# Tennessee Valley Authority

# Regional Energy Resource Council

Nashville, Tennessee

April 20-21, 2015


welcome

# Safety Moment

THE PROMISE WE MAKE TO EACH OTHER

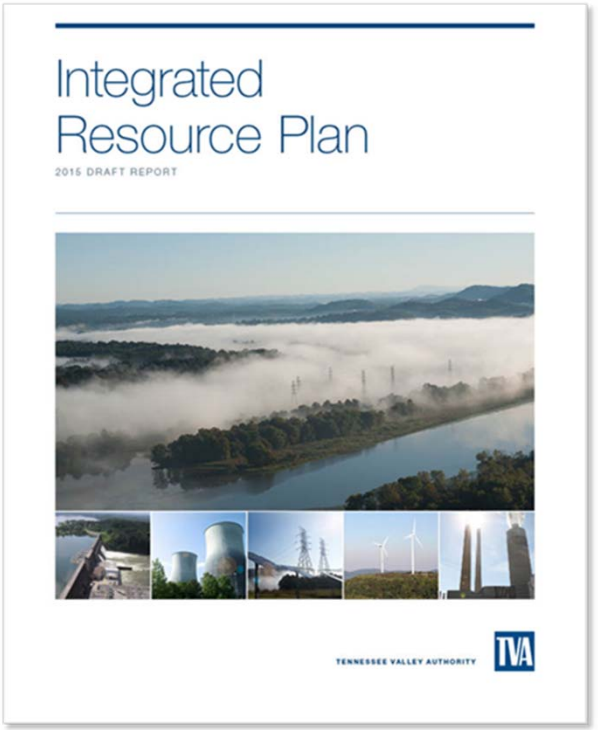

In the unlikely event of a building emergency,

TVA and Hotel Staff will direct you to shelter or exit.

*Today's Meeting Purpose*

# April 2015 Meeting Purpose

- Provide an update on the IRP process including the comments received from the IRP Working Group and the Public
- Review summary of results of further sensitivity analysis
- Discuss preliminary advice on adoption of the 2015 IRP
- Build understanding around implementation challenges and opportunities coming out of the 2015 IRP.



# RERC Meeting Protocols

**Agenda**

- Agenda prepared and approved by the Designated Federal Officer (DFO) in consultation with Council Chair
- Agenda distributed to Council and published in the Federal Register prior to each meeting
- Topics may be submitted to the DFO by any member of the Council, or non-members, including members of the public

**Meeting Minutes**

- DFO will ensure that minutes are prepared for each meeting, approved by the Chair, and made available to Council members

**Voting**

- Any member of the Council may make a motion for a vote
- Recommendations to TVA Board shall require an affirmative vote of at least a simple majority of the total Council members present on that date
- Council members may include minority or dissenting views

**Discussion**

- DFO (or his designee) will facilitate and ensure good order during all open discussions
- Only one speaker or attendee is permitted to comment at a time
- To be recognized by the Chair (or meeting facilitator) in order to provide comment, please turn your name card on its side

# Agenda

**Day 1: Monday April 20**

| | | |
|---|---|---|
| 9:00 | Welcome, Introduce New Members | Joe Hoagland, Designated Federal Officer<br>Dus Rogers, Council Chair |
| 9:15 | Meeting Purpose | Hoagland |
| 9:25 | Agenda and Protocols Review | Jo Anne Lavender, Facilitator |
| 9:30 | IRP Status | Brinkworth |
| 9:40 | Break | |
| 9:50 | IRP Draft Report Feedback | Brinkworth / Lavender / Council |
| 10:45 | Preview TVA Board Public Session on IRP with RERC | Hoagland |
| 11:00 | Lunch | |
| 12:00- 4:45 | Joint Session with TVA Board (Symphony I Ballroom) | Council |
| 4:45 | Adjourn | |

# Agenda (Cont'd)

**Day 2: Tuesday, April 21**

| | | |
|---|---|---|
| 8:30 | Welcome, Review of Day 1 | Lavender |
| 9:00 | Recap February 2015 Meeting | Lavender |
| 9:05 | TVA Update | Hoagland |
| 9:15 | IRP Public Comments | Brinkworth |
| 9:30 | Break | |
| 9:45 | IRP Sensitivity Case Runs and Preliminary | Tom Rice |
| 10:45 | IRP Direction | Brinkworth |
| 11:00 | Council Discussion | Lavender |
| 11:45 | IRP Next Steps | |
| 11:55 | Summary, Adjourn | Hoagland / Rogers |
| 12:00 | Lunch | |

# RERC Discussion Questions

1. What are your thoughts on the preliminary IRP direction for meeting TVA's future energy needs in terms of:
   - Balanced Portfolio
   - Cleaner
   - Low Cost
   - Reliable

2. What are your thoughts on the challenges and opportunities related to IRP implementation while meeting TVA's mission:
   - Energy (low cost, reliable, cleaner)
   - Environment (stewardship)
   - Economic Development?

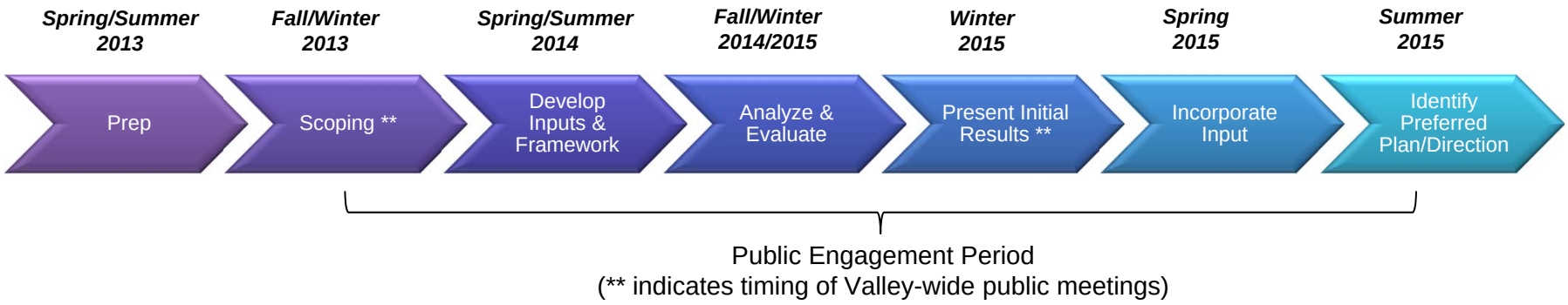
# IRP Status

Gary Brinkworth

Senior Program Manager, IRP

# 2015 IRP/SEIS Schedule: Major Phases/Milestones

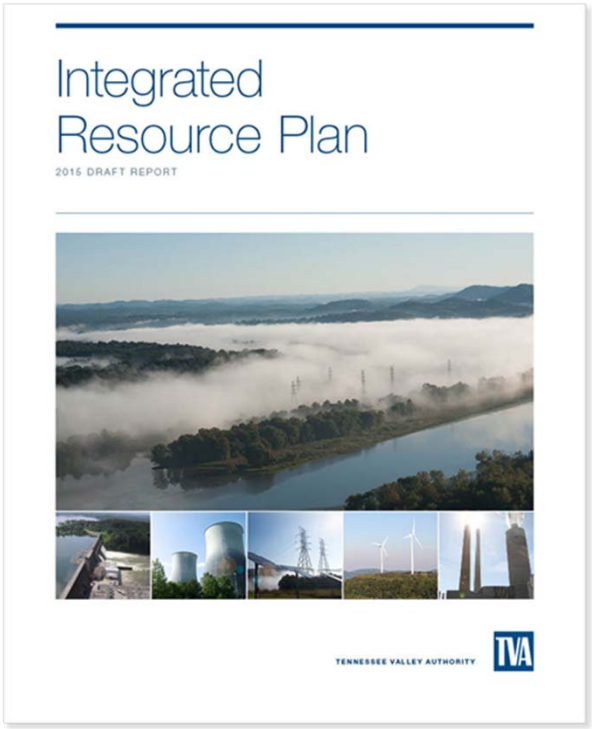
***The 2015 IRP is intended to ensure transparency and enable stakeholder involvement*.**




## Project Activities: February - April

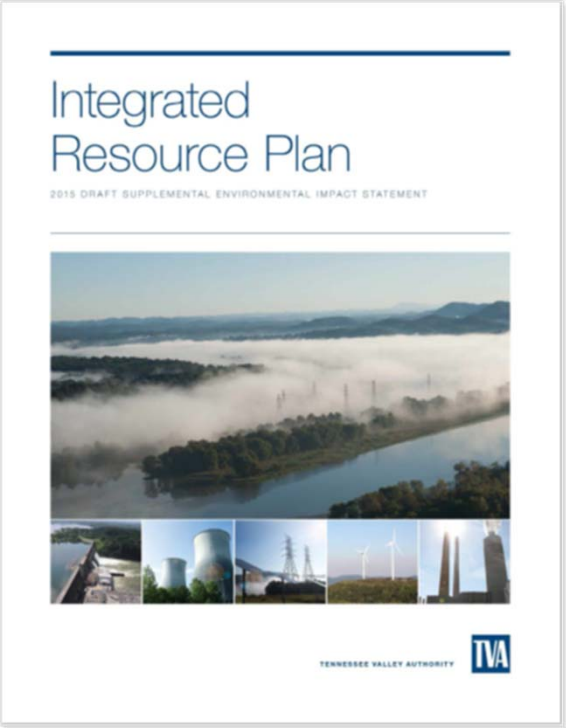
- Draft IRP/SEIS reports published
- Conducting public comment period (closes April 27th)
- Hosting comment sessions on the draft IRP/SEIS
- Complete sensitivity analyses and assess the results

