2015 Integrated Resource Plan

IRPWG Meeting

Session 2

December 5th, 2013

IRPWG Meeting – December Agenda

9:30	Welcome	Randy McAdams
9:45	IRPWG Administration	Randy McAdams
10:15	TVA Strategic Framework	Joe Hoagland
10:45	*Break*	
11:00	Scenario Development Process	Gary Brinkworth
12:00	*Lunch*	
12:45	Overview of Candidate Scenarios	Gary Brinkworth
1:45	Scenarios and Critical Uncertainties	Gary Brinkworth
2:30	*Break*	
2:45	Scenarios and Critical Uncertainties (Cont.)	Gary Brinkworth
3:30	Homework/Ranking of Scenarios	Randy McAdams
3:45	Wrap-up	Randy McAdams
4:00	Adjourn	

Board Resolution November 2013

Key Announcements:

- TVA plans to continue to operate the Paradise coal-fired plant in Kentucky until a new gas-fired combined-cycle plant is complete; at that point, Units 1-2 will be shut down (Unit 3 will continue to operate)
- In Alabama, five coal-powered units at the Colbert plant and one unit at the Widow's Creek plant will be shut down as part of the long-term plan to reshape TVA's generation fleet
- The decision is driven by stringent environmental regulations and flat power demand
- The objective is to achieve a balanced resource portfolio based on a mix of nuclear, coal, gas, hydro and other renewables

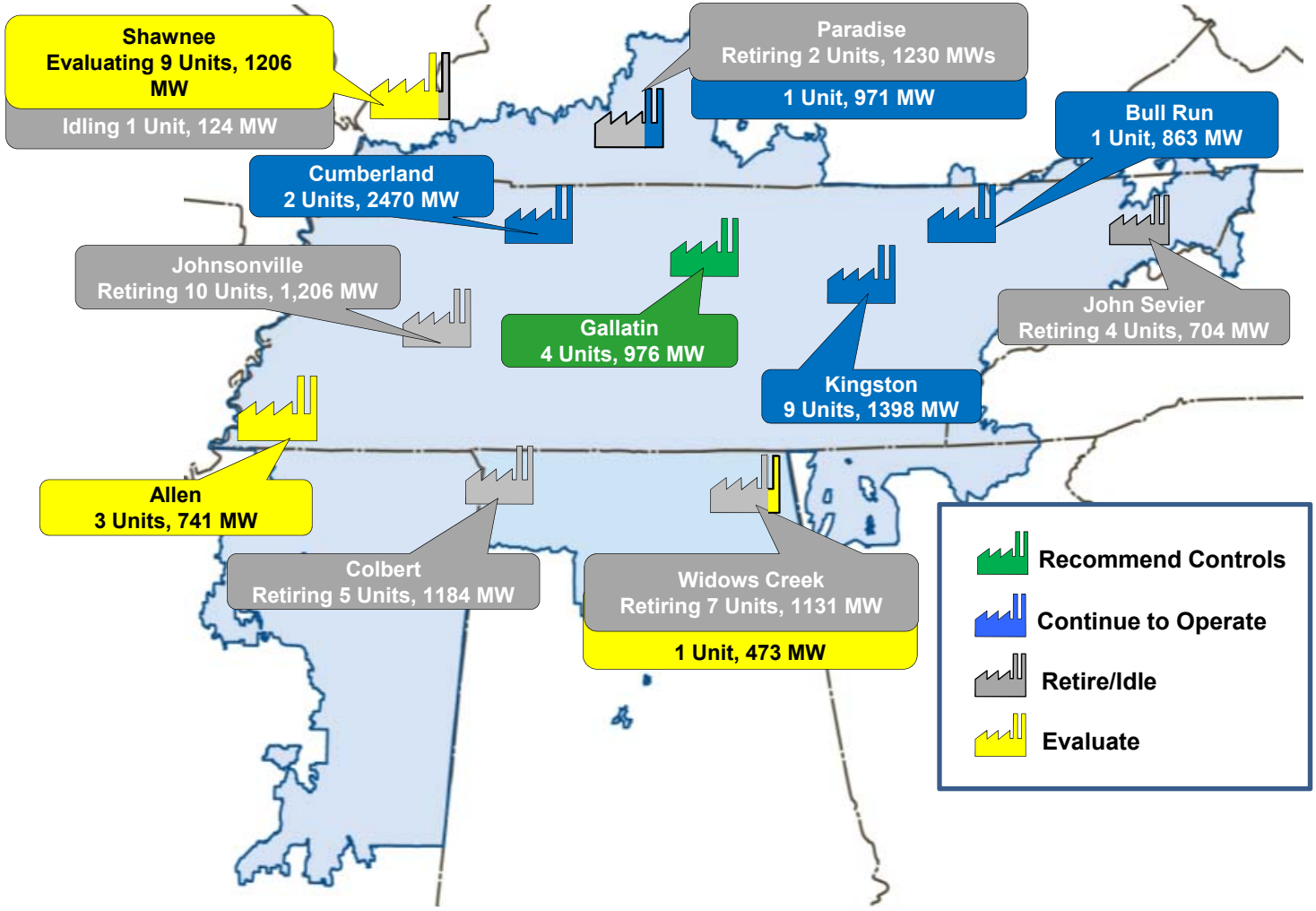
TVA to close 8 coal-powered units in Ala., Ky.

TVA's Coal Fleet: Current Status

Continue to Operate
- Bull Run 1
- Cumberland 1-2
- Paradise 3
- Gallatin 1-4
- Kingston 1-9

Retire / Idle
- Colbert 1-5
- John Sevier 1-4
- Johnsonville 1-10
- Paradise 1-2
- Widows Creek 1-6; 8
- Shawnee 10

Evaluate
- Allen 1-3
- Shawnee 1-9
- Widows Creek 7



- TVA plans to retain 17 coal units at 5 plant sites (6,678 MW) for long-term operation
- TVA plans to retire/idle about 5,579 MW of coal capacity by 2024, or 29 units at 6 plants
- TVA is evaluating about 2,420 MW of coal capacity, or 13 units at 3 plants

Note: MW reflect summer net capability consistent with TVA's 10k

November 5 IRPWG Meeting Action Items

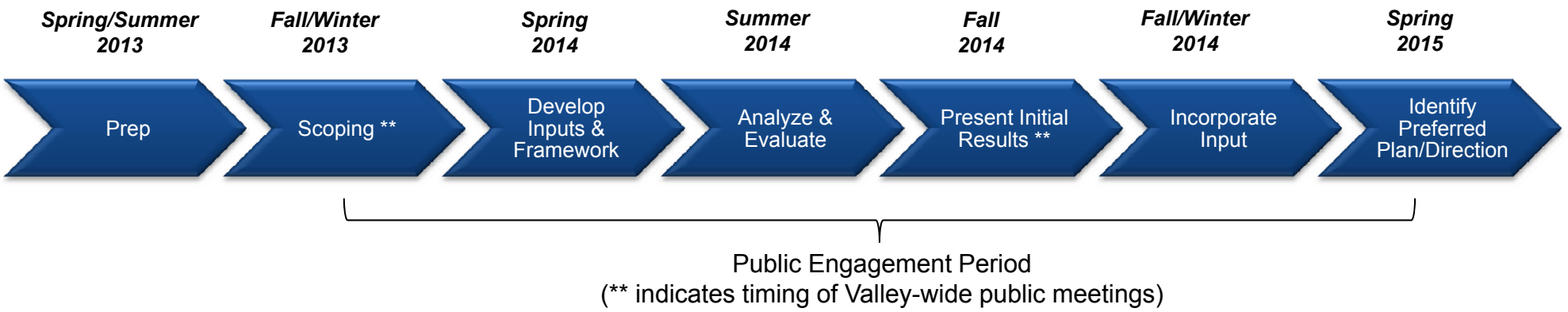
During today's meeting we will be covering the following action items from the November session:

- IRP Sessions Calendar and Agenda
- TVA's Strategic Goals
- Scenario Assumptions

After this meeting we will put on the IRP file sharing site the first version of the template, please review the action items and provide feedback by the next session

