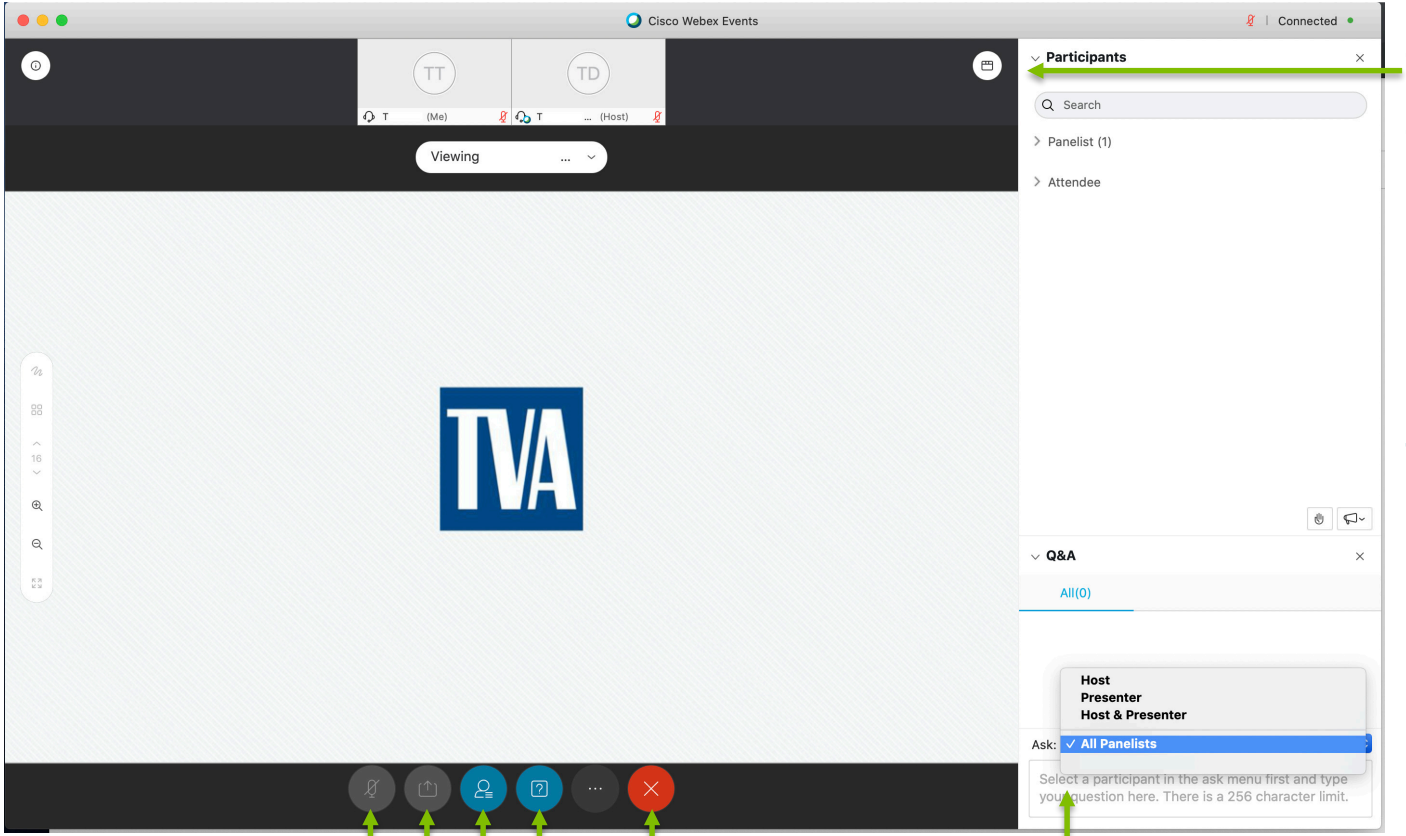
2019 IRP Near-term Action Update

Stakeholder Update

December 9, 2020



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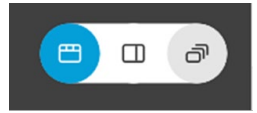

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Exit event

Mute

Ask a question

Share (disabled)

Participants

Q&A: Ask a question here and direct to All Panelists or an individual.


Welcome
Althea Jones

Agenda

Topic	Who	Time
Welcome	Althea Jones	12:30
2019 IRP Near-term Action Update	Jane Elliott	12:45
Regional Grid Transformation	Gary Brinkworth	1:15
Energy Programs Potential Study	Ray Knotts	1:30
Break	All	1:45
Electric Vehicles	Ray Knotts	1:55
TVA Renewables	Ethan Ogle	2:05
Q&A	All	2:30

