

Integrated Resource Plan

TVA'S ENVIRONMENTAL AND ENERGY FUTURE

Stakeholder Review Group
Working Session

June 29, 2010
Murfreesboro, TN 2010



9:00-9:15	Introduction	Randy McAdams
9:15-10:00	Overview and Evaluation of TVA's Fossil Fleet	Janet Watts
10:00-11:00	Review of IRP Scorecard and Evaluation Metrics	Gary Brinkworth
11:00-11:45	Lunch	
11:45-12:45	Open Discussion	
12:45-1:00	Break	
1:00-2:00	Modeling Results Framework	Gary Brinkworth
2:00-2:45	Open Discussion	
2:45-3:00	Wrap-Up	Randy McAdams

SRG Purpose

- ◆ Provide TVA with in-depth ongoing discussion and input from different stakeholder viewpoints
- ◆ Serve as a source of information, a coordination mechanism, and a professional review group
- ◆ Build efficiency into the study process by providing real-time public input to IRP issues and processes
- ◆ Validate the various steps in the IRP process

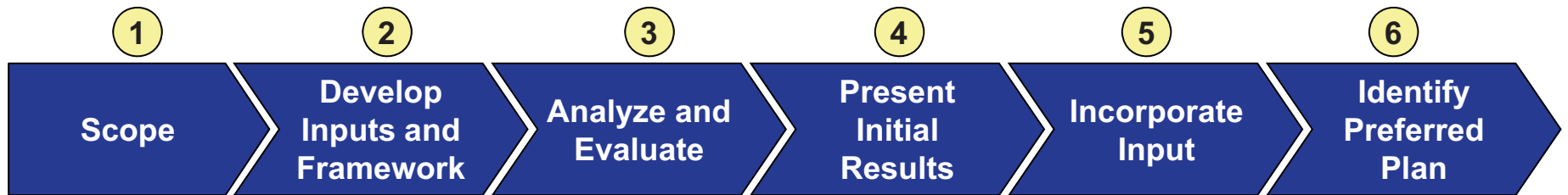
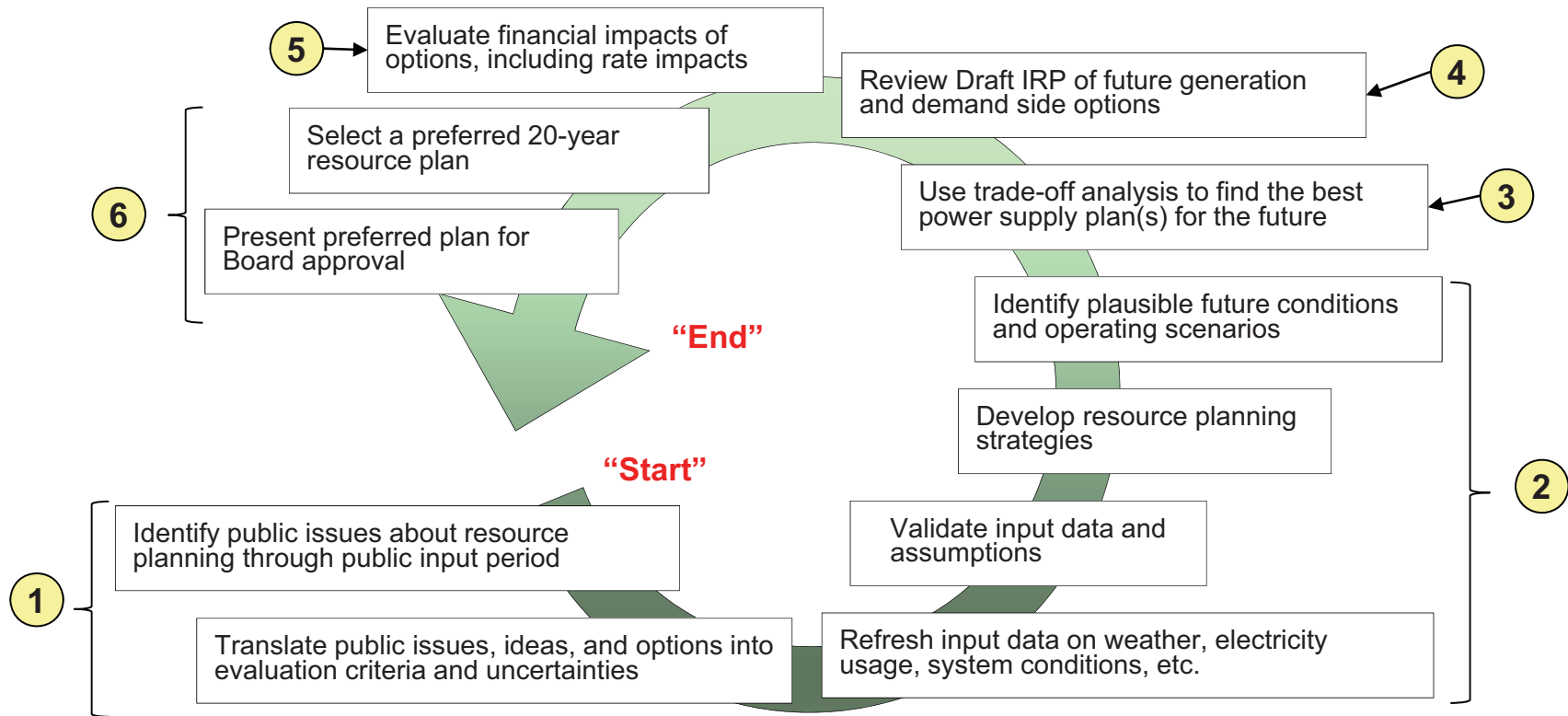
SRG Meeting Types

- ◆ *Working Sessions* – regular meetings that are not open to the general public
- ◆ *Workshops* – the SRG, by majority vote, can request TVA hold additional “workshops” to provide more in-depth information on specific topics to those members who are interested in attending
- ◆ *Public Comment Sessions* – by majority vote, the SRG may host a public comment session to receive input on specific topics



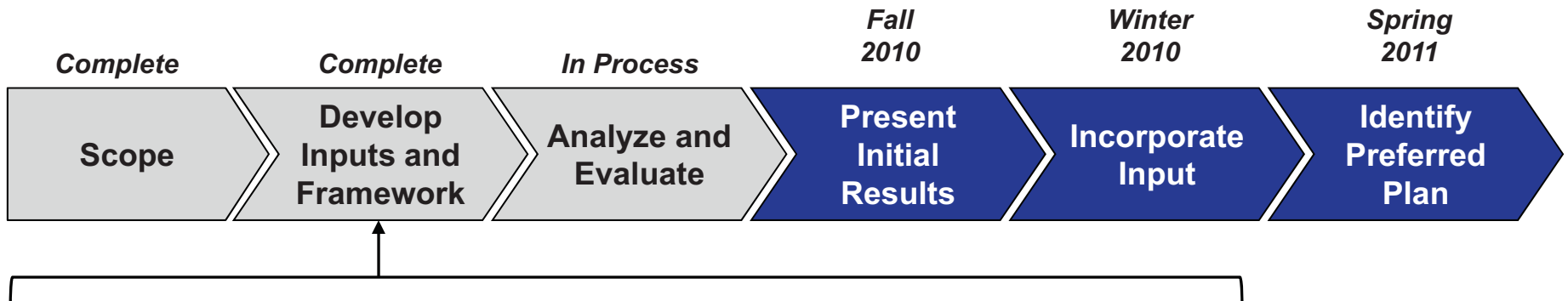
Introduction IRP Process Review

The IRP process that has been previously shared can be summarized into six high-level steps





The SRG has reviewed and provided input on the following topics:



