To change the view, select icon. In Thumbnail view (1 default), the focus shifts to the shared content when someone starts sharing. The Side-by-Side View (2 middle selection) allows you to view the shared content next to videos of presenters.

Q&A: Ask a question here and direct to All Panelists or an individual.
Welcome
Althea Jones
## Agenda

<table>
<thead>
<tr>
<th>Topic</th>
<th>Who</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welcome</td>
<td>Althea Jones</td>
<td>12:30</td>
</tr>
<tr>
<td><strong>2019 IRP Near-term Action Update</strong></td>
<td>Jane Elliott</td>
<td>12:45</td>
</tr>
<tr>
<td>Regional Grid Transformation</td>
<td>Gary Brinkworth</td>
<td>1:15</td>
</tr>
<tr>
<td>Energy Programs Potential Study</td>
<td>Ray Knotts</td>
<td>1:30</td>
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<tr>
<td>Break</td>
<td>All</td>
<td>1:45</td>
</tr>
<tr>
<td>Electric Vehicles</td>
<td>Ray Knotts</td>
<td>1:55</td>
</tr>
<tr>
<td>TVA Renewables</td>
<td>Ethan Ogle</td>
<td>2:05</td>
</tr>
<tr>
<td>Q&amp;A</td>
<td>All</td>
<td>2:30</td>
</tr>
</tbody>
</table>
COVID-19 Response

$200 Million Pandemic Relief Credit
2.5% Rate Credit

Regulatory Relief and Flexibility for Local Power Companies

Community Care Fund
More Than $4 Million in Matching Funds Disbursed
Investing More Than $10 Million In Back-to-Business Incentive Program

Investing Additional $2 Million Community Care Fund
Update on 2019 IRP
Near-term Actions
Jane Elliott
IRP Evaluated Scenarios and Options to Meet the Valley’s Future Electricity Needs

The IRP strives to achieve six key goals:

- Low Cost
- Risk Informed
- Environmentally Responsible
- Reliable
- Diverse
- Flexible
2019 IRP Focused on Flexibility

Focus Areas:
- Distributed Energy Resources (DER)
- System Flexibility
- Portfolio Diversity
Utilized Rigorous Analytical Process

Stakeholder and public comments informed the scope, as well as the additional sensitivity analyses to test the impact of changes in key assumptions.
2019 IRP Results Indicate:

- Over the next 20 years
- Up to 14 GW solar additions (nameplate)
- Up to 5 GW storage additions

All portfolios point to a TVA power system that will be LOW COST, RELIABLE, and CLEAN.

- 2 to 17 GW Natural Gas Additions
- Evaluation of additional coal and gas retirements
- Projected 70% reduction in CO₂ intensity (lbs/MWh)

Average results from 2005 baseline
Signposts to Guide Long-Term Actions

- Changing market conditions
- More stringent regulations
- Technology advancements
Signpost Changes since the IRP

**Demand for electricity**
- Increased data center load, largely offset by COVID impacts

**Natural gas prices**
- Lower fundamental prices over the long-term

**Customer expectations**
- Acceleration of renewables due to customer demand

**Regulatory requirements**
- Effluent Limitation Guidelines rule, election results, etc.

**Operating costs for existing units**
- Better understanding of fleet investments needed, helping inform portfolio direction

**Solar and wind costs**
- Competitive solar RFP offers, with forecasts pointing to continued decline

**Emerging and developmental technologies**
- Continued advancements in storage; DOE and utility interest in advancing Small Modular Reactors
Near-Term Actions Recommended in the IRP

Renewables & Flexibility
- Add solar based on economics and to meet customer demand
- Enhance system flexibility to integrate renewables and distributed resources
- Evaluate demonstration battery storage to gain operational experience

Existing Fleet
- Pursue option for license renewal for TVA’s nuclear fleet
- Evaluate engineering end-of-life dates for aging fossil units to inform long-term planning

Energy Usage
- Conduct market potential study for energy efficiency and demand response
- Collaborate with states and local stakeholders to address low income energy efficiency
- Collaboratively deploy initiatives to stimulate the local electric vehicle market