COVID-19 Response

$200 Million
Pandemic Relief Credit
2.5% Rate Credit

Community Care Fund
More Than
$4 Million
in Matching Funds Disbursed

Investing More Than
$10 Million
In Back-to-Business
Incentive Program

Regulatory Relief and Flexibility
for Local Power Companies

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

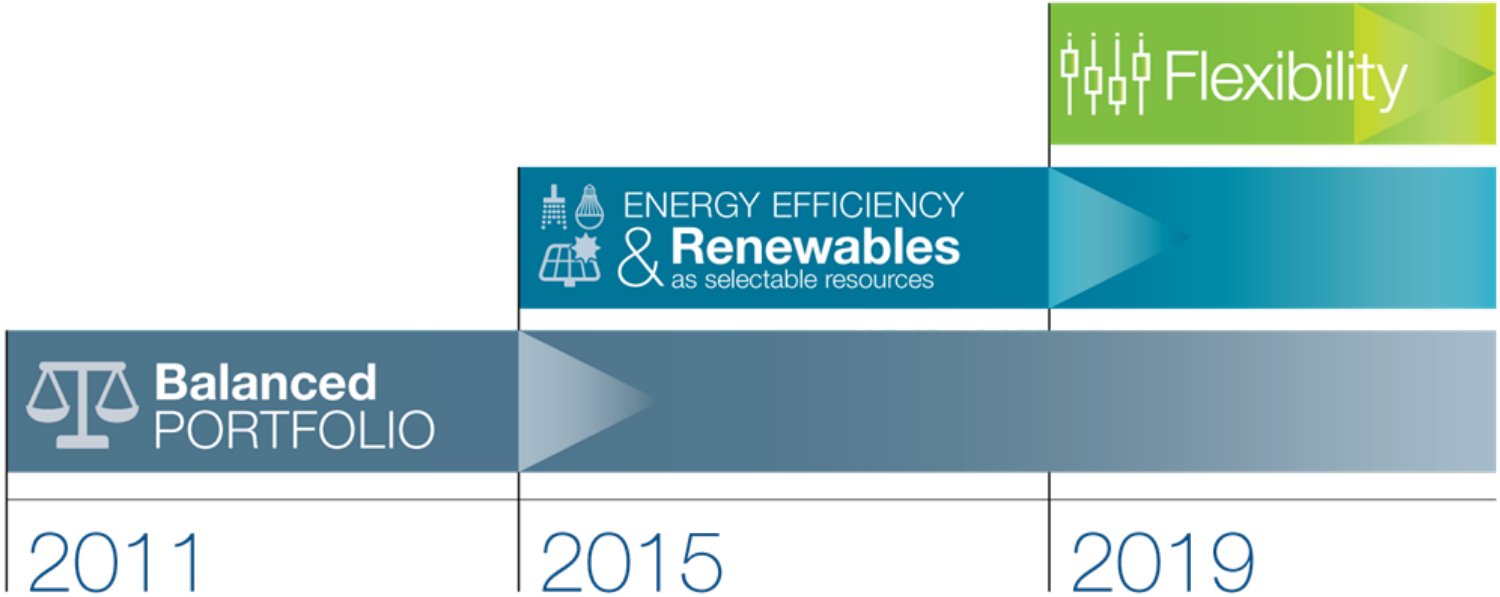
THE IRP STRIVES TO ACHIEVE SIX KEY GOALS:

- Low Cost
- Risk Informed
- Environmentally Responsible
- Reliable
- Diverse
- Flexible

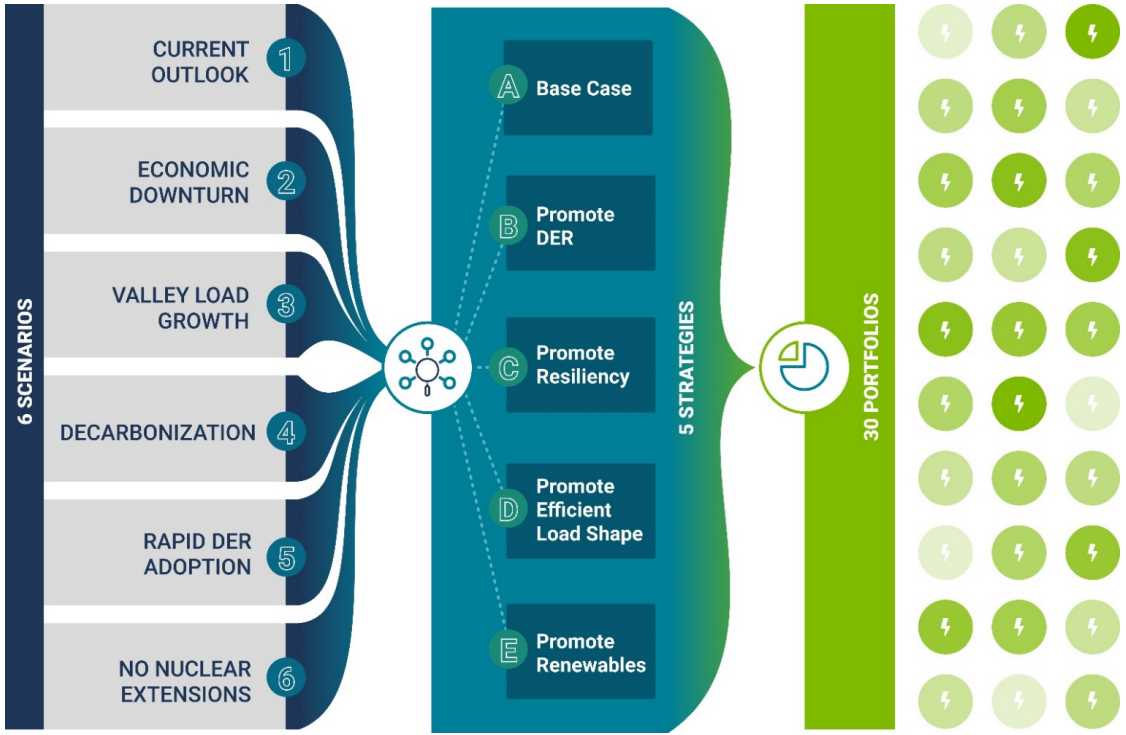
2019 IRP Focused on Flexibility

Focus Areas:

- *Distributed Energy Resources (DER)*
- *System Flexibility*
- *Portfolio Diversity*

