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Risk Integrated Resource Planning

EPIS Electric Market Forecasting Conference

***Tucson, AZ
October 20, 2006***

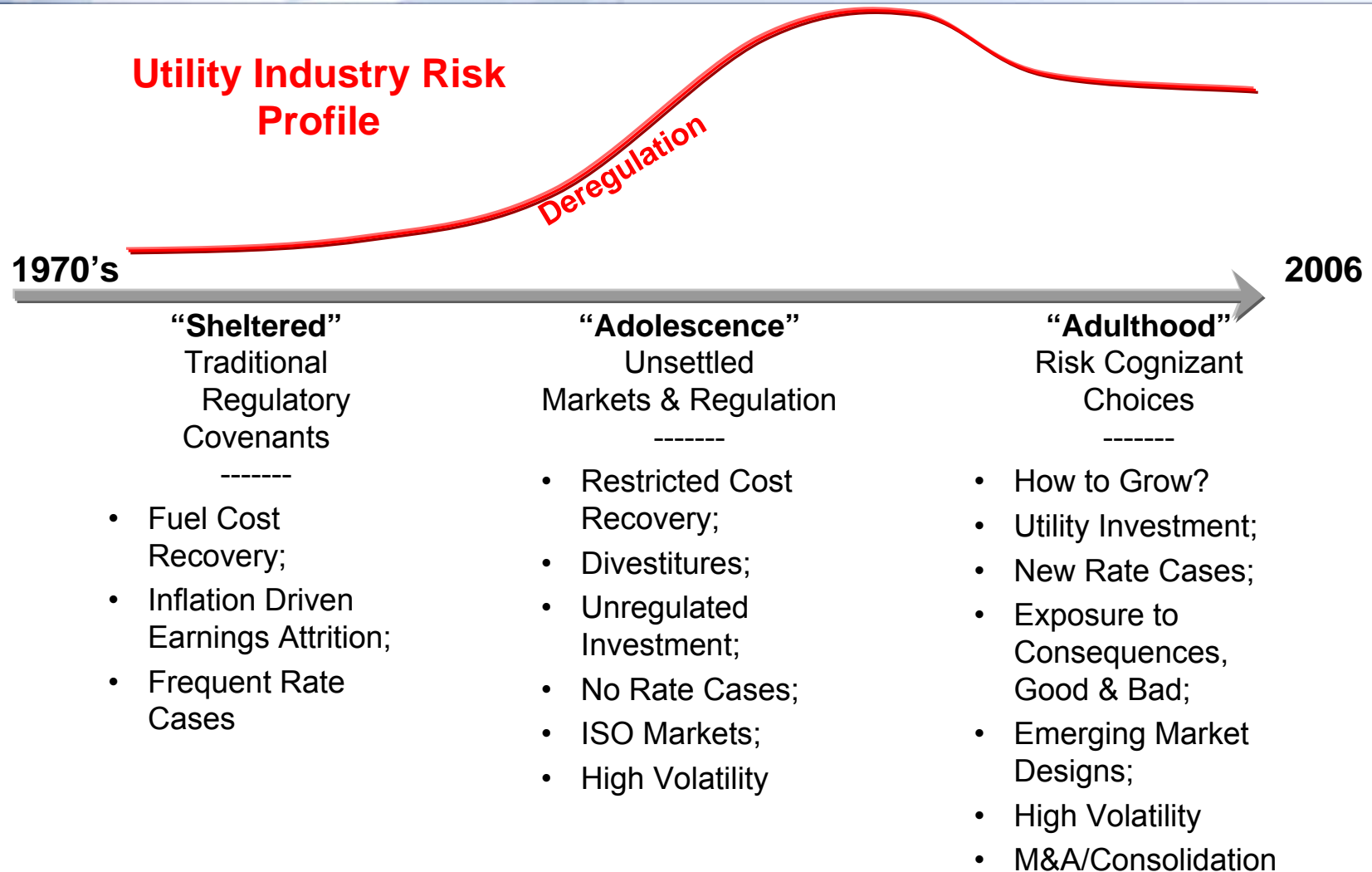
Agenda

- Conceptual Context: Executive Decision Framework
- Risk Integrated Resource Planning
 - What is RIRP?
 - Why is it Needed?
 - The RIRP Approach
 - Setting Business Objectives
 - Creating a Risk Profile
 - Selecting an Optimized Supply Portfolio
 - Stress Testing for Quantum Risks
- RIRP Using the Aurora Model
- Case Study: Comparing RIRP to Traditional IRP



Executive Decision Framework

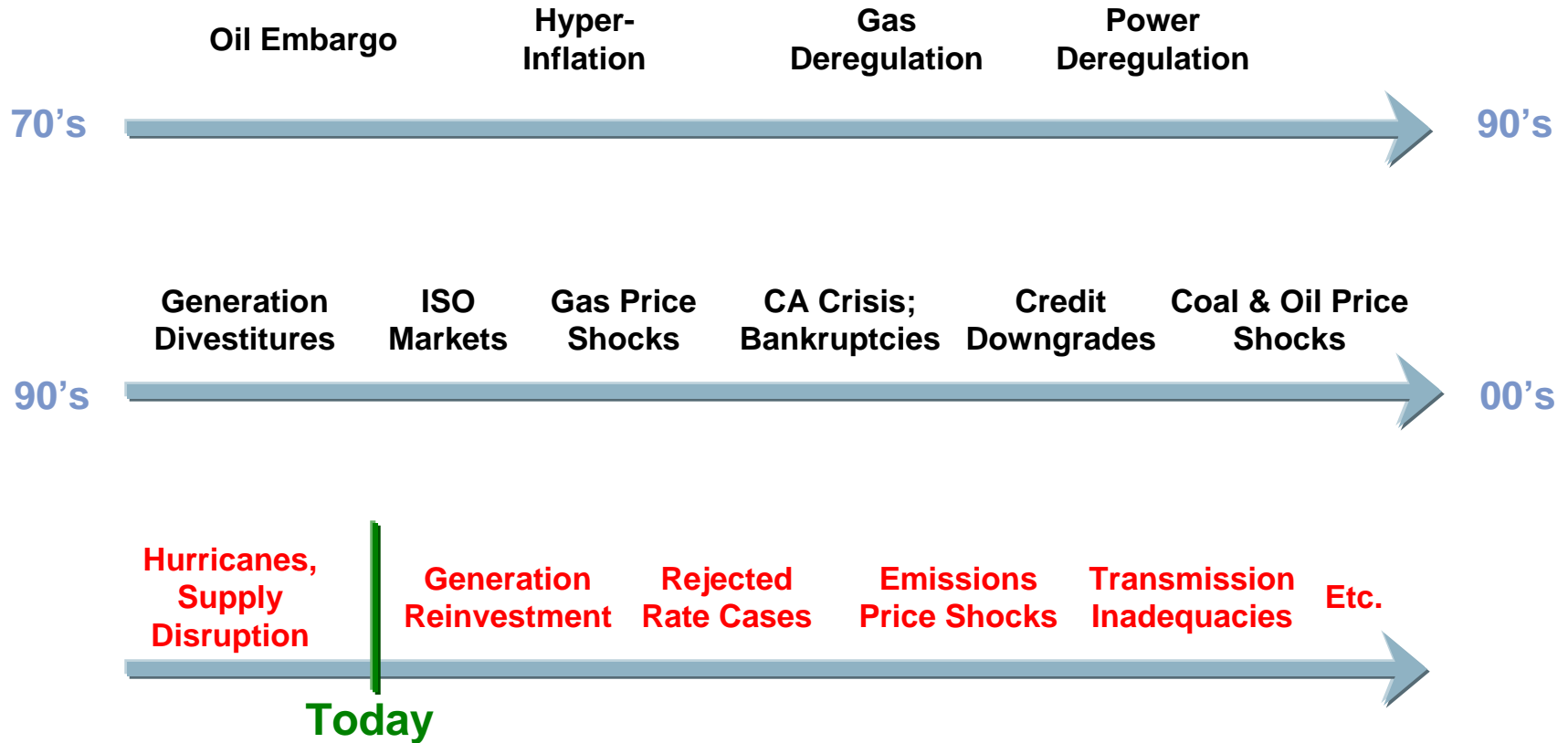
Maturation of The Utility Industry



Planning Issues are More Complex

- What is the next mix of generating stations going to look like?
 - Constantly changing and highly volatile markets
 - New RPS standards
 - Statewide emission standards on mercury, carbon etc
 - Evolving ISO and RTO standards
 - Evolving merchant business and funding mechanisms
 - Evolving markets for allowances, RECs etc
 - Developers focusing on unproven technologies
 - Push back to nuclear

Historical and Prospective “Quantum-Risk” Timeline



Quantum risks should be assessed via management consensus, supplemented by quantitative analysis where applicable

Adopting An Explicit Risk Perspective Creates Sustained Value Across All Functions