Distribution Planning
- Support development of Distribution Resource Planning for integration into TVA’s planning process
Renewables & Flexibility: Solar Fleet Strategy

- **MARKET FORCES DRIVE RENEWABLE NEEDS**
- **LAND REQUIREMENTS ARE KEY CONSTRAINT**
- **STRATEGIC APPROACH TO IMPLEMENTATION**

**CUSTOMER DEMAND**

**LAND REQUIREMENTS**

- Acres per MW

**COMPETING LAND USES**

- Economic Development
- Agricultural
- Power Generation

**FOCUS AREAS**

- Procurement
- Pipeline
- Partnerships

**COST-COMPETITIVENESS**

- **RE 100**

**RENEWABLE SOLUTIONS**

- TVA-driven
- Customer-driven
- Flexibility-enabled

**PRICE OF SOLAR HAS DECLINED BY A FACTOR OF EIGHT OVER THE LAST DECADE**

Source: Lawrence Solar Study 2019
Renewables & Flexibility: Solar Expansion

<table>
<thead>
<tr>
<th>PARTNER FLEXIBILITY</th>
<th>To provide flexibility for Valley Partners to meet local customer solar needs</th>
<th>Up to 2,000 MW if all LPCs were to become partners and added max amount of solar</th>
</tr>
</thead>
<tbody>
<tr>
<td>GREEN INVEST</td>
<td>To meet customer needs for utility-scale solar beyond Partner Flexibility</td>
<td>1,200 MW contracted with 2020 RFP signings underway; some include storage</td>
</tr>
<tr>
<td>TVA BUILDS</td>
<td>To gain direct experience with solar builds to inform future builds or PPAs</td>
<td>First TVA solar site of 200 MW planned in Lawrence County, AL (online by Dec 2023)</td>
</tr>
<tr>
<td>FUTURE SOLAR</td>
<td>Balance of additions to meet system needs, which could be a mix of PPAs and TVA builds</td>
<td>Additional solar expansion expected beyond those noted above, consistent with the IRP</td>
</tr>
</tbody>
</table>
Renewables & Flexibility: Integrating Solar

Aeroderivative Combustion Turbine

- Highly flexible gas units with non-start based maintenance
- Efficient heat rate and full power in 10 minutes
- TVA Board approved 500-600 MW of Aeroderivatives expected to come online by end of 2024

Utility-scale Battery Storage

- Efficient movement within operating range to store or generate across and within hours
- Pursuing initial battery projects to demonstrate on the system
- TVA Board approved 20 MW / 2-hour battery, and TVA signed 50 MW / 4-hour battery (paired with solar) to come online by end of 2023; 2020 RFP signings underway
Existing Fleet: Nuclear Fleet Relicensing

- Pursue NRC Operating License Renewal for all seven nuclear units out to 80 years
- Assess nuclear unit upgrades or modifications required to achieve 80 years of safe and reliable operation (reliability investments today reduce these future costs)
- Perform business case analysis and develop optimized investment plan for license renewal upgrades and modifications

ILLUSTRATIVE TIMELINE

- License Renewal Application
- NRC Review
- Current License Expiration
Existing Fleet: Evaluating Coal Fleet Risks

How have age and cycling impacted the **material condition** of each plant?

How is **plant performance** being impacted by material condition and use?

How do plants contribute to **system flexibility** now and with more renewables?

What are the anticipated **carbon and other environmental impacts** or risks?

What **grid support** do these plants provide compared to other alternatives?
Energy Usage: Low Income Energy Efficiency

**Home Uplift Program**
1,500+ Homes Upgraded

**Pilot Funding Sources**
(Leveraged $9M through partnerships with LPCs and non-profits)

- 3rd Party, 41%
- TVA Funding, 46%
- LPC, 13%

- 4,300 kWh savings per home ($430 per year)
- Home Uplift Fund established Feb 2020 for matching funds

