A Tactical Roadmap Guide

for Tennessee Valley Regional Grid Transformation

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TVA | TENNESSEE VALLEY AUTHORITY

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Acronyms

This guide was designed so each tactical roadmap could be pulled out and viewed as its own standalone document. With that in mind, technologies and other terms are defined the first time in each roadmap section. Below are acronyms used throughout this guide.

ADMS
Advanced distribution management system

AMI
Automated metering infrastructure

BIL
Bipartisan Infrastructure Law

C&I
Commercial and industrial

CVR
Conservation voltage reduction

DER
Distributed energy resource

DERMS
Distributed energy resources management system

DMS
Distribution management system

DOE
Department of Energy

DR
Demand response

DRMS
Demand response management system

EE
Energy efficiency

EPB
EPB of Chattanooga, formerly Electric Power Board of Chattanooga

EPRI
Electric Power Research Institute

ESG
Environmental, social and governance

EV
Electric vehicle

FLISR
Fault location, isolation and system restoration

GIS
Geographic information systems

HU
Huntsville Utilities

IIJA
Infrastructure Investment and Jobs Act

IRP
Integrated Resource Plan

ISOP
Integrated system operations planning

IVR
Interactive voice response

KUB
Knoxville Utilities Board

LTC
Load tap changers

LPC
Local power company

MDMS
Meter data management system

NES
Nashville Electric Service

OMS
Outage management system

ORNL
Oak Ridge National Laboratory

PV
Photovoltaics

R
Residential

SAIDI
System average interruption duration index

SCADA
Supervisory control and data acquisition

T&D
Transmission and distribution

TOU
Time of use

TVA
Tennessee Valley Authority

Contents

Summary

Regional Grid Transformation

Regional Grid Transformation (RGT) is an initiative that **examines transforming the grid in the TVA service region to address current and future needs of all customers.**

Working with local power companies (LPCs), subject matter experts and industry research organizations, TVA developed a strategic roadmap as the groundwork for communicating how LPCs can collectively respond to the coming changes.

After developing a **Strategic Regional Grid Transformation Roadmap**, TVA and the LPC Working Team, which comprises nine LPC members that vary in size, density, resources, existing technology applications and current priorities, worked together to create tactical grid transformation roadmaps for each LPC.

Tactical Roadmaps

The tactical roadmaps in this guide were developed through a series of meetings and interviews with subject matter experts from each member of the LPC Working Team.

These roadmaps are specific to each LPC's current system characteristics, technology deployment progress, planned initiatives and future priorities.

LPC WORKING TEAM

9 members

that vary in size, density, resources, existing technology applications and current priorities.

Capability Areas

RGT is comprised of **five capability areas**, each playing a distinctive role in the development of the grid of the future.

1 INTEGRATED PLANNING

2 ENHANCED TRANSMISSION AND DISTRIBUTION OPERATIONS

3 REGIONAL GUIDELINES

4 EXCEPTIONAL END-USER EXPERIENCE

5 GRID TRANSFORMATION ENABLING

Within each capability area, subsequent capabilities categorize the needed activities, technologies and processes to support that area.

The purpose of the roadmaps in this guide is to provide more information about the individual actions of each LPC participating in this initiative and help other LPCs consider the best-fit activities and technologies to prepare for their future grid.
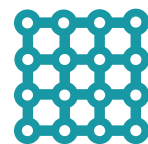
Regional Grid Transformation

Current Conditions

The energy sector is witnessing major trends with market shifts, regulatory changes and evolving customer demands. Emerging energy technologies, extreme weather events, decarbonization efforts and more are pushing the limits of what the traditional, one-way power system can address. Legislation allocating funds toward clean energy and updated electrical infrastructure has paved the way for the next generation of power systems across the country.

Additionally, advancing technology has changed what customers demand from their providers, including utilities. Customers want insights into energy use and easy methods for reducing energy bills. Many customers also want more clean energy options on the grid. Local power companies (LPCs) are actively working to address these new requests and to improve the overall experience for end-use customers.

What is Regional Grid Transformation?

The progression of technology — increasing availability of electric vehicles (EVs), new grid software programs and changing customer demands, such as more control over energy usage or sources of clean energy — confirms **the time is now for grid transformation.**

Regional Grid Transformation (RGT) is an initiative that examines transforming the grid in the TVA service region to address current and future needs of all customers.