Executive Decision Framework

Market Risk

- Open Exposure Metrics
- Prudency metrics
- Credit
- Hedging Decision Protocols

Enterprise Risk Management

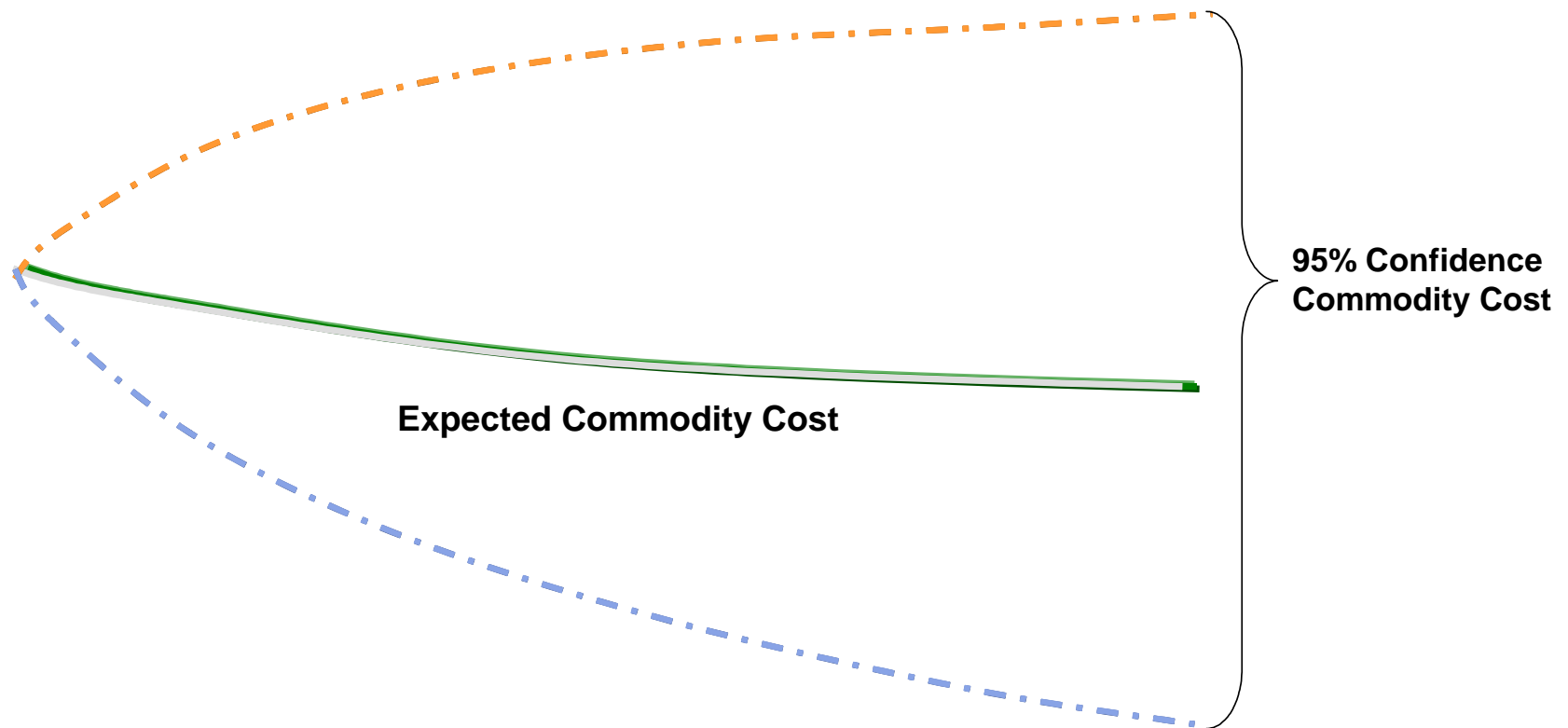
- Market Risk
- Credit Risk
- Operations & Systems
- Strategic & Regulatory
- Liquidity
- Environmental
- Tax, Legal & Compliance
- Sovereign
- Financial Documentation
- Staffing & Organization

Opportunity Management

- Resource Planning
- New Technology
- RTO Decisions
- Regulatory Decisions
- Growth Strategies
- M&A
- Environmental Investments
- Legislative Initiatives
- Customer Communications
- Paradigm Shift
- Portfolio Restructuring

Understanding The Risk Environment Facilitates Better Decisions

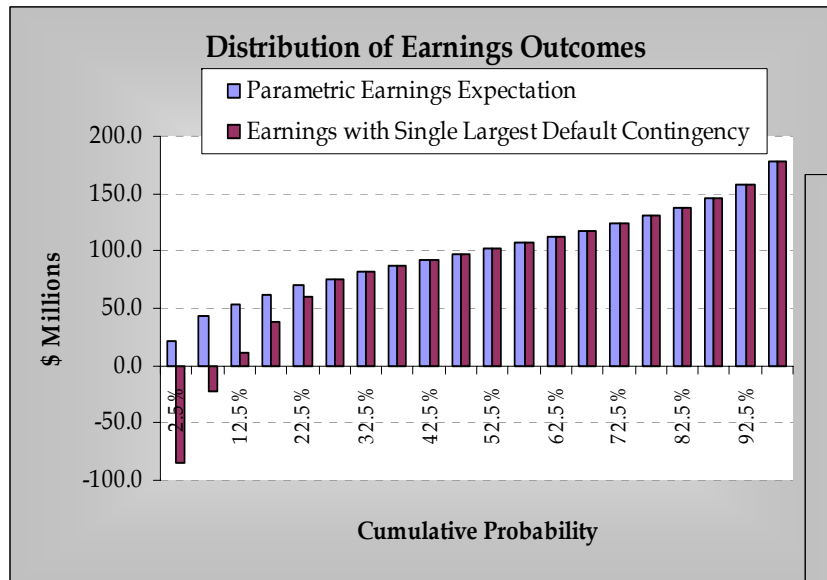
Start With Commodity Cost Variability



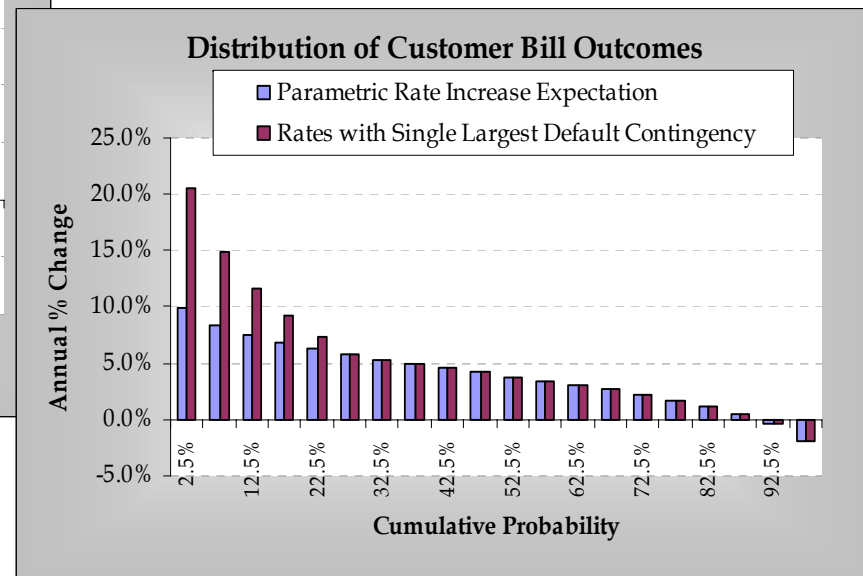
Range of commodity-cost environments must reflect volatility, correlations among fuels, further migration of all parameters, and *little confidence in the ultimate mean expectation*

Integrating Risk Perspectives with Plan Evaluation

Illustrative Examples



← Higher price scenarios



← Higher price scenarios

A risk-cognizant resource planning recommendation would look at the overlay of contingent-event risk on distributions for alternative plans for each year of the planning horizon



Risk-Integrated Resource Planning

What is Risk Integrated Resource Planning?

Executive Decision Framework

A formalized executive consensus on risk provides a reliable framework for strategic decisions . . .

RIRP is a systematic approach for fully evaluating risks into Resource Planning and investment decisions.



Opportunity Management

- **Resource Planning**
- New Technology
- RTO Decisions
- Regulatory Decisions
- Growth Strategies
- M&A
- Environmental Investments
- Legislative Initiatives
- Customer Communications
- Paradigm Shift
- Portfolio Restructuring

Traditional Long-term Integrated Resource Planning

- Create base case energy and peak demand forecast
- Evaluate existing supply-side and demand-side resources
- Identify resource shortage potential
- Determine additional resource requirements
- Evaluate resource options
- Choose low cost option (lowest net present value)
- Test high and low sensitivities

What is Wrong with the Traditional IRP Approach?

- Making decisions based on a view of the most likely forecast is very risky
- Investment decisions are often irreversible
- Regulations are changing too fast
- A limited number of sensitivities are insufficient to fully evaluate the risks of alternative portfolios
- Process does not lend itself to having multiple objectives
- A picture of the risks and opportunities of alternative portfolios is worth a thousand words or a single number.
- The investment portfolios can not be properly evaluated using a single metric.
- One can not ignore one and two year events that can undermine a portfolio.

The Risk Integrated Resource Planning Approach

Critical First Step

Identify Business Objectives and Risk Perspectives

Risk Integrated Market Price Forecasts, "Game Changer" Fundamental Risk, etc.

Establish Current and Future Risk Profile

Consideration of Resource Options Consistent with Business Objectives and Updated Risk Profiles

Analyze Resource Options & Supply Portfolios

Consideration of "What-If" Scenarios, (contract abrogation, supplier default, long-term asset outage etc.)

Assess Quantum Risks

Continually Honed Analysis and Conclusions

Optimal Portfolio(s) selected on the basis of commercial reality, balance of business objectives, and perspective of acceptable risk.