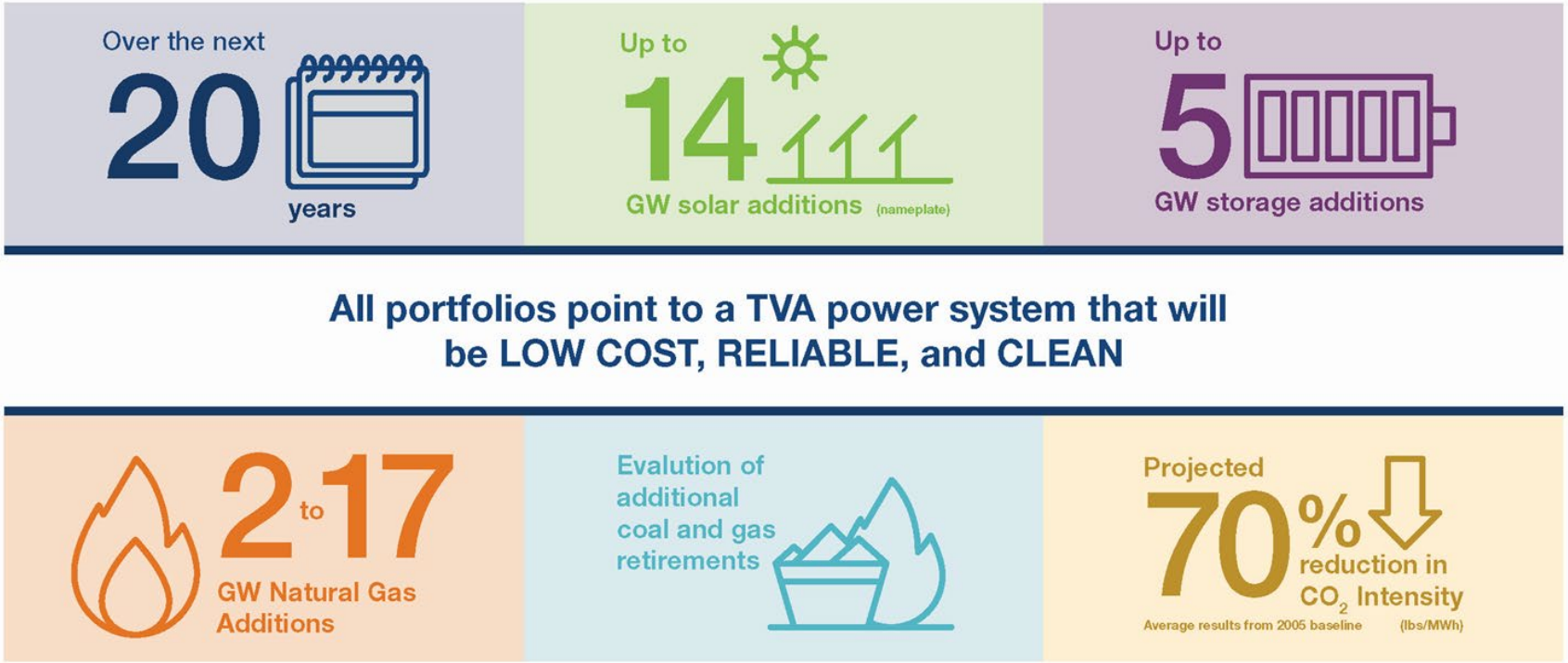


Utilized Rigorous Analytical Process



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:



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

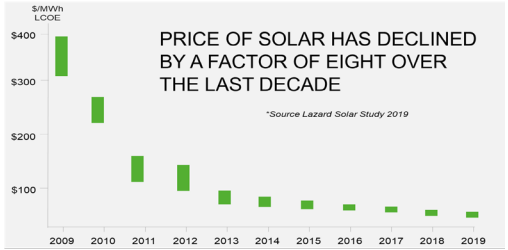
Renewables & Flexibility: Solar Fleet Strategy

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

CUSTOMER DEMAND

RE 100

COST-COMPETITIVENESS



LAND REQUIREMENTS

7+ Acres per MW

COMPETING LAND USES

- Economic Development
- Agricultural
- Power Generation

FOCUS AREAS

- Procurement
- Pipeline
- Partnerships

RENEWABLE SOLUTIONS

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

Renewables & Flexibility: Solar Expansion

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

Renewables & Flexibility: Integrating Solar

Aeroderivative Combustion Turbine

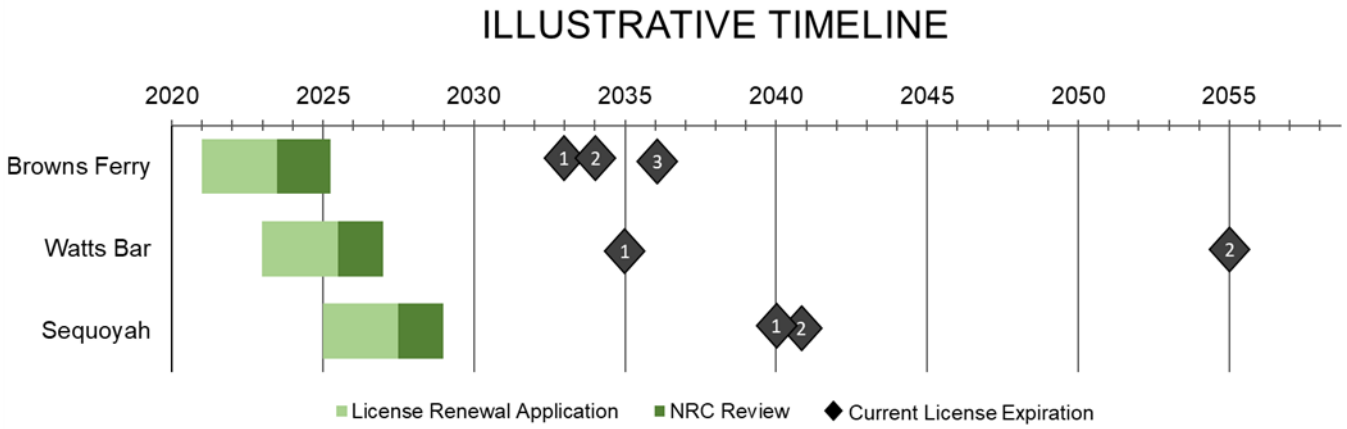
- Highly flexible gas units with non-start based maintenance
- Efficient heat rate and full power in 10 minutes
- **TVA Board approved 500-600 MW of Aeroderivatives expected to come online by end of 2024**

