to support high fixed costs.

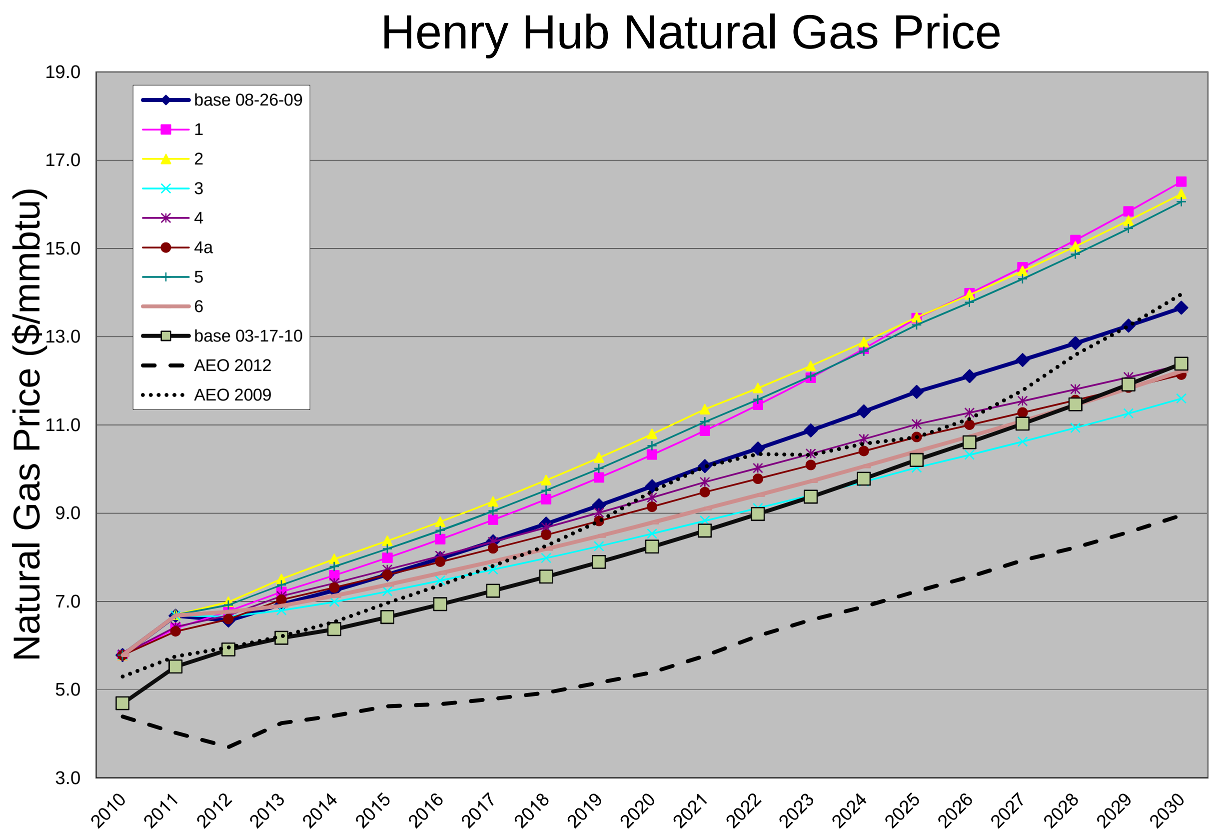
Minnesota Power's 2009 Electric Utility Forecast