Select Optimal Portfolios

Honed Portfolio Recommendations Consistent with Business Objectives

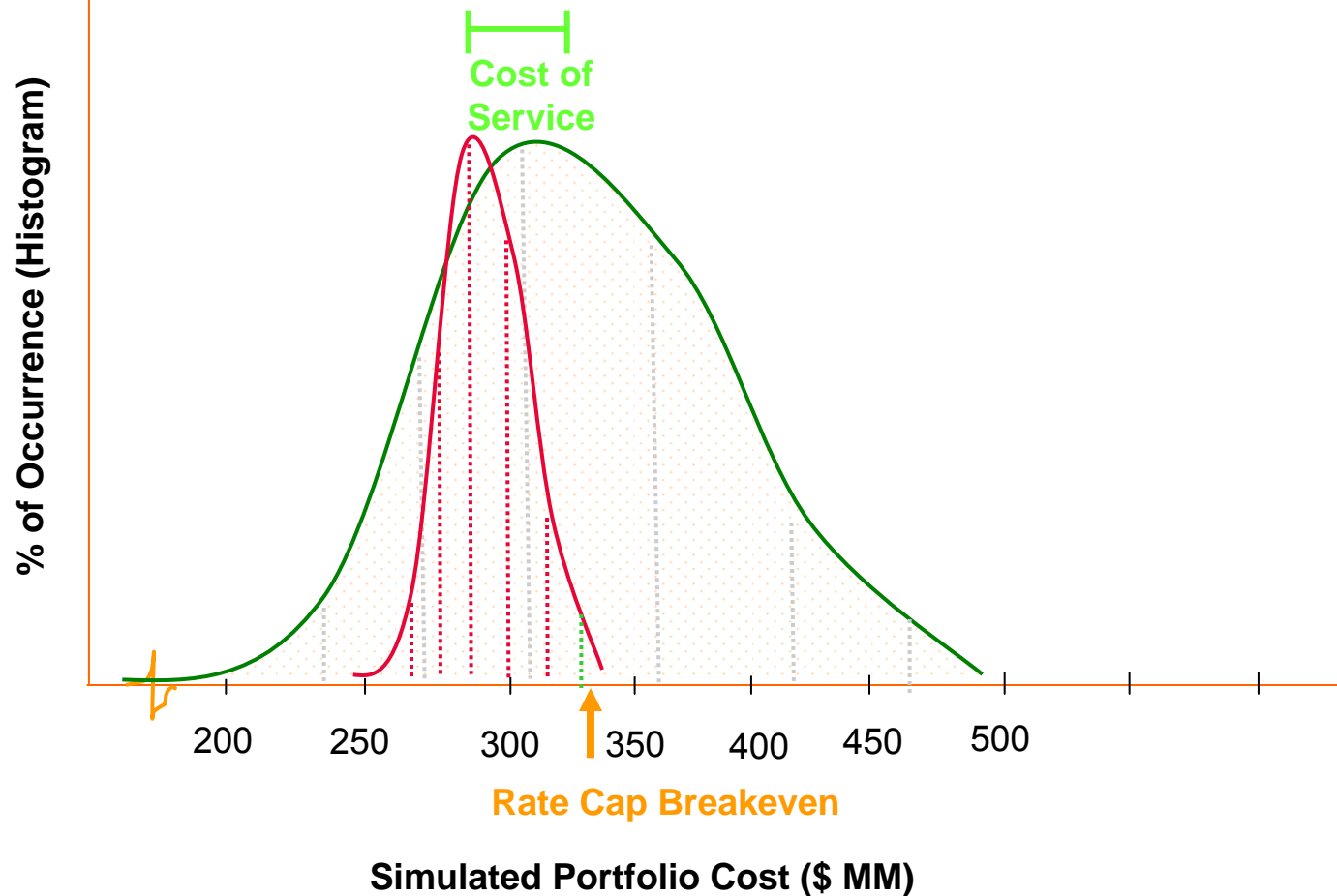
Setting Business Objectives

- Understanding Your Corporate Objectives is Critical to Selecting a Sound Resource Plan
 - Rate Stability
 - Supply Reliability
 - Maintaining Rate Levels Competitive w/ Neighboring Utilities
 - Prudent Plan that Achieves Regulatory Approval
 - Corporate Solvency & Preserving Strong Financial Condition
- These Objectives may be inconsistent with each other
- The Selection of an Optimum Portfolio may be Quite Different for each Objective
- The proper portfolio will achieve the most important objectives most of the time and avoid unacceptable outcomes all of the time.

RIRP Portfolio Design Approaches—Rate Cap Example

2009, Risk Profile That Must Be Managed – “Open Position”

2009, Portfolio Objective - Rate Stability & Under Rate Cap



Creating a Risk Profile

Volume Uncertainty

Key Factors

- Demographics
- Weather
- Externalities



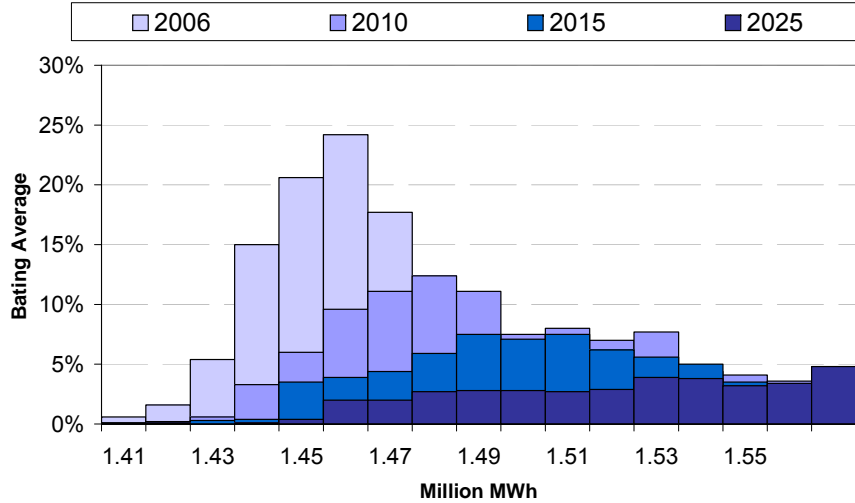
Price Uncertainty

Key Factors

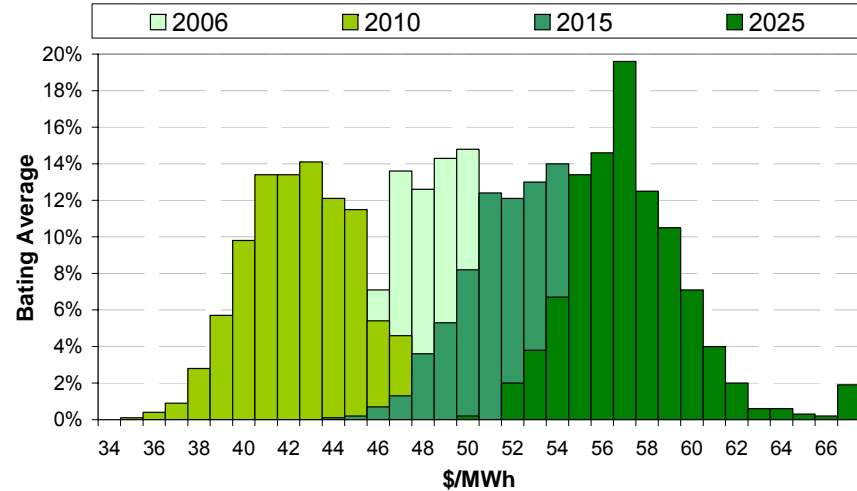
- Gas + Coal Prices
- Supply vs. Demand
- Market Fundamentals
- Environmental Compliance