- ◆ Planning process
- ◆ Key uncertainties
- ◆ Updated scenario/worlds
- ◆ Demand-side resource options
- ◆ Supply-side resource options
- ◆ Busbar screening results for supply-side resource options
- ◆ Load forecast
- ◆ Environmental outlook
- ◆ Commodity price forecasts
- ◆ Financial parameters
- ◆ Energy efficiency and demand response
- ◆ Planning strategies

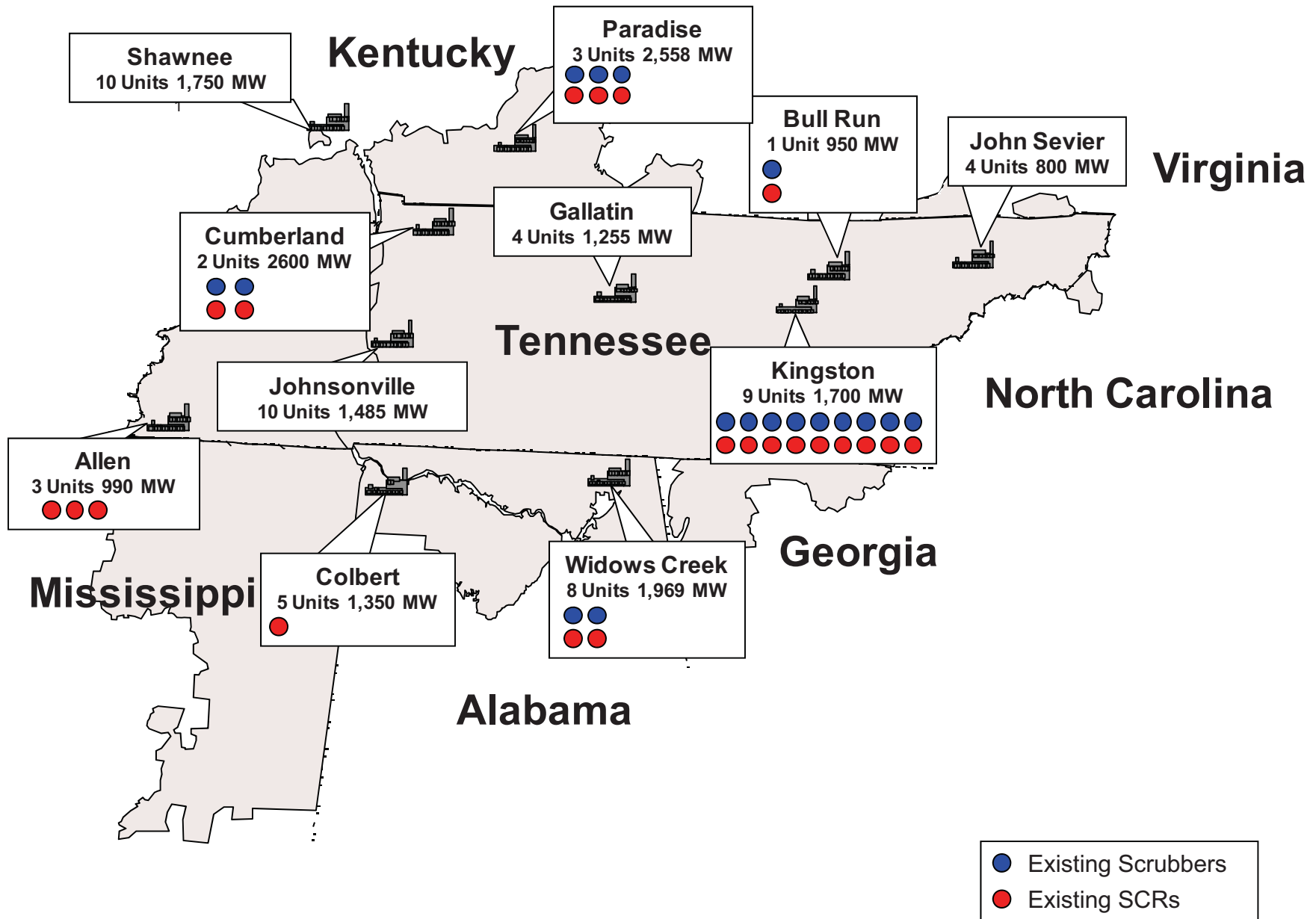
Today's discussion will cover

- Review of IRP scorecard and evaluation metrics
- Modeling results framework

Complete or In Process
 Not Started



Overview and Evaluation of the Fossil Fleet Background



1 – All capacity values are nameplate capacity



Overview and Evaluation of the Fossil Fleet

Coal Unit Relative Merit Assessment and Ranking

- ◆ Strategic business decisions relating to the coal fleet require a methodology for comparison of the merits of the units in the fleet (coal unit relative merit)
- ◆ The evaluation compares nine key elements that capture different aspects of the value of each unit:

Factor	Measure
Operating cost	\$/MWh
Equivalent Forced Outage Rate (EFOR)	%
Transmission impact	\$/kW
Remaining clean air capital	\$/kW
Fixed O&M and yearly plant capital	\$/kW-year
Future ash handling costs	\$/kW
Fuel flexibility	1 to 5 scale
Required capital improvements	\$/kW
CO ₂ intensity	Tons/MWh

- ◆ Comparison of these key elements for each coal unit provides a means for determination of their relative merit
 - Determination of relative merit facilitates allocation of resources and planning for future operation
 - Provides insight regarding future fossil asset strategies



Overview and Evaluation of the Fossil Fleet Ranking Process

- ◆ The financial impact on TVA for each of the nine factors was determined for each unit
- ◆ For each factor, the best performing unit was given a score of “10” and the poorest performing unit a score of “1.0”
 - Other units were given scores based on their relative position between the best and poorest units
- ◆ Each factor was assigned a weighting based on the magnitude of the range of financial impacts between the units
 - Factors with the largest range of impact were assigned a weight of “10” with the weight of the other factors scaled proportionally
- ◆ Each unit’s raw score was determined by adding the product of its score for each factor and the factor weight
- ◆ The unit with the highest raw score was assigned a rank of “10” and the unit with the lowest raw score was assigned a rank of “1”
 - Other units were assigned ranks based on their relative position between the highest and lowest ranked units



Overview and Evaluation of the Fossil Fleet Ranking Process Results

The coal fleet can be divided into three groups based on relative merit ranking process results

Group MW ¹	Unit Group	Score Range	Characteristics
9,100	Highest ranking	7.6 – 10	<ul style="list-style-type: none">— Low operating cost— Fuel flexible— Usually low EFOR, has lower required capital investment— Low remaining clean air capital
3,500	Medium ranking	4.4 – 6.7	<ul style="list-style-type: none">— Higher clean air capital— Reduced fuel flexibility— Medium operating costs
2,000	Lowest ranking	1.0 – 3.0	<ul style="list-style-type: none">— High operating cost— High remaining clean air capital



Overview and Evaluation of the Fossil Fleet

Other Considerations

- ◆ There are other qualitative considerations outside of the quantitative ranking process that will factor into a final decision

- ◆ These considerations may influence a decision to retire more or fewer MWs than the ranking process alone suggests

- ◆ Other considerations include (but are not limited to)
 - Power system reliability
 - Overall portfolio design and diversity
 - Political (local) considerations
 - Employment and local economic impacts
 - Age of assets