**Pathway Lending**

**Home Uplift Roll-out**
- Concept 2017
- Pilot 2018-2020
- Valley-Wide 2021+

**Energy Efficiency Education**

- Expanded Energy Education options
- Energy Monsters – Kid-focused workshops
- Partnerships with schools, libraries, and non-profits
Distribution Planning: Integrated Optimization

- TVA is supporting development of integrated system planning and grid transformation efforts.
- Flexibility opportunities available to long-term partners will factor into these plans.
- Resulting insights into transmission and distribution alternatives will be incorporated into TVA’s next Integrated Resource Plan.
- Leveraging integrated planning and operations can inform regionally optimized investments.
Regional Grid Transformation

Gary Brinkworth
Transformative Innovation Initiatives

Storage Integration
• Implement a long-term strategy to integrate energy storage into the electric grid

Electric Vehicle Evolution
• Accelerate the TN Valley EV market to create load growth and benefits for Valley communities

Regional Grid Transformation
• Develop an interconnected, intelligent grid to support a dynamic and flexible energy network

Connected Communities
• Expand smart technologies with communities to efficiently manage energy and services

Advanced Nuclear Solutions
• Explore advanced technology, cost sharing, and risk reduction

Decarbonization Options
• Reduce and offset carbon emissions via emerging technologies
Imagine the Grid of the Future:

1. Facilitates two-way power flow.
2. Supported by an end-to-end communications system.
3. Relies on sensors and intelligent devices for grid operations.
4. Leverages smart metering to monitor/manage the grid edge.
5. Provides a platform for DER integration (T&D).
6. Maintains reliability while increasing resiliency across the footprint.
7. Planned and operated as a fully integrated system.
For the Valley to maintain its legacy of reliable, clean, and affordable energy, the previously independent Transmission and Distribution systems will need to be integrated, automated, and intelligent to unlock efficiency and optimization.

Approaching this need in a strategic and coordinated way can result in greater value and benefits for all, long into the future.

Central, one-way power system focused on safe, reliable and affordable power

Distributed, two-way power system that supports safe, reliable and affordable power into the future while offering:

- real-time situational awareness for grid operators
- remote and automated outage management functionality for rapid restoration and increased grid resiliency
- greater flexibility for customer generators
Regional Grid Transformation Initiative

**WHERE**

**Vision of the Future**
Where we are trying to go as a region (Look and feel of our final destination)

Think: Aspirational end state (25-30 yrs in future)
“Shiny spot on the wall”

**WHAT**

**Definition**
What capabilities and enabling technologies are needed over the next planning horizon to move us closer to the vision

Think: Definition of Regional Grid Transformation

**WHY**

**Value Propositions**
Why the journey is needed (Why business as usual is threatened)

Think: Shared Value Venn diagram Business Case

**HOW**

**Collaboration Approach**
How we work together to agree on the path forward and deliver the features and capabilities needed

Think: Rules of Engagement Principles & Objectives

**WHO**

**Tennessee Valley**
Who reaps the value, who is doing the work, who is bearing the cost

Think: Regional Stakeholders (TVA, LPCs, Community) Working & Steering Teams

**WHEN**

**Strategic Roadmap**
When the capabilities and enabling technologies will be piloted and implemented

Think: Walk, Jog, Run Evolution Implementation Plan
Key Capabilities Enable the Grid of the Future

<table>
<thead>
<tr>
<th>EXCEPTIONAL END-USER EXPERIENCE</th>
<th>ENHANCED T&amp;D OPERATIONS</th>
<th>COLLABORATIVE GOVERNANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Informed End-Use Customer Insights</td>
<td>Coordinated &amp; Resilient Grid Operations</td>
<td>Strategic Goal Alignment</td>
</tr>
<tr>
<td>Targeted End-Use Customer Engagement</td>
<td>Advanced Grid Management</td>
<td>Transformative Policy &amp; Regulatory Design</td>
</tr>
<tr>
<td>Versatile Tools &amp; Platforms</td>
<td>Symbiotic Third-Party Coordination</td>
<td>Stakeholder-Engaged Process</td>
</tr>
<tr>
<td>Advanced Programs &amp; Pricing</td>
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</table>