Illustrative Risk Profile: 2006 to 2025

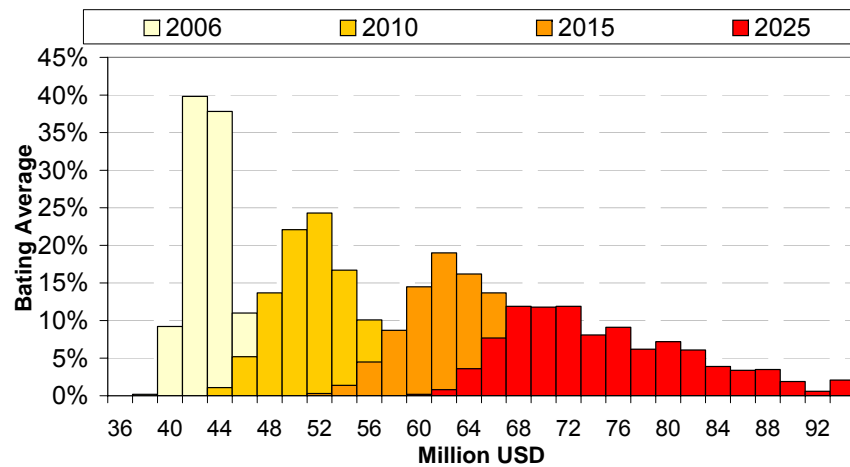
Total Annual Energy Consumption



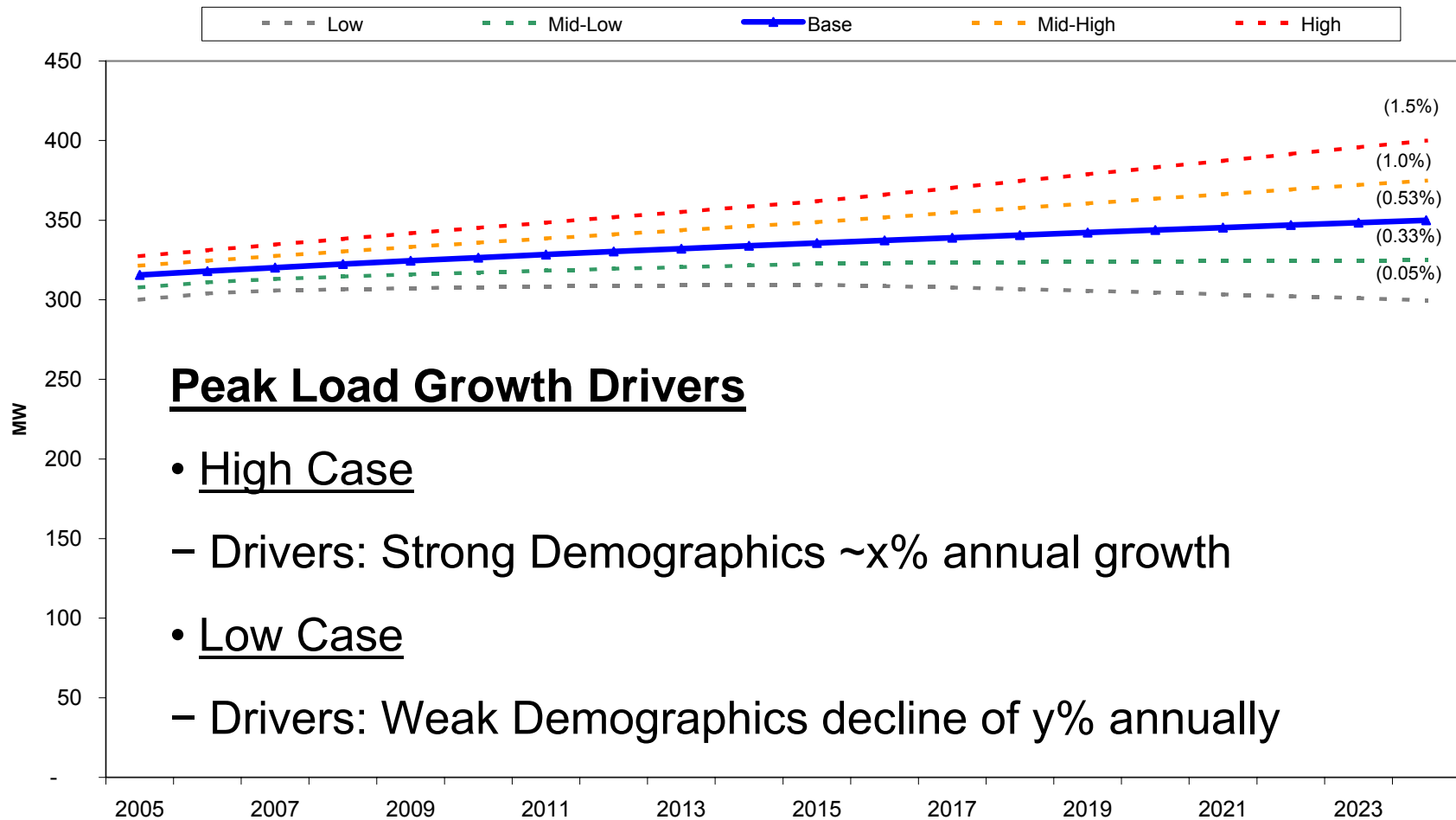
Average Annual Peak Price



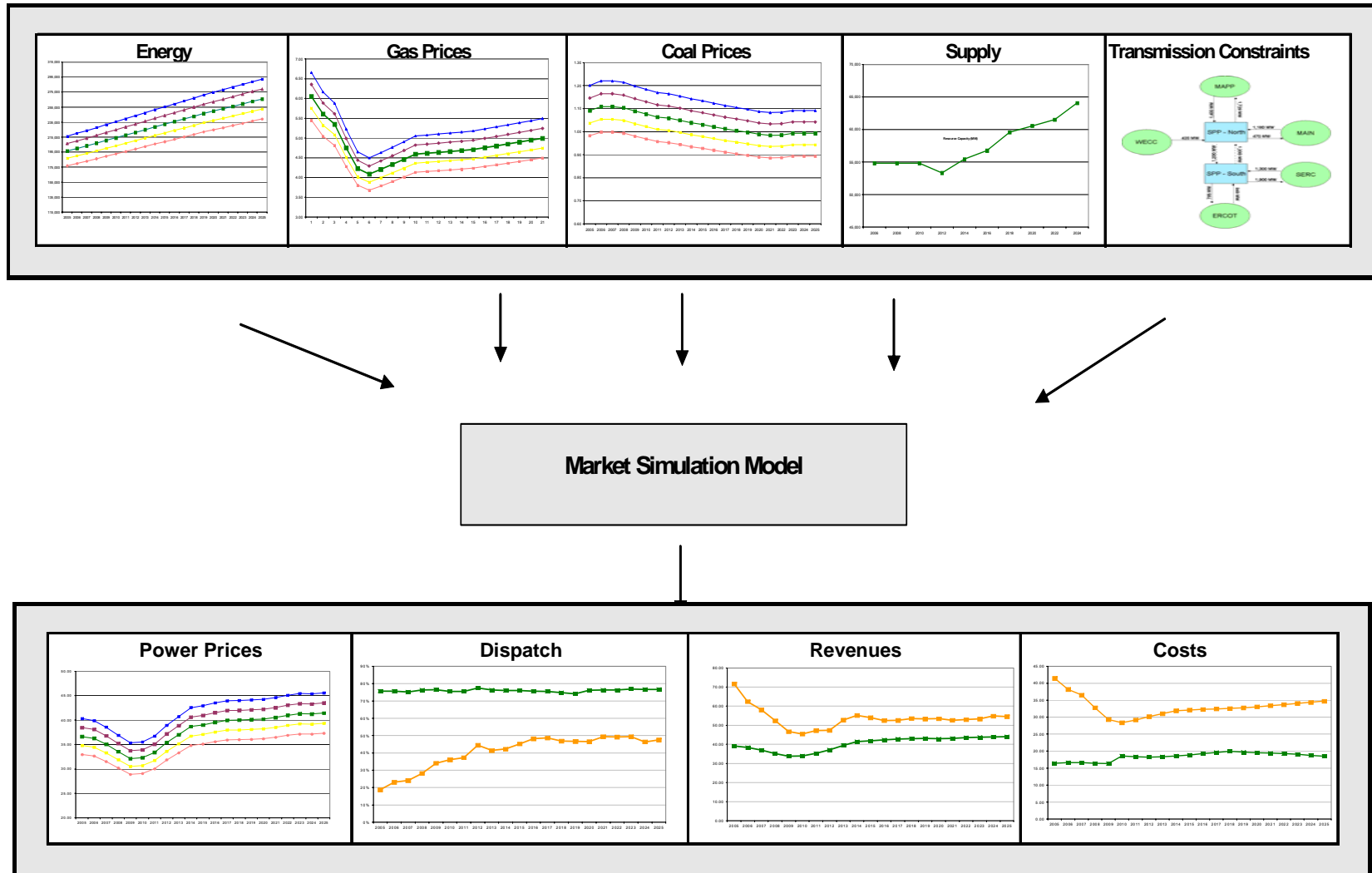
Total Annual Energy Cost Forecast



Illustrative Peak Load Growth Scenarios



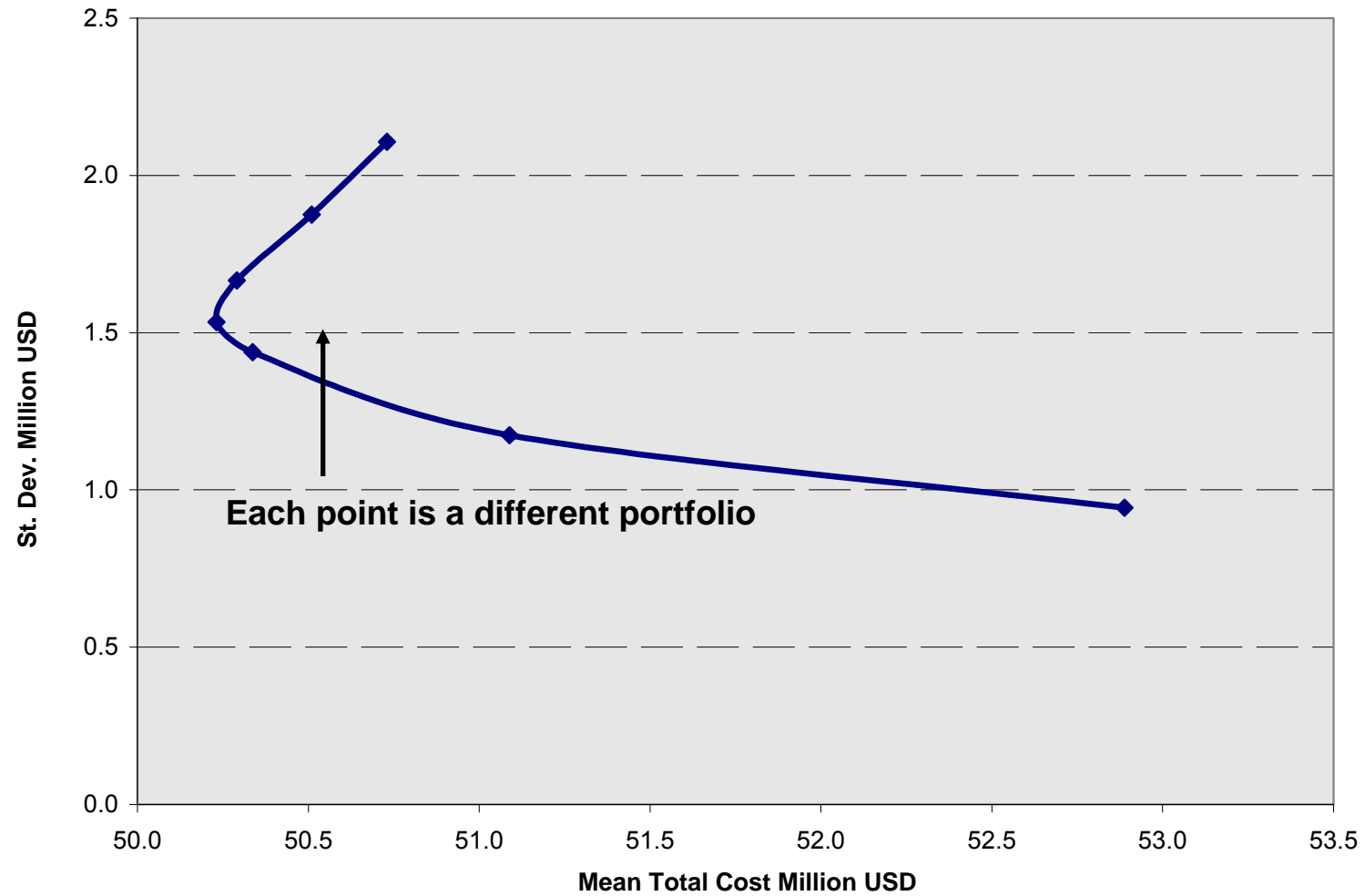
Market Fundamentals Assessment



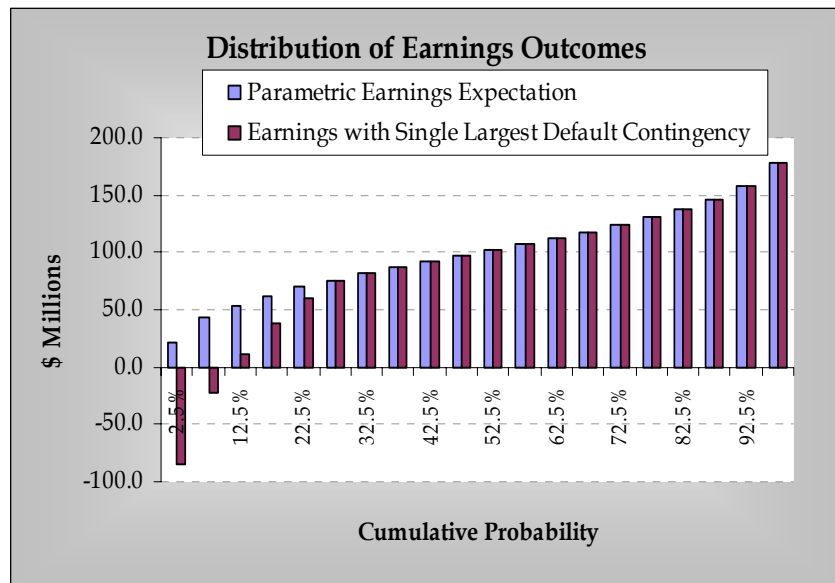
Selecting an Optimized Supply Portfolio

- **Step #1:** Develop a Continuum of Risk Profiles across a full range of generation mixes
- **Step #2:** Plot Portfolio Results: Mean Cost vs. Standard Deviation of Cost
- **Step #3:** Look for Portfolios that strike the best balance of Cost and Portfolio Cost Variance
- **Step #4:** Stress Test Portfolio w/ “Quantum” Scenarios that affect single or multiple years
- **Step #5:** Choose the portfolio that meets multiple objectives most of the time and avoids unacceptable risk to the company.

Portfolio Evaluation: Risk/Return Trade-Offs



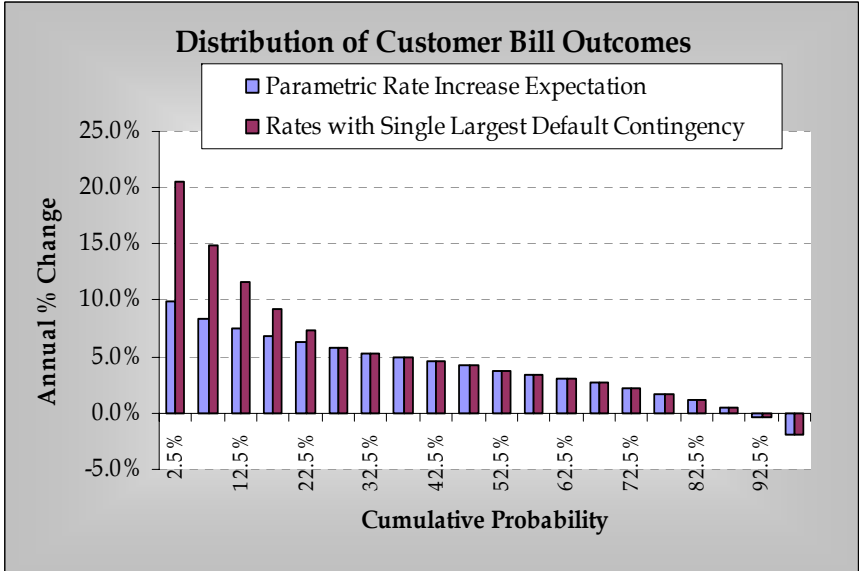
Stress Testing for Quantum Risks




← Higher price scenarios

- **Illustrative Quantum Scenarios**
 - Contract Abrogation/Supplier Default
 - Environmental Changes
 - Transmission Projects
 - Regulatory Changes

Illustrative Examples of 2008 Results

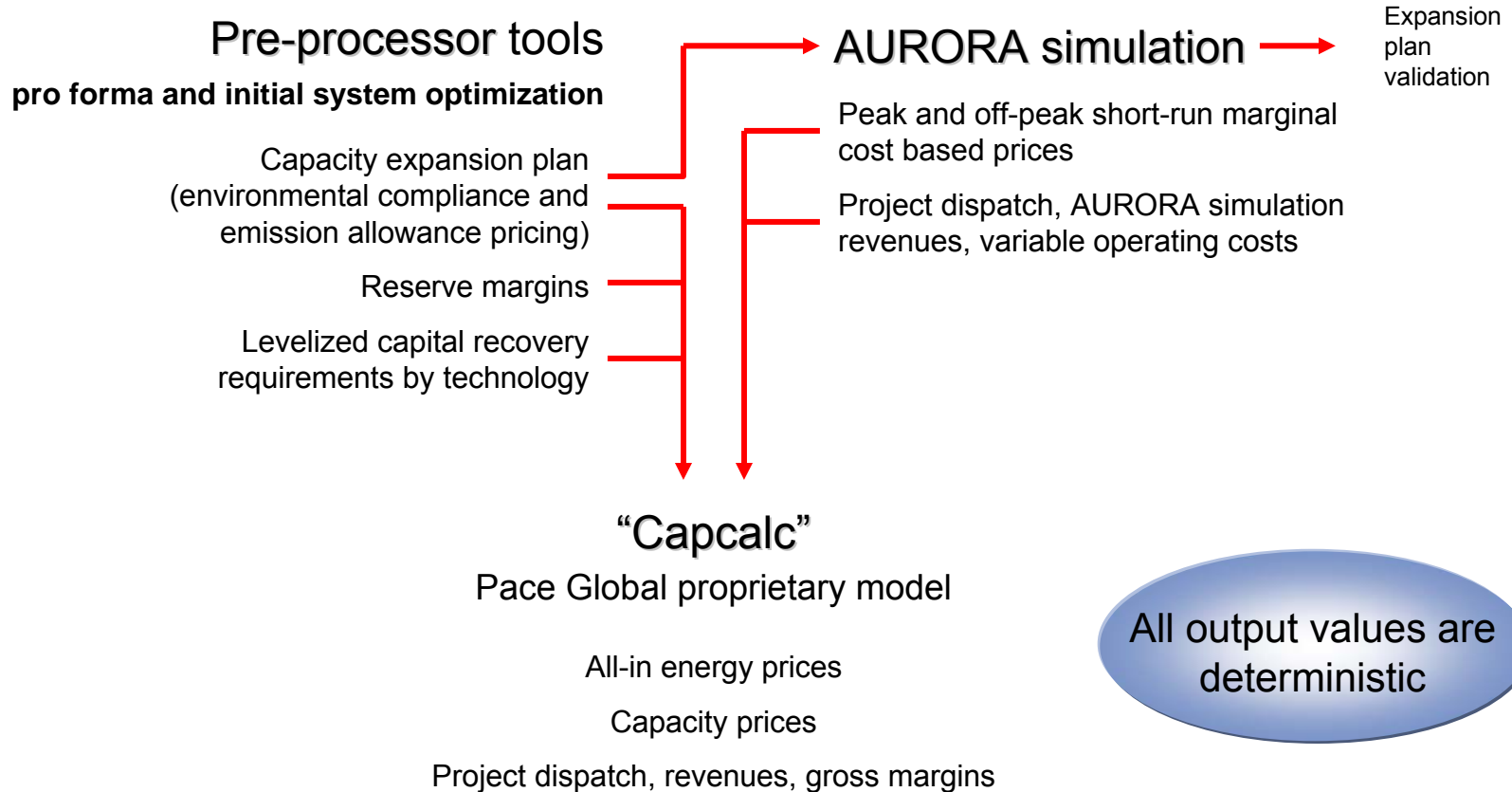


← Higher price scenarios



RIRP Using the Aurora Model

Pace Global “Single Simulation” Forecasting Process Flow