Source: Minnesota Power 2009

Commodity Prices

TVA 2012 Internal Planning



Source: TVA 2012

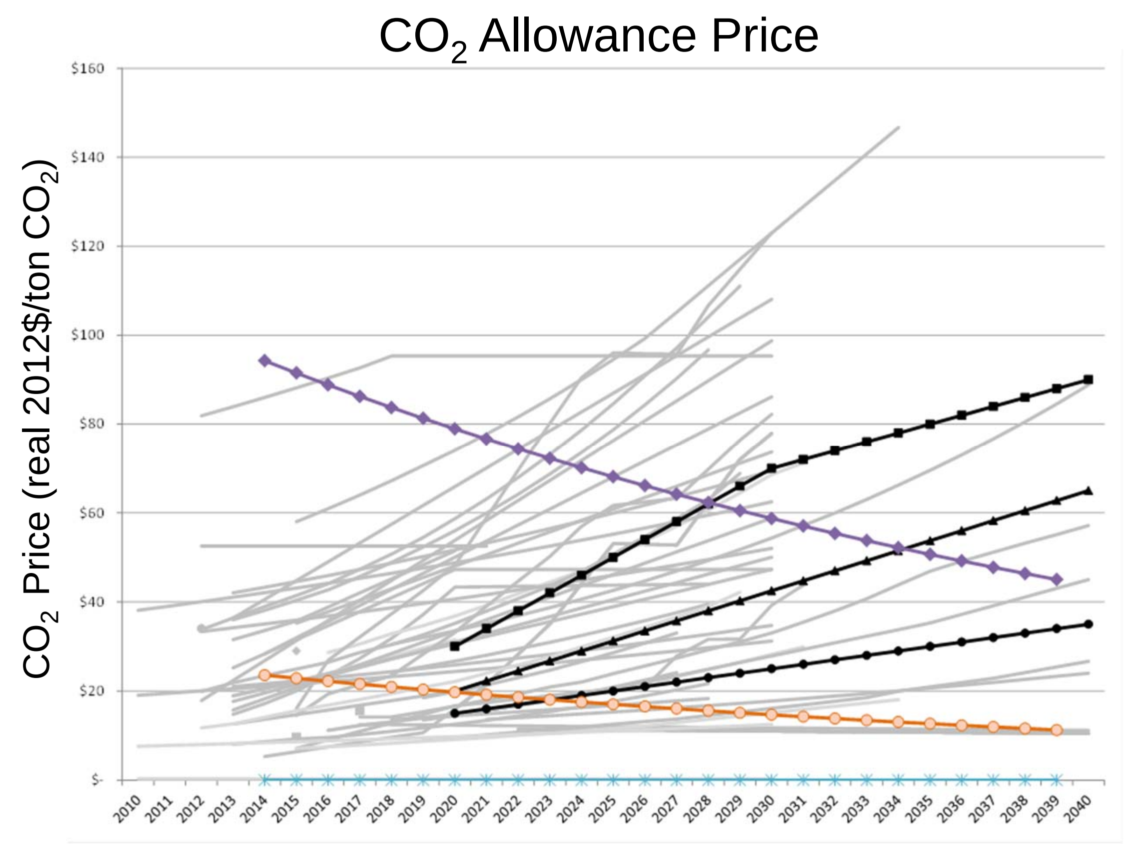
When was the commodity price developed? Is it fresh?

What is the source of the forecast?

How are multiple forecasts considered?

Commodity Prices

Hawaii Electric Company (HECO) 2013 IRP



Source: Hawaii Electric Company, 2013

Review of CO_2 price assumptions are critical.

Does price include "allowances," if so, what assumptions underlie those allowances? Does it rise faster than inflation? Or much, much slower?

Zero is a strong forecast.