# Overview of Draft IRP Document



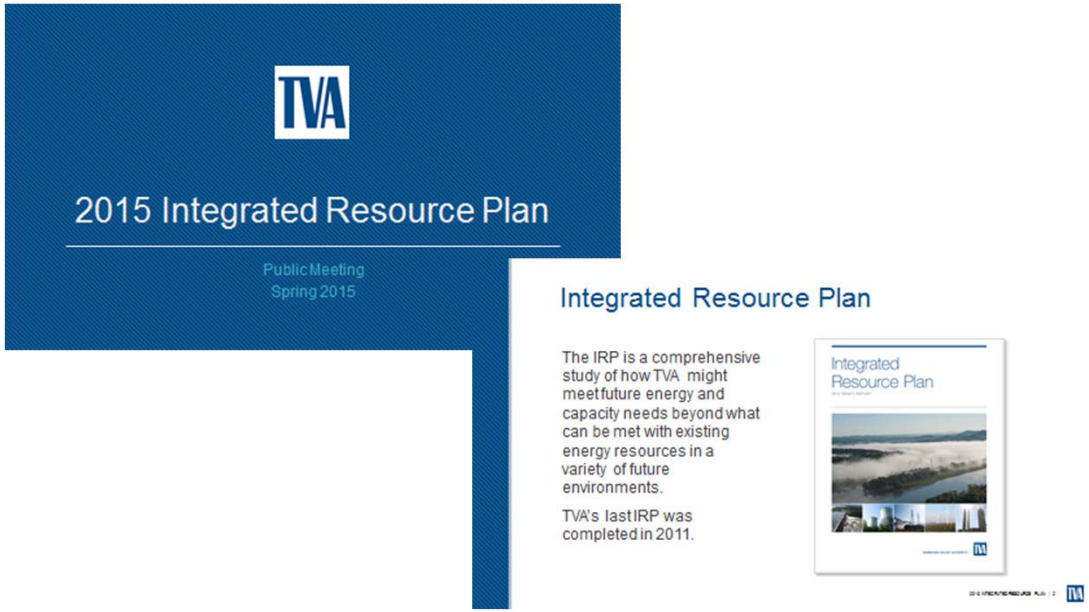

| Chapter | Contents |
|---|---|
| **Chapter 1:** | Introduction |
| **Chapter 2:** | IRP Process |
| **Chapter 3:** | Public Participation |
| **Chapter 4:** | Need for Power Analysis |
| **Chapter 5:** | Energy Resource Options |
| **Chapter 6:** | Resource Plan Development and Analysis |
| **Chapter 7:** | Draft Study Results |
| **Chapter 8:** | Strategy Assessment and Next Steps |
| **Appendices:** | Detailed Data and Supplemental Information |

# Overview of Draft SEIS




| Chapter | Contents |
|---|---|
| **Chapter 1:** | Introduction |
| **Chapter 2:** | Resource Planning Process |
| **Chapter 3:** | TVA Power System |
| **Chapter 4:** | Affected Environment |
| **Chapter 5:** | Energy Resource Options |
| **Chapter 6:** | Alternatives |
| **Chapter 7:** | Anticipated Impacts |
| **Chapters 8-10:** | Literature Cited, Preparers, Draft Document Recipients |

# Public Meetings Underway

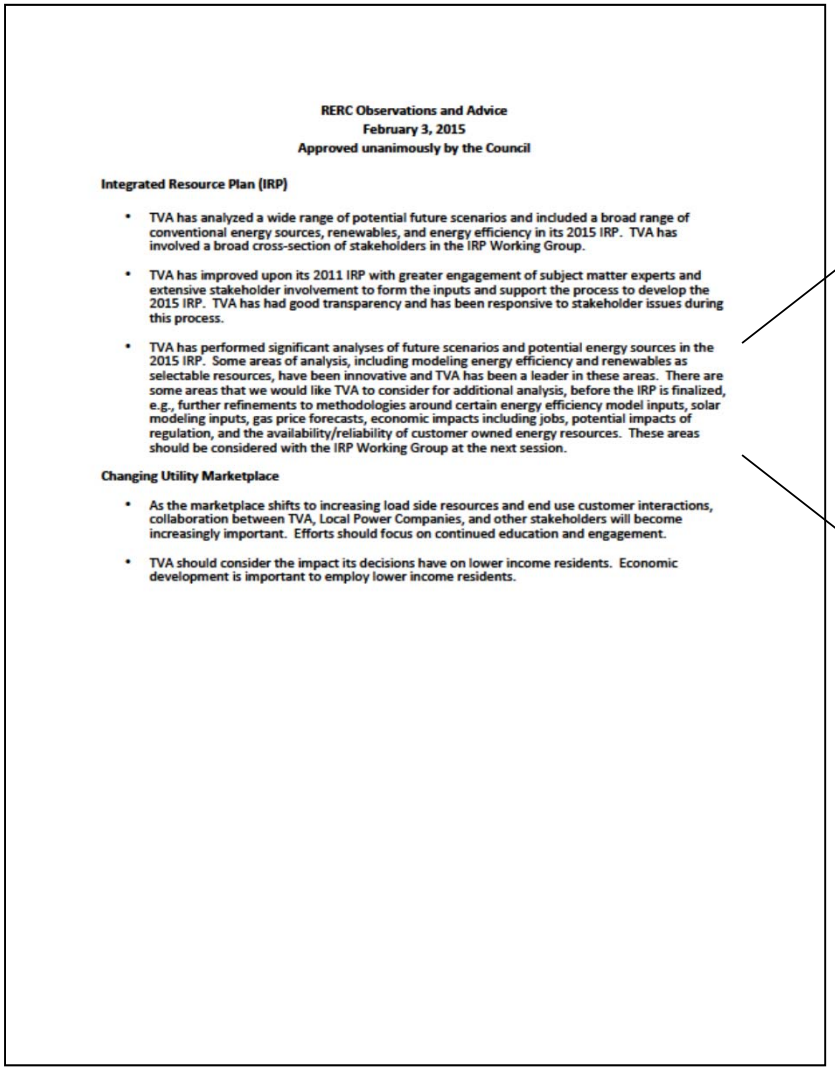



- 7 Regional Public Meetings (March 19 – April 22)
- Presentation and opportunity for Q&A
- Written comments are also being accepted
- More info at [www.tva.gov/irp](http://www.tva.gov/irp)

Two Sessions Remain:

April 21 – Nashville
April 22 – Bowling Green

# RERC Advice on the IRP: About Sensitivity Cases



**RERC Observations and Advice**
**February 3, 2015**
**Approved unanimously by the Council**

**Integrated Resource Plan (IRP)**

- TVA has analyzed a wide range of potential future scenarios and included a broad range of conventional energy sources, renewables, and energy efficiency in its 2015 IRP. TVA has involved a broad cross-section of stakeholders in the IRP Working Group.
- TVA has improved upon its 2011 IRP with greater engagement of subject matter experts and extensive stakeholder involvement to form the inputs and support the process to develop the 2015 IRP. TVA has had good transparency and has been responsive to stakeholder issues during this process.
- TVA has performed significant analyses of future scenarios and potential energy sources in the 2015 IRP. Some areas of analysis, including modeling energy efficiency and renewables as selectable resources, have been innovative and TVA has been a leader in these areas. There are some areas that we would like TVA to consider for additional analysis, before the IRP is finalized, e.g., further refinements to methodologies around certain energy efficiency model inputs, solar modeling inputs, gas price forecasts, economic impacts including jobs, potential impacts of regulation, and the availability/reliability of customer owned energy resources. These areas should be considered with the IRP Working Group at the next session.

**Changing Utility Marketplace**

- As the marketplace shifts to increasing load side resources and end use customer interactions, collaboration between TVA, Local Power Companies, and other stakeholders will become increasingly important. Efforts should focus on continued education and engagement.
- TVA should consider the impact its decisions have on lower income residents. Economic development is important to employ lower income residents.

**There are some areas that we would like TVA to consider for additional analysis**, before the IRP is finalized, e.g., further refinements to methodologies around certain energy efficiency and solar modeling model inputs, gas price forecasts, economic impacts including jobs, potential impacts of proposed legislation or regulation, availability/reliability of customer-owned energy resources. These areas should be considered with the IRP Working Group at the next session.