2015 IRP Schedule: Major Project Phases and Milestones

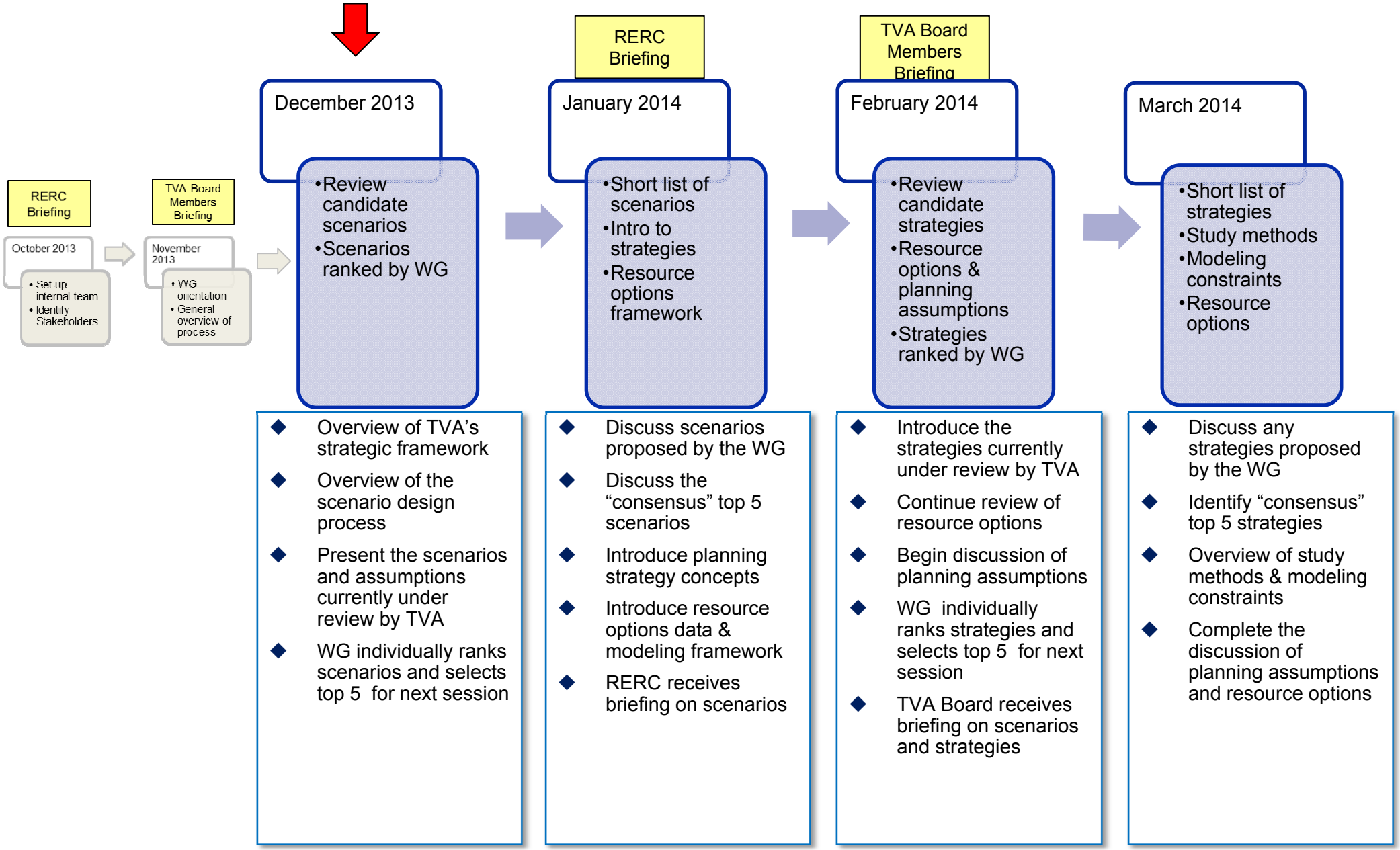
The 2015 IRP is intended to ensure transparency and enable stakeholder involvement.



Key tasks/milestones in this study timeline include:

- Establish stakeholder group and hold first meeting (Nov 2013)
- Complete first modeling runs (June 2014)
- Publish draft Supplemental Environmental Impact Statement (SEIS) and IRP (Nov 2014)
- Complete public meetings (Jan 2015)
- Final publication of SEIS and IRP and Board approval (exp. Spring 2015)

Meeting Objectives for IRPWG thru Spring 2014



Strategic Considerations in the IRP Process

The IRP will use the scenario and strategy framework, with enhanced modeling techniques to capture possible impacts from renewables (solar), distributed generation alternatives, energy efficiency programs, and optimized transmission investments

Planning Strategies	Scenarios					
	Current Situation	#1	#2	#3	#4	#5
Planning Strategy A						
Planning Strategy B						
Planning Strategy C						
Planning Strategy D						
Planning Strategy E						

Modeling Results

Metrics and Priority

Internal/External Stakeholder Input

Other Strategic Considerations

TVA Leadership

Integrated Resource Plan

Modeling, stakeholder input, and other strategic considerations all serve as inputs for TVA to consider when selecting the final resource plan

TVA Mission and Vision

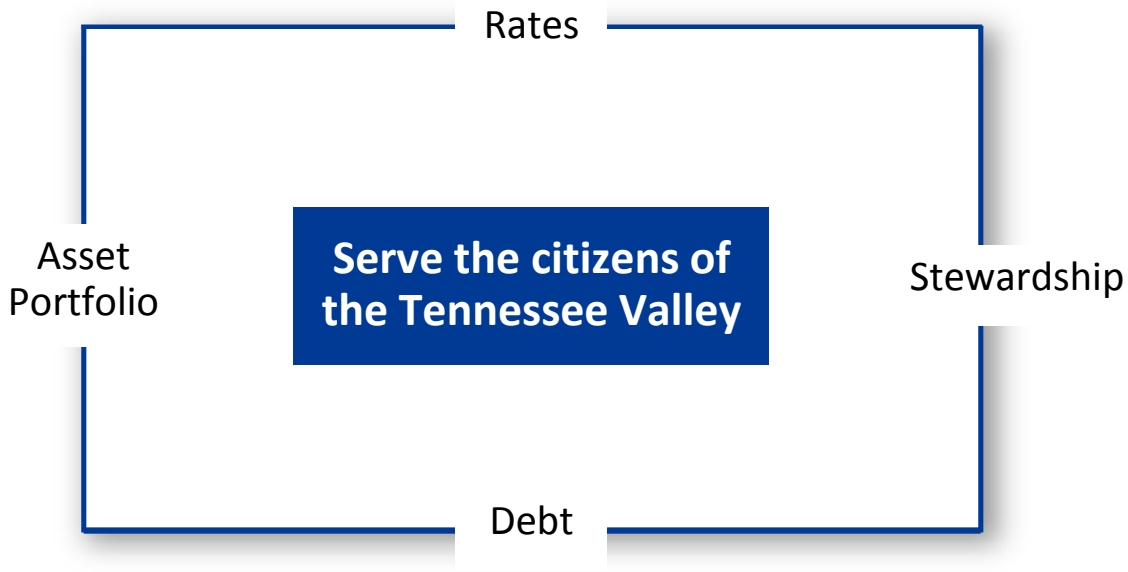
Mission

- Provide low-cost power
- Improve navigation and provide for flood control
- Provide for reforestation and the proper use of marginal lands
- Provide for agricultural and industrial development
- Provide for the national defense
- Technological innovation
- Environmental stewardship

Vision

One of the nation's leading providers of low-cost and cleaner energy by 2020

TVA Strategic Imperatives



Key Imperatives

- ***Rates:*** we must maintain low rates that encourage regional economic development, encourage energy efficiency and accommodate changing paradigms (e.g., distributed generation, etc.) in our region
- ***Debt:*** we must live within our means
- ***Asset Portfolio:*** we must optimize the value of the resource portfolio for the valley
- ***Stewardship:*** we must be responsible stewards for the environment/economic resources entrusted to our care

Consistent with Financial Guiding Principles

Current Debt Information

- Statutory debt = $24.5 billion with a cap of $30 billion
- Total financial obligations = $27 billion

Key Principles

- Debt may only be used for new assets or asset improvements
- Principal and interest must be repaid when a project goes into service
- All other activities must be paid through current rates
- Board can authorize regulatory exceptions (e.g.: Kingston, $1 billion pension contribution)

Statutory Debt: traditional debt instruments (TVA bonds and notes) subject to the $30B debt ceiling
Total Financing Obligations: includes statutory debt (bonds and notes), lease-leaseback and lease-purchase obligations, and energy prepayment obligations.

Imperative 2: Optimize the Resource Portfolio

TVA's Resource Portfolio Plan: A Balanced Approach

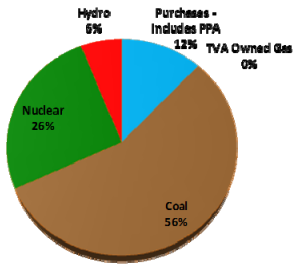
TVA performs a periodic revision of its generation portfolio adapting it to changing market conditions

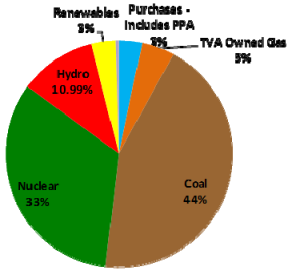
The objective is to maximize customer's value while maintaining a balanced approach that minimizes risks

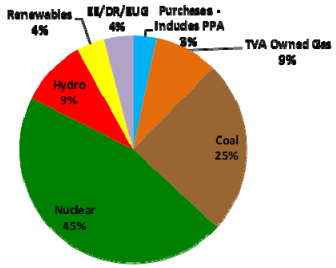
2011 IRP

Board Meeting Nov. 2013

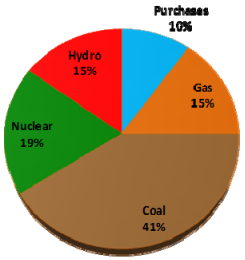
ENERGY

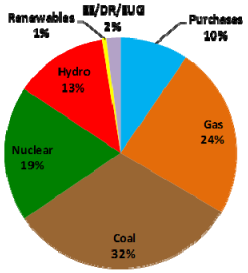


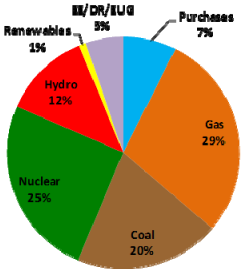




CAPACITY







TVA to close 8 coal-powered units in Ala., Ky.