A DYNAMIC GRID SYSTEM

Building a resilient, flexible and integrated electric system that meets Valley customer needs of the future.
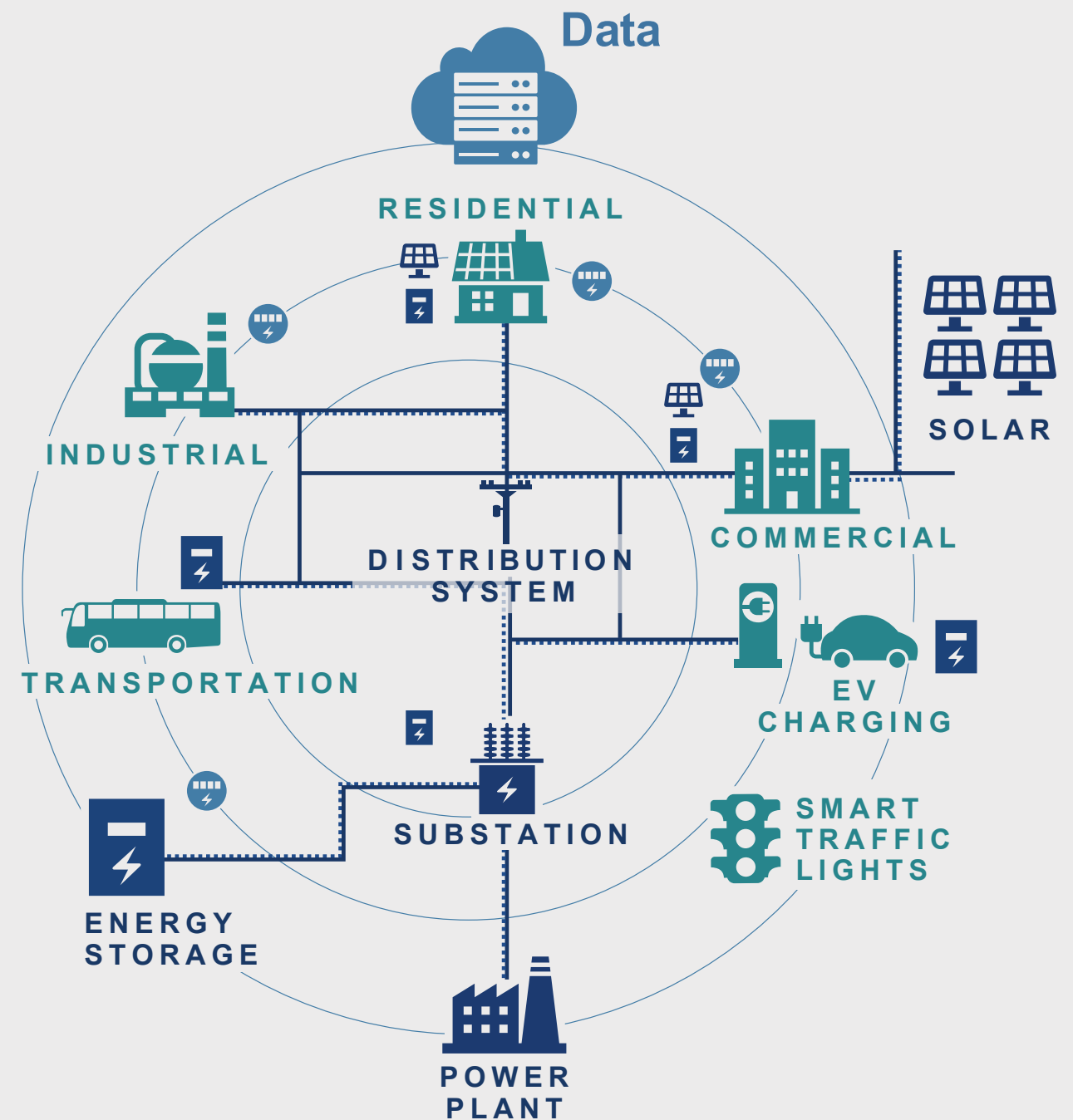
By upgrading the electrical grid infrastructure, the region can better protect against cybersecurity threats, add more sources of clean energy, increase resilience, maintain reliability and keep costs affordable.

Working with LPCs, subject matter experts and industry research organizations, TVA developed a strategic roadmap as the groundwork for communicating how LPCs can collectively respond to coming changes.

STRATEGIC ROADMAP TO TACTICAL ROADMAPS

After development of the Strategic Regional Grid Transformation Roadmap, TVA and the LPC Working Team, which comprises nine LPC members that vary in size, density, resources, existing technology applications and current priorities, worked together to create tactical grid transformation roadmaps for each LPC.

Tactical Roadmaps Overview

PROCESS AND DEVELOPMENT

The tactical roadmaps that follow were developed through a series of meetings and interviews with subject matter experts from each member of the LPC Working Team. These groups met to discuss their existing grid plans and potential opportunities to add Regional Grid Transformation initiatives to future plans. From these discussions, a unique

tactical roadmap was developed for each LPC specific to their current system characteristics, technology deployment progress, planned initiatives and future priorities. The variation in LPC Working Team members and their individual roadmaps demonstrate that every community can implement Regional Grid Transformation initiatives, no matter size, current progress or priorities.

PURPOSE

The purpose of the roadmaps in this guide is to provide more information about the individual actions of each LPC participating in this initiative. The wide range of roadmaps can help any LPC interested in Regional Grid Transformation examine the approach another LPC with similar characteristics may be taking to transform their own grid. By outlining the technologies being explored or implemented and the estimated timelines for deployment, other LPCs can consider the best-fit activities and technologies to prepare for their future grid.