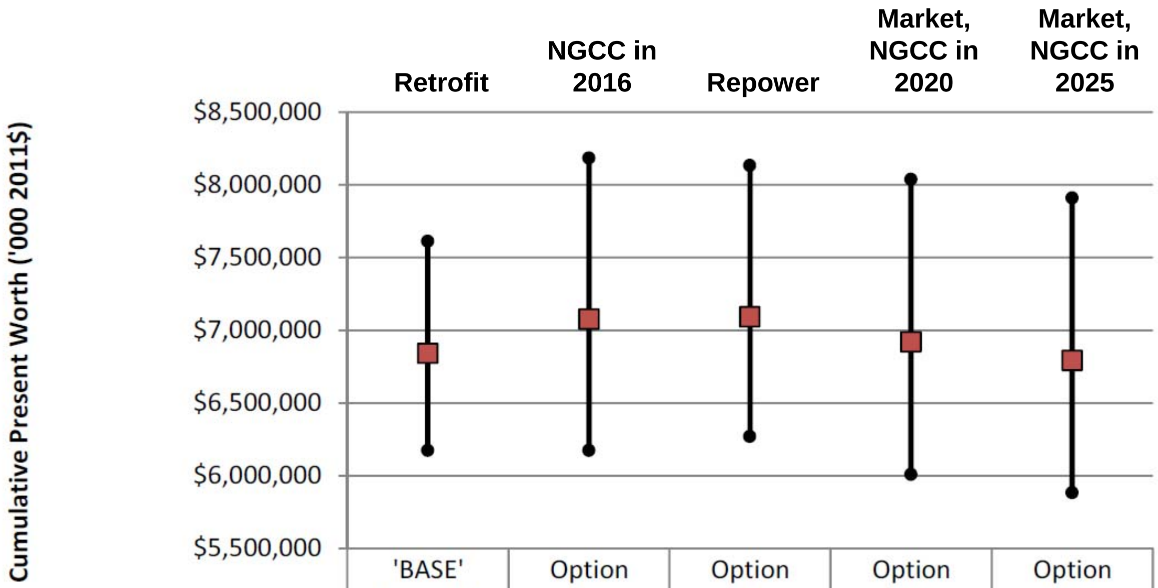
Commodity Price Relationship

"World View" scenarios and stochastic analyses introduce a new form of uncertainty: <u>relationship between variables.</u>

Does analysis outcome depend on this relationship?

What is the basis of that relationship?

KPCo Big Sandy Retrofit Stochastic Analysis



	'BASE' Option #1	Option #2	Option #3	Option #4A	Option #4B
95th % Aurora Risk	7,609,980	8,182,166	8,130,133	8,034,108	7,907,927
Strategist ("Base") Outcome	6,838,879	7,075,297	7,091,182	6,917,767	6,791,587
5th % Aurora Risk	6,171,648	6,172,690	6,268,489	6,008,162	5,881,981

Source: KPCo / AEP (2011)

Commodity Price Relationship

“World View” scenarios and stochastic analyses introduce a new form of uncertainty: <u>relationship between variables.</u>

Does analysis outcome depend on this relationship?

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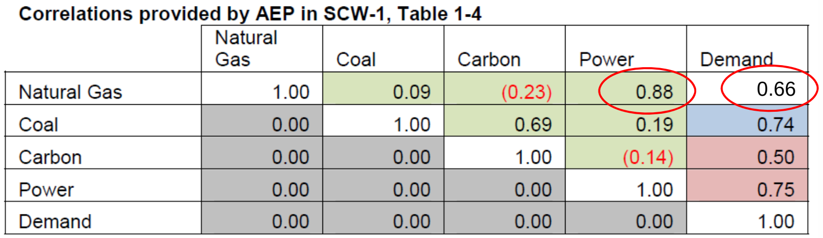
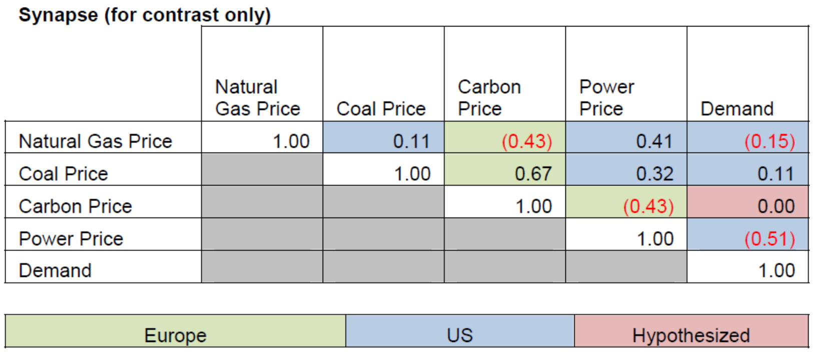
KPCo Big Sandy Retrofit Stochastic Analysis Correlation Variables



Correlations provided by AEP in SCW-1, Table 1-4

	Natural Gas	Coal	Carbon	Power	Demand
Natural Gas	1.00	0.09	(0.23)	0.88	0.66
Coal	0.00	1.00	0.69	0.19	0.74
Carbon	0.00	0.00	1.00	(0.14)	0.50
Power	0.00	0.00	0.00	1.00	0.75
Demand	0.00	0.00	0.00	0.00	1.00

Analysis assumed strong relationship between stochastic gas price, power price, and demand.