***The project team reviewed this advice along with suggestions from the IRP stakeholder working group in developing a set of sensitivity cases to test key assumptions used in the study.***

# Sensitivity Analysis: Alignment with RERC & IRPWG

| Sensitivity Case Name | RERC/ EE Se. | IRPWG |
|---|---|---|
| **Nuclear** | | |
| Bellefonte | | |
| AP 1000 | | |
| SMRs | | ✓ |
| **EEDR** | | |
| No EE Resources | ✓ | ✓ |
| No DR Resources | ✓ | ✓ |
| No EEDR Resources | ✓ | ✓ |
| EE Planning Factor Adjustment | ✓ | ✓ |
| EE Ramp Rate Sensitivity | ✓ | ✓ |
| **Renewables** | | |
| Extension of Solar Tax Credits | ✓ | ✓ |
| Slower Solar Cost De-escalation | ✓ | ✓ |
| Slower Wind Cost De-escalation | ✓ | ✓ |
| Higher HVDC Wind NDC & Lower Cost | ✓ | ✓ |

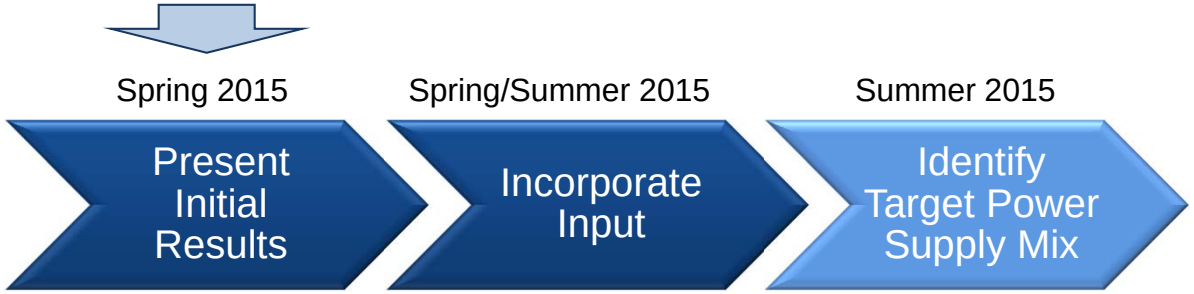
| Sensitivity Case Name | RERC/ EE Se. | IRPWG |
|---|---|---|
| **Resource Sensitivities** | | |
| Pumped Storage | | ✓ |
| Compressed Air Energy Storage | | ✓ |
| PC with CCS | | |
| IGCC with CCS | | |
| Biomass | | |
| **Other Sensitivities** | | |
| Higher load | | ✓ |
| No CO2 | | |
| Low gas price | ✓ | ✓ |
| High gas price | ✓ | ✓ |
| Strategy C Sensitivity | | ✓ |

**The results of these sensitivity cases will be discussed with the Council on day 2**

# 2015 IRP/SEIS Schedule: Draft 2 Final

Public Comment Sessions

| | |
|---|---|
| • 3/19 Chattanooga<br>• 4/6 Knoxville<br>• 4/9 Huntsville<br>• 4/14 Tupelo | • 4/15 Memphis<br>• 4/21 Nashville<br>• 4/22 Bowling Green |




- Draft report posted for comments
- Public Comment Sessions set to accept feedback

IRPWG

RERC

- Review public comments
- Complete additional analyses if needed
- Revise the study report

IRPWG

- Develop study recommendations
- Prepare final report & post
- Request TVA Board action

RERC

# Main Take-Aways from the Draft IRP

- **There is a need for new capacity in every scenario being modelled**
  - New natural gas unit additions in virtually every case; first unit could be added as early as 2020

- **No additional significant baseload expansion indicated currently, beyond Watts Bar Unit 2 and Browns Ferry extended power uprates**
  - Most of the variation in expansion plans is around CTs (peaking units) and Renewables (utility-scale solar & wind)

- **Higher EE and Renewable levels than current budget in all cases**
  - Solar showing up in mid 2020s; HVDC wind generally not until early 2030s
  - Seeing tradeoffs between EE, renewables and gas resources
  - Generally selecting more CTs than CCs – EE is acting as an intermediate resource

# Feedback from the IRPWG on the Draft Report

- **The working group applauds TVA's transparency and hard work**
  - Both the IRP and EIS documents are comprehensive, well written, and the presentation is very effective
  - "It reflects the investment put in the process"

- **Presentation of results is generally clear, but opportunities exist to improve quality**
  - Clarity of some graphics can be increased
  - The explanation of the methodology that has been followed can also be improved (i.e. include some kind of flowgraph)
  - More transparency and clarity around modelling results and assumptions could be added
  - Clarification and alignment with the Clean Power Plan could be included

- **TVA is getting cleaner: "…the IRP demonstrates that least cost planning is consistent with carbon reduction"**
  - All strategies represent a significant carbon reduction
  - Non traditional generation plays a bigger role in all strategies

# Feedback from the IRPWG on the Draft Report (Cont.)

- **This is not your grandfather's IRP: little "new steel" is put in the ground**
  - The working group almost unanimously applauds the new direction pointed by the IRP
  - Transition to non-traditional resources has to be managed carefully
  - TVA must not lose focus on reliability and the obligation to serve
  - Most importantly, the IRP represents a significant implementation challenge

The IRP results indicate over the next decade our portfolio will begin to shift toward more dispersed resources like energy efficiency and solar. This trend will require even closer collaboration between TVA and its local power company partners


# Roundtable: Input From RERC on Draft Report

- The goal of this session is to give each stakeholder an opportunity to speak so that we can capture your input
- We would like to hear from you about your feedback on the draft IRP report: your main observations on findings, the format and the information provided
- Guidelines
  - Each member will have three minutes to discuss any observations, feedback, questions, or input
  - Stakeholders will be respectful while others are speaking and respectful of the time limit when it is his/her turn to provide input
  - This is not a time for debate or response. During this session, we want to capture each participant's input

# TVA Board IRP Public Session - Today

- Explore challenges and opportunities related to the evolution of the supply and demand side portfolio indicated by the preliminary findings in the 2015 IRP
- Discussion of policy, technical, and social implications of the changing business environment
- Three panel segments
  - Looking Ahead in Renewables
  - Looking Ahead in Energy Efficiency
  - The Changing Utility Landscape
- Public comment (listening) session

# Tennessee Valley Authority

# Regional Energy Resource Council

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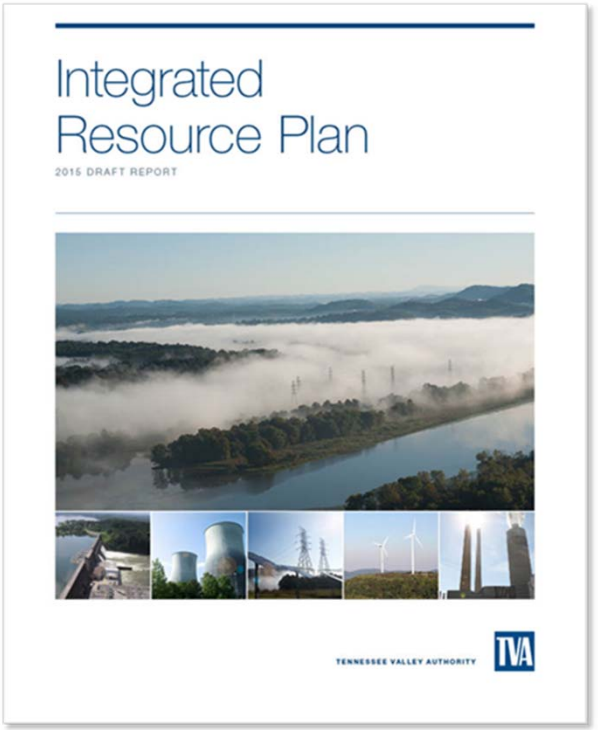
# RERC Observations

# February 2015 Meeting Purpose

- Provide update and briefing on preliminary results of the IRP
- Develop advice around the IRP process to date in terms of range of resources studied, depth of analysis, stakeholder involvement and continuing to provide low-cost, reliable power
- Introduce emerging energy policy issues for discussion and future consideration