The results of the work of the IRPWG will help define the plan for the next 20 years

Key Aspect of TVA's Mission

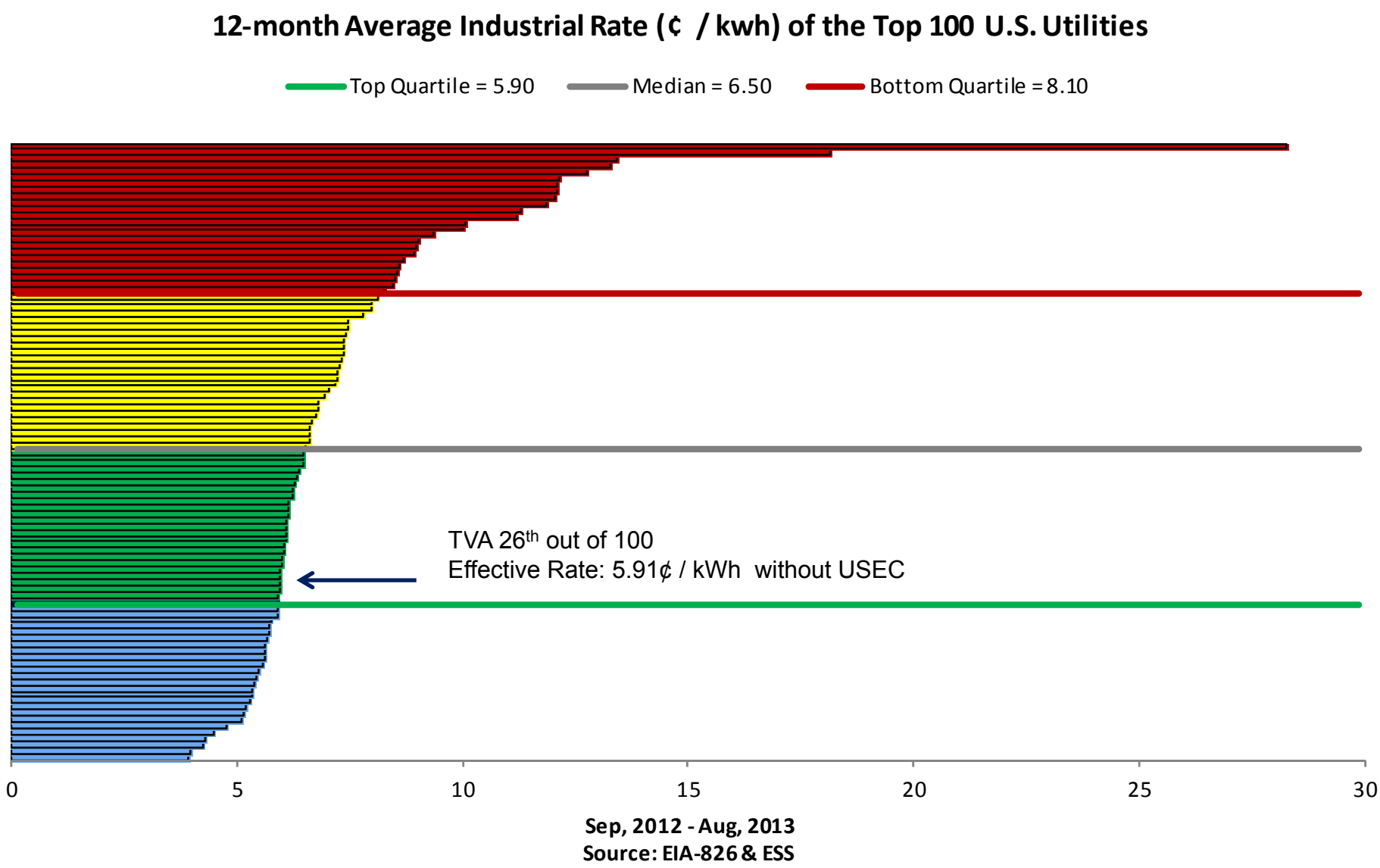
Mission

- Provide low-cost power
- Improve navigation and provide for flood control
- Provide for reforestation and the proper use of marginal lands
- Provide for agricultural and industrial development
- Provide for national defense
- Technological innovation
- Environmental stewardship

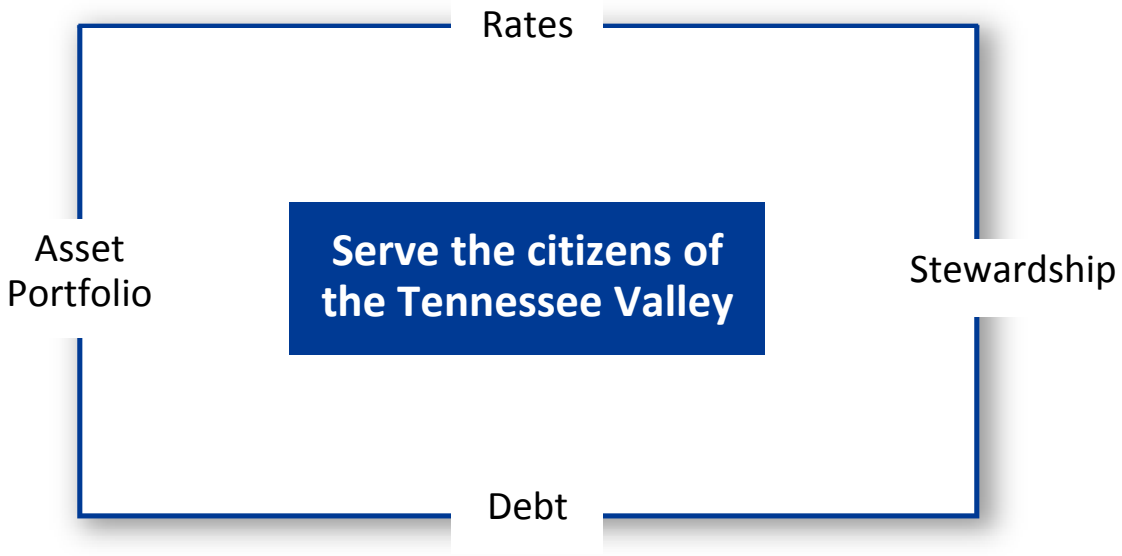
Stewardship of Resources

- River System Stewardship
  - Operating river system
  - Management of lands and reservoirs for public benefit
- Natural Resource Management
  - Biological and cultural resources
  - Water resource management
  - Reservoir lands planning
- Technology Innovation
  - Research and development
  - Work with partners on new energy technologies
- Economic Development
  - Work to recruit and retain economic development prospects
  - Assist communities in being prepared for economic growth through training, capacity building, and technical services

National Rate Comparison



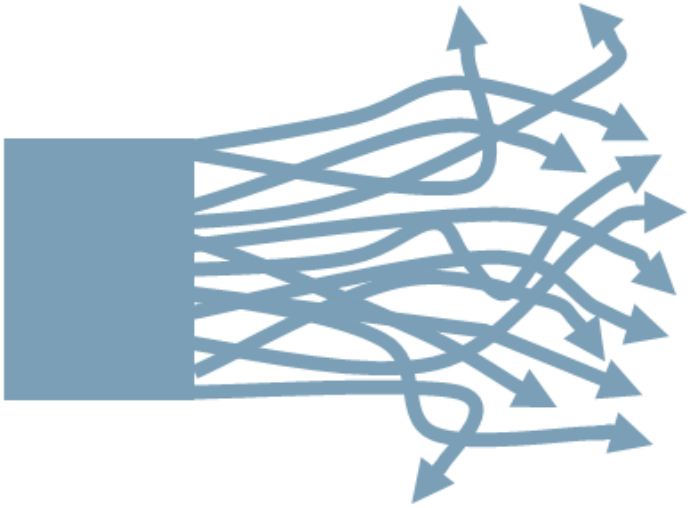
Addressing the Key Strategic Imperatives in the IRP Process



- ***Rates:*** *rates and the impact on economic development are assessed indirectly in the IRP study through scorecard metrics*
- ***Debt:*** *the debt limit is explicitly considered in the financial modeling for each planning strategy*
- ***Asset Portfolio:*** *the optimization of asset choices is the central task of the IRP*
- ***Stewardship:*** *the consideration of environmental impacts and stewardship obligations are included both directly in the system modeling and through scorecard metrics*

A Maze of Future Possible Paths

- Our industry is subject to rapid and unpredictable change, driven by a multitude of challenges including:
  - Uncertain growth rates
  - A highly volatile regulatory future
  - Maturity of new generation technologies
  - Fuel costs
  - Uncertainty over nuclear generation
  - Growth of demand-side resources

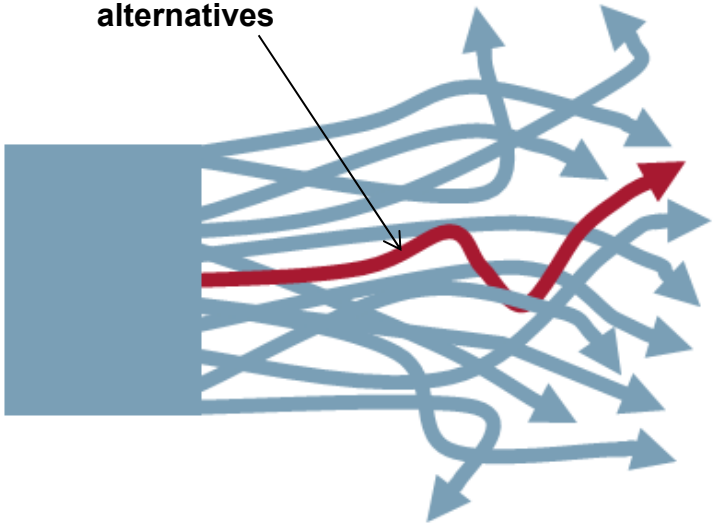


- These drivers interact with each other and with still unknown drivers that will emerge in coming years. The result is a business environment that could evolve along any number of different paths

- In the face of complexity and uncertainty, the temptation can sometimes be to gravitate around the path that seems the most likely

- This approach is fraught with risks, since commitment to a single forecast could serve as a straitjacket for strategic thinking and significant business risks could be ignored