INTEGRATED PLANNING
- Advanced Forecasting
- Data Standardization & Intelligence
- Integrated IT/OT Tools & Architecture
- Regionally Optimized Investment
Integrated Planning: Regionally Optimized Investment (G/T/D)

- Locational Impacts
- Non-Wire Alternatives (NWAs)
- DER Integration & Control
- T&D Interconnection
- Resiliency Solutions

ATP = Advanced Transmission Planning
IDP = Integrated Distribution Planning
DRP = Distributed Resource Planning
IRP = Integrated Resource Planning

Grid Planning

1. ATP ➔ IDP ➔ DRP ➔ IRP ➔ ATP

Resource Planning

2. IDP ➔ DRP ➔ IRP ➔ IDP

3. DRP ➔ IRP ➔ DRP

4. IRP ➔ IDP ➔ ATP ➔ IRP

- Bulk Power Alternatives
- DER Optimization
- EE/DR, Grid Enabled Bldgs.
- Energy Storage
- IRP/DRP Interface

ATP = Advanced Transmission Planning
IDP = Integrated Distribution Planning
DRP = Distributed Resource Planning
IRP = Integrated Resource Planning
We are in the “establish vision” phase of a multi-year initiative to deliver Grid Transformation in the TN Valley.
Energy Programs
Potential Study
Ray Knotts
What is an Energy Programs Potential Study?

A snapshot of regional opportunities for influencing consumers’ electric load through various programs, such as energy efficiency (EE), demand response (DR), or beneficial electrification (BE)

- Results are typically shown in annual GWh or percentage of sales
- Top programs can be listed by customer type, such as residential space conditioning or commercial gas-to-electric fleet conversions
- Potential reported at varying degrees of feasibility
How does TVA use a Potential Study in our Modeling?

- 2019 IRP tiered DER programs by cost and adoption level
- The three tiers assume not all DER programs cost the same and some require higher incentive levels to encourage program participation
- The potential study will inform impact estimates across a range of programs based on level of investment
Why is an Updated Potential Study Needed?

- **Supports annual planning process using least-cost planning**
  - Updates EE, DR, and BE resource assumptions
  - Provides additional resource options and better informs program types and volumes

- **Supports and provides valuable reference for the next TVA IRP**
  - Refresh study used in 2019 IRP for future IRPs
  - Enhances resource options offered in IRP

- **Aligns energy programs to TVA’s mission and lower carbon future**
  - Helps identify ways to accomplish mission
  - Helps inform most effective investment of funds

- **Captures impacts of macro environment changes since previous study**
  - DOE codes and standards
  - Consumer behaviors and interfacing technology improvements
  - COVID-19 impact on load
Challenges to Completing a Potential Study

• Execute a study that is broad enough to assess the market, but specific enough to be actionable

• Obtain a clear view of the future amidst rapidly changing consumer market, technology landscapes, and innovations

• Exclude naturally occurring impacts
  o Avoid “double counting”
  o Identify opportunities to influence codes and address existing building stock

• Address participant vs non-participant issues and other subsidies

• Consider BE and DR potential in addition to EE
Strategic Considerations for Study Scope

A broad study to provide the full range of market potential and inform focus areas

A targeted study to provide a deeper dive into missional areas of interest, such as:
- Low Income
- Carbon Potential
- Economic Development
- High-Value Measures
- Distressed Industries
- Locational Needs

Hybrid approach to provide broad overview of potential and deeper dive into a few areas of interest (e.g. “Top 5 ways to reduce system cost, energy burden and carbon footprint”)

Top ways to partner with LPCs
Next Steps

1. Request for Information completed 12/8/20 review underway

2. Finalize scope

3. Issue Request for Proposal

4. Develop study timeline to support completion by end of CY22
10-Minute Break
Electric Vehicles

Ray Knotts
Transformative Innovation Initiatives

Storage Integration
• Implement a long-term strategy to integrate energy storage into the electric grid

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• Accelerate the TN Valley EV market to create load growth and benefits for Valley communities

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• Develop an interconnected, intelligent grid to support a dynamic and flexible energy network