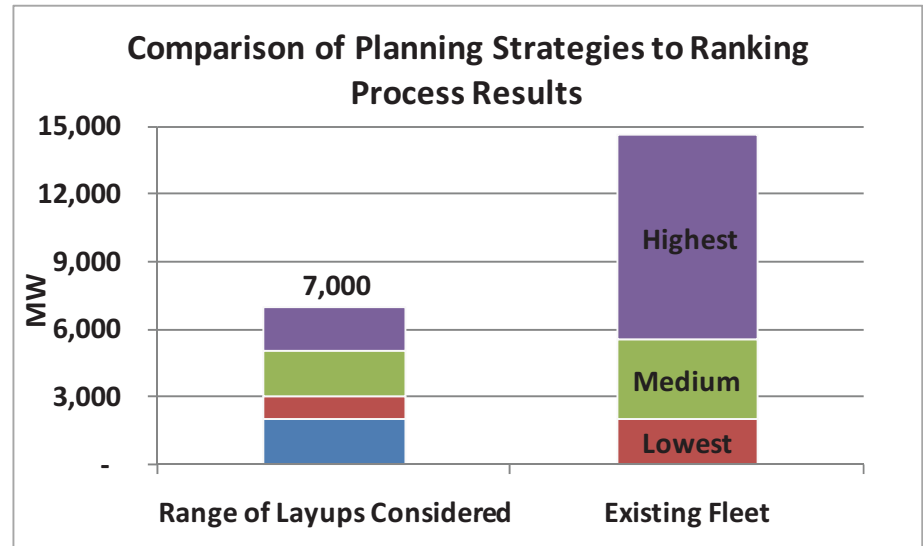


Overview and Evaluation of the Fossil Fleet Contribution to IRP Process

- ◆ The coal unit relative merit analysis shows there are obvious groups of coal units with varying degrees of merit
- ◆ Fossil asset layup strategy is one of nine attributes used to describe the IRP Planning Strategies (as shown to the upper right)
- ◆ The results of the coal unit relative merit assessment and ranking process were used to develop the fossil fleet reductions considered in the planning strategies
- ◆ A comparison of the existing fleet rankings and the range of layups considered is shown to the lower-right
 - A reduction of 2,000 MW corresponds with the lowest ranking units
 - The maximum reduction considered (7,000 MW) represents about one-half of the total fleet capacity and would include some units with the highest relative merit

Attributes	A – Limited Change in Current Resource Portfolio	B – Baseline Plan Resource Portfolio	C – Diversity Focused Resource Portfolio	D – Nuclear Focused Resource Portfolio	E – EE/DR and Renewables Focused Resource Portfolio
EE/DR	– 1,940 MW & 4,725 annual GWh reductions by 2020	– 2,100 MW & 5,900 annual GWh reductions by 2020	– 3,600 MW & 11,400 annual GWh reductions by 2020	– 4,000 MW & 8,900 annual GWh reductions by 2020	– 5,900 MW & 14,400 annual GWh reductions by 2020
Renewable Additions	– 1,300 MW & 4,600 GWh competitive renewable resources or PPAs by 2020	– Same as Planning Strategy A	– 2,500 MW & 8,600 GWh competitive renewable resources or PPAs by 2020	– Same as Planning Strategy C	– 3,500 MW & 12,000 GWh competitive renewable resources or PPAs by 2020
Fossil Asset Layup	– No fossil fleet reductions	– 2,000 MW total fleet reductions by 2017	– 3,000 MW total fleet reductions by 2017	– 7,000 MW total fleet reductions 2017	– 5,000 MW total fleet reductions by 2017
Energy Storage	– No new additions	– Same as Planning Strategy A	– Add one pumped storage unit	– Same as Planning Strategy C	– Same as Planning Strategy A
Nuclear	– No new additions after WBN2	– First unit online no earlier than 2018 – Units at least 4 years apart	– Same as Planning Strategy B	– First unit online no earlier than 2018 – Units at least 2 years apart	– First unit online no earlier than 2022 – Units at least 2 years apart – Additions limited to 3 units
Coal	– No new additions	– New coal units are outfitted with CCS – First unit online no earlier than 2025	– Same as Planning Strategy B	– Same as Planning Strategy B	– No new additions
Gas-Fired Supply (Self-Build)	– No new additions	– Meet remaining supply needs with gas-fired units	– Same as Planning Strategy B	– Same as Planning Strategy B	– Same as Planning Strategy B
Market Purchases	– No limit on market purchases beyond current contracts and contract extensions	– Purchases beyond current contracts and contract extensions limited to 900 MW	– Same as Planning Strategy B	– Same as Planning Strategy B	– Same as Planning Strategy B
Transmission	– Potentially higher level of transmission investment to support market purchases – Transmission expansion (if needed) may have impact on resource timing and availability	– Complete upgrades to support new supply resources	– Increase transmission investment to support new supply resources and ensure system reliability – Pursue inter-regional projects to transmit renewable energy	– Same as Planning Strategy C	– Potentially higher level of transmission investment to support renewable purchases – Transmission expansion (if needed) may have impact on resource timing and availability

Defined model inputs
 Constraints in model optimization





Review of IRP Scorecard and Evaluation Metrics Background

Planning strategies (and scenarios) set the boundaries for analysis

Planning strategies evaluate attributes such as:

- EE/DR portfolio
- Renewable additions
- Fossil asset strategy
- Energy storage
- Gas-fired supply (self-build)
- Nuclear expansion
- Coal technology
- Market
- Transmission

Each cell contains a 20-year resource plan (portfolio)

		Scenarios						
		Spring 2010 Baseline	#1	#2	#3	#4	#5	#6
Planning Strategies	Planning Strategy A							
	Planning Strategy B							
	Planning Strategy C							
	Planning Strategy D							
	Planning Strategy E							

Scenarios are composed of uncertainties including:

- Greenhouse gas requirements
- Total load and change in load shape
- Commodity prices
- Renewable energy standards
- Financing and construction costs



Review of IRP Scorecard and Evaluation Metrics Background (Cont'd)

		Planning Strategies				
Planning Strategy Attributes	Attributes	Planning Strategy A	Planning Strategy B	Planning Strategy C	Planning Strategy D	Planning Strategy E
	EE/DR Portfolio					
	Renewable Additions					
	Fossil Asset Strategy					
	Energy Storage					
	Nuclear Expansion					
	Coal Technology					
	Gas-Fired Supply (Self-Build)					
	Market					
	Transmission					

Attribute values vary from strategy to strategy

Attribute values are either an input or constraint to the model

Key points

- ◆ IRP planning strategies are used to identify, through modeling, impacts on different evaluation criteria
- ◆ Planning strategies are being used for evaluation purposes only and do not reflect decisions by TVA Management or the TVA Board
- ◆ These planning strategies do not imply that they are the only resource portfolio options considered by TVA



Review of IRP Scorecard and Evaluation Metrics

IRP Scorecard

- ◆ A scorecard will be applied to evaluate the results of resource plan modeling
- ◆ The viability of different *planning strategies* (not a single portfolio) will be compared across many plausible futures (i.e. scenarios)
- ◆ The portfolio scorecard is intended to:
 - Summarize complex analysis into a clear and easy-to-understand picture
 - Solicit input from internal and external stakeholders on prioritizing key metrics
 - Demonstrate the changes in results based on different scorecard priority
 - Facilitate a discussion of trade-offs between key metrics
- ◆ The portfolio scorecard will not produce the “answer” but will illustrate the relative positive attributes of various planning strategies across many plausible futures

Scenario planning, and the modeling that supports it, will inform a strategic decision by TVA leadership



Review of IRP Scorecard and Evaluation Metrics

IRP Scorecard (Cont'd)

Ranking Metrics				Strategic Indicators				
Energy Supply				Environmental Stewardship		Economic Development		Technology Innovation
Portfolios	Cost	Risk	Ranking Metric Score	Carbon Footprint	Composite Impact	Total Employment	Growth in Sustainable Business	Technology Indicator
			Total					