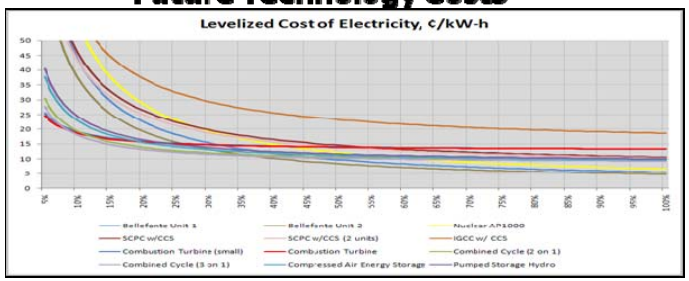
Adopting this single path forward could be the right choice, but if the future evolves along one of the other paths, we will be locked in with few alternatives



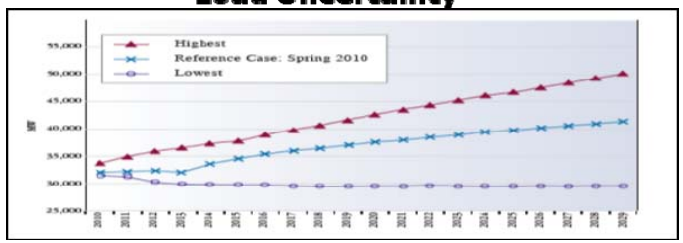
The Value of the Scenario Planning Approach for TVA

The electric utility industry is very capital intensive with significant investments recovered over long horizons, exposing plans to numerous uncertainties

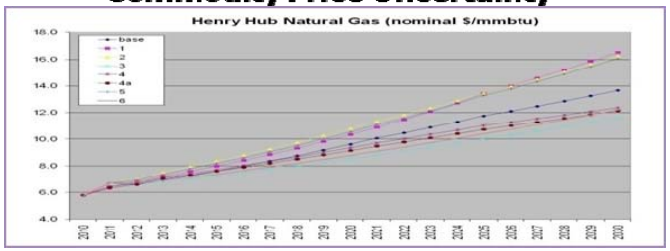
Future Technology Costs



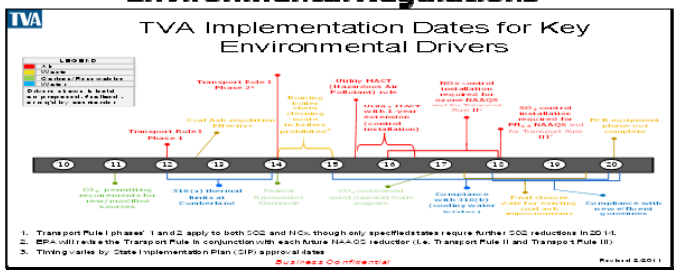
Load Uncertainty



Commodity Price Uncertainty



Environmental Regulations

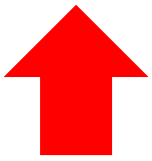


- Scenarios allow us to put boundaries around key uncertainties to create a wide range of possible future outcomes
- Scenario analysis looks at a set of "*plausible futures*". They do not cover the universe of unpredictable possibilities and are not intended to predict the future
- Plans developed in these "*futures*" show how the value of near-term and future decisions could change under different conditions, giving an idea of robustness
- Basic assumption is that a *"good"* strategy is one that performs well in most possible futures. High potential for regret if decisions are not robust to multiple possible futures (stranded costs)
- Scenario planning leads to better understanding of risks and potential opportunities. Commonality across scenarios concerning near-term decisions give some comfort that decisions are less "risky" and less leveraged to specific futures

"Scenarios and Strategies" Establish the Planning Framework

Scenarios

- Describe potential outcomes of factors (uncertainties) outside of TVA's control
- Represent possible conditions and are not predictions of the future
- Include uncertainties that are volatile and could significantly impact operations such as:
  - Commodity prices
  - Environmental regulations



Focus of the working group December session

Planning Strategies

- Test various business options within TVA's control
- Defined by a combination of resource assumptions such as:
  - EEDR portfolio
  - Nuclear expansion
  - Energy storage
- Consider multiple viewpoints
  - Public scoping period comments
  - Assumptions that would have the greatest impact on TVA long-term

A well-designed and robust set of scenarios is one of the most fundamental components for a successful planning process

The Value of Scenario Thinking

"Scenario thinking is both a process and a posture.

It is the process through which scenarios are developed and then used to inform decision-making.

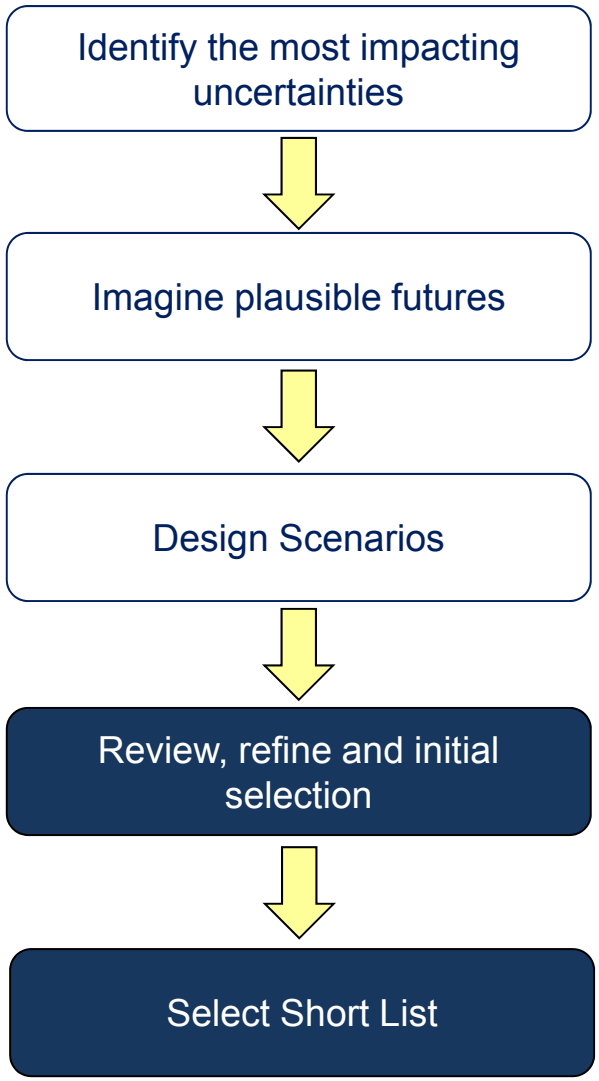
After that process itself is internalized, scenario thinking becomes, for many, a posture towards the world – a way of thinking about and managing change, a way of exploring the future so that they might meet it better prepared.

At its most basic, scenarios help people and organizations order and frame their thinking about the long-term while providing them with the tools and confidence to take action soon.

At its most powerful, scenarios help people and organizations find strength of purpose and strategic direction in the face of daunting, chaotic, and even frightening circumstances."

– Heinrich Vogel, Why Scenarios?

TVA's Process for Building Scenarios



- TVA identified trends and factors with an unknown outcome – "uncertainties"- that could potentially affect its business environment
- Selected the ones that will have the biggest impact on TVA's business
- This list of uncertainties become a set of building blocks to help TVA think about plausible futures

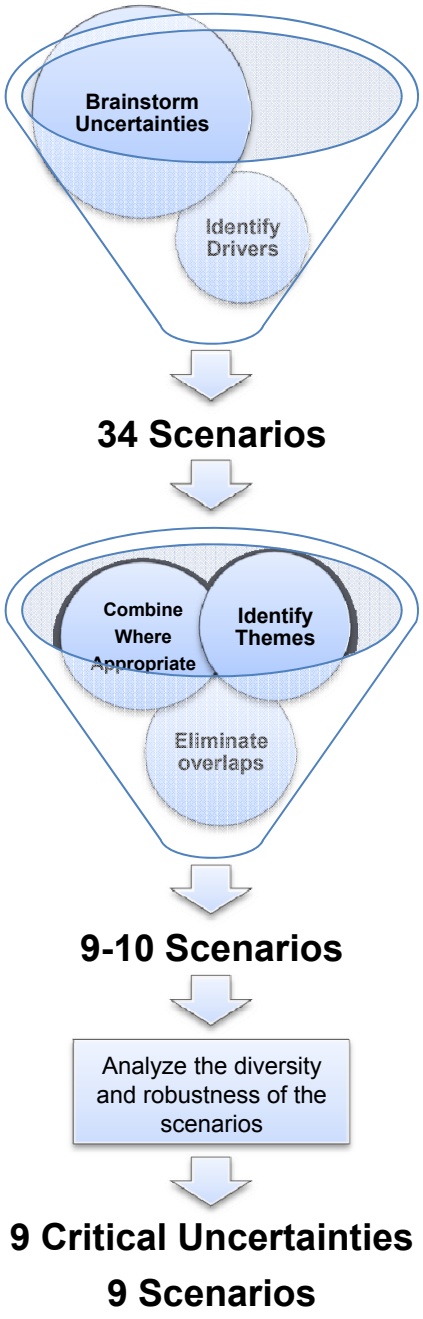
- The next step was to imagine different futures
- TVA used the building blocks to help frame what it is about these futures that matters to TVA

- Developed stories that describe the plausible futures
- Gave each one a name: these are what we call scenarios
- Defined the list of scenarios and grouped them by common "themes"

- Discuss the draft scenarios and refine description narratives
- Analyze the proposed scenarios and define selection criteria (i.e. probability of occurrence, potential impact on the business, etc.)
- Collect stakeholders input

- Finally, TVA, selects a short list of scenarios that covers the range of the most critical uncertainties (i.e. booming economy, slow economic growth)