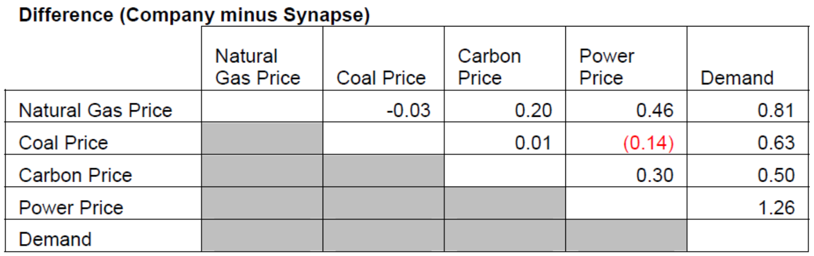


Synapse (for contrast only)

	Natural Gas Price	Coal Price	Carbon Price	Power Price	Demand
Natural Gas Price	1.00	0.11	(0.43)	0.41	(0.15)
Coal Price		1.00	0.67	0.32	0.11
Carbon Price			1.00	(0.43)	0.00
Power Price				1.00	(0.51)
Demand					1.00

Europe	US	Hypothesized

With these assumptions, any cases with market or gas purchases becomes highly volatile (both upside and downside risk).

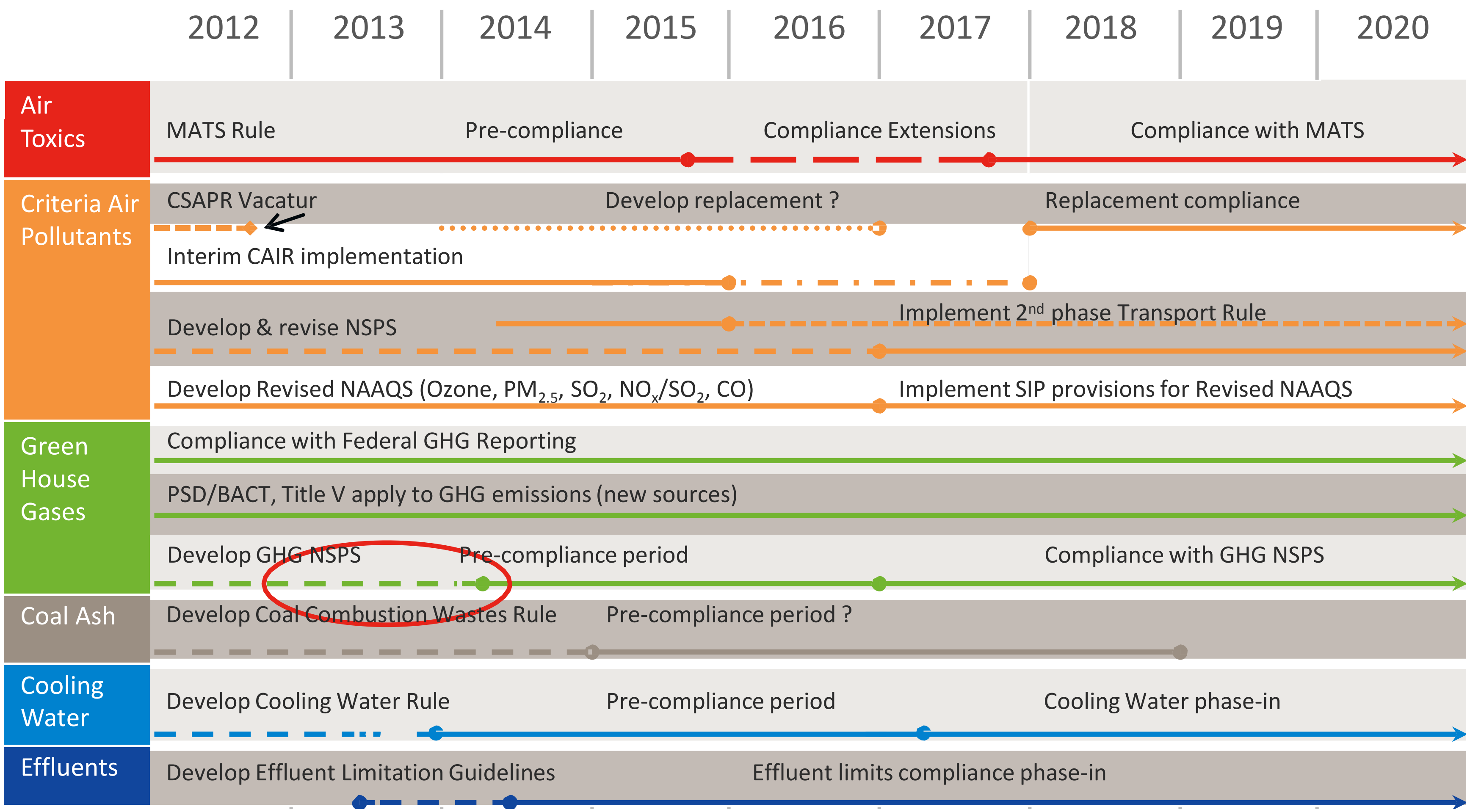


Difference (Company minus Synapse)

	Natural Gas Price	Coal Price	Carbon Price	Power Price	Demand
Natural Gas Price		-0.03	0.20	0.46	0.81
Coal Price			0.01	(0.14)	0.63
Carbon Price				0.30	0.50
Power Price					1.26
Demand					

Correlations were incorrectly calculated and sourced; result was much lower risk.

Environmental Compliance Obligations



2012 2013 2014 2015 2016 2017 2018 2019 2020

Air Toxics

MATS Rule
Pre-compliance
Compliance Extensions
Compliance with MATS

Criteria Air Pollutants

CSAPR Vacatur
Develop replacement ?
Replacement compliance
Interim CAIR implementation
Develop & revise NSPS
Implement 2nd phase Transport Rule
Develop Revised NAAQS (Ozone, $PM_{2.5}$, SO_2, NO_x/SO_2, CO)
Implement SIP provisions for Revised NAAQS

Green House Gases

Compliance with Federal GHG Reporting
PSD/BACT, Title V apply to GHG emissions (new sources)
Develop GHG NSPS
Pre-compliance period
Compliance with GHG NSPS

Coal Ash

Develop Coal Combustion Wastes Rule
Pre-compliance period ?

Cooling Water

Develop Cooling Water Rule
Pre-compliance period
Cooling Water phase-in

Effluents

Develop Effluent Limitation Guidelines
Effluent limits compliance phase-in

Environmental Compliance Obligations

- Why can't we assume costs for finalized regulations only?

  (i.e. Why should we consider NAAQS, CSAPR 2.0, coal combustion residuals, effluent limitation, cooling water rules or CO_2?)

Ignoring impending regulations assigns them a **zero** dollar cost.

Zero is an **absolute** forecast. It implies **100%** certainty that there will be **no** cost of compliance.