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



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?

2020 → 2025 → 2030 → 2035 → 2040

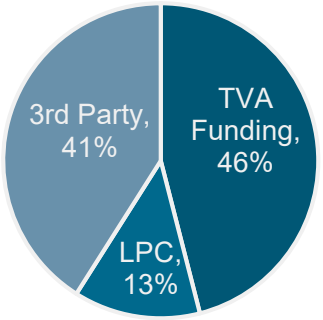
Energy Usage: Low Income Energy Efficiency

Home Uplift Program

1,500+ Homes Upgraded

Pilot Funding Sources

(Leveraged $9M through partnerships with LPCs and non-profits)



4,300 kWh savings per home ($430 per year)

Pathway Lending **Home Uplift Fund** established Feb 2020 for matching funds

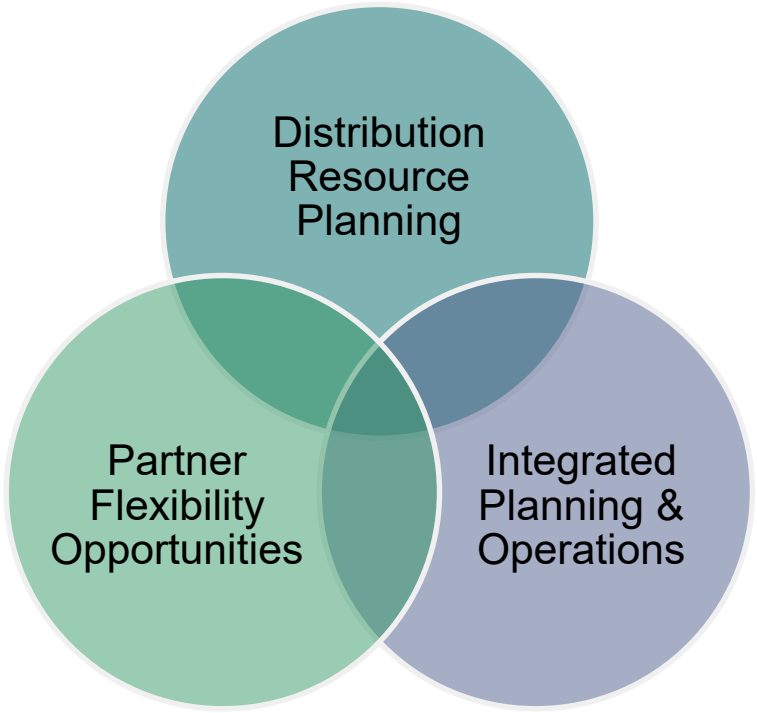
Home Uplift Roll-out

Concept	Pilot	Valley-Wide
2017	2018-2020	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

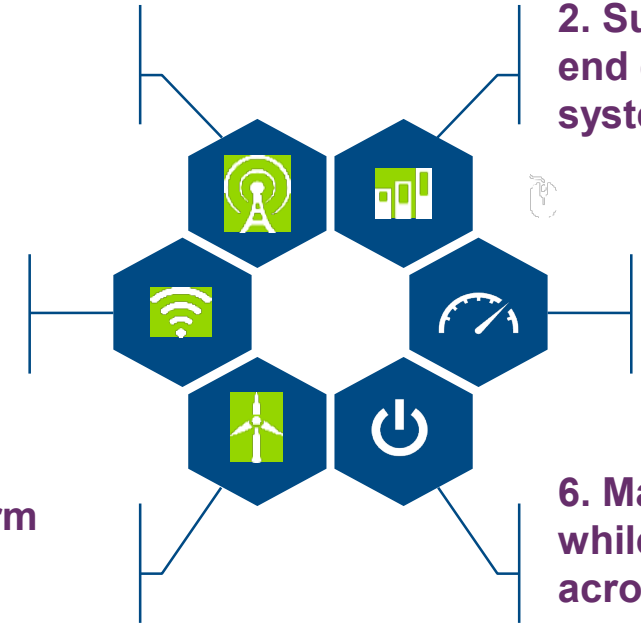
Decarbonization Options

- 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.

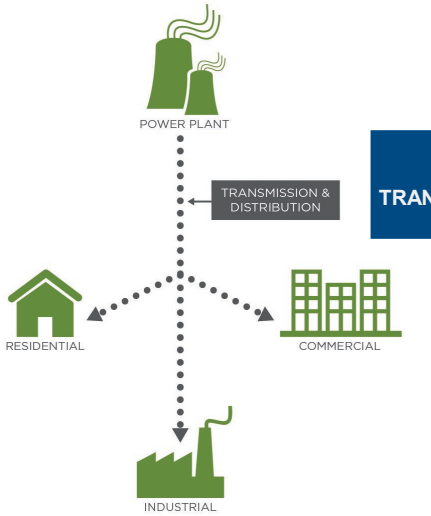
7. Planned and operated as a fully integrated system.