Pace Global “RIRP” Power Forecasting Process Flow Each 20+ Year Iteration; Short-Term Uncertainty

Monster File

Random walk (serial correlation) monthly 20-year draw sets capture short-term (monthly to annual) uncertainty such as weather events and non-regime change fundamental price driver volatility that would not be expected to alter expansion plans

Henry Hub

Coal price (all relevant delivered prices basin + transport)

Demand

Hydroelectric generation (if applicable)

Other as appropriate



AURORA Simulation

Consolidated regions and abbreviated hours for speed of simulation

Peak and off-peak prices

Project dispatch, AURORA simulation revenues, variable operating costs



“Capcalc”

Automation for call from or to AURORA and Capcalc operation required

All-in energy prices

Capacity prices


Project dispatch, revenues, gross margins

After X iterations, energy prices and project outputs will be stochastic in nature, expressed as probability bands

RIRP Using the Aurora Model

AURORA-related development features used in the RIRP process:

- Set up AURORA to minimize run time for multiple iterations:
 - Regional consolidation
 - Abbreviated time representation
- Read in external draw sets
- Automate call to Capcalc (or Capcalc call to AURORA)
- Use computational data sets for back end results reporting
- Use portfolio function to designate:
 - Load to be served,
 - Resources available to serve load,
 - Expansion resource options (new portfolio options)