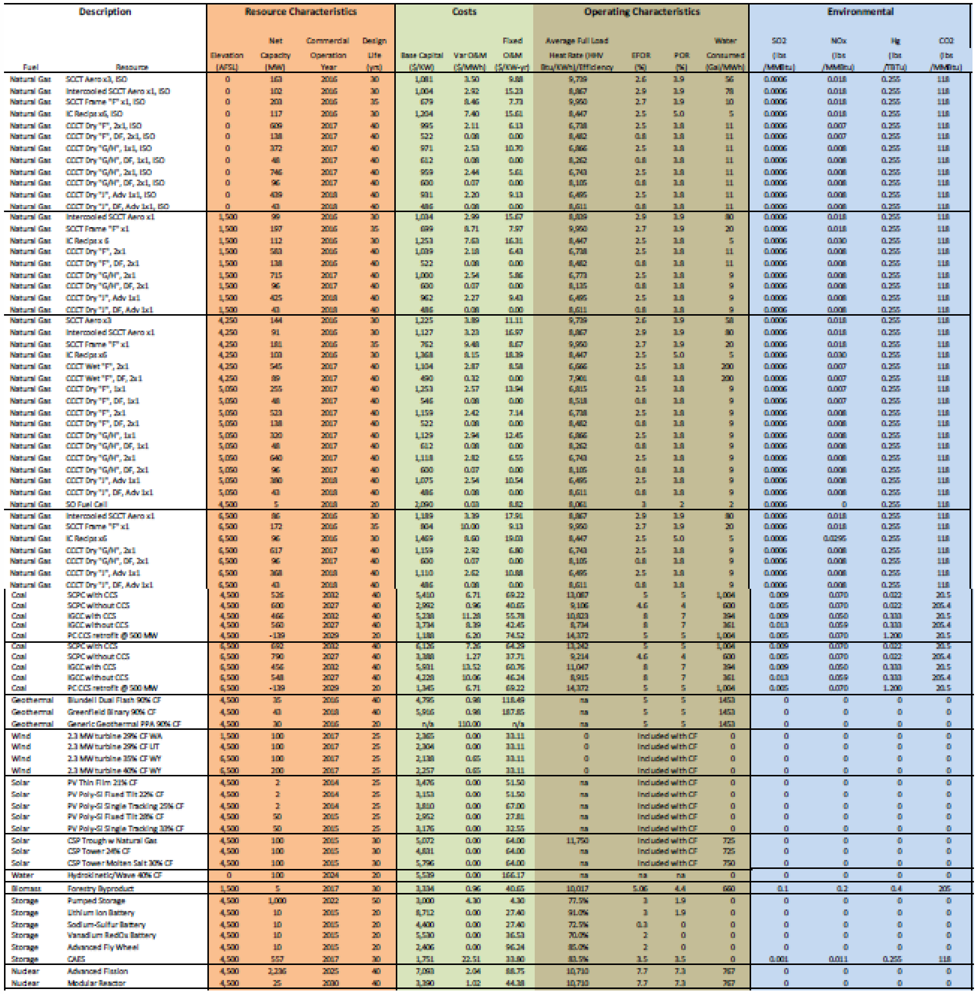
Alternative options include proxy costs or estimates.

Supply-Side Options

- Reasonable diversity of supply options?
  - Range of thermal types/sizes, renewable resources, demand reduction, efficiency, storage?
  - Purchase of existing assets?
  - Partial ownership?
  - Transmission options considered, if viable?
- Source and date of capital estimates. Learning curve for solar and wind?
- Capacity and energy markets included?
- Did the utility consider divesting resources? How?

PacifiCorp 2013 IRP

Table 6.1 - 2013 Supply Side Resource Table (2012$)