Tennessee Valley – Regional Grid Transformation

- 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.

Past

Traditional Power Grid

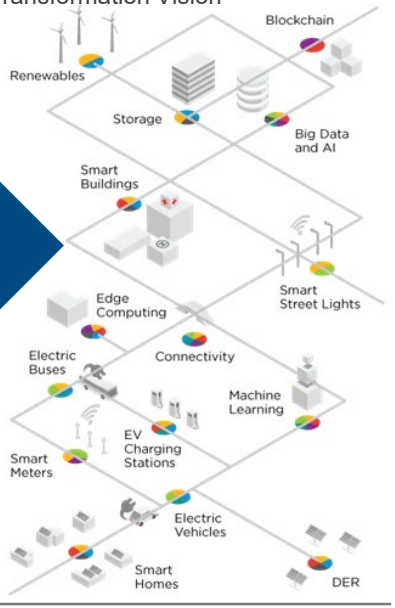


Central, one-way power system focused on safe, reliable and affordable power

GRID TRANSFORMATION

Future

Grid Transformation Vision



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"

WHY

Value Propositions

Why the journey is needed
(Why business as usual is threatened)

Think: *Shared Value Venn diagram*
Business Case

WHAT

Definition

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

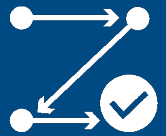
Think: *Definition of Regional Grid Transformation*

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



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

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

INTEGRATED PLANNING

- Advanced Forecasting
- Data Standardization & Intelligence
- Integrated IT/OT Tools & Architecture
- Regionally Optimized Investment

EXCEPTIONAL END-USER EXPERIENCE

- Data Informed End-Use Customer Insights
- Targeted End-Use Customer Engagement
- Versatile Tools & Platforms
- Advanced Programs & Pricing

ENHANCED T&D OPERATIONS

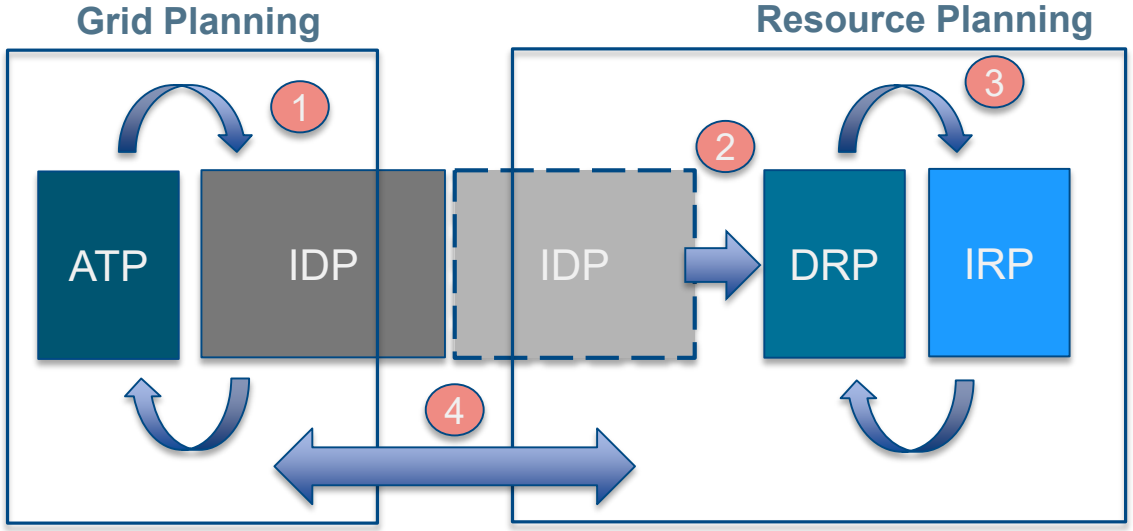
- Coordinated & Resilient Grid Operations
- Advanced Grid Management
- Symbiotic Third-Party Coordination

COLLABORATIVE GOVERNANCE

- Strategic Goal Alignment
- Transformative Policy & Regulatory Design
- Stakeholder-Engaged Process

Integrated Planning:
Regionally Optimized Investment (G/T/D)