Overview

- ◆ The IRP scorecard was developed to reflect components of TVA’s mission that influence the long-range power supply plan: energy supply, environmental stewardship, economic development, and technology innovation
 - Input from the May 13th Working Session was considered and influenced development of many scorecard components

- ◆ The portfolios shown on the far left column are created by applying a planning strategy in a scenario
 - One scorecard will be developed for each planning strategy (5 total)
 - Ranking metrics are financial measures of cost and risk that are used to rank planning strategies
 - Strategic indicators are paired with ranking metrics to complete the IRP scorecard for selection of preferred portfolios

The IRP Scorecard will be applied to inform selection of a preferred 20-year resource plan

Step 1

- ◆ Planning strategies are ranked by summing financial scores for a planning strategy in all scenarios
 - Sensitivity analysis is conducted to refine preliminary results and/or capture other portfolio options
 - A preferred planning strategy is selected using ranking and judgment

Energy Supply			
Portfolios	Cost	Risk	Ranking Metric Score
Portfolio #1	124	92	113
Portfolio #2	127	96	116
Portfolio #3	99	67	88
Portfolio #4	122	231	160
Portfolio #5	167	89	140
Portfolio #6	143	45	109
Portfolio #7	201	119	172
Total Ranking Metric Score			898

Rank	Planning Strategies	Total Ranking Metrics Scores
1	Planning Strategy B	Highest
2	Planning Strategy C	↓
3	Planning Strategy A	
4	Planning Strategy D	
5	Planning Strategy E	Lowest

Step 2

- ◆ Selected resource portfolios in the preferred planning strategy are included in the draft IRP and discussed in the associated Environmental Impact Statement (EIS)
 - Additional portfolios may be included to maintain breadth of evaluation
 - Strategic indicators will be constructed for selected portfolios and paired with ranking metrics

Scorecard for Selected Portfolios

Ranking Metrics			
Energy Supply			
Selected Portfolios	Cost	Risk	Ranking Metric Score
Portfolio #1			
Portfolio #2			
Portfolio #3			
Portfolio #4			
Portfolio #5			
Portfolio #6			
Portfolio #7			

Strategic Indicators				
Environmental Stewardship		Economic Development		Technology Innovation
Carbon Footprint	Composite Impact	Total Employment	Growth in Sustainable Business	Technology Indicator

Step 3

- ◆ Resource portfolios are refreshed and re-scored (as necessary) following the public comment period
- ◆ A short list of resource portfolios are presented to the Board for consideration with ranking metrics and strategic indicators
- ◆ The Board adopts a preferred resource portfolio by either selecting one of the portfolios on the short list or blending options into a final integrated resource plan

Scorecard for Final Portfolios

Ranking Metrics			
Energy Supply			
Final Portfolios	Cost	Risk	Ranking Metric Score
Portfolio A			
Portfolio B			
Portfolio C			

Strategic Indicators				
Environmental Stewardship		Economic Development		Technology Innovation
Carbon Footprint	Composite Impact	Total Employment	Growth in Sustainable Business	Technology Indicator

Review of IRP Scorecard and Evaluation Metrics

IRP Scorecard – Ranking Metrics (Cont'd)

- ◆ Actual values of ranking metrics (e.g., PVRR, short-term rate impacts) will be converted to a Kepner-Tregoe (K-T) style score on a 100 point scale
 - The highest ranking (“best”) value will receive 100
 - The rest of the scores will be based on their relative position to the “best” value (i.e., a value that is 75% of the “best” would receive a 75)

- ◆ All ranking metrics indicators will be shown as a qualitative (color-coded) score to demonstrate relative difference across portfolios
 - There will be a scorecard for each planning strategy (5 total)
 - An example is shown to the right

- ◆ The shading indicates relative performance of planning strategies within each scenario
 - Dark green indicates the highest K-T score (“best”) within a scenario
 - Red indicates the lowest K-T score (“worst”)
 - Colors range from dark green to red based on relative position in the range

Ranking Metrics			
Energy Supply			
Portfolios	Cost	Risk	Ranking Metric Score
Portfolio #1	Yellow	Green	Yellow
Portfolio #2	Green	Red	Light Green
Portfolio #3	Green	Yellow	Green
Portfolio #4	Yellow	Yellow	Yellow
Portfolio #5	Red	Orange	Red
Portfolio #6	Yellow	Yellow	Yellow
Portfolio #7	Light Green	Orange	Yellow
Total Score			Yellow

Legend	
	Highest K-T Score
	75th Percentile
	50th Percentile
	25th Percentile
	Lowest K-T Score



Review of IRP Scorecard and Evaluation Metrics

Completed IRP Scorecard

Ranking Metrics			
Energy Supply			
Selected Portfolios	Cost	Risk	Ranking Metric Score
Portfolio #1	Yellow	Green	Yellow
Portfolio #2	Green	Red	Light Green
Portfolio #3	Green	Light Green	Green
Portfolio #4	Yellow	Light Green	Yellow
Portfolio #5	Red	Orange	Red
Portfolio #6	Yellow	Yellow	Yellow
Portfolio #7	Light Green	Orange	Yellow

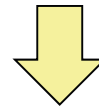
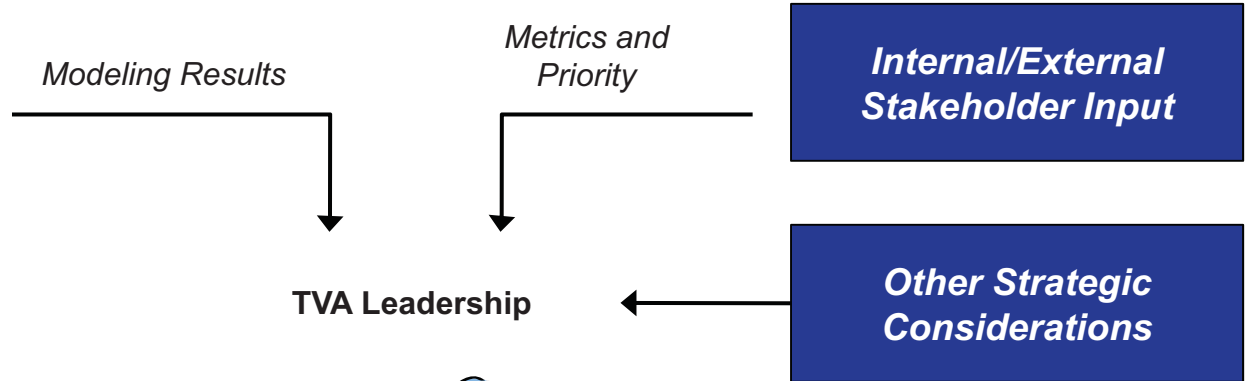
Strategic Indicators				
Environmental Stewardship		Economic Development		Technology Innovation
Carbon Footprint	Composite Impact	Total Employment	Growth in Sustainable Business	Technology Indicator
Yellow	Green	Red	Red	Light Green
Red	Red	Yellow	Orange	Yellow
Light Green	Light Green	Yellow	Yellow	Red
Light Green	Light Green	Green	Green	Yellow
Green	Orange	Orange	Green	Green
Orange	Yellow	Light Green	Light Green	Yellow
Light Green	Orange	Light Green	Yellow	Orange

Legend	
Green	Highest K-T Score
Light Green	75th Percentile
Yellow	50th Percentile
Orange	25th Percentile
Red	Lowest K-T Score

- ◆ Strategic indicators will be constructed for selected portfolios and paired with ranking metrics to complete the IRP scorecard
- ◆ Strategic indicators will be shown as a qualitative (color-coded) score to demonstrate relative difference across portfolios
 - Methodology for assigning color-coded score will be the same used for the ranking metrics
- ◆ The selection of a preferred portfolio will consider the complete IRP scorecard that includes ranking metrics and strategic indicators