# Watts Bar Unit 2 Update

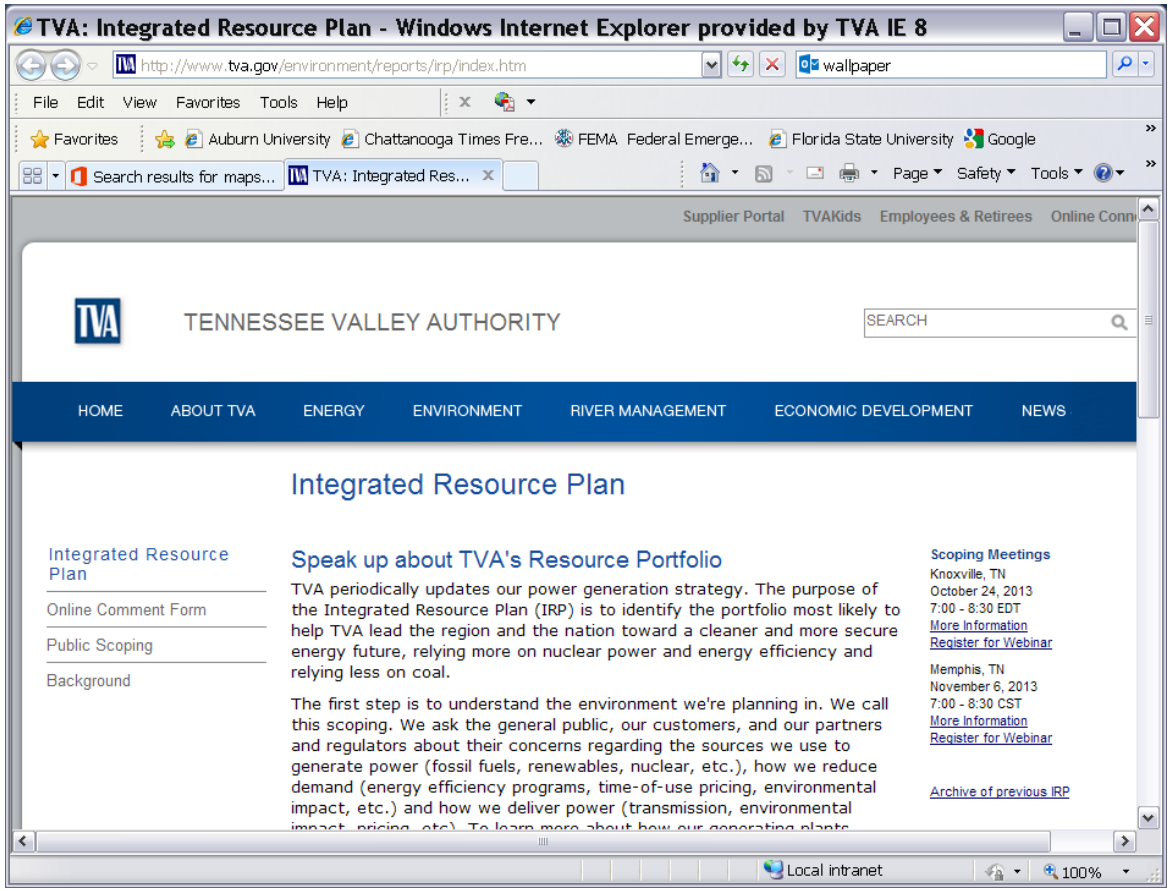
**Status:**

- 97% Complete
- Comprehensive testing in progress
- Moving through regulatory licensing process
- Readying for dual-unit operations
- Significant work and challenges ahead


**Benefits:**

- 1,150 MW of clean, carbon-free energy
- Estimated to avoid 6-8 million tons of carbon dioxide emissions annually
- Increases portfolio diversity and controls fuel costs

# Comments on the Draft Study Results




**Various Methods to Accept Comments:**

**Speak to staff at the public briefings**

**Complete a comment card**

**Use the online IRP comment form www.tva.gov/irp**

**Or send an email to irp@tva.gov**

# Summary of Public Comments Received to Date

| Topic | Comments |
|---|---|
| Strategic direction | – Generally positive strategic direction being signaled by the IRP<br>– Maximize Energy Efficiency and consider alternate delivery methods<br>– General support for increased use of solar energy |
| Portfolio | – Make more investment and funding of EE programs<br>– Use storage to reduce intermittence issues<br>– Test a strategy with a majority of renewable resources<br>– Comments about the uncertainties on natural gas supply/price<br>– Comments that cost assumptions for Energy Efficiency and Renewables seem too high<br>– Concerns over impacts from extraction of natural gas<br>– Some questions about overall cost of the plans; concern about cost increases in the future |
| Environment | – Comments on the environmental impact of continuing using coal<br>– Questions on modeling the impact on public health<br>– Select the strategy with the lowest CO2 emissions |

# Summary of Public Comments Received to Date

| Topic | Comments |
|---|---|
| Model Assumptions | – Questions on source of data for renewables and energy efficiency<br>– Challenges on the assumptions around uncertainty in the performance of energy efficiency<br>– Questions about risk for natural gas price and availability<br>– A concern around accuracy of power demand forecasts |
| Financials | – Low cost (and reliability) must be the key criteria for all plans<br>– Consider the final cost to the system in the model; are all costs fully considered?<br>– Include LPC lost revenue in the cost model |
| Socioeconomics | – Consider the social impact of increased levels of EE and renewables<br>– Are consumers willing to pay more for renewables?<br>– Increase the efforts in customer education<br>– Some suggestions about encouraging a less consumer-driven attitude toward energy use |

# IRP Sensitivity Case Runs and Preliminary IRP Results

Tom Rice

Senior Manager, Capacity Planning and Fleet Strategy

# Sensitivity Cases

- In February, the RERC suggested additional areas of analysis in its advice statement
- The IRP Working Group and TVA staff also requested several sensitivity case runs
- Today's discussion will cover sensitivity case results designed to further refine methodologies and recommendations around energy efficiency and solar modeling inputs, test gas price forecast assumptions, as well as other key drivers

# Sensitivity Analysis Cases

| Sensitivity Case Name |
|---|
| **Nuclear Sensitivities** |
| Bellefonte U1 and U1 & U2 |
| AP 1000 |
| Small Modular Reactors (SMRs) |
| **Energy Efficiency and Demand Response (EEDR) Sensitivities** |
| No EE Planning Factor Adjustment |
| Faster EE Ramp Rate |
| No EE Resources |
| No DR Resources |
| No EEDR Resources |
| **Renewable Sensitivities** |
| Extension of Solar Tax Credits |
| Extension of Wind Tax Credits with Higher Guaranteed Net Dependable Capacity (HVDC wind) |
| Slower Solar Cost De-escalation |
| Slower Wind Cost De-escalation |

| Sensitivity Case Name |
|---|
| **Resource Sensitivities** |
| Pumped Storage |
| Compressed Air Energy Storage |
| Pulverized Coal with Carbon Capture and Sequestration (CCS) |
| Integrated Gasification Combined Cycle (IGCC) with CCS |
| Biomass |
| **Key Driver Sensitivities** |
| Higher load |
| No CO2 |
| Low gas price |
| High gas price |
| Strategy C Sensitivity |

# Nuclear Sensitivities

| Sensitivity Case Name | Comments |
|---|---|
| **Nuclear** | |
| Bellefonte Unit 1 | Force BLN into plan (U1 in 2026) |
| Bellefonte Unit 1 and Unit 2 | Force BLN into plan (U1 in 2026, U2 in 2028) |
| AP 1000 | Force AP 1000 into plan in 2028 |
| Small Modular Reactors (SMRs) | Force SMRs into plan in 2028 |

# Summary: Nuclear Sensitivities

- New nuclear additions result in higher overall system costs than reference plan but would deliver value beyond the study window. Cost-sharing is not included for SMRs but would render those options more attractive
- Short-term system average costs are higher with nuclear builds but long-term average costs are similar to non-nuclear cases
- New nuclear units eliminate the need for natural gas builds and some renewables, since they were the primary expansion units in the reference case; EE levels similar to reference plan
- Energy profile and CO2 emissions are significantly different as nuclear units replace gas, renewable, and coal generation

# EEDR Sensitivities

| Sensitivity Case Name | Comments |
|---|---|
| **EEDR** | |
| No EE Planning Factor Adjustment | Remove planning factor adjustment |
| EE Ramp Rate Sensitivity | Increase initial and lower out year ramp rates:<br>2014-2017 → 25% ramp rate<br>2018-2022 → 40% ramp rate<br>2023-2025 → 30%, 20%,15% ramp rate respectively<br>2026-2033 → 10% ramp rate |
| No EE Resources | No EE expansion in plan (with exception of minimum EPA requirements) |
| No DR Resources | No DR expansion in plan |
| No EEDR Resources | No EE or DR expansion in plan (with exception of minimum EPA requirements) |