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

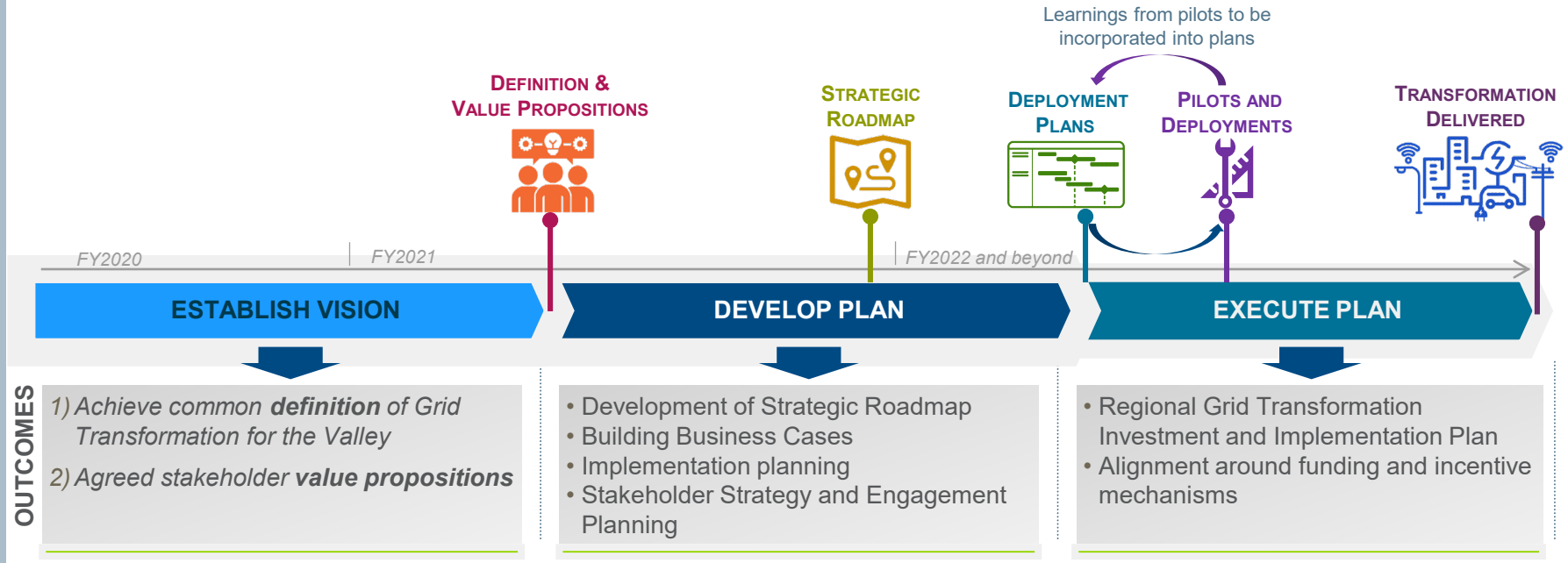


- Bulk Power Alternatives
- DER Optimization
- EE/DR, Grid Enabled Bldgs.
- Energy Storage
- IRP/DRP Interface

ATP = Advanced Transmission Planning
IDP = Integrated Distribution Planning

DRP = Distributed Resource Planning
IRP = Integrated Resource Planning

Regional Grid Transformation Initiative



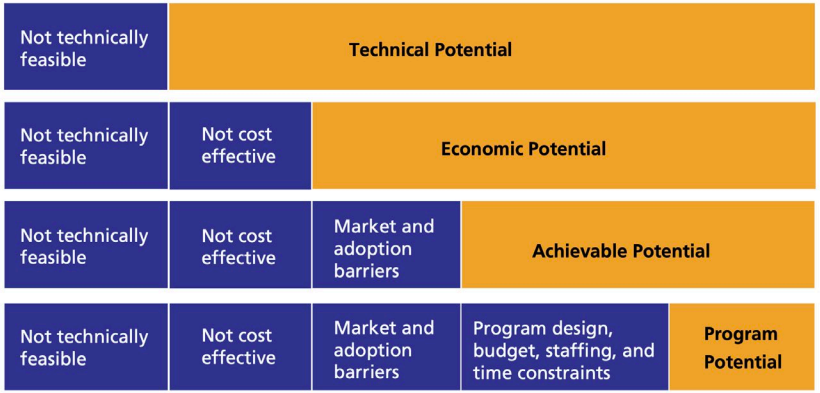
We are in the “establish vision” phase of a multi-year initiative to deliver Grid Transformation in the TN Valley.

Energy Programs Potential Study

Ray Knotts

What is an Energy Programs Potential Study?

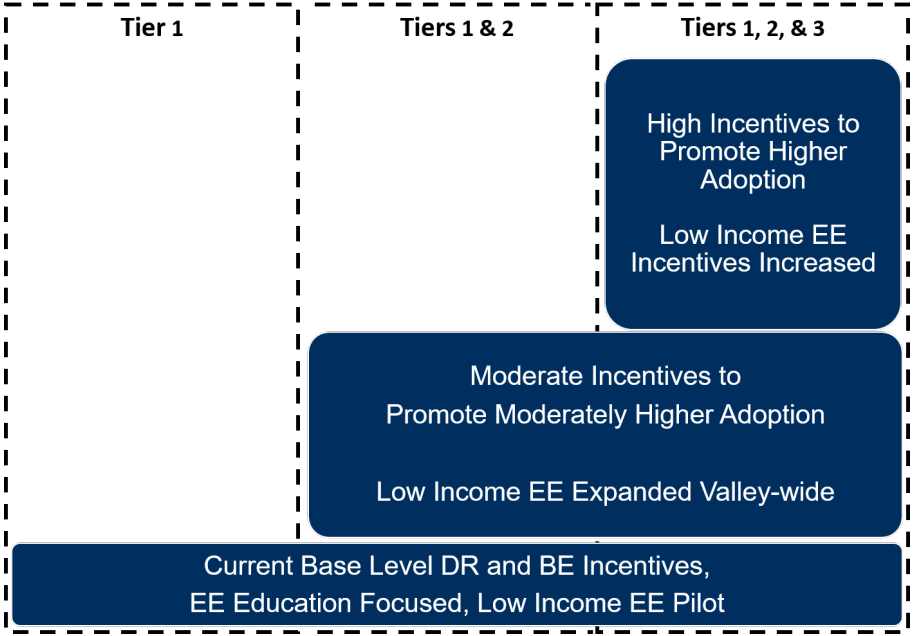
A snapshot of regional opportunities for influencing consumers' electric load through various programs, such as energy efficiency (EE), demand response (DR), or beneficial electrification (BE)