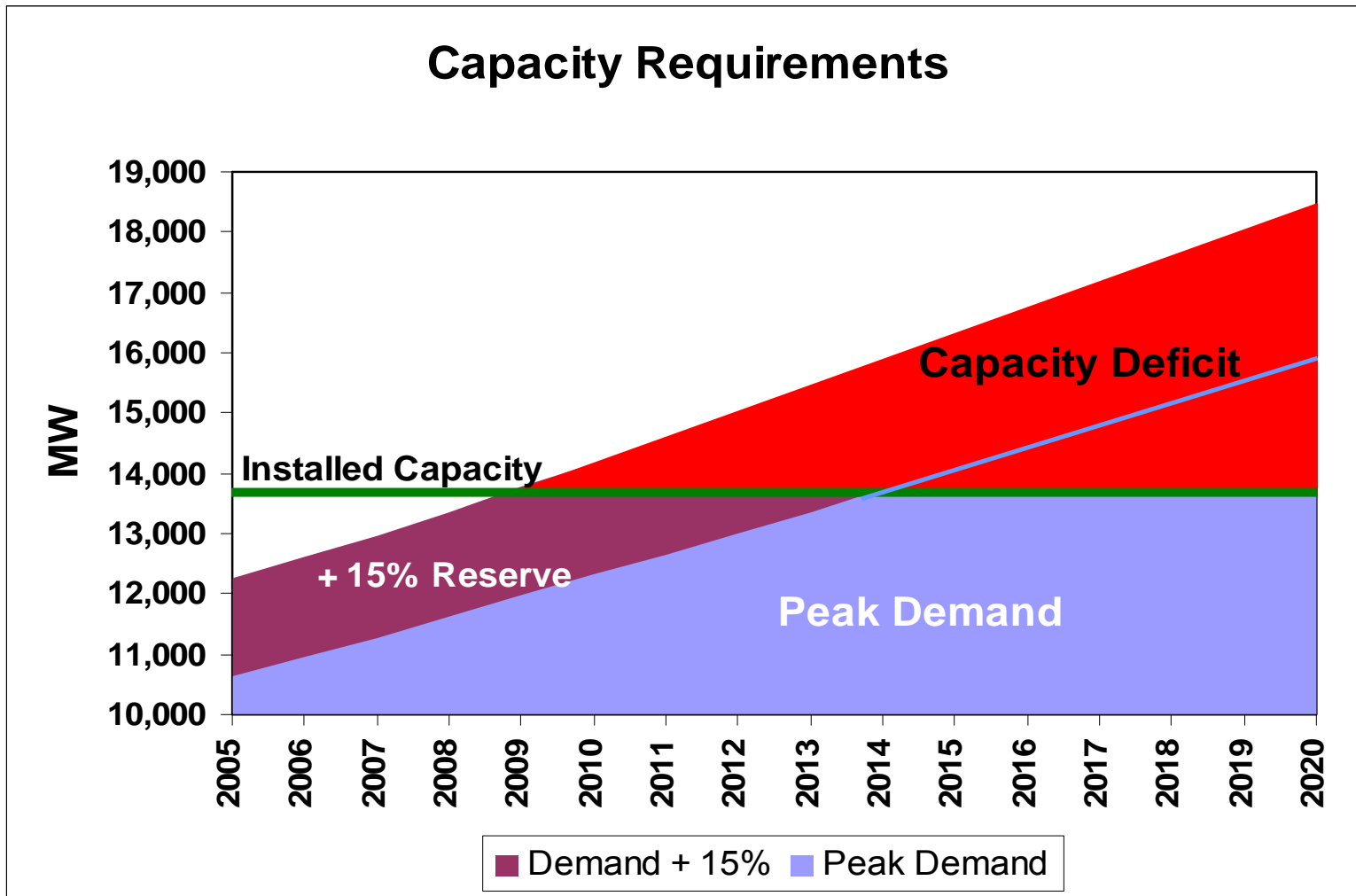



Case Study: RIRP vs. Traditional IRP

Planning Problem

- Utility X had the following problem:
 - New generation needed by 2009
 - Environmental issues on horizon, but uncertain
 - No RPS standards yet
 - Limited experience with coal, gas, peaking
 - No experience with clean coal technologies
 - No fuel cost pass through, been under rate freeze
 - Multiple goals of lowest cost, rate stability and earnings

Traditional IRP: Key Inputs



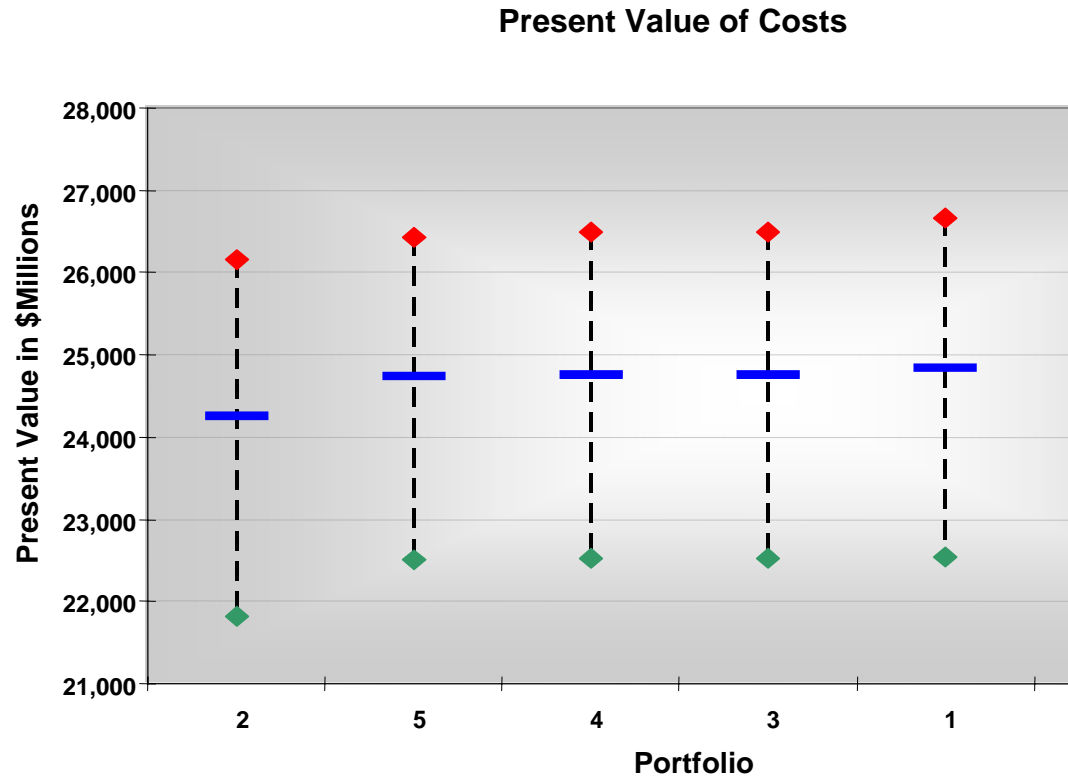
Portfolio Alternatives Considered (Resource Additions through 2020)

Portfolio	New Coal Units	New CC Units	New CT Units	New IGCC Units
1	6	4	3	0
2	6	5	0	0
3	3	7	3	0
4	2	8	3	0
5	1	9	3	0
IGCC	0	4	3	6

The Traditional IRP Approach

- The Standard IRP process was followed in our first analysis consisting of the following steps:
 - **Identify Objectives:**
 - Low costs, stable rates and high reliability.
 - **Develop Best Guess forecasts for load, coal, gas, power prices**
 - Best guess forecasts +/- 20% range around it
 - **Determine capacity needed to meet load in each year, maintaining reserve margins given load growth**
 - **Screen capacity options based on costs for different technology options**
 - **Determine portfolio that provides lowest NPV of all portfolio options.**
 - **Run low and high case (up and down 20%) to see if portfolio remains reasonable.**

Results of Traditional IRP Analysis: Portfolio 2 (6 coal, 5 CC) is Clearly Optimal Portfolio



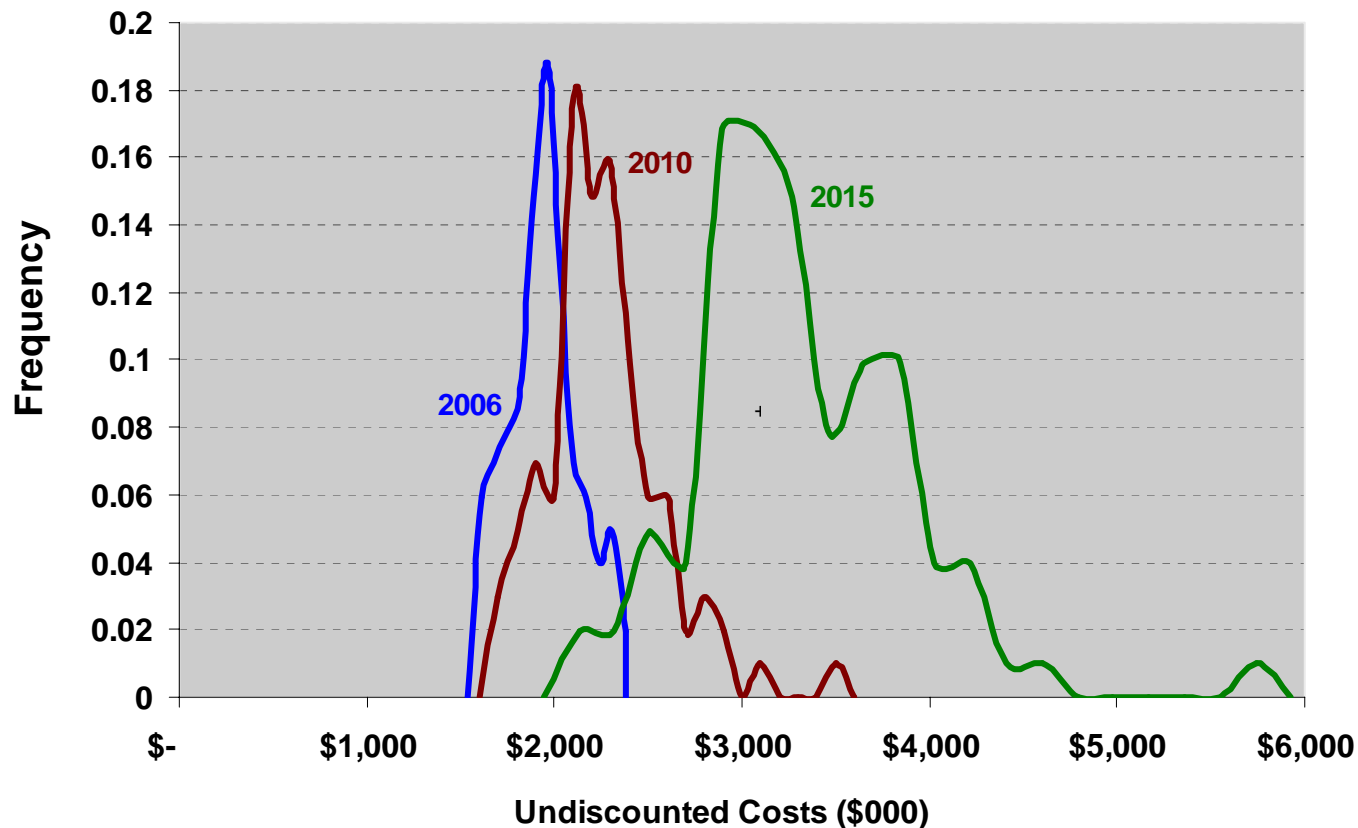
RIRP: Integrating Risk into the Methodology

- Start with Risk Profile
- Consider Multiple Objectives
- Develop distributions for load, coal, gas, power prices (can also do them for both capital and operating costs but not here), plus characterization of volatility and correlation between variables
- Screen same portfolio options
- Evaluate each portfolio across full spectrum of alternatives
- Present results considering both costs and variability of costs
- Test results against alternate regulatory scenarios
- Test portfolios assuming quantum events
- Select portfolio that meets all objectives over range of outcomes

Starting Point: The “No-Build” Risk Profile

- What can happen to costs over time if no capacity is added?