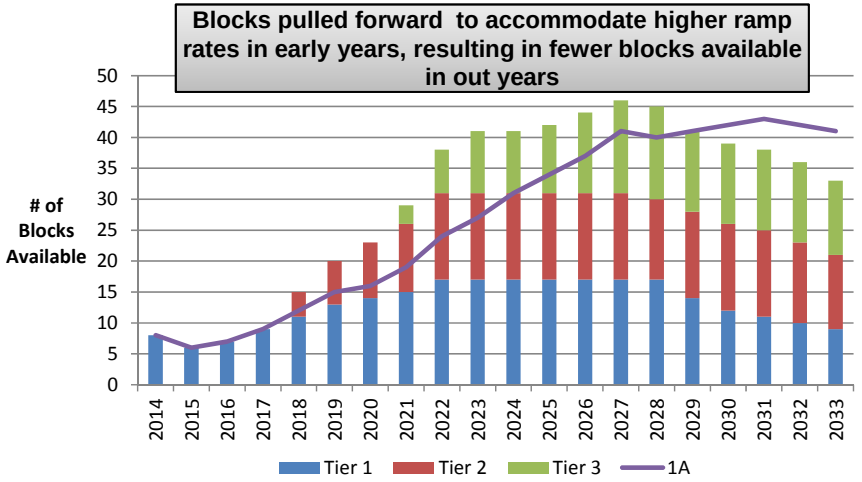
# EE Sensitivity Case Assumptions

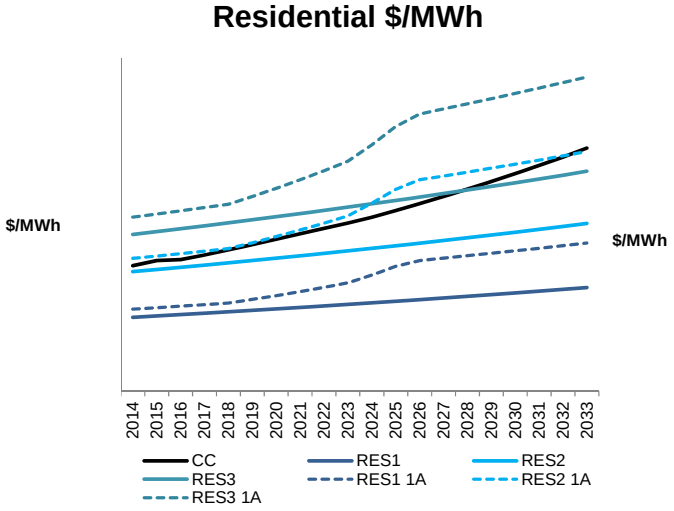
## Ramp Rate Sensitivity

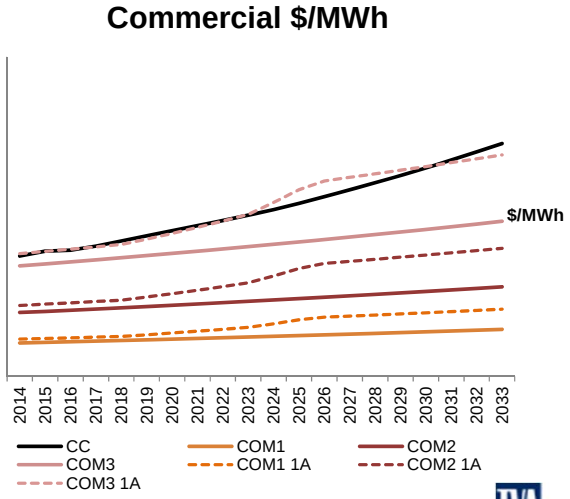
- Same energy amounts assumed available as reference plan with faster initial ramp rate (up to 40% over near term)

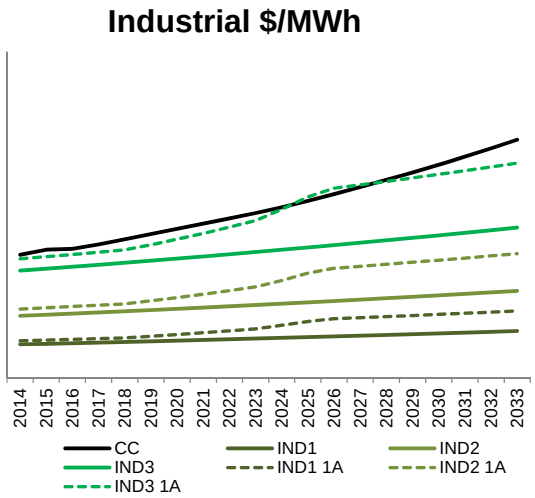
## Planning Factor Sensitivity

- Stakeholder questions around impact of long term planning factor adjustment in reference case (case 1A)
- Sensitivity case removed this adjustment which lowered out-year EE costs as shown below



# Summary: EE Sensitivity

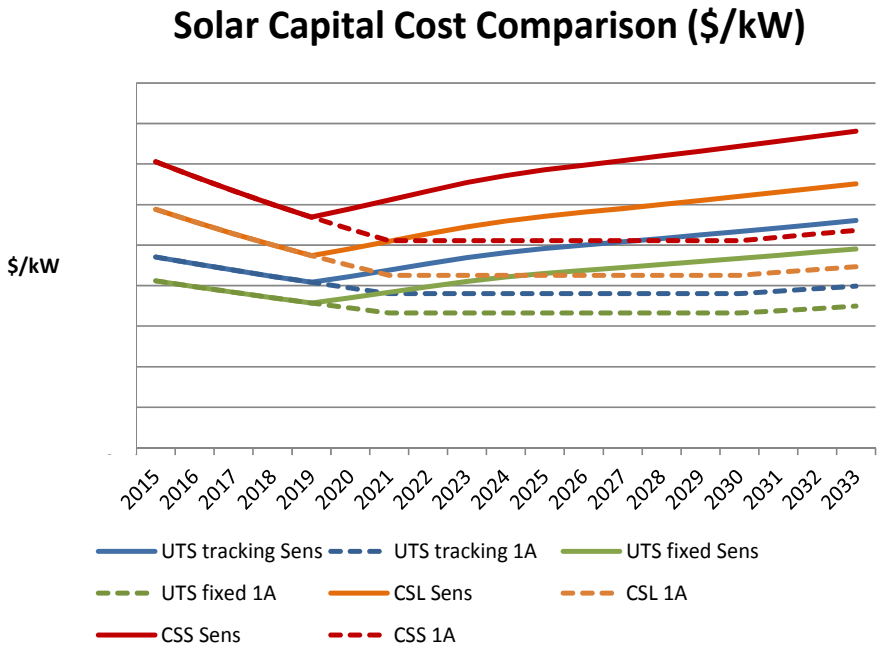
- Removing the planning factor adjustment results in generally the same EE volumes as reference case (case 1A) through 2023, increasing thereafter to midway between the reference case and the Maximize Energy Efficiency strategy (case 1D) by 2033
- Increasing the ramp rate in the early years of the study results in small increases in EE by 2033 with slightly more selections near to mid term and little impact to overall system cost
- Higher volumes of EE equate to higher system average costs, and there is a tradeoff between average system cost and total system costs (PVRR) even in the reference case
- EE as a resource continues to be demonstrated in model results:
  - EE programs eliminate the need for CT and CC builds as well as some renewable purchases. EE volumes reduce generation from gas, coal, and renewable resources
  - Demand response programs generally eliminate the need for CT builds and market purchases

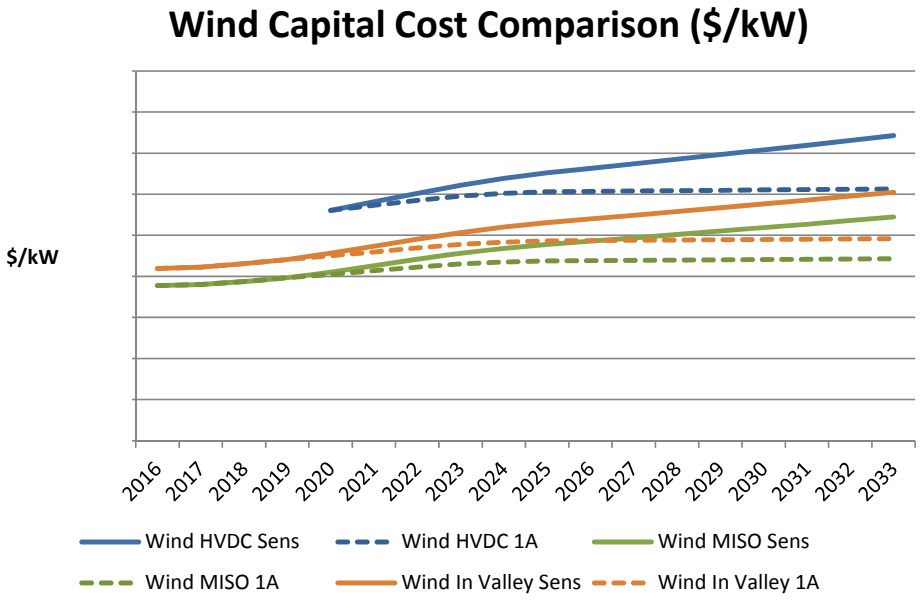
# Renewable Sensitivities

| Sensitivity Case Name | Comments |
|---|---|
| **Renewable Sensitivities** | |
| Extension of Solar Tax Credit | Extend solar tax credits at existing levels and lower price for 1,000 MW at prime sites |
| Low-cost HVDC Wind with high guaranteed Net Dependable Capacity | Extend tax credits and lower cost for HVDC wind while increasing net dependable capacity |
| Slower Solar Cost De-escalation | Costs maintain original trajectory until 2020 and then increase at inflation |
| Slower Wind Cost De-escalation | Costs maintain original trajectory until 2020 and then increase at inflation |

# Solar and wind escalation sensitivities

- Base case assumed solar de-escalation at 3.5% until 2020, then 0% escalation until 2030, after which it escalated at inflation
  - Slower solar cost de-escalation sensitivity case has de-escalation rate of 3.5% until 2020 and remains flat with inflation thereafter
- Base case assumed wind escalation varied between 0.7% - 2.2% until 2026 after which it remained mostly flat at a rate of 0.1% (lower than rate of inflation)
  - Wind escalation sensitivity case assumes wind capital costs rise with inflation over time