The role of modeling in the decision process

	Scenarios						
	Spring 2010 Baseline	#1	#2	#3	#4	#5	#6
Planning Strategy A							
Planning Strategy B							
Planning Strategy C							
Planning Strategy D							
Planning Strategy E							



Integrated Resource Plan

Modeling serves as only one input for TVA leadership to consider when selecting the optimal resource portfolio



Review of IRP Scorecard and Evaluation Metrics Summary

Key Takeaways

- ◆ A scorecard will be applied to evaluate the results of resource plan modeling – one scorecard will be developed for each planning strategy (5 total)

- ◆ The IRP scorecard was developed to reflect the following components of TVA’s mission:
 - Low-cost reliable power
 - Environmental stewardship
 - Economic development
 - Technology innovation

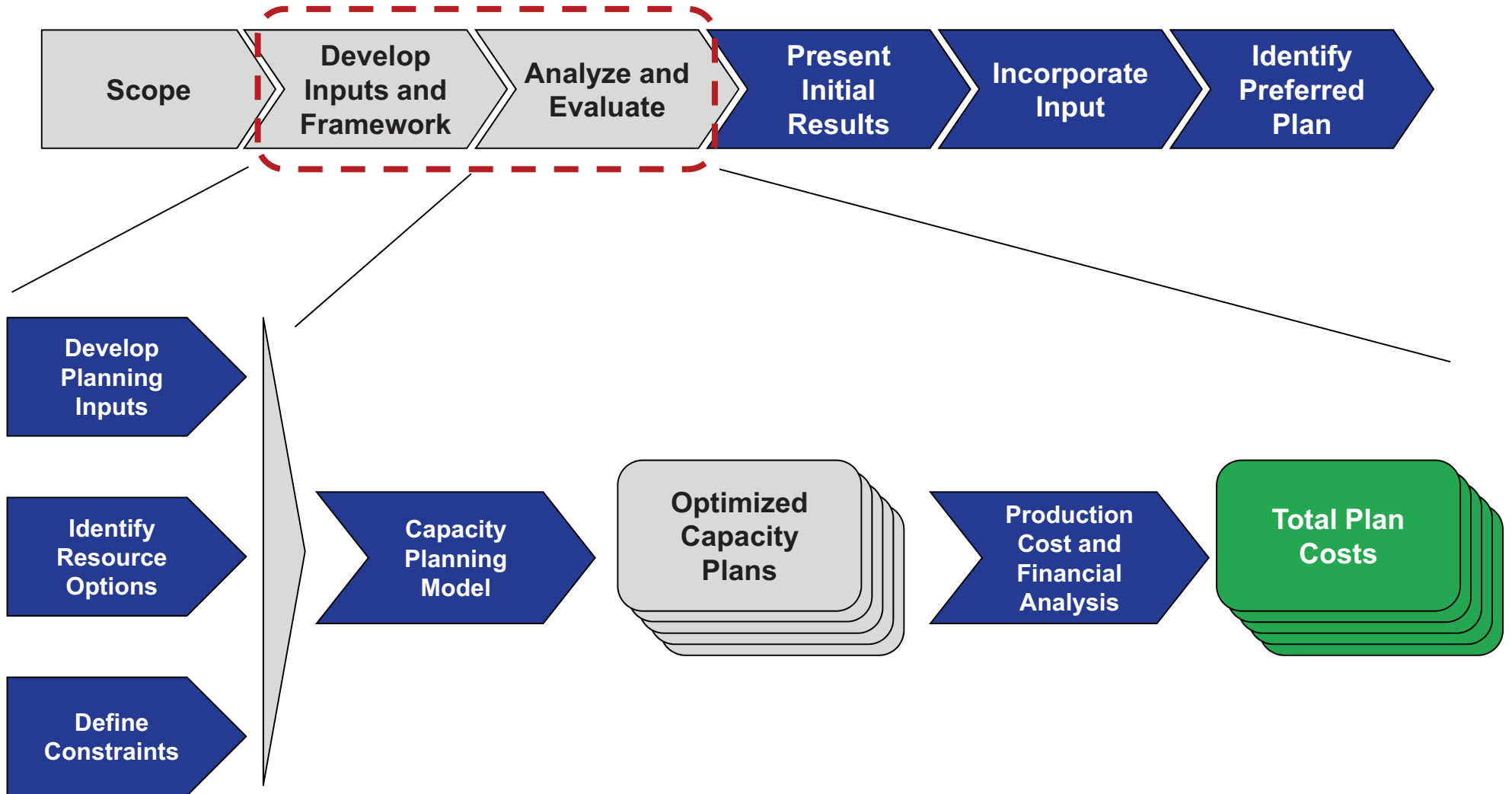
- ◆ Input from the May 13th Working Session was integral to developing the IRP scorecard

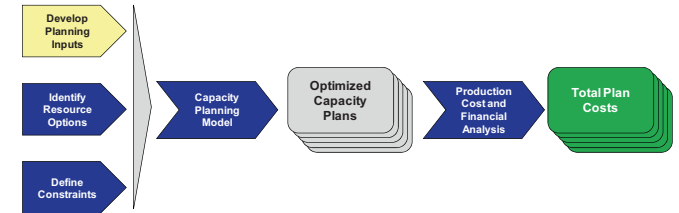
- ◆ The portfolio scorecard will not produce the “answer” but will illustrate the relative positive attributes of various planning strategies across many plausible futures

- ◆ Scenario planning, and the modeling that supports it, will inform a strategic decision by TVA leadership

Modeling Results Framework Overview of the Modeling Process

High-Level Schematic of the IRP Modeling Process





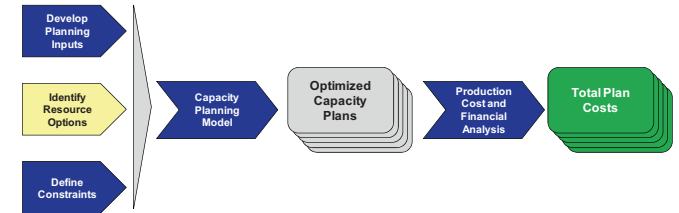
Develop Planning Inputs

- ◆ Total energy forecast
 - Projects the total energy required to meet customer demands by sector (residential, commercial and industrial, and directly served)
 - Includes transmission and distribution line losses

- ◆ Peak load forecast
 - Converts energy forecast to hourly load shapes for 8,760 hours of each year based on typical weather patterns and reflect typical hourly usage for TVA customers
 - Identifies the highest hourly load, which becomes the peak forecast for each year

- ◆ Commodity prices forecasts
 - Include forecasts for commodities such as natural gas, coal, electricity, and emissions offsets
 - Represent the expected market price for a given commodity
 - Do not represent expected cost to TVA

- ◆ Financial parameters
 - Forecasts inflation which is used to escalate constant-dollar values to nominal
 - Considers interest rates which are used as a guide in the TVA long-term financing rate from Treasury



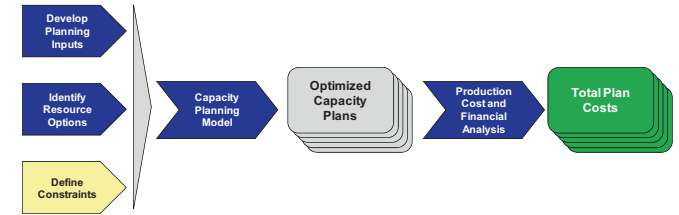
Identify Resource Options

- ◆ Supply-side options
 - Develop a list of candidate technology options
 - Apply multiple screening steps to identify likely (candidate) technologies including policy, feasibility, and economic criteria
 - Input operating characteristics and costs into capacity planning model