In Reality the Process Is Not as Linear



- Creating scenarios and defining critical uncertainties is an iterative process
- The TVA team started brainstorming and producing numerous but vague possible futures and uncertainties
- As TVA went deeper into the understanding of the possible scenarios, it identified the drivers of change as well as common themes that allowed the team to group the scenarios and consolidate overlapping possibilities
- At times, the analysis of consistency of the possible scenarios identified new drivers or the need for new scenarios
- Scenario building is an iterative process of creating/consolidating different possibilities.
- Candidate scenarios are being assessed for diversity and robustness to determine if they are internally consistent and that the variation of each key uncertainty across all the scenarios makes sense

Sampling of Initial Scenario Brainstorming

Great Recession II

Looking Great

The Heat is On

CO2 Makes Us Blue

Game Changing Tech Increases Electricity Use

Abandoned City

Mandatory Coal Retirement

Stagnation Based Environmental Regulations

Diminishing loads

Environmental-driven Economy

Fukushima Effect

Strong Valley Economy

Technology Snowball (DG Takes Off)

Green Energy is a National Priority

Strong Global Economy, Weak US economy

Economic Boom

Doldrums

Competitive Threats

Limited Water

Reliability > Cost

Safety Violations

Push Toward Energy Independence (driven by global unrest)

Continued economic slowdown

Increasing distributed resources

Regulatory constraint on natural gas production or availability

Customer-Driven Transition (Bottom-up approach)

Climate-Driven Legislation (Top-down approach)

No backing for “fracking”

Evolving Energy mix

Initial Scenarios Reflect 5 Themes

Declining Economics	Strong Economics	Stringent Environmental	Changing Paradigm	Other Futures
The Final Straw	Strong Valley Economy	Mandatory Coal Retirement	Reliability > Cost	No backing for "fracking"
Great Recession II	Economic Boom	Energy mix	Competitive Threats	Fukushima Effect
Abandoned City	Looking Great	The Heat is On	Technology Snowball (DG Takes Off)	
Strong Global Economy, Weak US economy	TVA Off-fence	CO2 Makes Us Blue	Energy demand	
Doldrums	Game Changing Tech Increases Electricity Use	Safety Violations	Customer-Driven Transition (Bottom-up approach)	
Stagnation Based Environmental Regulations		Green Energy is a National Priority	Increasing distributed resources	
Diminishing loads		Environmental-driven Economy	Aggressive Greener & DG	
Push Toward Energy Independence (driven by global unrest)		Regulatory constraint on natural gas production or availabilty		
Continued economic slowdown		Climate-Driven Legislation (Top-down approach)		
		Limited Water		

TVA Has Selected 9 Critical Uncertainties

Critical uncertainties were selected based on their variability (range of unknown outcome) and the level of potential impact to TVA's business

Example of Uncertainties Identified During Brainstorming Sessions

Energy Markets	Financial	Regulatory	Technology	Climate
Adoption of Electric Vehicles	Cost of capital	GHG legislation	Industrial CHP	Weather
Implementation of Smart Grid	Inflation/Deflation	Nuclear licensing risks	Smart Grid	Water availability and temperature
Public support for renewables and clean energy	Monetary policy	Nuclear fuel storage	Home generators	Demand for power
Adoption of EE/DR and DG	Geo-political issues	Nuclear regulations due to new accidents	Improved DG technologies and EE costs	Load shape
Level of LPC participation	Access to capital markets	Availability and permitting of new sites	3rd party aggregators of DG resources (Solar City)	
Population growth	Construction costs	Renewable energy credits	Penetration of customer installed solar	
Level of energy utilization (household)	Tax incentives for renewables	Renewable energy standards	Feed-in tariff structures	
Appliance mix	Rate structure	Construction codes and standards	Cost of utility level renewables	
Demand for power	Commodity prices	Air quality regulation		
Load shape	Electricity prices	Fracking regulation		

Critical Uncertainties

- TVA Sales
- Natural Gas Prices
- Electricity Prices into TVA
- Coal Prices
- Regulations
- CO2 Regulation/Price
- Distributed Generation Penetration
- Nat'l Energy Efficiency Adoption
- Economic Outlook (National/Regional)

Description of the Critical Uncertainties

Uncertainty	Description
TVA Sales	◆ The customer energy requirements (GWh) for the TVA service territory including losses; it represents the load to be served by TVA
Natural Gas Prices	◆ The price ($/MMBtu) of the commodity including transportation
Electricity Prices into TVA	◆ The hourly price of energy ($/MWh) at the TVA boundary; used as a proxy for market price of power
Coal Prices	◆ The price ($/MMBtu) of the commodity including transportation
Regulations	◆ All regulatory and legislative actions, including applicable codes and standards, that impact the operation of electric utilities excluding CO2 regulations
CO2 Regulation/Price	◆ The cost of compliance with possible CO2 related regulation and/or the price of cap-and-trade legislation, represented as a $/Ton value
Distributed Generation Penetration	◆ National trending of distributed generation resources and potential regional activity by customers or third party developers (not TVA)
Nat'l Energy Efficiency Adoption	◆ An estimate of the adoption of energy efficiency measures by customers nationally; a measure of interest/commitment of customers in general to adopt EE initiatives
Economic Outlook (National/Regional)	◆ All aspects of the regional and national economy including general inflation, financing considerations, population growth, GDP and other factors that drive the overall economy

The Critical Uncertainties: Other Utilities

Duke Energy Carolinas -2013

Electric Load
Fuel Prices
Energy Efficiency and Demand Management Adoption
Renewable Energy Requirements
Environmental Legislation

Georgia Power - 2013

Electric Load
Fuel Prices
Greenhouse Legislation
Economic Environment Regional/National
Demand Side Programs

TVA - 2015

TVA Sales
Natural Gas Prices
Electricity Prices into TVA
Coal Prices
Regulations
CO2 Regulation/Price
Distributed Generation Penetration
Nat'l Energy Efficiency Adoption
Economic Outlook (National/Regional)

Sources: Duke Energy Carolinas 2013 Annual IRP
Georgia Power 2013 IRP

The Critical Uncertainties: 2011 IRP vs. 2015

TVA - 2011
Greenhouse gas requirements
Total load
Change in load shape
Commodity prices
Renewable electricity standards
Environmental outlook
Capital expansion viability
Financing
Construction cost
Purchased power

TVA -2015
TVA Sales
Natural Gas Prices
Electricity Prices into TVA
Coal Prices
Regulations
CO2 Regulation/Price
Distributed Generation Penetration
Nat'l Energy Efficiency Adoption
Economic Outlook (National/Regional)

Feedback from the Working Group

- Your thoughts about the proposed uncertainties?
- Any other critical uncertainties that TVA should take into consideration?
- Other comments?

TVA Is Considering 9 Scenarios Grouped Around 5 Themes

A Declining Economy

- *Major Industry Leaves the Valley (DE1)*
- *Prolonged Stagnant National Economy (DE2)*
- *Stringent Environmental Regulations Lead to Weak Energy Sales (DE3)*

Economic Growth

- *Economic Boom (EG1)*
- *Game-Changing Technology Increased Load (EG2)*

Stringent Environmental Requirements

- *De-carbonized Energy Future (SE1)*
- *Southeast Hot & Dry (SE2)*

Changing Paradigm

- *Customer-Driven Competitive Resources (CP1)*

Other Possible Futures

- *Existing Coal Exploited (OF1)*

- Initial brainstorming work by TVA identified over 30 plausible futures grouped into 5 broad categories
- From this initial list, TVA is considering 9 candidate scenarios for further consideration and refinement

Scenario Group 1:
A Declining Economy

DE1 *Major Industry Leaves the Valley*

Scenario Narrative

- A major valley industry becomes obsolete or moves overseas (e.g. paper or chemical industries)
- Sales are reduced, but the national economy is largely unaffected
- TVA revenues are impacted, while commodity prices and GDP increase as planned
- Decreased capacity need leads to delayed expansion for new generation

DE2 *Prolonged Stagnant National Economy*

Scenario Narrative

- Prolonged, stagnant economy results in low to negative growth and delayed expansion of new generation
- Stringent environmental regulations are delayed due to concerns of adding further pressure to the economy
- Cost of capital is decreased, inflation increases

DE3 *Stringent Environmental Regulations Lead to Weak Energy Sales*

Scenario Narrative

- Stringent environmental regulations are passed and implemented quickly. Increased federal subsidies for DG
- High cost of production, due to fracking and environmental legislation for gas and CO2 allowances, increase electricity prices significantly
- Federal renewable portfolio standards are implemented with new, more stringent MATS regulations
- U.S. based industry is non-competitive in global markets which leads to economic downturn

Scenario Group 2:
Economic Growth

EG1 *Economic Boom*

Scenario Narrative

- Rapid economic growth translates into higher than forecasted energy sales and energy expansion
- Increasingly positive public attitude toward adoption of energy efficiency programs and new technology
- Advances in electric vehicles make it cheaper to buy electric than gas cars
- Tightened environmental legislation with increased focus on cost-efficient energy efficiency choices and pressure for retirement of existing coal assets
- Ambient and water temperatures remain normal. Gas, oil, and coal are more costly due to regulations

EG2 *Game-Changing Technology Increased Load*

Scenario Narrative

- Technology driven growth: more plug-in's, flatter load shape enabled by storage, end-use technology, electric vehicle, renewables generation storage, smart-meters/appliances
- Moderately higher economic growth during and after the tech shift; expected growth in first 10 years
- Advances in electric vehicles make it cheaper to buy electric instead than gas
- Renewable generation technology cost becomes more competitive due to innovation in storage technology
- A neutral or tightened position on greenhouse gases but other regulations remain neutral