# Summary: Renewable Sensitivities

- Extending wind tax credits, lowering costs, and providing a higher guaranteed net dependable capacity results in additional wind selections as early as 2020
- Assuming a tax credit extension and lower prices driven by availability of favorable solar sites, utility-scale solar tracking is selected as early as 2020.
- Increasing solar escalation rates pushes out utility-scale solar selection to 2029 and halves the volume compared to reference case
- Increasing wind escalation rates pushes out wind selection to beyond 2033. In 2033, a CC build replaces wind HVDC
- As seen in other sensitivity cases, these results are also highly sensitive to gas prices

# Resource Sensitivities

| Sensitivity Case Name | Comments |
|---|---|
| **Resource Sensitivities** | |
| Pumped Storage | Force pumped storage into plan in 2028 |
| Compressed Air Energy Storage | Force CAES into plan in 2028 |
| Pulverized Coal with Carbon Capture & Sequestration (CCS) | Force PC with CCS into plan in 2028 |
| Integrated Gasification Combined Cycle (IGCC) with CCS | Force IGCC with CCS into plan in 2028 |
| Biomass | Force Biomass option into plan in 2028 |

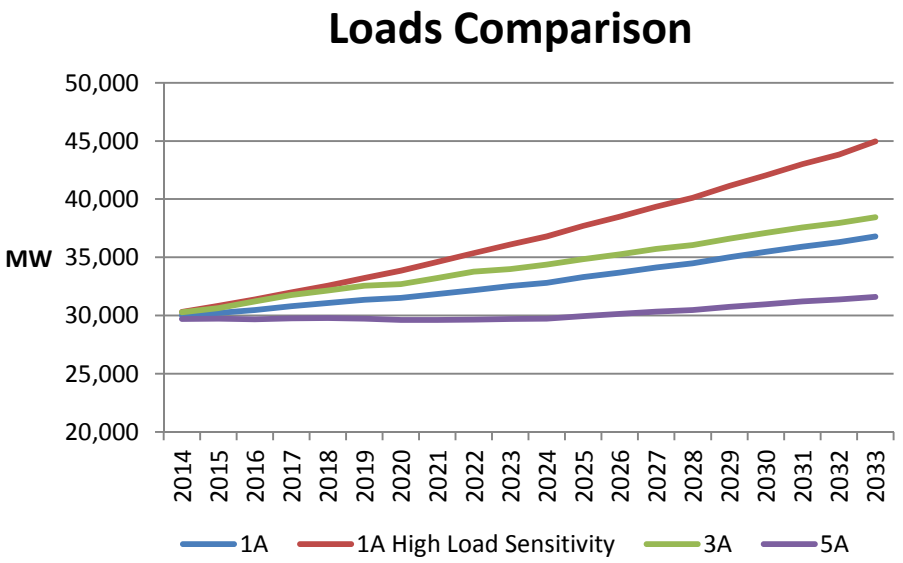
# Summary: Resource Sensitivities

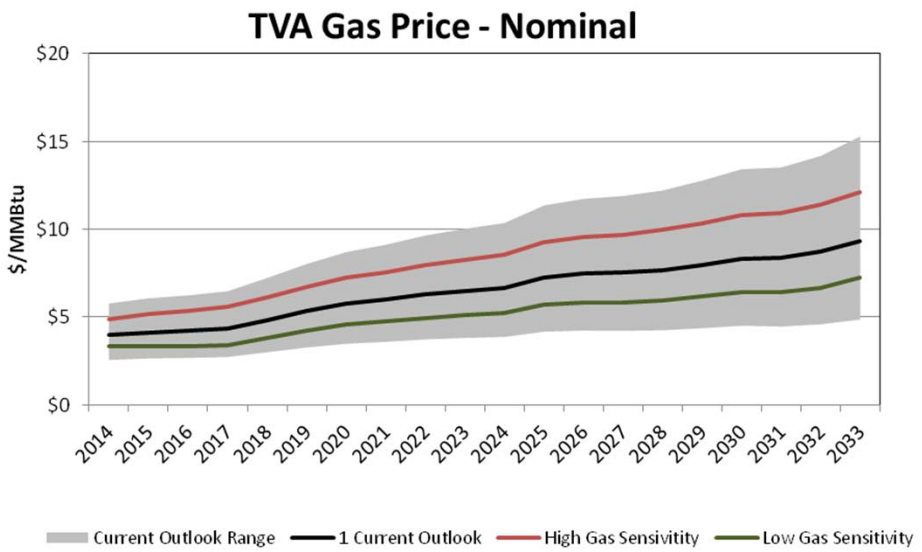
- Coal options: generally displace demand response, natural gas, and renewable generation. Each coal option increases total system costs
- Biomass: offsets small amounts of demand response
- Pumped storage: offsets future gas generation and some renewables
- CAES:  offsets demand response and renewables

# Key Driver Sensitivities

| Sensitivity Case Name | Comments |
|---|---|
| **Other Sensitivities** | |
| Higher load | Test scenario with faster load growth than Growth Economy case |
| No CO2 | Remove CO2 assumptions from reference case |
| Low gas price | Lower gas and market electricity prices |
| High gas price | Higher gas and electricity prices |
| Strategy C Sensitivity | Change PPA terms to 20 years; fully recover asset costs over PPA term |

# Key Driver Sensitivities



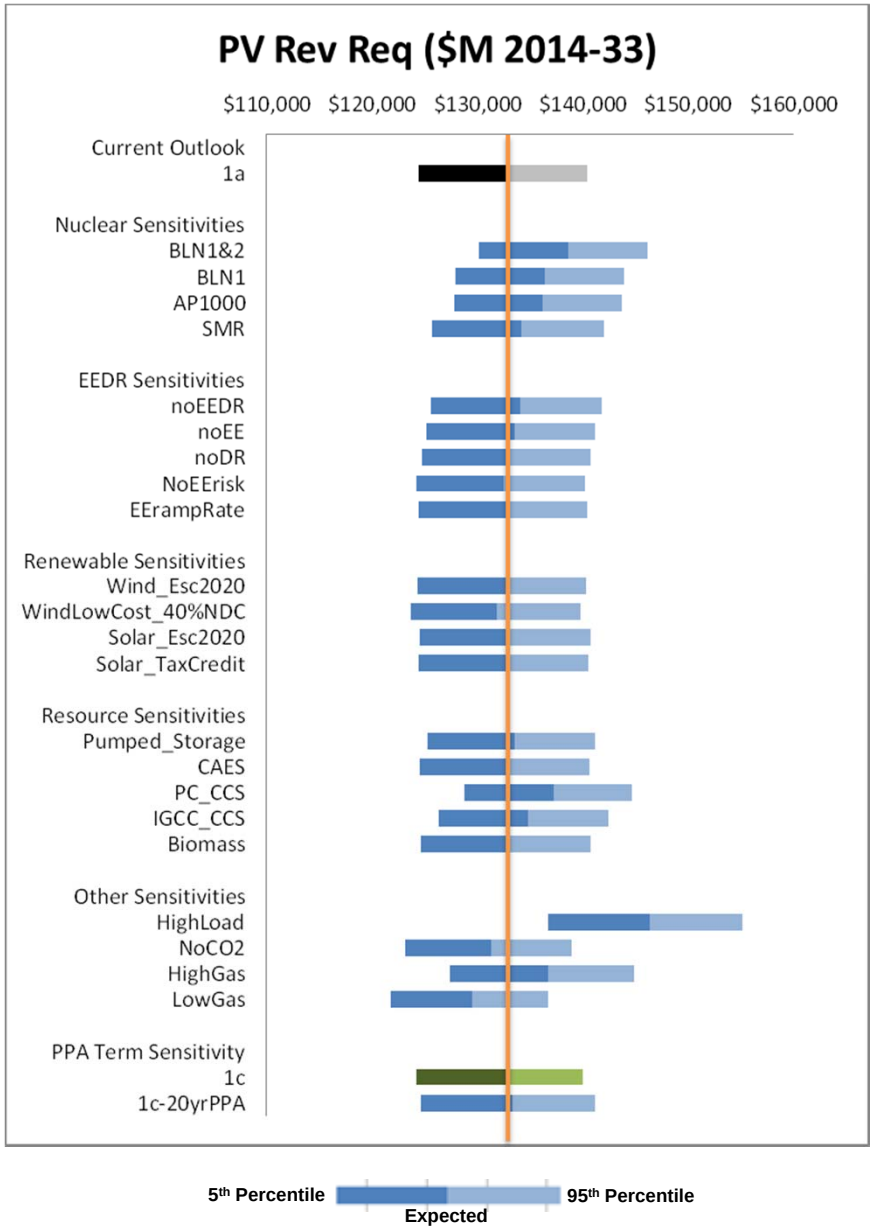




- Load Sensitivity:
  - The load CAGR for the reference case (1A) was 1.05%
  - The load CAGR for the Growth Economy scenario (3A) was 1.2%
  - The high load sensitivity has a load CAGR of 2.1%
- Natural Gas sensitivity
  - The reference case (1A) gas prices ranged from $4 - $13/mmBTU
  - Low gas price sensitivity ranges from $ 3 - $10/mmBTu
  - High gas prices range from $ 5 - $16.5/mmBTU