- ◆ Renewable supply-side options
 - Define as a composite hourly shape (capacity value) with annual costs for portfolios that include wind, solar, and biomass
 - Apply as a defined input that is given priority over selection of other supply-side options

- ◆ Demand-side
 - Define Energy Efficiency and Demand Response (EE/DR) portfolios as an hourly load shape with annual costs
 - Apply as a defined input that is given priority over selection of supply-side options

- ◆ Purchased Power Agreements (PPA)
 - Include conventional and renewable PPA characteristics
 - Consider capacity schedule (MW), price (by season/year), and duration of the transactions
 - Include costs for transmission expansion and/or interface capability increases (if required) in total cost of the transaction
 - Apply as an alternative to supply-side resource additions



Define Constraints

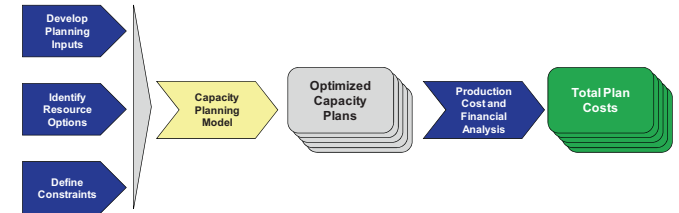
- ◆ Operational constraints
 - Constructability – limits first year resource is available to reflect timeline to bring a unit online and/or set minimum time between units
 - Deliverability – timeline required to ensure transmission system can support unit (or purchase)
 - Fuel supply – any limitations in fuel delivery routes or infrastructure
 - Capability changes – incremental adjustments to existing generating fleet and/or planned layouts

- ◆ The reserve margin for long-range planning has changed from 18% to 15%
 - Change is based on recent studies that identify the risk-adjusted reserve margin that balances the cost of reliability (outages) versus the cost of additional capacity

- ◆ Constraints are also reflected in the planning strategies

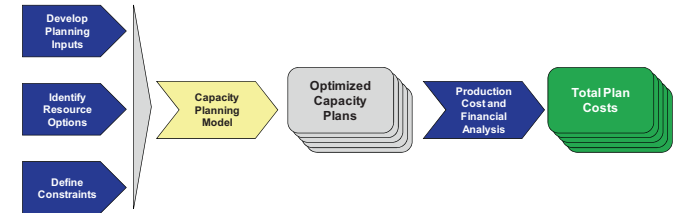
Capacity Planning Model

- ◆ The capacity planning model finds the “optimum” combination of resources to meet projected demand/energy requirements over the study period subject to constraints
- ◆ The model optimizes resource mix based on a single objective function – minimize the net Present Value of Revenue Requirements (PVRR) subject to the following constraints:
 - Energy balance
 - Reserve margin
 - Reliability
 - Generation and transmission
 - Fuel purchase
- ◆ The model generates multiple combinations of resource additions for each year of the study period and computes costs for each combination
 - Capital costs for supply-side options are amortized for investment recovery
 - This method eliminates the “end effect bias” and avoids the need for residual value accounting or modeling extension periods to capture the full asset cost



Capacity Planning Model (Cont'd)

- ◆ PVRR includes system production costs. Capacity optimization tools use a simplified dispatch algorithm to compute production costs because of the number of possible states evaluated
 - The model uses a “representative hours” approach, in which average generation and load values in each representative period in a week are scaled up appropriately to span all hours of the week and days of the months
- ◆ Year to year changes in resource mix are then evaluated and infeasible “states” are eliminated
 - For example, if the total number of resources decreased from one year to the next, that state is deemed infeasible and eliminated from further consideration
- ◆ The least cost (i.e., lowest PVRR) path through the possible states in the study period is the optimized capacity plan



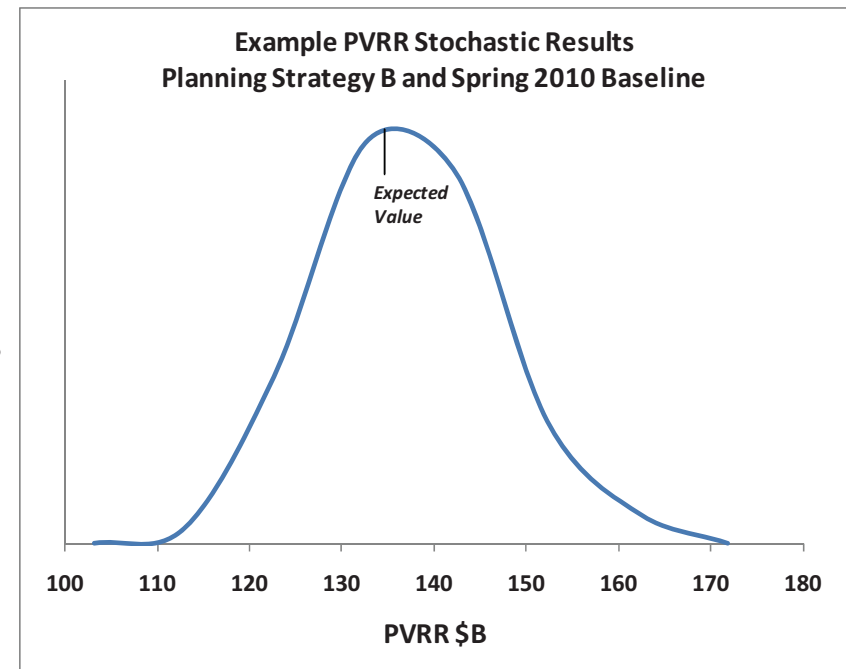
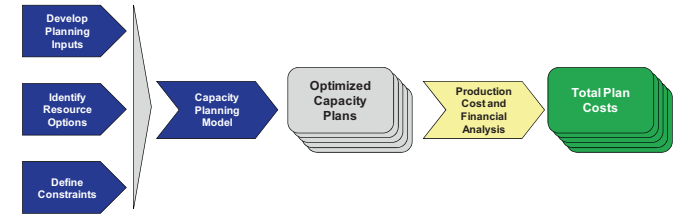
Production Cost and Financial Analysis

- ◆ Detailed analysis of operating costs and related characteristics is needed when selecting a preferred resource plan
 - An hourly production costing model is used to compute those costs for plan evaluation/comparison

- ◆ The optimized capacity plans selected by the capacity planning model are inputs to production cost and financial analysis
 - Consistent assumptions are used in the capacity planning and production cost models

- ◆ A stochastic model estimates probability distributions of potential outcomes by allowing for simultaneous random-walking variation in many inputs over time

- ◆ A representative monte-carlo distribution comprised of 72 stochastic iterations is developed for each of the 35 portfolios
 - An example stochastic result for planning strategy B is shown to the right
 - A total of 2,520 cases (35x72) are considered





- ◆ The scenario planning approach applied to the IRP, and the modeling that supports it, will generate a substantial amount of data and results
 - Total portfolios = 35 (7 scenarios x 5 planning strategies)
 - Total stochastic iterations = 2,520 (72 iterations x 35 portfolios)

- ◆ A selection of summary charts for capacity planning results have been developed that will:
 - Synthesize a sea of data into manageable components
 - Allow the relative performance of planning strategies to be compared across the scenarios considered
 - Identify trends in analysis results
 - Reflect common industry representations of IRP analysis results

- ◆ The summary charts selected (and described on the following slides) are:
 - Capacity gap
 - Expansion plans
 - Energy mix