Distribution of No-Build Cost in Selected Years

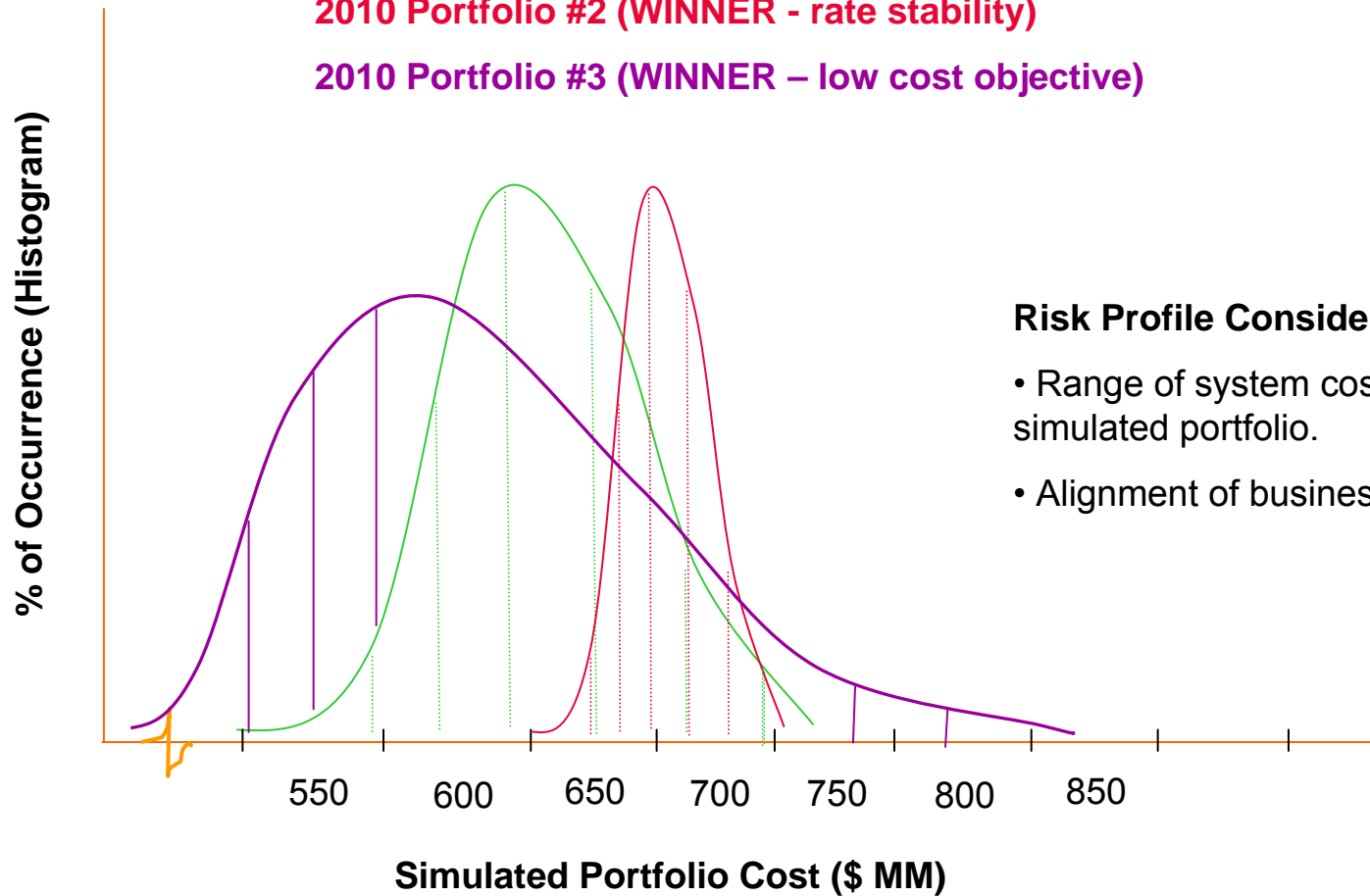


Simultaneously Evaluating Objectives

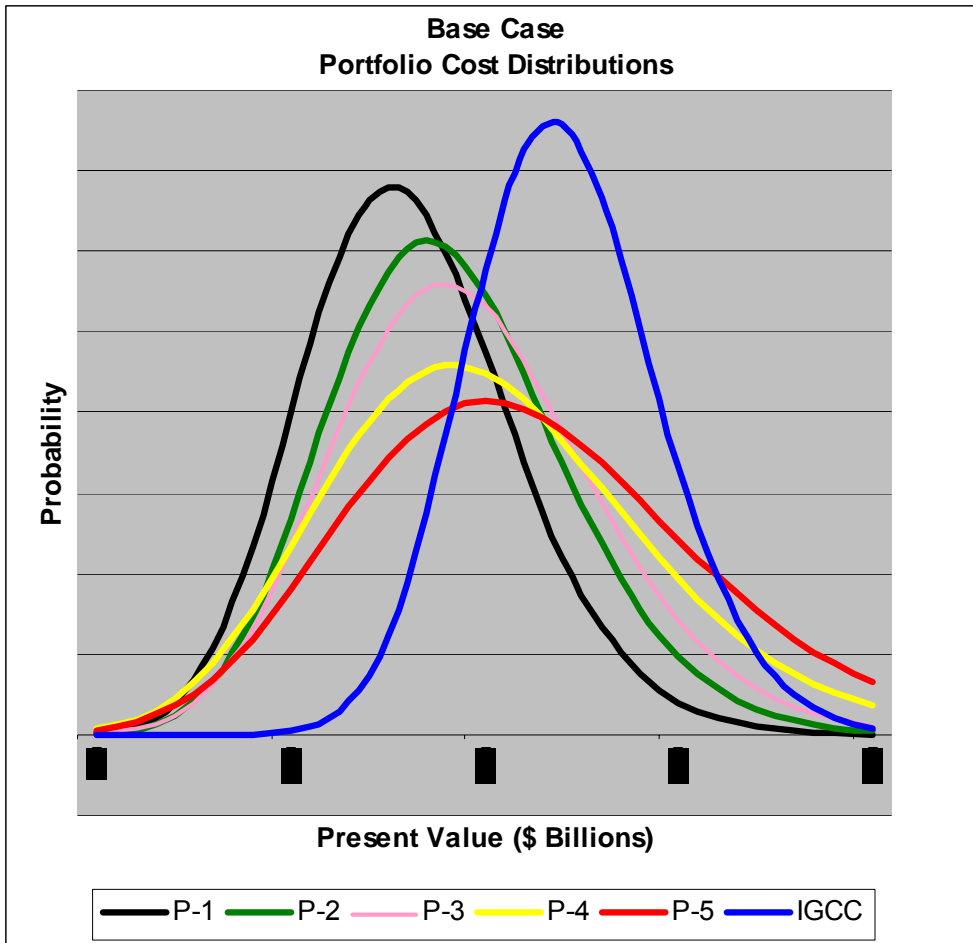
Example: **2010 Portfolio #1 (WINNER – balance of competing objectives)**

2010 Portfolio #2 (WINNER - rate stability)

2010 Portfolio #3 (WINNER – low cost objective)



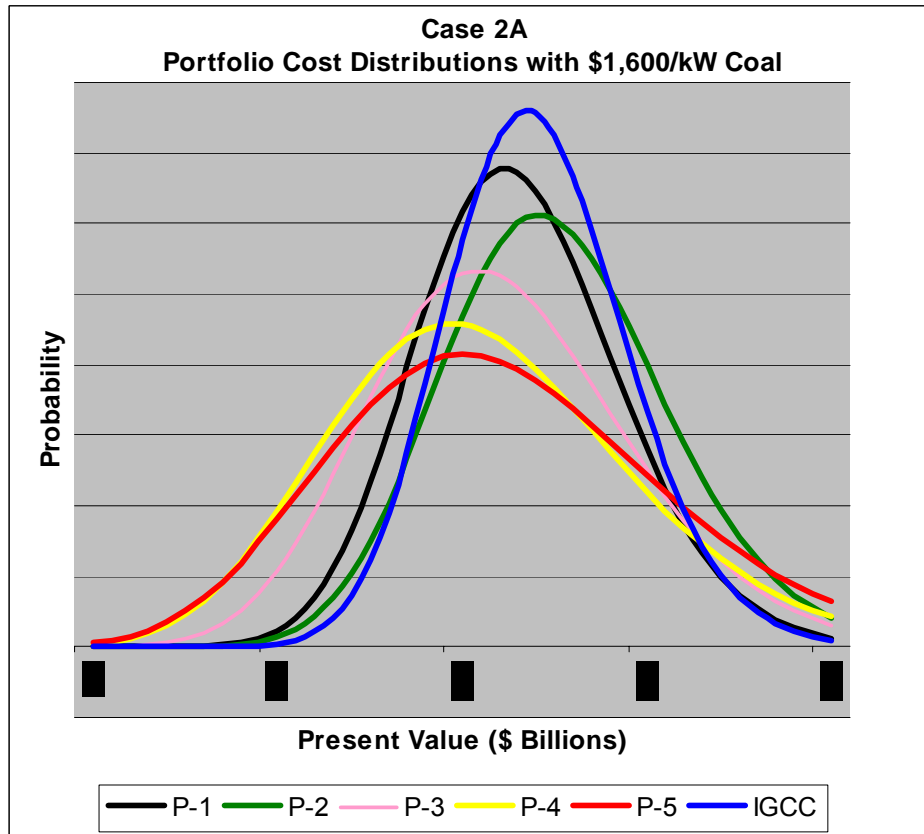
RIRP Results; Reference Case: 6 coal, 4 CCs and 3 CTs