# Sensitivity Summary: Key Drivers

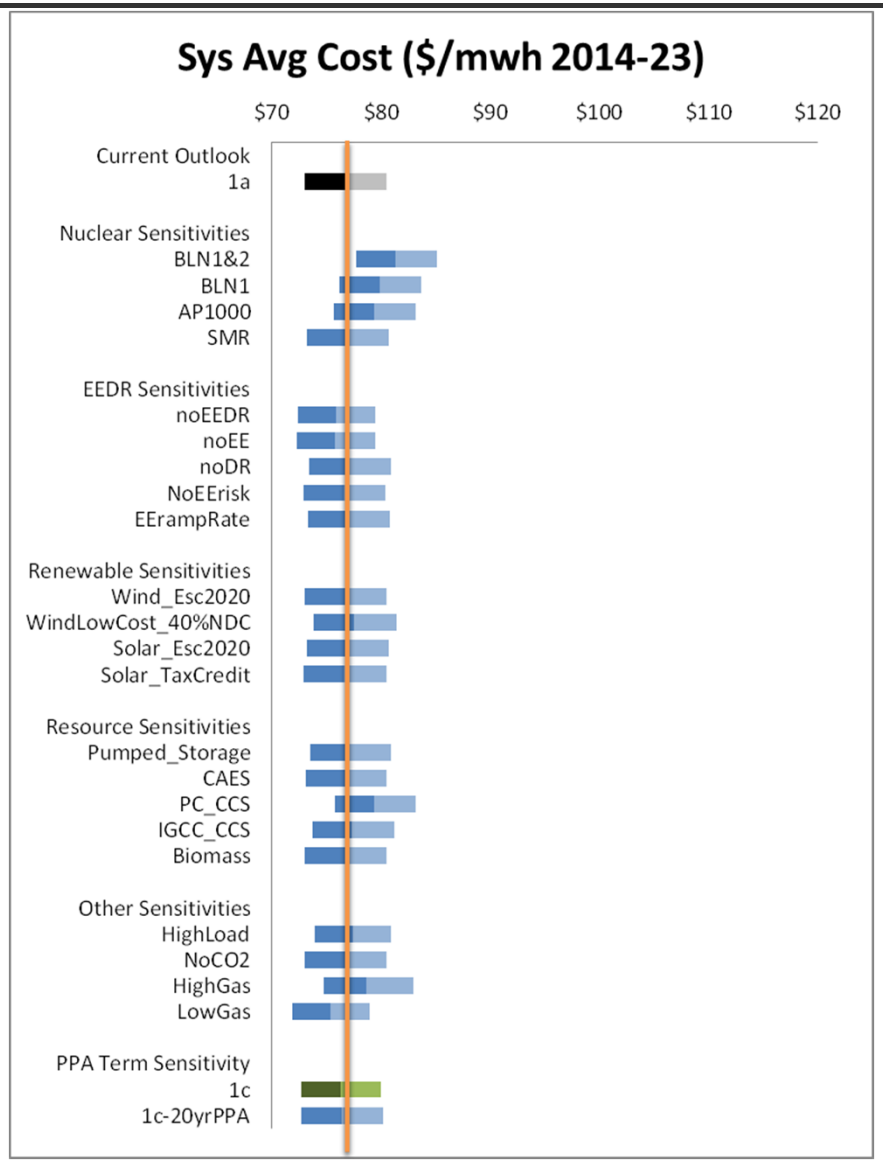
- High load sensitivity: higher needs supplied primarily by new CC and CT builds and market purchases; renewables and EE remain similar to reference case
- Low gas sensitivity: more CT/CC builds and coal retirements; less renewable purchases and energy efficiency
- High gas sensitivity: fewer CT/CC builds; more renewable purchases and controlled coal
- No CO2 sensitivity: more controlled coal; less renewable purchases
- Strategy C Sensitivity:
  - More renewable purchases than original Strategy C; fewer natural gas PPAs
  - Higher system average cost than original Strategy C and reference case; better reflects current market conditions

# Total System Cost Ranges



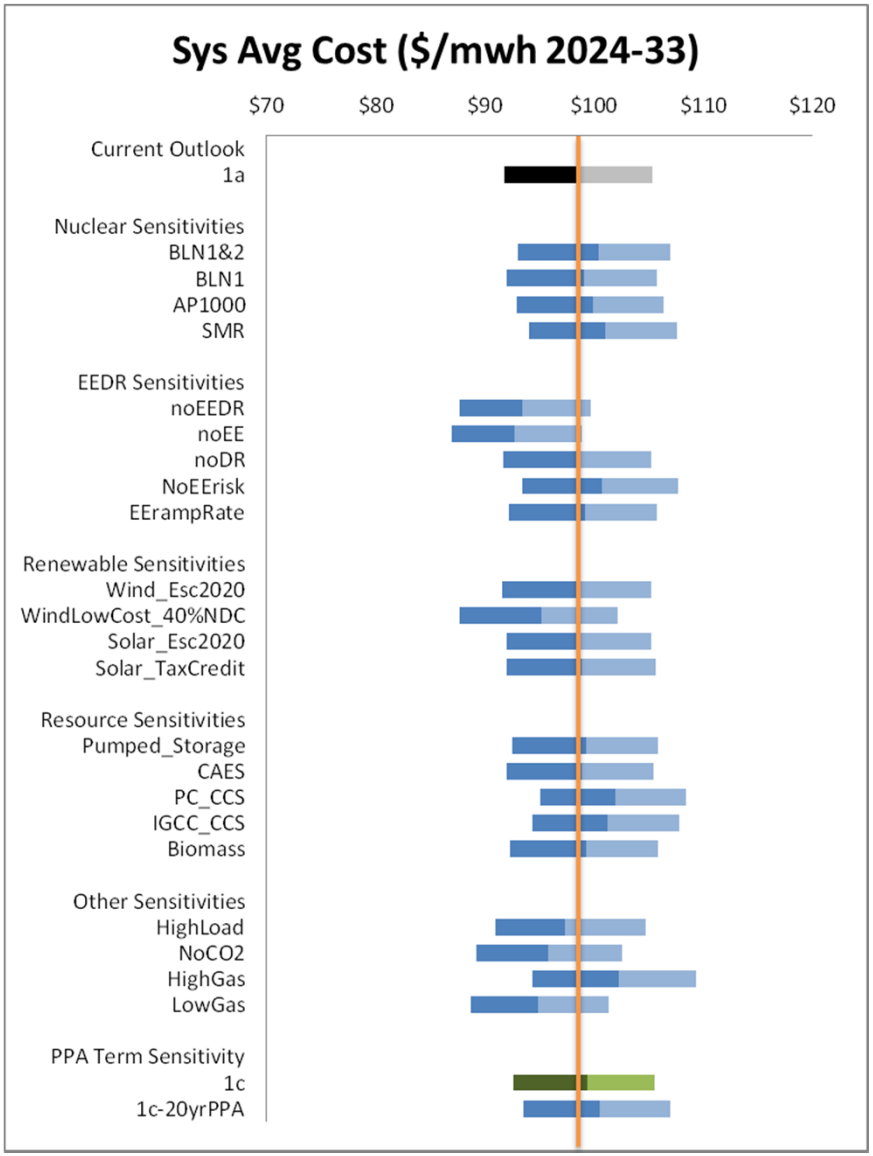

- Cases with higher PVRR include
  - Nuclear cases
  - PC with CCS and IGCC with CCS
  - High load and high gas
- Case with lower PVRR include
  - No CO2 and Low gas