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Decarbonization Options
• Reduce and offset carbon emissions via emerging technologies
Electric Vehicles Market Opportunity

**Electric Vehicles:** Transportation electrification presents a substantial opportunity

- **Lead the Charge** – innovation leadership, driving sustainability
- **Reduce the largest source of CO₂** – and other air pollutants
- **Attract economic development prospects** – EV production and suppliers
- **Grow sales** – largest electrification opportunity
- **Balance the power system** – off-peak charging helping keep rates low
- **Invest locally** – economic benefits of more locally produced fuel

The growing EV market is a significant opportunity for TVA and the Valley as a whole
TVA’s Approach to Electric Vehicles

Accelerate EV adoption through partnerships to remove key market barriers

Charging Infrastructure Availability  
EV Availability and Offerings  
Innovative and Supportive Policies  
Consumer Awareness

Removing market barriers in key areas

TVA is working with stakeholders to make these initiatives available throughout the Valley region
Supportive Policies and Pricing

- Pricing and policy updates will provide a foundation for supporting more rapid adoption of EVs in the Valley.

- Pricing and policy updates will enable resale of electricity supporting fair, consistent, and transparent pricing for high-power charging stations and consumers.

- Current rate schedules are not well designed for high-power charging customer characteristics and result in prohibitive costs which hinder EV adoption.

- TVA seeks to enable LPCs to provide non-discriminatory electric service pricing for EV charging through a straightforward wholesale EV high-power charger rate on a per kWh basis.
Summary of Board Actions

• Contract updates to allow conditional resale of electricity for transportation

• Creation of EV charging wholesale and retail rate classifications

• A wholesale EV high-power charging rate

• TVA staff enabled to take further actions to implement EV policy and pricing
2020
Renewable/Storage RFP
1,175 MW OF NEW-TO-THE-WORLD, UTILITY-SCALE SOLAR SINCE 2018

$1.4B IN SOLAR INVESTMENTS
TVA Renewable Programs

- Residential
- Small Business
- Corporations
- Datacenters
- Universities
- Cities
- Manufacturing
- LPCs

CONNECT  SWITCH  FLEX  INVEST
COMING JANUARY 2021

GREEN CONNECT

TVA GREEN
**GREEN CONNECT**

Program benefits

**FOR INSTALLERS**

- Increased standardization
- Customer leads
- Green Connect contact center

**FOR CUSTOMERS**

- Access to quality solar installers
- Educational resources
- Installation verifications
GREEN SWITCH

TVA GREEN
**Program highlights**

**No long-term commitment**
No contract with participants – they can enroll and un-enroll on a monthly basis.

**No upfront cost**
Payments can be added to your customers monthly utility bill.

**No infrastructure needed**
Your customers do not need any additional infrastructure to get started using renewable energy.

**For as little as $2 a month**
Customers can reduce their environmental impact.
GREEN FLEX

TVA GREEN
GREEN FLEX
Program highlights

Free to sign up and get started with no additional infrastructure needed

1-year agreement
January – December

Certified through Green-e, guaranteeing renewable generation coverage for all purchased RECs

2,000 RECs
Annual minimum purchase

Purchase may not exceed 105% of participant’s annual electricity consumption
GREEN INVEST

TVA GREEN
GREEN INVEST

Help end-use customers meet their sustainability goals by partnering with LPCs and TVA to bring new, renewable energy to the Tennessee Valley.
GREEN INVEST
Program highlights

Utility scale renewables
Competitive procurement

Lowest cost option
Site specific

Long-term load
Aggregate projects
FLEXIBILITY OPTION FOR LOCAL POWER COMPANIES
Valley Partners now have the ability to provide cleaner, greener power.
Help local organizations go solar and meet their sustainability goals

Provide solutions that help attract, retain and grow local business

Help create long term customer commitments to the local community

Use solar + storage to enhance system’s reliability

Get creative to meet your customers’ needs
TVA Green

renewables@tva.gov
(866) 673-4340

FLEXIBILITY
flexibility@tva.gov

www.tvagreen.com
Questions and Answers