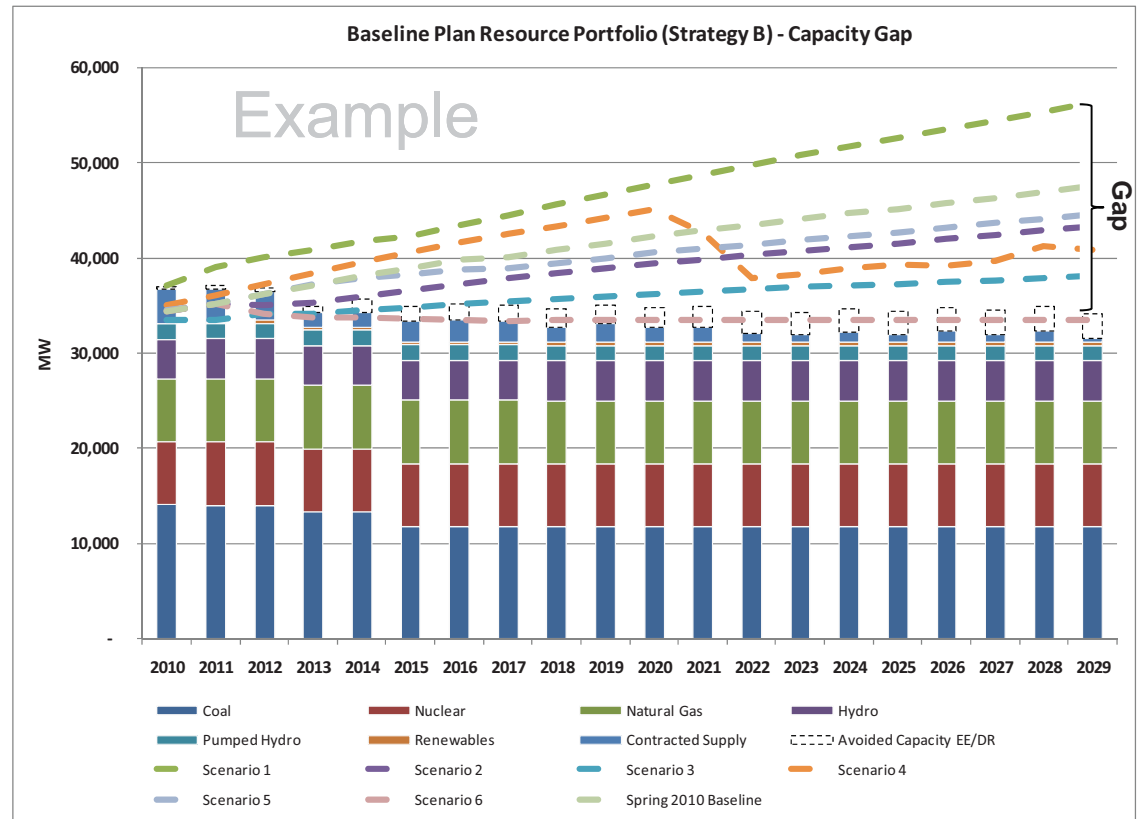


Modeling Results Framework Capacity Gap

- ◆ The capacity gap is the difference between
 - Existing firm capacity adjusted for defined planning strategy inputs
 - Firm requirements which is the load forecasts in each of the seven scenarios plus reserve margins

- ◆ A capacity gap chart will be provided for each of the five planning strategies
 - An example for planning strategy B is shown to the right

- ◆ Scenario and planning strategy combinations with small capacity gaps will have few resource additions and vice versa



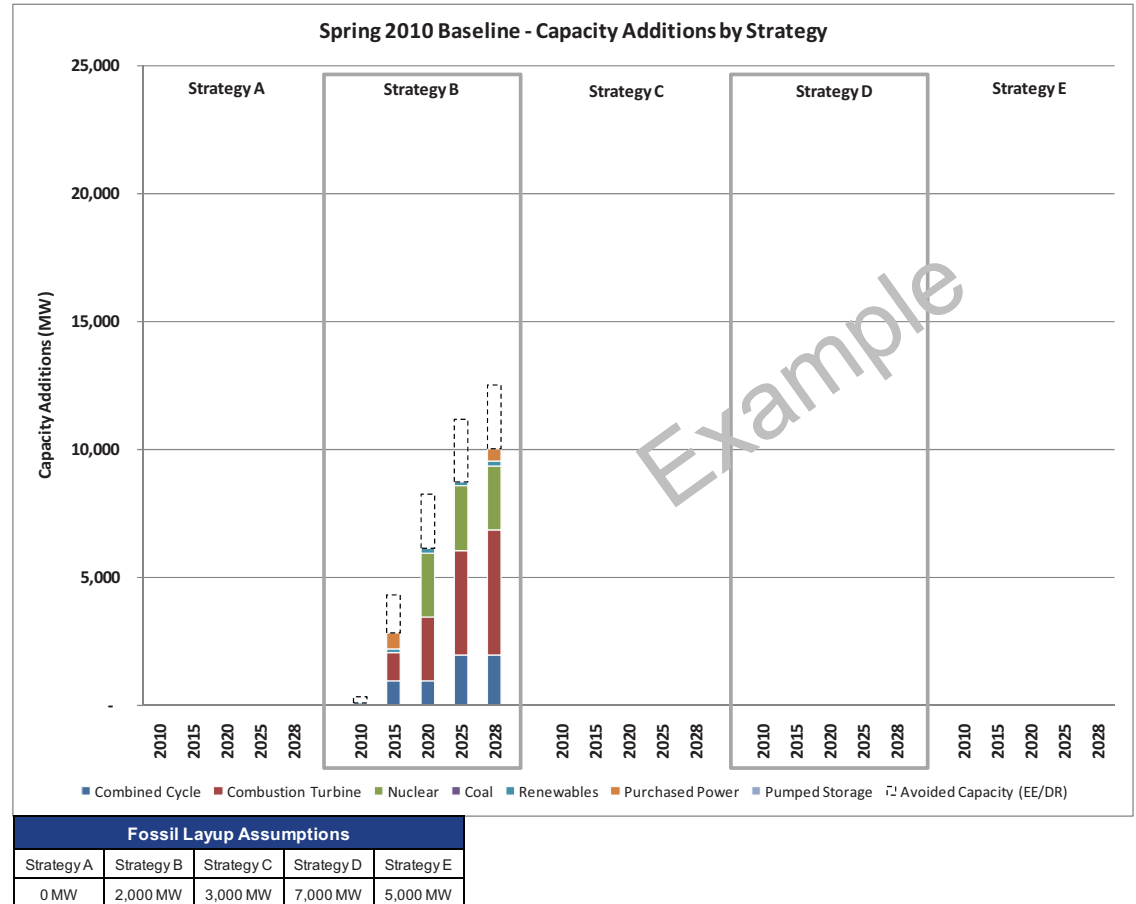


Modeling Results Framework Expansion Plans

- ◆ The capacity planning model will produce 35 portfolios to optimally close the capacity gaps
 - There is one portfolio per scenario and planning strategy combination

- ◆ Expansion plan charts will show total MW of capacity additions by fuel type in 5-year increments
 - There are a total of 35 expansion plans (one per portfolio)
 - The charts include defined model inputs for each of the planning strategies