# Short-Term System Average Cost Ranges



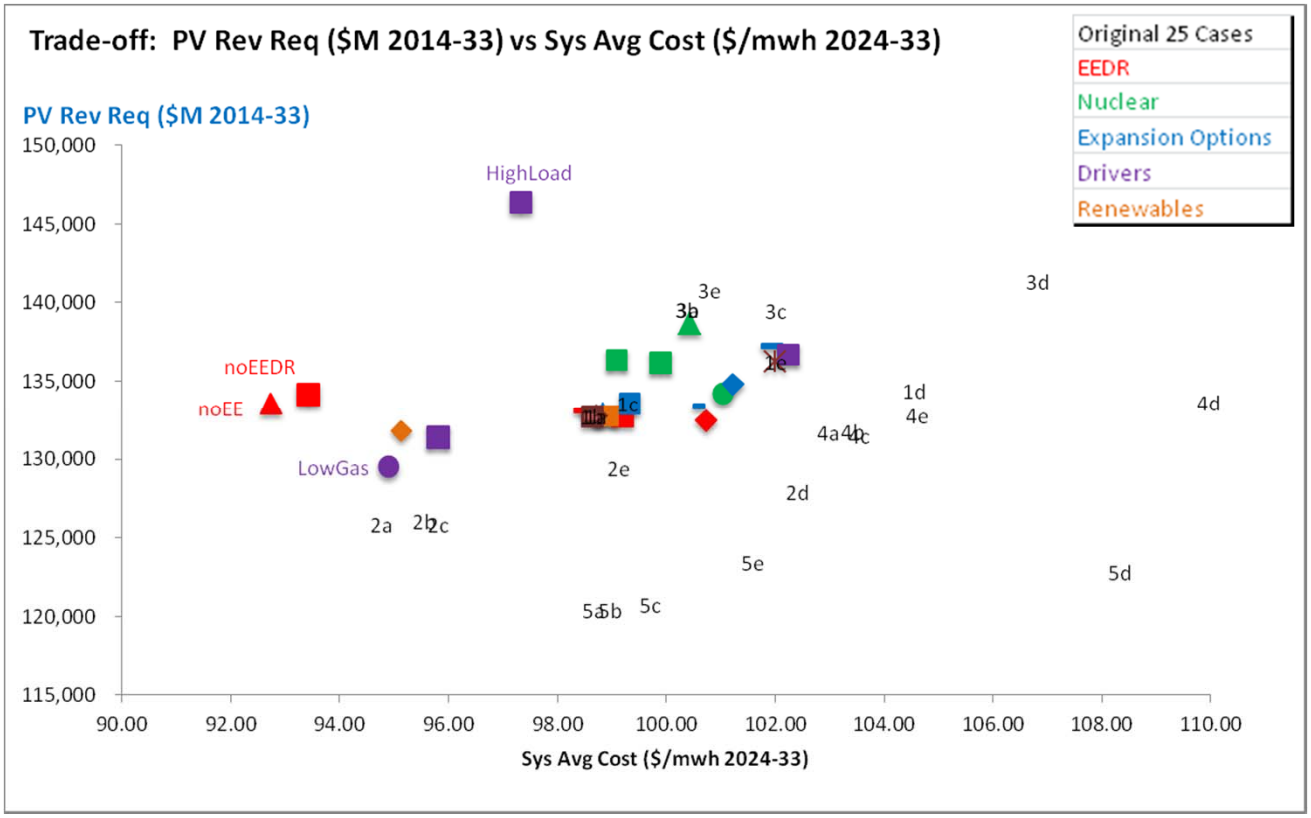

- Over the first 10 years, many system average costs are similar
- Investing in large base load assets tends to increase system average cost of the first 10 years as they are funded
- As expected, high gas case results in higher cost
- The low gas price and no EE cases show lower system average costs in the short term

# Long-term System Average Cost Ranges




- Cases with higher long-term System Average Costs include
  - Nuclear cases
  - EE without risk adjustment
  - PC with CCS and IGCC with CCS
  - High gas
- System average cost impacts of increased EE are similar to nuclear build
- Case with lower long-term System Average Costs include
  - No EEDR and No EE
  - Low-cost HVDC Wind (tax credits extended) with high guaranteed Net Dependable Capacity
  - No CO2 and Low gas

# Total System Cost vs. System Average Cost




- This plot illustrates the tradeoff between total plan cost (PVRR) and long term system average cost for the original 25 IRP cases and the 25 IRP sensitivity cases
- Sensitivity cases are generally consistent with original scenario + strategy cases, suggesting we have robust boundaries for analysis

# Preliminary Sensitivity Conclusions

- New nuclear or coal assets would offset gas builds and renewable purchases
  - Nuclear additions increase total cost but lower fuel risk
  - Cost-sharing would render SMRs more attractive; nuclear license expirations may occur just beyond study window
- Original EE case results (Maximize Energy Efficiency Strategy) still form an effective boundary for EE results
  - Planning factor adjustment impacts selection in later years; increasing near-term ramp rates does not materially change trajectory or costs
  - Energy efficiency programs eliminate the need for CT and CC builds as well as some renewable purchases
  - Higher volumes of EE result in higher system average costs – this is evident even in reference case. In some cases, impact to average cost is similar to nuclear builds
- Renewable selection is highly dependent on gas price assumptions, load, and unit cost and characteristics
- Revised Strategy C parameters appear to produce more reasonable results on financial and uncertainty measures
- Natural gas pricing remains a key sensitivity

**Sensitivity cases suggest that original scenario and strategy cases still form effective boundary for results**

# IRP Direction: The Future of Our Energy Supply

- TVA power will still be reliable, affordable and sustainable
- We will rely more on cost-effective energy efficiency
- There will be more solar and wind power, and less coal
- Natural gas will play a bigger role
- TVA will continue to provide for economic growth in the Tennessee Valley

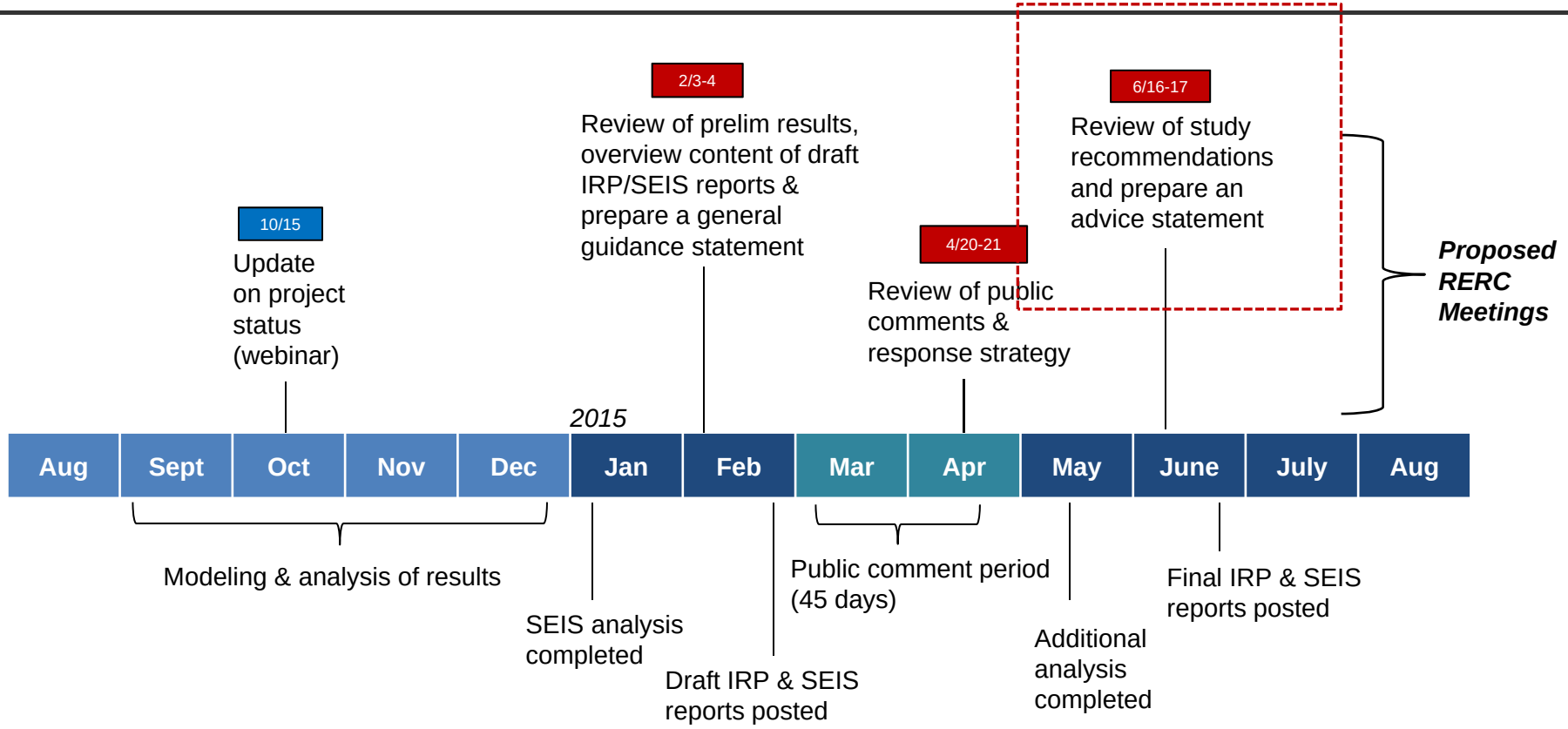
# Break

# RERC Discussion Questions

1. What are your thoughts on the preliminary IRP direction for meeting TVA's future energy needs in terms of:
   - Balanced Portfolio
   - Cleaner
   - Low Cost
   - Reliable

2. What are your thoughts on the challenges and opportunities related to IRP implementation while meeting TVA's mission:
   - Energy (low cost, reliable, cleaner)
   - Environment (stewardship)
   - Economic Development?

# RERC Engagement




*The meetings shown on this timeline are focused on providing the RERC with sufficient information to develop an advice statement on the IRP. More detailed discussions are scheduled with the IRP stakeholder working group that assist TVA in development of the final IRP study report.*

# Next Steps: Upcoming Meetings

- **Summer Meeting:** June 16-17, 2015

  **Location:** Knoxville

  **Topic:** Final IRP review and statement to TVA Board


Thank you and Please Travel Safely!