EPA – National Guide for Resource Planning

- 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

✓

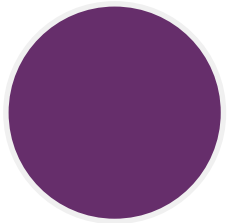
Captures impacts of macro environment changes since previous study

- 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
  - Avoid “double counting”
  - 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

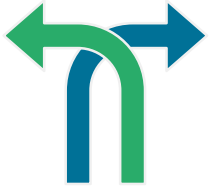


A broad study to provide the full range of market potential and inform focus areas

A targeted study to provide a deeper dive into missional areas of interest, such as:

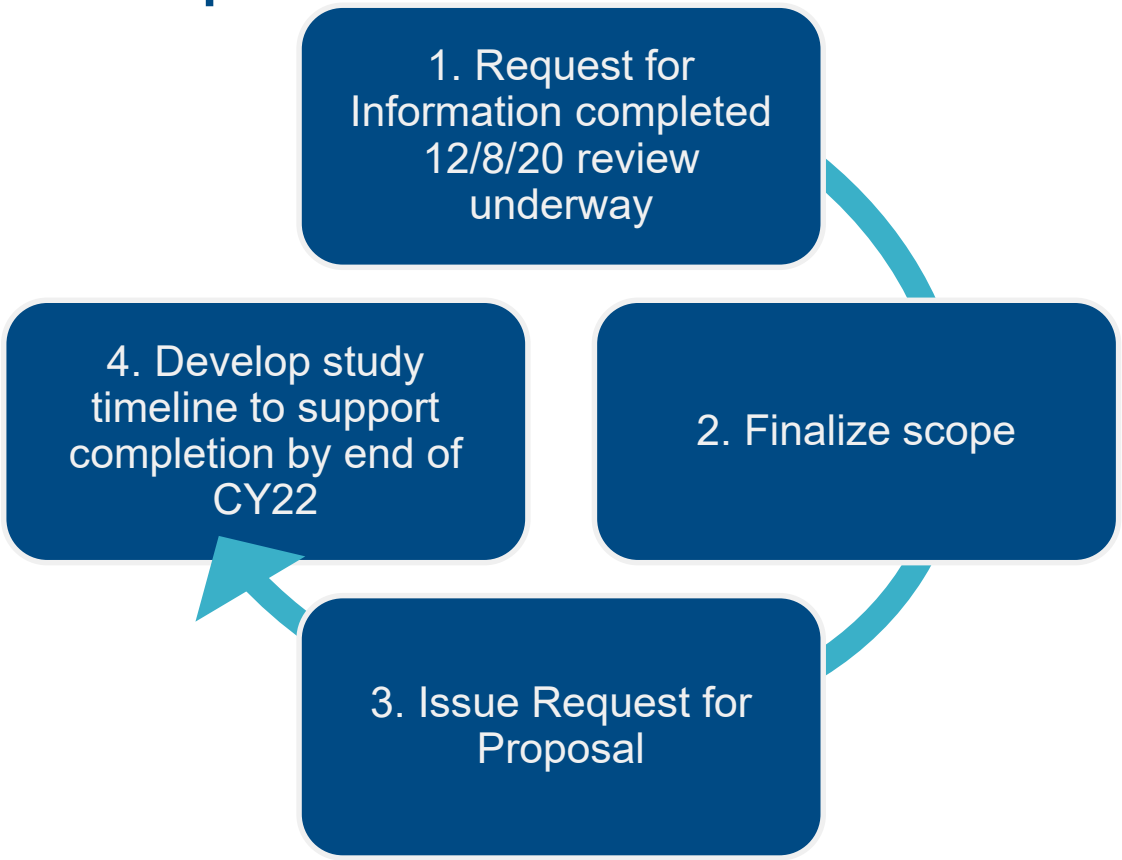
- Low Income
- Carbon Potential
- Economic Development
- High-Value Measures
- Distressed Industries
- Locational Needs

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

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

Electric Vehicles Market Opportunity

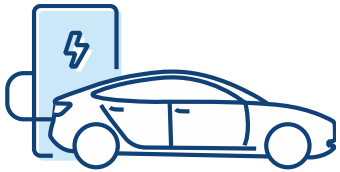
Electric Vehicles: Transportation electrification presents a substantial opportunity

- **Lead the Charge** – innovation leadership, driving sustainability
- **Reduce the largest source of CO_2** – 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