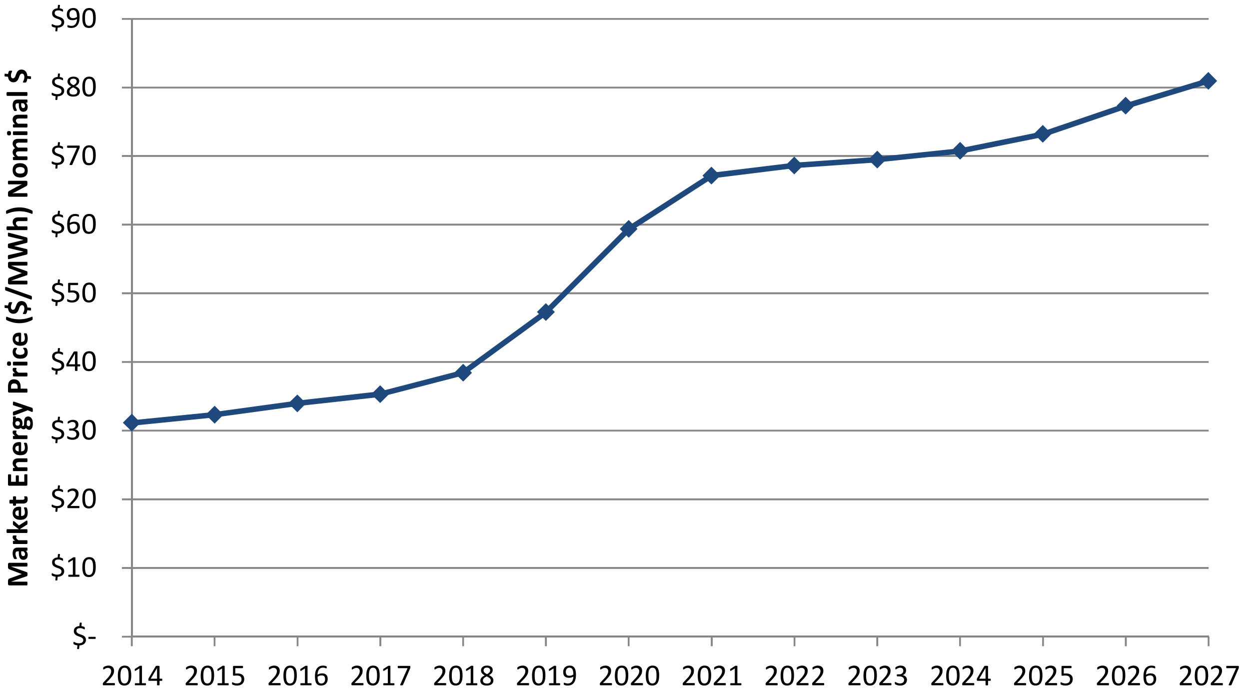


Market Prices

Energy market price forecasts guide value of existing resources and consumer risk of loss.

Are prices reasonable and consistent?