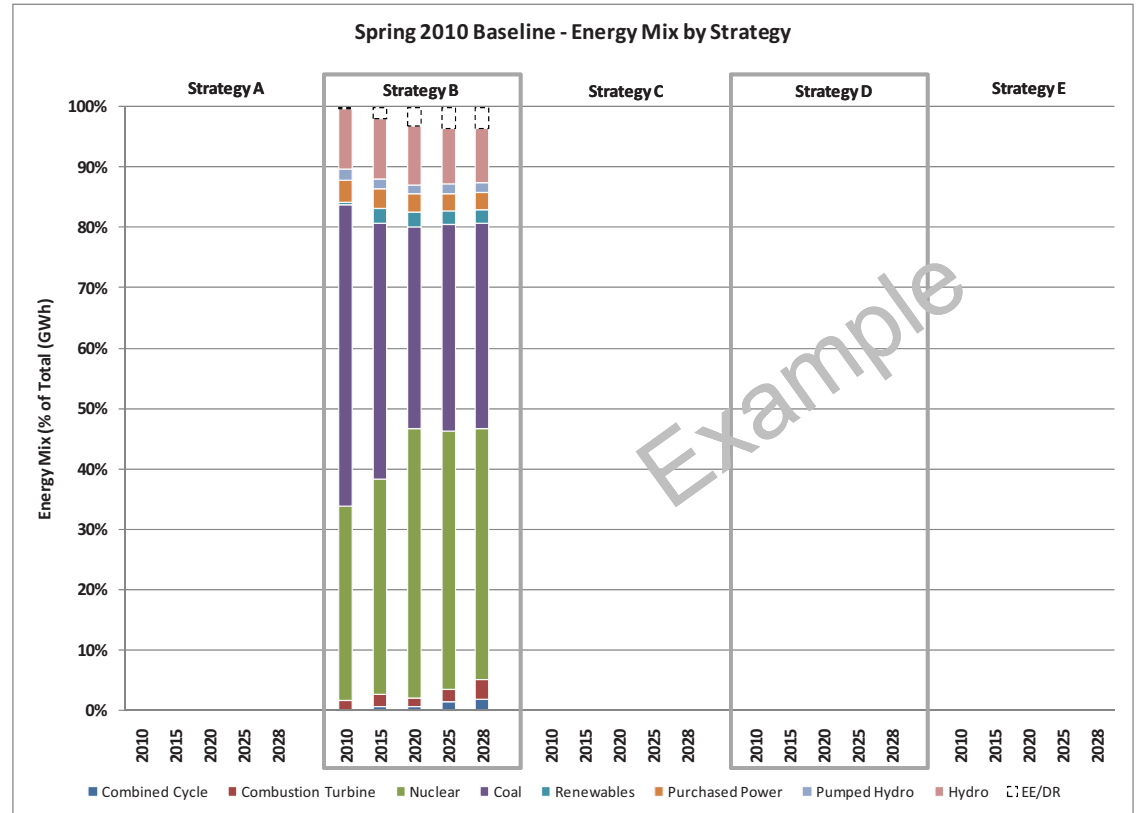
- ◆ A total of seven expansion plan charts will be provided
 - One chart per scenario to illustrate outcomes of the planning strategies
 - An example with planning strategy B is shown to the right





Modeling Results Framework Energy Mix

- ◆ Changes in resource mix will influence changes in total energy generated by fuel type
- ◆ Energy mix charts will show expected GWh of generation by fuel type in 5-year increments
- ◆ The purpose of these figures is to show the relative changes in energy mix over time across all 35 portfolios
- ◆ A total of seven energy mix charts will be provided
 - One chart per scenario to illustrate outcomes of the planning strategies
 - An example with planning strategy B is shown to the upper-right





Modeling Results Framework

Next Steps

- ◆ The next SRG working session is scheduled for July 20th and 21st in Chattanooga

- ◆ The purpose of the session is to present preliminary results for discussion and input from the SRG

- ◆ The following information will be presented:
 - Populated IRP scorecards
 - Capacity gap charts for all planning strategies
 - Expansion plan summary charts for all 35 portfolios
 - Energy mix summary charts for all 35 portfolios
 - Other supporting information and data (as needed)



Appendix Scenario Summaries

Scenario	Key Characteristics
◆ Economy Recovers Dramatically	<ul style="list-style-type: none"> — Economy recovers stronger than expected and creates high demand for electricity — Carbon legislation and renewable electricity standard are passed — Demand for commodity and construction resources increases — Electricity prices are moderated by increased gas supply
◆ Environmental Focus is a National Priority	<ul style="list-style-type: none"> — Mitigation of climate change effects becomes a national priority — The cost of CO₂ allowances, gas, and electricity increase significantly — Industry focus turns to nuclear, renewables, conservation, and gas to meet demand
◆ Prolonged Economic Malaise	<ul style="list-style-type: none"> — Prolonged, stagnant economy results in low to negative load growth and delayed expansion of new generation — Federal climate change legislation is delayed due to concerns of adding further pressure to the economy
◆ Game-Changing Technology	<ul style="list-style-type: none"> — Strong economy with high demand for electricity and commodities — High price levels and concerns about the environment incentivize conservation — Game-changing technology results in an abrupt decrease in load served after strong growth
◆ Energy Independence	<ul style="list-style-type: none"> — The U.S. focuses on reducing its dependence on non-North American fuel sources — Supply of natural gas is constrained and prices for gas and electricity rise — Energy efficiency and renewable energy move to the forefront as an objective of achieving energy independence
◆ Carbon Regulation Creates Economic Downturn	<ul style="list-style-type: none"> — Federal climate change legislation is passed and implemented quickly — High prices for gas and CO₂ allowances increase electricity prices significantly — U.S. based energy-intensive industry is non-competitive in global markets and leads to an economic downturn



Planning Strategies: Detailed Descriptions

Attributes	A – Limited Change in Current Resource Portfolio	B – Baseline Plan Resource Portfolio	C – Diversity Focused Resource Portfolio	D – Nuclear Focused Resource Portfolio	E – EE/DR and Renewables Focused Resource Portfolio
EE/DR	– 1,940 MW & 4,725 annual GWh reductions by 2020	– 2,100 MW & 5,900 annual GWh reductions by 2020	– 3,600 MW & 11,400 annual GWh reductions by 2020	– 4,000 MW & 8,900 annual GWh reductions by 2020	– 5,900 MW & 14,400 annual GWh reductions by 2020
Renewable Additions	– 1,300 MW & 4,600 GWh competitive renewable resources or PPAs by 2020	– Same as Planning Strategy A	– 2,500 MW & 8,600 GWh competitive renewable resources or PPAs by 2020	– Same as Planning Strategy C	– 3,500 MW & 12,000 GWh competitive renewable resources or PPAs by 2020
Fossil Asset Layup	– No fossil fleet reductions	– 2,000 MW total fleet reductions by 2017	– 3,000 MW total fleet reductions by 2017	– 7,000 MW total fleet reductions 2017	– 5,000 MW total fleet reductions by 2017
Energy Storage	– No new additions	– Same as Planning Strategy A	– Add one pumped storage unit	– Same as Planning Strategy C	– Same as Planning Strategy A
Nuclear	– No new additions after WBN2	– First unit online no earlier than 2018 – Units at least 4 years apart	– Same as Planning Strategy B	– First unit online no earlier than 2018 – Units at least 2 years apart	– First unit online no earlier than 2022 – Units at least 2 years apart – Additions limited to 3 units
Coal	– No new additions	– New coal units are outfitted with CCS – First unit online no earlier than 2025	– Same as Planning Strategy B	– Same as Planning Strategy B	– No new additions
Gas-Fired Supply (Self-Build)	– No new additions	– Meet remaining supply needs with gas-fired units	– Same as Planning Strategy B	– Same as Planning Strategy B	– Same as Planning Strategy B
Market Purchases	– No limit on market purchases beyond current contracts and contract extensions	– Purchases beyond current contracts and contract extensions limited to 900 MW	– Same as Planning Strategy B	– Same as Planning Strategy B	– Same as Planning Strategy B
Transmission	– Potentially higher level of transmission investment to support market purchases – Transmission expansion (if needed) may have impact on resource timing and availability	– Complete upgrades to support new supply resources	– Increase transmission investment to support new supply resources and ensure system reliability – Pursue inter-regional projects to transmit renewable energy	– Same as Planning Strategy C	– Potentially higher level of transmission investment to support renewable purchases – Transmission expansion (if needed) may have impact on resource timing and availability

Defined model inputs
 Constraints in model optimization