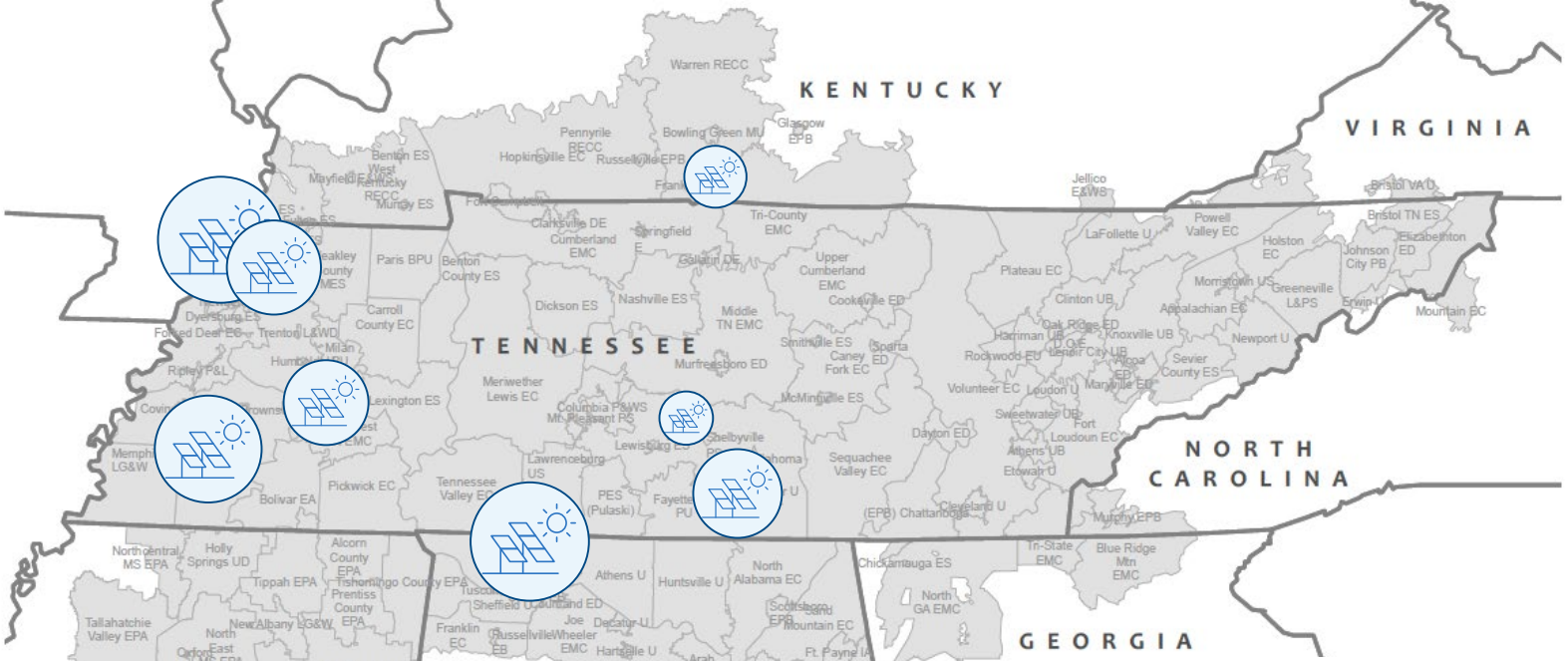
Summary of Board Actions

- 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

TVA Renewables

Ethan Ogle

2020 Renewable/ Storage RFP



1,175 MW

OF NEW-TO-THE-WORLD, UTILITY-SCALE SOLAR SINCE 2018

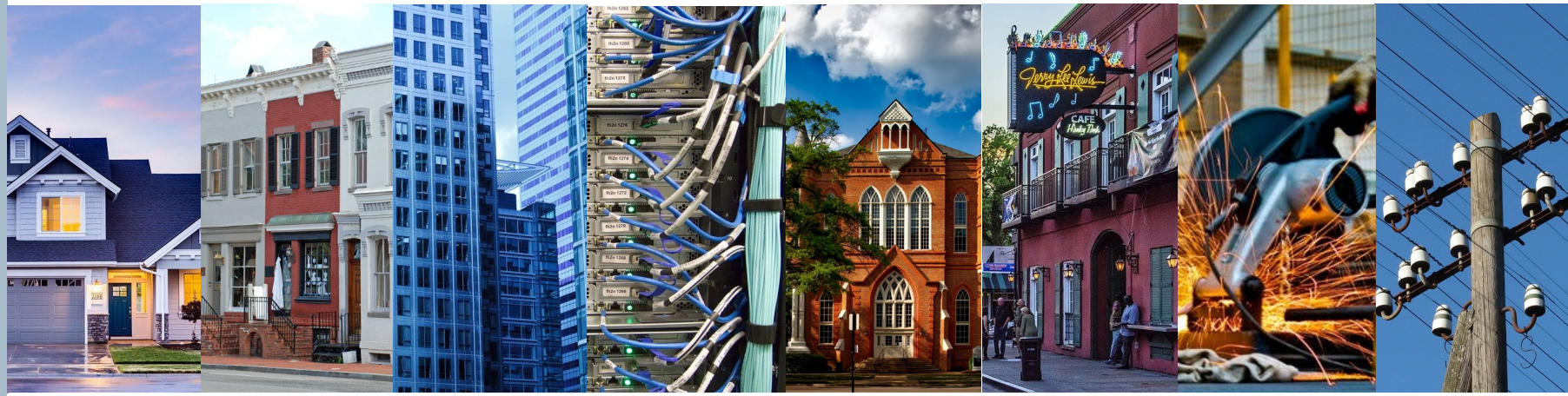
$1.4B

IN SOLAR INVESTMENTS

TVA Green

TVA Renewable Programs

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



CONNECT SWITCH FLEX INVEST

TVA Green

COMING JANUARY 2021

GREEN CONNECT

TVA GREEN

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

TVA Green

GREEN SWITCH

TVA GREEN

GREEN SWITCH

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

TVA Green

GREEN FLEX

TVA GREEN

TVA Green

GREEN FLEX

Program highlights

1-year
agreement
January – December

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

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

TVA Green

GREEN INVEST

TVA GREEN

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.

100%

RENEWABLE

TVA Green

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


FLEX
Valley Partners now have the ability
to provide cleaner, greener power.
TVA VALLEY Partners

FLEXIBILTY OPTION

How Partners could use it

- 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 VALLEY Partners

TVA Green

TVA Green

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FLEXIBILITY

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Questions and Answers