Midwest Utility “A” Rate Case



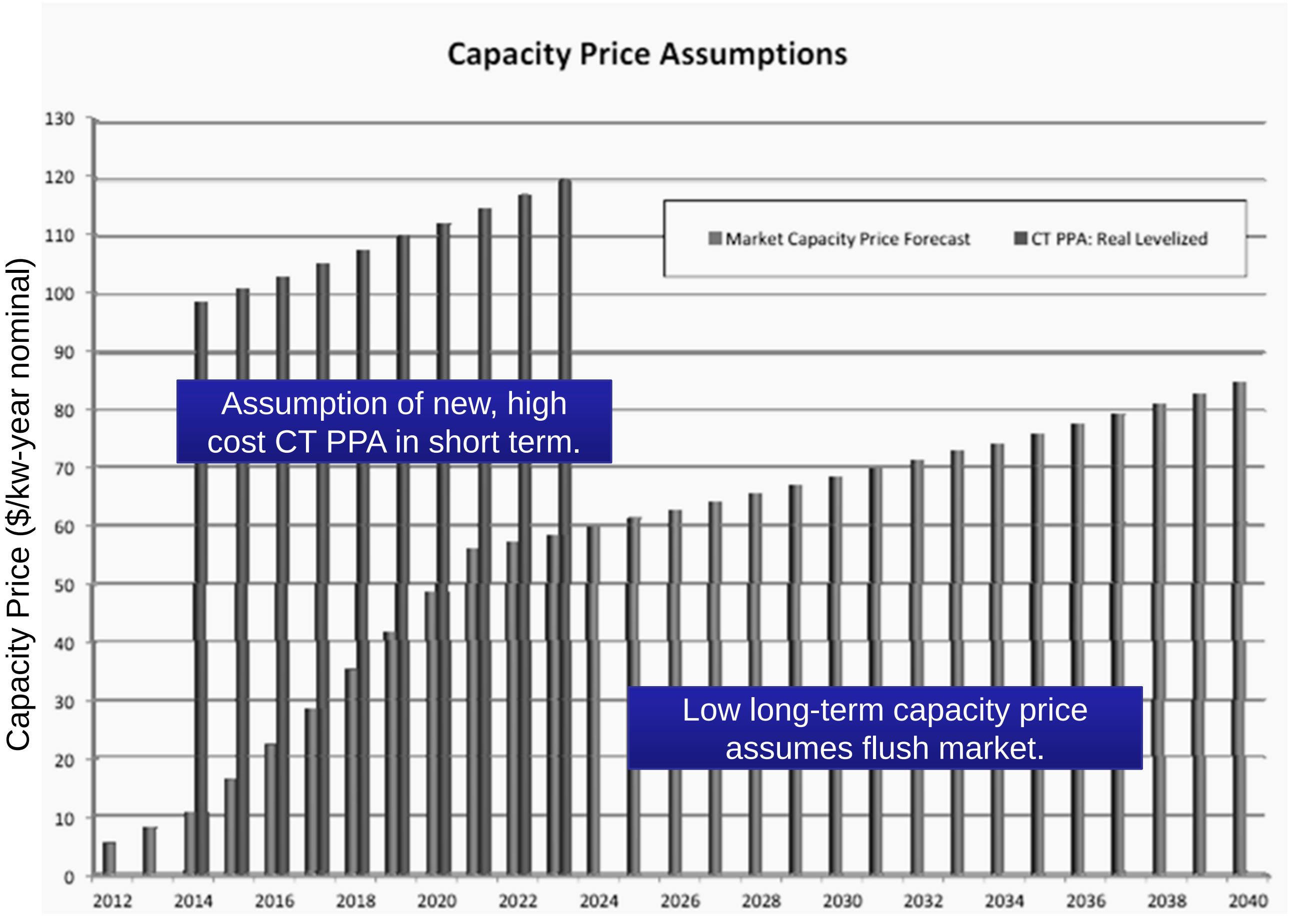
Source: Midwest Utility “A”, 2012

Market Prices

Capacity prices are company’s estimate of risk of “going short”.

Assumed payments for capacity can overwhelm an analysis.

Midwest Utility “B” CPCN



Assumption of new, high cost CT PPA in short term.

Low long-term capacity price assumes flush market.

Source: Midwest Utility “B”, 2012

Optimization

- Was every reasonable portfolio combination considered?
- What was excluded, and why?
- Was every commodity price combination and regulatory requirement considered, or just a limited selection?

Optimization

Large number of unknown variables results in large number of runs.

(i.e. low-mid-high range on gas prices, coal prices, CO_2 prices, and environmental stringency results in 81 scenarios.)

Modeling one-off scenarios is embarrassingly parallel.

Incremental cost of computing power pales in comparison to annual investments.

Toward Automatic Management of Embarrassingly Parallel Applications

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Abstract. Large-scale applications that require executing very large numbers of tasks are only feasible through parallelism. In this work we present a system that automatically handles large numbers of experiments and data in the context of machine learning. Our system controls all experiments, including re-submission of failed jobs and relies on available resource managers to spawn jobs through pools of machines. Our results show that we can manage a very large number of experiments, using a reasonable amount of idle CPU cycles, with very little user intervention.

1 Introduction

Large-scale applications may require executing very large numbers of tasks, say, thousands or even hundreds of thousands of experiments. These applications are only feasible through parallelism and are nowadays often executed in clusters of workstations or in the Grid. Unfortunately, running these applications in an unreliable environment can be a complex problem. The several phases of computation in the application must be sequenced correctly: dependencies, usually arising through data written to and read from files, must be respected. Results will be grouped together, a summarised report over the whole computation should be made available. Errors, both from the application itself and from the environment, must be handled correctly. One must check whether experiments terminated successfully, and verify integrity of the output.

Most available software for monitoring applications in parallel and distributed environments, and more recently, in grid environments, concentrate on modelling and analysing hardware and software performance [8], prediction of lost cycles [9] or visualisation of parallel execution [12], to mention some. Most of them focus on parallelised applications. Few efforts have been spent on managing huge number of independent experiments and the increasing growth of interdisciplinary databases such as the ones used in biological or biomedical applications. Only recently, we have seen work in the context of the Grid such as

H. Kosch, L. Böszörményi, H. Hellwagner (Eds.): Euro-Par 2003, LNCS 2790, pp. 509–516, 2003.

Participant Roles in Productive IRP Planning

Utility

- Continuously improve planning
- Responsive to stakeholder concerns
- Transparent as often as possible
- Use stakeholder input as a process audit

Stakeholders

- Engage seriously, and at a technical level
- Realistic expectations

Staff/PUC

- Provide backstop and/or recourse for transparency, concerns
- Guide priorities