Scenario Group 3:
Stringent Environmental Requirements

SE1 *De-carbonized Energy Future*

Scenario Narrative

- Increasing climate-driven effects create strong federal push to curb GHG emissions: new legislation caps and penalizes CO2 emissions from the utility industry and incentivizes non-emitting technologies
- Compliance with new rules increases energy prices and US based industry becomes less competitive; later in the decade, the US economy begins another downward turn and loads begin to decline
- Fracking regulations never materialize but gas contends with the CO2-adder
- New expansion units are necessary to replace existing CO2-emitting fleet and not to meet load growth

SE2 *Southeast Hot & Dry*

Scenario Narrative

- Persistent drought conditions develop over the next decade, reducing output from TVA's hydro resources and the availability of water for cooling fossil and nuclear units
- Steady load growth persists due to higher temperatures, with more constrained options to meet it
- TVA electric prices increase causing greater penetration of distributed energy resources

Changing Paradigm

CP1 ***Customer-Driven Competitive Resources***

Scenario Narrative

- Customers' awareness of growing competitive energy markets and the rapid advance in energy technologies produce unexpected high penetration rates in distributed generation (DG) and energy efficiency (EE)
- Utilities are no longer the only source of generation and multiple options are available to customers (solar, wind, hydro, Wal-Mart, Distributed Generation, First Solar, Solar City, Google…etc.), causing load to diminish
- Growing implementation of DG and EE resources by customers lead to a continual decrease in supply-side generation sources and an increased need for transmission infrastructure and utilization planning.

Other Possible Futures

OF1 ***Existing Coal Exploited***

Scenario Narrative

- Due to environmental issues and increased regulatory restrictions, fracking becomes increasingly costly and drilling is restricted. Supply diminishes and costs increase
- Nuclear option requires increasing capital costs (e.g., storage issues, safety requirements) and permitting timeframes become excessive
- CO2 regulations take a backseat to natural gas fracking and nuclear safety and storage regulations making existing coal the most viable and economic option

Feedback from the Working Group

- Your thoughts about the proposed scenarios?
- Any suggestions from the group about other futures?
- Other comments?

Scenarios are described using the critical uncertainties

A Declining Economy
- *Major Industry Leaves the Valley (DE1)*
- *Prolonged Stagnant National Economy (DE2)*
- *Stringent Environmental Regulations Lead to Weak Energy Sales (DE3)*

Economic Growth
- *Economic Boom (EG1)*
- *Game-Changing Technology Increased Load (EG2)*

Stringent Environmental Requirements
- *De-carbonized Energy Future (SE1)*
- *Southeast Hot & Dry (SE2)*

Changing Paradigm
- *Customer-Driven Competitive Resources (CP1)*

Other Possible Futures
- *Existing Coal Exploited (OF1)*

Critical Uncertainties

TVA Sales
Natural Gas Prices
Electricity Prices into TVA
Coal Prices
Regulations (non CO2)
CO2 Regulations/Price
Distributed Generation
National Energy Efficiency
Economic Outlook (National/Regional)

When describing the scenarios, the critical uncertainties are expressed relative to the current view of the future: very low, low, same, high or very high.

The Current View of the Future

Slow Load Growth Continues

Near-term peak growth remains relatively unchanged, with a compound annual growth rate of less than 1% for 2014-2024. Energy growth also remains below 1% as slow economic growth persists and energy efficiency programs (e.g., DOE efficiency standards) continue to reduce average energy usage.

Less Stringent Environmental Regulation Persist

Environmental requirements unchanged from previous projections; final MATS less stringent than draft, and reduced GHG penalties still expected (TVA penalty for carbon emissions cut in half from the FY13 Budget forecast).

Low Natural Gas Prices

Gas price forecast relatively unchanged compared to previous forecast. Seasonal patterns for gas seen in the past not expected in the current forecast. Long term gas prices grow faster than GDP deflator 2018-2033, reflecting the expectation that higher cost production will be required to meet future demand.

EEDR Contribution and Costs

Program growth scaled back to reflect expectations of reduced funding. Summer capacity benefit levels off around FY2020. Energy savings (GWh) continues to increase, albeit at a slower rate.

Bellefonte

BLN not included in the current base planning assumptions. Site spending will proceed (at a reduced rate) to maintain the expansion option. Analysis will continue, and the 2015 IRP will help determine the least cost approach to meet future demand.

Scenario Group 1: A Declining Economy

Major Industry Leaves the Valley

Scenario Narrative

- A major valley industry becomes obsolete or moves overseas (e.g. paper or chemical industries)
- Sales are reduced, but the national economy is largely unaffected
- TVA revenues are impacted, while commodity prices and GDP increase as planned
- Decreased capacity need leads to delayed expansion for new generation

Uncertainty	Level Of Impact (*)	Rationale
TVA Sales	Low	A major valley industry becomes obsolete or moves overseas, leading to lower TVA sales.
Natural Gas Prices	Same	Commodity prices and GDP increase as planned
Electricity Prices into TVA	Same	It will likely have an impact on the amount of electricity purchased by TVA but not on the price
Coal Prices	Same	Commodity prices and GDP increase as planned
Regulations	Same	Regulations evolve as planned
CO2 Regulation/Price	Same	Greenhouse regulation and CO2 prices evolve as planned
Distributed Generation Penetration	Same	No impact at national level and very limited (if any) at a regional level
Nat'l Energy Efficiency Adoption	Same	No impact at national level and very limited (if any) at a regional level
Economic Outlook (National/Regional)	Same/Lower	Regional economic outlook is lower due to loss of industry sector.

(*) Note: Compared to current view of the future

Scenario Group 1: A Declining Economy

Prolonged Stagnant National Economy

Scenario Narrative

- Prolonged, stagnant economy results in low to negative growth and delayed expansion of new generation
- Stringent environmental regulations are delayed due to concerns of adding further pressure to the economy
- Cost of capital is decreased, inflation increases

Uncertainty	Level Of Impact (*)	Rationale
TVA Sales	Very Low	Very low sales due to stagnant economy
Natural Gas Prices	Lower	Low natural gas prices due to low demand and less stringent environmental legislation
Electricity Prices into TVA	Lower	Lower demand creates lower commodity prices
Coal Prices	Lower	Low coal prices due to low demand and less stringent environmental legislation
Regulations	Lower	Economic downturn and decreased energy demand lead to less stringent environmental regulations
CO2 Regulation/Price	None	Economic downturn and decreased energy demand lead to delay of CO2 legislation beyond the forecast horizon
Distributed Generation Penetration	Lower	Traditional generation over-capacity decreases the interest of investing in these technologies
Nat'l Energy Efficiency Adoption	Low	Energy efficiency is not a priority due to sluggish economy and energy sales
Economic Outlook (National/Regional)	Very Low	Stagnant national and regional economy

(*) Note: Compared to current view of the future

Scenario Group 1: A Declining Economy

Stringent Environmental Regulations Lead to Weak Energy Sales

Scenario Narrative

- Stringent environmental regulations are passed and implemented quickly. Increased federal subsidies DG
- High cost of production, due to fracking and environmental legislation for gas and CO2 allowances, increase electricity prices significantly
- Federal renewable portfolio standards are implemented with new, more stringent MATS regulations
- U.S. based industry is non-competitive in global markets and leads to economic downturn

Uncertainty	Level Of Impact (*)	Rationale
TVA Sales	Low	Lower sales due to higher energy prices
Natural Gas Prices	High	Stringent fracking legislation leads to higher gas prices
Electricity Prices into TVA	High	Higher due to high commodity prices
Coal Prices	High	Higher due to stringent environmental legislation
Regulations	High	New, more stringent MATS regulations are passed
CO2 Regulation/Price	Very High	Very stringent CO2 legislation
Distributed Generation Penetration	High	Federal subsidies for solar distributed generation and increased energy costs result in higher penetration
Nat'l Energy Efficiency Adoption	High	Energy efficiency standards are increased
Economic Outlook (National/Regional)	Same	Higher inflation pressure due to higher energy costs is neutralized by lower energy demand

(*) Note: Compared to current view of the future

Scenario Group 2: Economic Growth

The Economic Boom

Scenario Narrative

- Rapid economic growth translates into higher than forecasted energy sales and energy expansion
- Increasingly positive public attitude toward adoption of energy efficiency programs and new technology
- Advances in electric vehicles make it cheaper to buy electric than gas cars
- Tightened environmental legislation with increased focus on cost-efficient energy efficiency choices and pressure for retirement of existing coal assets
- Ambient and water temperatures remain normal. Gas, oil, and coal are more costly due to regulations

Uncertainty	Level Of Impact (*)	Rationale
TVA Sales	High	Higher due to overall economic growth; similar to TVA experience in the 1990s
Natural Gas Prices	High	Higher due to increased demand and regulations
Electricity Prices into TVA	High	Electricity driven by NG prices and higher demand
Coal Prices	High	Higher regulations, but they do not overcome coal utilization in coal / gas tradeoff
Regulations	High	Prosperity as a regulatory driver…
CO2 Regulation/Price	High	Prosperity drives more stringent and earlier CO2 goals
Distributed Generation Penetration	High	This scenario focuses in the economic impact and the feedback of higher prices more than adoption of DG
Nat'l Energy Efficiency Adoption	High	Higher prices mitigated by greater energy efficiency (prices drive response)
Economic Outlook (National/Regional)	High	Overall economic growth is higher on both a TVA level and a National level similar to 1990s