- Portfolio 1 (6 coal, 4 CC & 3 CT) saves \$120 million compared to Portfolio 2 (previously “optimal” portfolio)

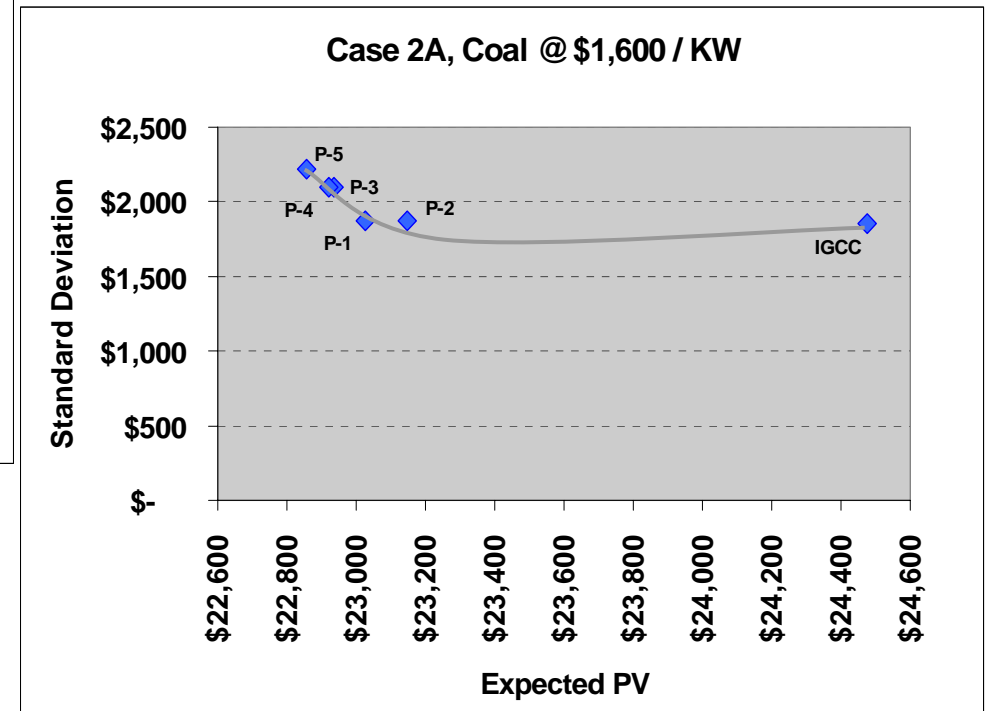
Portfolio	Expected	High	Low
P-1	22,591	26,710	19,221
P-2	22,711	26,828	19,343
P-3	22,702	27,309	18,933
P-4	22,698	27,314	18,921
P-5	22,741	27,618	18,751
IGCC	23,695	27,771	20,359

Case 2A: Consider Higher Capital Cost Recovery



- Portfolios with greater reliance on gas may have much lower cost
- Selection depends on best fit to all objectives

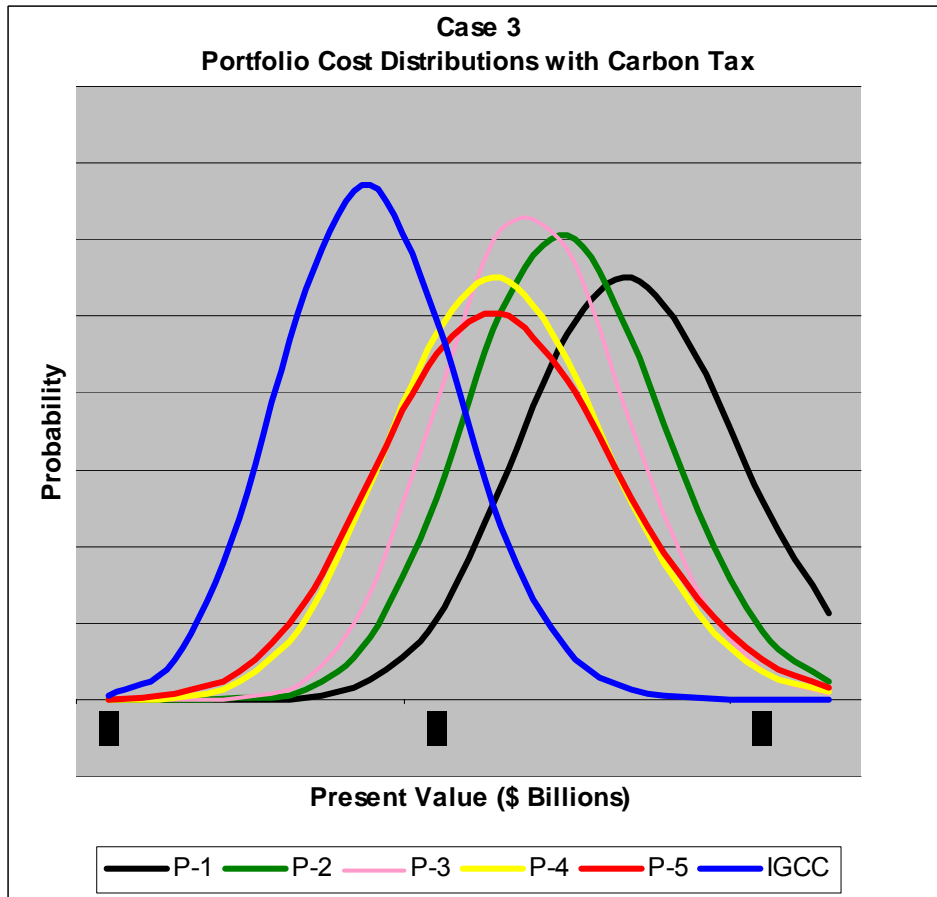
What Happens if Coal Plants cost \$1600/KW to build?



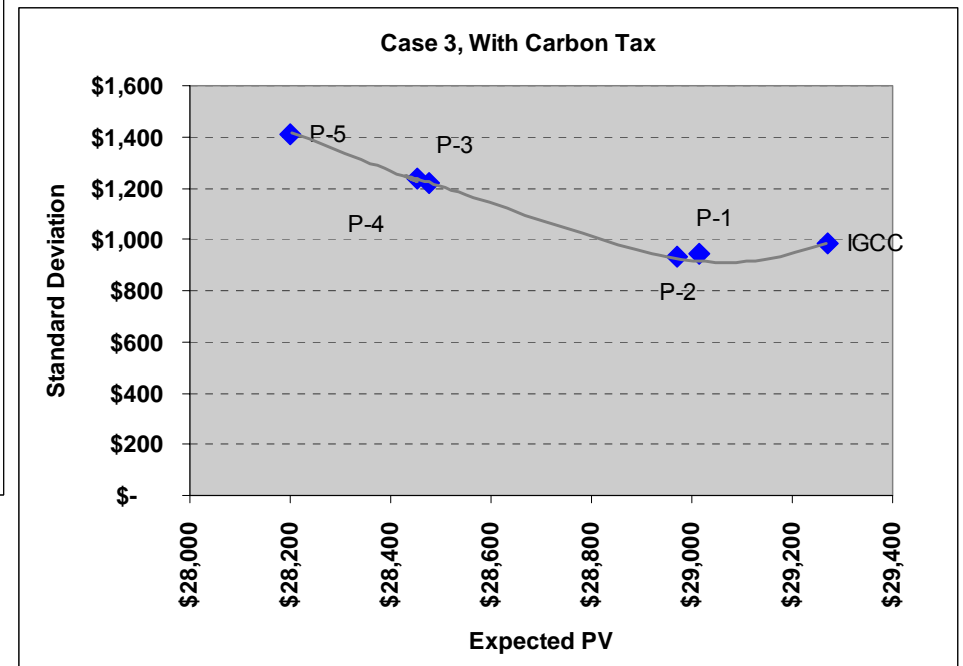
Case 4: Carbon Tax Possibility

- Consider the possibility of a Carbon Tax by 2010.
 - Cost of compliance: \$25 per ton (High end of estimates)
- This sensitivity will change the shape of the Portfolio curve and possibly the selection of the “best portfolio.”
 - We plotted the Base case Curve (without a Carbon Tax) against the Curve with a Carbon Tax.
 - Consider: If you didn’t consider the Carbon Tax Case, you have underestimated the risks to your portfolio.

Case 3: Carbon Tax Results



- Portfolio with IGCC and sequestration appears preferable to all other portfolios



Conclusions

- Market volatility is not symmetrical—measuring volatility is important
- Regulatory recovery is not ensured—consider both earnings & costs
- Rate stability may help retain load—consider multiple objectives
- Portfolios have both risks & rewards—don't use a single NPV
- Markets & regulations are complex & interrelated—don't oversimplify
- Merchants went under in the first two years after commercial dates. Don't evaluate on the basis of only a 25 year investment.
- Technology & market options are expanding—consider them
- Evaluate hedging as part of the strategy—it changes the risk picture
- Evaluate your REC, environmental, transmission and generation options simultaneously—they shouldn't be separated
- Use a Risk Integrated approach to resource planning:
 - Your Board will understand it
 - Your rating agencies, regulators & customers will value it