(*) Note: Compared to current view of the future

Scenario Group 2: Economic Growth

Game-changing technology increases load

Scenario Narrative

- Technology driven growth-more plug-in's; flatter load shape enabled by storage, end-use technology, Hybrid/EV, renewables generation storage, smart-meters/appliances
- Moderately higher economic growth during and after the tech shift; expected growth in first 10 years
- Advances in electric vehicles make it cheaper to buy electric than gas
- Renewable generation technology cost becomes more competitive due to innovation in storage technology
- A neutral or tightened position on green house gases but other regulations remain neutral

Uncertainty	Level Of Impact (*)	Rationale
TVA Sales	Very High	Energy use increases as central station efficiency and load shape improves
Natural Gas Prices	Low	Storage technology and renewable competitiveness drives down demand
Electricity Prices into TVA	Same	Flatter load shape, higher cost and NG gas cost lead to neutral electricity prices
Coal Prices	Same	Regulations do not overcome coal utilization in coal / gas tradeoff
Regulations	Low	The presence of lower emissions through renewables and storage technology diminishes the impetus for more regulations
CO2 Regulation/Price	Very High	Prosperity is a driver but CO2 becomes a proxy replacement for other fossil fuel based regulations.
Distributed Generation Penetration	Same	Large scale storage technology improves; it Is not effectively scaled and is part of the driving force behind the improved load shape
Nat'l Energy Efficiency Adoption	Higher	Awareness and acceptance is high driven by technology breakthroughs, such as smart meters
Economic Outlook (National/Regional)	High	Economic growth is higher, but it is the technology growth that is the engine behind the sales growth

(*) Note: Compared to current view of the future

Scenario Group 3: Stringent Environmental Requirements

De-carbonized Energy Future

Scenario Narrative

- Increasing climate-driven effects create strong federal push to curb GHG emissions: new legislation caps and penalizes CO2 emissions from the utility industry and incentivizes non-emitting technologies
- Compliance with new rules increases energy prices and US based industry becomes less competitive; later in the decade, the US economy begins another downward turn and loads begin to decline
- Fracking regulations never materialize but gas contends with the CO2-adder
- New expansion units are necessary to replace existing CO2-emitting fleet and not to meet load growth

Uncertainty	Level Of Impact (*)	Rationale
TVA Sales	Low	CO2 penalties drive industry to non-emitting technologies; raising prices and leading to economic decline later in the decade
Natural Gas Prices	High	Demand for gas increases spiking prices
Electricity Prices into TVA	High	Rush to switch to lower-emitting/non-emitting technologies results in increase in energy prices
Coal Prices	Same	Demand decreases and keeps prices in current forecasted range
Regulations	Same	No additional coal requirements/controls
CO2 Regulation/Price	High	Stringent federal CO2 penalties
Distributed Generation Penetration	High	DG resources increase due to higher energy prices and CO2 penalties
Nat'l Energy Efficiency Adoption	High	Higher energy prices drive EE
Economic Outlook (National/Regional)	Low	Higher energy prices make US less competitive and economy downturns

(*) Note: Compared to current view of the future

Scenario Group 3: Stringent Environmental Requirements
Southeast Hot & Dry

Scenario Narrative

- Persistent drought conditions develop over the next decade, reducing output from TVA's hydro resources and the availability of water for cooling fossil and nuclear units.
- Steady load growth persists due to higher temperatures, with more constrained options to meet it
- TVA electric prices increase causing greater penetration of distributed energy resources.

Uncertainty	Level Of Impact (*)	Rationale
TVA Sales	Same	Steady load growth due to higher temperature
Natural Gas Prices	Same	Abundant gas supply continues
Electricity Prices into TVA	High	Dryer weather leads to less hydro and more derates on coal and nuclear generation. Prices increase as less economic assets are utilized and more energy is purchased.
Coal Prices	Same	Current forecasted trends continue. TVA's demand similar, may even decrease but barge transport limited
Regulations	High	Closed cycle cooling required on all new coal and nuclear and existing units on temperature sensitive rivers
CO2 Regulation/Price	Same	Current forecasted trends continue
Distributed Generation Penetration	High	Higher electricity prices drive development of DG
Nat'l Energy Efficiency Adoption	High	Higher electricity prices lead to increased customer EE
Economic Outlook (National/Regional)	Same	While electricity cost is higher in the Valley, cost from dryer weather nationally is not great enough to drive economic decline

(*) Note: Compared to current view of the future

Scenario Group 4: Changing Paradigm

Customer Driven Competitive Resources

Scenario Narrative

- Customers' awareness of growing competitive energy markets and the rapid advance in energy technologies produce unexpected high penetration rates in distributed generation (DG) and energy efficiency (EE)
- Utilities are no longer the only source of generation and multiple options are available to customers (solar, wind, hydro, Wal-Mart, Distributed Generation, First Solar, Solar City, Google…etc.), causing the load to diminish
- Growing implementation of DG and EE resources by customers lead to a continual decrease in supply-side generation sources and an increased need for transmission infrastructure and utilization planning.

Uncertainty	Level Of Impact (*)	Rationale
TVA Sales	Low	End use customers continue to find ways to control their energy demands and look to the utility to fill in the gaps
Natural Gas Prices	Low	Reduced energy demand lessens the dependency on CT/CC's
Electricity Prices into TVA	Low	Utilities are long on capacity
Coal Prices	Low	Nuclear and DG has coal only filling in the gaps when needed
Regulations	Same	Codes and standards for EE and renewables drive emissions lower, diminishing the impetus for more regulation
CO2 Regulation/Price	Same	CO2 goals are being met with the increased EE and DG
Distributed Generation Penetration	Very High	DG becomes an integral part of customers' energy supply
Nat'l Energy Efficiency Adoption	Very High	Codes and standards increases the adoption of EE
Economic Outlook (National/Regional)	Same	The economy continues to grow but, businesses will continue to work on process efficiencies to gain more market share

(*) Note: Compared to current view of the future

Scenario Group 3: Other Possible Futures

Existing Coal Exploited

Scenario Narrative

- Due to environmental issues and increased regulatory restrictions, fracking becomes increasingly costly and drilling is restricted. Supply diminishes and costs increase.
- Nuclear option requires increasing capital costs (e.g., storage issues, safety requirements) and permitting timeframes become excessive.
- CO2 regulations take a backseat to natural gas fracking and nuclear safety and storage regulations making existing coal the most viable and economic option

Uncertainty	Level Of Impact (*)	Rationale
TVA Sales	Same	Demand follows expected growth in the TVA region as electricity prices remain low compared to other areas
Natural Gas Prices	High	Fracking regulations decrease supply and increase NG prices
Electricity Prices into TVA	Low	TVA through existing coal assets keeps prices low Coal on margin
Coal Prices	Same	Coal demand doesn't increase national enough to drastically change price
Regulations	High	Fracking regulation increase and nuclear storage issues cause increased permitting timelines and higher capital costs
CO2 Regulation/Price	Low	CO2 regulations take a back seat to fracking regulations
Distributed Generation Penetration	Same	Forecasted trends continue
Nat'l Energy Efficiency Adoption	Same	Forecasted trends continue
Economic Outlook (National/Regional)	Same	Higher electricity prices cause economic slump nationally, but the Valley is able to fend off the effects

(*) Note: Compared to current view of the future

Ensuring the Breadth of Scenario Analysis

- To assess the adequacy of the candidate scenarios for use in the IRP study, TVA is performing different analyses to gauge the robustness and diversity of scenarios

- The objective is to ensure that, among the different scenarios, there is both an internal consistency within each plausible future (uncertainties are appropriately correlated) and sufficient diversity in the uncertainties values across scenarios

- As a gauge of robustness, the scenario design team reviewed the variation of 3 uncertainties considered most likely to influence the resource plan: TVA sales (load), natural gas prices, and the cost of CO2 compliance
  - —A graphical “metric” was developed based on an x-y plot of gas price vs. TVA sales with CO2 price as a correlated variable
  - —A second x-y plot was also developed to compare level of EE/DG penetration vs. TVA sales

- As a measure of diversity, the qualitative values for each of the uncertainties were converted to numerical values using a 5-point scale. A chart was developed that displayed for each of the 9 key uncertainties the % of futures that designated that uncertainty very high, high, same, low or very low

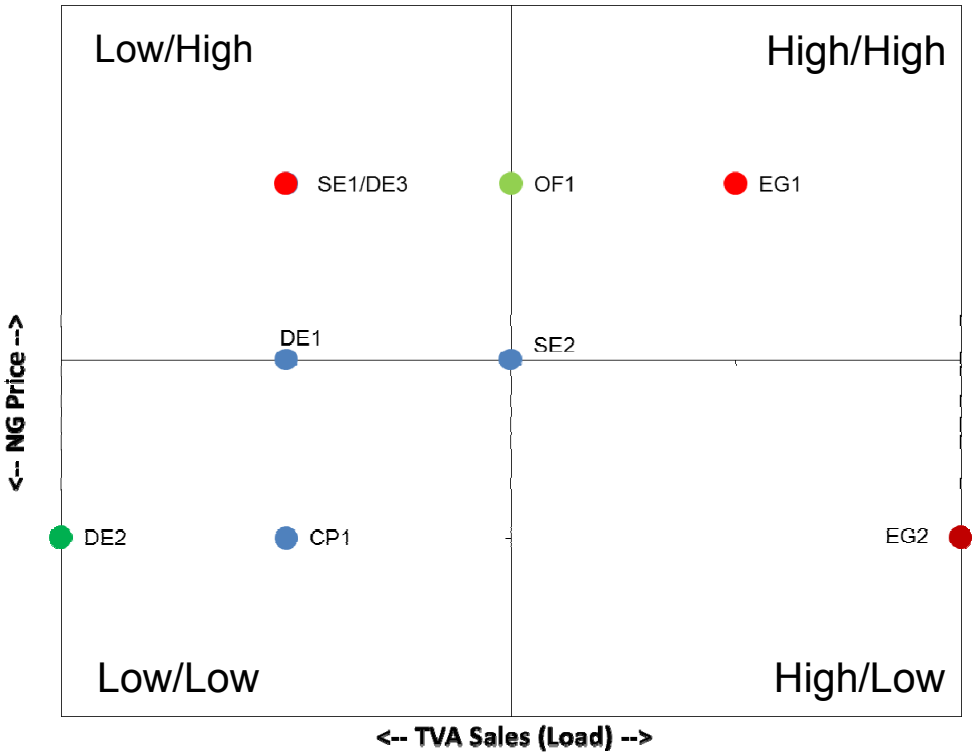
Further work on evaluating the breadth of the scenarios is underway and those results will be shared with the working group at the January meeting

Ensuring the Breadth of Scenarios Scenario Analysis

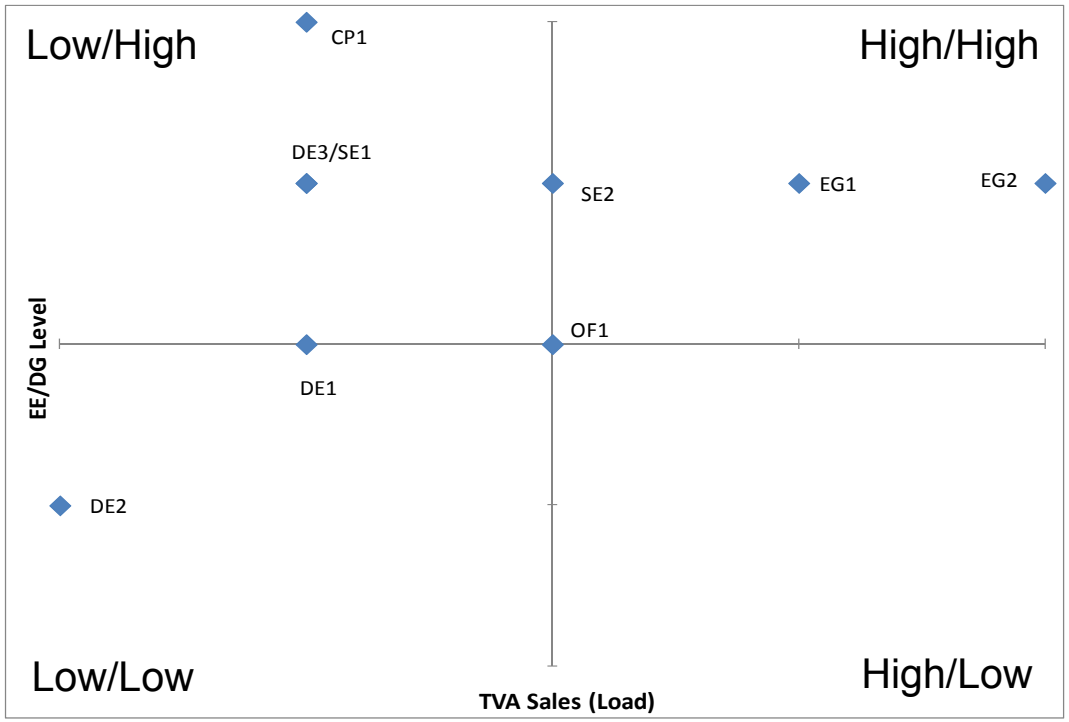
Example of Scenario Analysis Performed: Scenario X-Y Plots

The Scenario Matrix is constructed by juxtaposing the two axes of uncertainty that reflect the most important uncertainties, offer the most insight or provide the most intriguing glimpse of the future.

TVA Sales/NG$ with CO2 indicator



TVA Sales/EE and DG Level



- Very High CO2$
- High CO2$
- Same
- Low CO2$
- Very Low CO2$

Ensuring the Breadth of Scenarios

Example of Scenario Analysis Performed: Diversity of Uncertainties

The key uncertainties are expressed in relation to the current view of the future (very low, low, same, high, very high). This table summarizes the distribution of the uncertainties across the 9 candidate scenarios by counting the number of occurrences of each ranking value:

	1	2	3	4	5
	Very Low	Low	Same	High	Very High
TVA Sales	1	4	2	1	1
Natural Gas Prices	0	3	2	4	0
Electricity Prices into TVA	0	3	2	4	0
Coal Prices	0	1	6	2	0
Regulations	0	2	3	4	0
CO2 Regulation/Price	1	1	3	2	2
Distributed Generation Penetration	0	1	3	4	1
Nat'l Energy Efficiency Adoption	0	1	2	5	1
Economic Outlook (National/Regional)	1	1	5	2	0

For example, 56% of scenarios (5 of 9) assume lower TVA sales; coal prices are assumed to be the same as currently forecasted in 67% of scenarios (6 of 9)

Summary of the Selected Scenarios and Uncertainties

		Potential Scenarios								
		Major Industry Leaves the Valley (DE1)	Prolonged Stagnant National Economy (DE2)	Stringent Environmental Regulations Lead to Weak Energy Sales (DE3)	Economic Boom (EG1)	Game-changing Technology Increases Load (EG2)	De-carbonized Energy Future (SE1)	Southeast Hot & Dry (SE2)	Customer Driven Competitive Resources (CP1)	Existing Coal Exploited (OF1)
Uncertainties (Relative to Current Forecasts)	TVA Sales	Low	Very Low	Low	High	Very High	Low	Same	Low	Same
	Natural Gas Prices	Same	Low	High	High	Low	High	Same	Low	High
	Electricity Prices into TVA	Same	Low	High	High	Same	High	High	Low	Low
	Coal Prices	Same	Low	High	High	Same	Same	Same	Same	Same
	Regulations	Same	Low	High	High	Low	Same	High	Same	High
	CO2 Regulation/Price	Same	Very Low	Very High	High	Very High	High	Same	Same	Low
	Distributed Generation Penetration	Same	Low	High	High	Same	High	High	Very High	Same
	Nat'l Energy Efficiency Adoption	Same	Low	High	High	High	High	High	Very High	Same
	Economic Outlook (National/Regional)	Same	Very Low	Same	High	High	Low	Same	Same	Same

Key Points

- The selected scenarios represent a ample breadth of possible futures
- The scenarios cover a wide rage of values for the critical uncertainties

Feedback from the Working Group

- Your thoughts or questions about the proposed scenarios and their impacts on critical uncertainties?
- Other comments?

Ranking of Selected Scenarios by the IRPWG

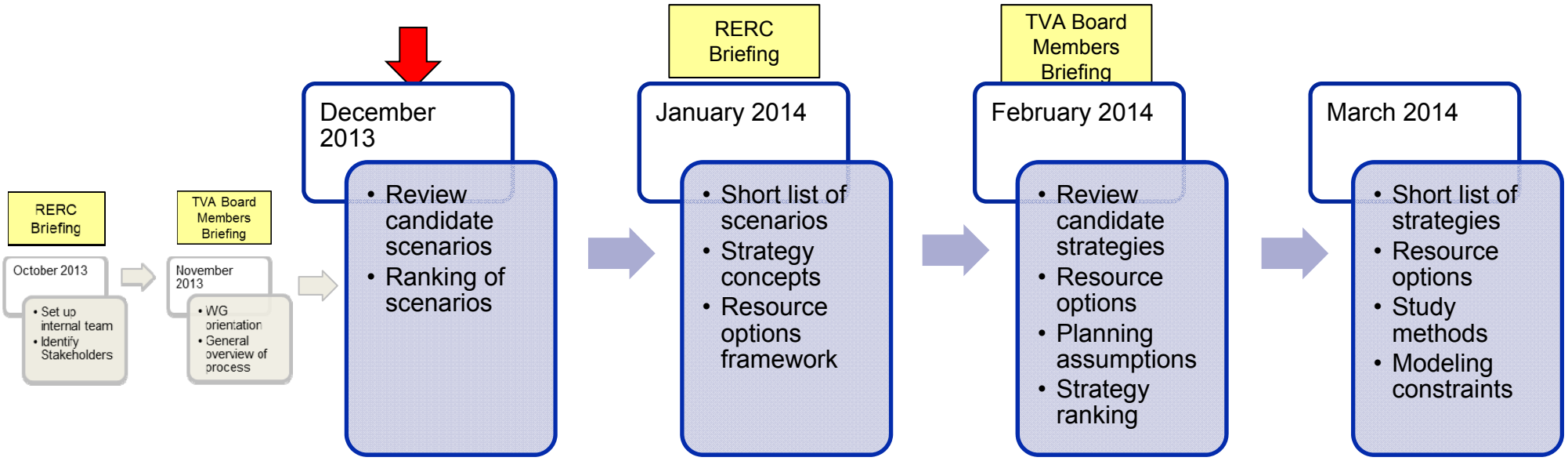
- We ask the working group to individually select their 5 top scenarios (1st being their top selection) to be analyzed during the rest of IRP process

- The working group needs to post their selection in the file site before the January session
  - We will put a ranking sheet template in the file sharing site
  - Please download that template, enter your rankings, and then email to us

- Ranking criteria could include:
  - Potential impact of the scenario on TVA business
  - Intriguing future that should be analyzed by TVA

- The members of the working group can propose new scenarios as part of their selection if the believe the proposed set does not reflect an important aspect that should to be explored

Pending items for next meetings



- We are proposing the next meeting on January 13th in the Nashville area
- February and March meetings may be two-day sessions

Happy Holidays – See You in January!

Thanks