USING THE ROADMAPS

Finding the similarities and differences will help identify a starting point for implementing new technologies and methods for grid planning. However, taken together, the roadmaps highlight the benefits and needs for all LPCs to work together with TVA toward transforming the regional grid to the grid of the future.

To follow are key topics and considerations for implementing future Regional Grid Transformation tactical roadmaps.

Tactical Roadmap Considerations

TIMING

The order of activities and technologies is an important detail of the tactical roadmaps. Many of the technologies that appear first on the roadmaps are required before more advanced activities can take place. For instance, communications technologies or protocols must be established and installed before more complex applications, such as a demand response management system, can be introduced. Roadmap activities are organized by capability area, and each capability area outlines planned deployments and their anticipated start. The proposed order of activities or technologies can be viewed in the tactical roadmap and are explained sequentially in each capability section.

EACH ROADMAP IS UNIQUE

No two roadmaps are the same in this guide. LPCs have varying customer or member bases and unique considerations for long-term planning. In fact, the roadmaps below are organized in ascending order of customer density per mile, starting with low density and ending with high density LPCs. The tactical roadmaps are intended to provide a glimpse into the potential grid-transforming options LPCs are pursuing to prepare for the grid of the future. Other LPCs can use these as reference points for modeling their own Regional Grid Transformation roadmaps.

Each roadmap represents a 5-year planning horizon.

Roadmap Similarities Include:

Distribution automation

Enhanced customer interactions

Distributed energy resources (DER) interconnection standards

Data governance practices

Solar and storage deployments

Electric vehicle infrastructure

COMMON ROADMAP ACTIVITIES

The roadmaps reflect several common activities and technologies being deployed by participating LPCs. The deployments may have different schedules and timelines, but many are repeated across several tactical roadmaps. Some common technologies are foundational to the more complex, advanced Regional Grid Transformation-related capabilities, while others are part of a collaborative effort among LPCs to create regional guidelines. As each LPC's tactical roadmap is unique and may be used as a stand-alone document from this larger guide, common activities and technologies could be a starting point for any LPC considering their own roadmap.

FUNDING

With recently passed federal legislation, there may be opportunities for grid transformation funding. The Infrastructure Investment Jobs Act (IIJA) has a focus on updating and modernizing infrastructure around the U.S., including the electrical grid. Funding opportunities from IIJA, such as the Preventing Outages and Enhancing the Resilience of the Electric Grid and the Building Resilient Infrastructure and Communities programs, are designed to help utilities start investing in grid upgrades. With the help of IIJA funding, the tactical roadmaps can help LPCs understand and prepare for projects and activities that may have been cost prohibitive before.

LEVERAGED PARTNERSHIP

Another goal of the tactical roadmaps is to encourage partnerships. Regional Grid Transformation is not an initiative that can be tackled individually or in individual workstreams. Shared learnings, especially those from the LPC Working Team, will reduce the need for each LPC to re-invent the wheel when implementing their specific grid transformation plans. LPCs and TVA can work together to discuss challenges and create solutions that work for specific areas or regions.

Capability Areas

RGT is comprised of five capability areas, each playing a distinctive role in the development of the grid of the future. Each of the capability areas are addressed in the individual tactical roadmaps with a variety of individual capabilities, which represent the technologies, projects and applications related to that area. Short descriptions of these capability areas are below, with more in-depth explanations in the Strategic Roadmap.

❶ INTEGRATED PLANNING

Integrated planning is needed to determine best practices, manage region-wide efforts and optimize investments.

❷ ENHANCED TRANSMISSION & DISTRIBUTION OPERATIONS

This capability area utilizes situational awareness to provide Transmission and Distribution (T&D) operators with the ability to operate the grid with coordination and resiliency.

❸ REGIONAL GUIDELINES

To assist the advancement of the grid transformation process, regional guidelines should be used for facilitating partnership and collaboration around common standards, architecture, information sharing and stakeholder alignment.

❹ EXCEPTIONAL END-USER EXPERIENCE

Developing meaningful tools and service offerings with an intentional customer focus is another way to support the work of grid transformation. By establishing strong relationships with customers, TVA and LPCs can help manage customer energy usage and costs and set up clear lines of communication for increased transparency and understanding.

❺ GRID TRANSFORMATION ENABLING

The grid transformation enabling capability area is the groundwork for this process as it outlines the foundational capabilities and technologies to implement grid transformation successfully.

LPC Tactical Roadmaps

LOW customer density

North East Mississippi Electric Power Association

Overview

North East Mississippi Electric Power Association (NEMEPA) is a member-owned electric cooperative in Mississippi that serves more than 29,000 meters of all sizes. NEMEPA has a low-density member-base and serves over 2,000 miles of electrical line in its territory. NEMEPA has installed a high-speed fiber broadband system to all 29,000 locations and is providing service to nearly 10,000 customers to date.

NEMEPA is focused on reliability, resiliency and consistency for their territory. Joining the LPC Working Team and TVA in Regional Grid Transformation (RGT) is driven by a strong desire to ensure their members benefit from innovations in technologies and cooperative planning across TVA's service region. Shared learnings from the LPC Working Team will enable more efficient planning and execution.

Capability Areas

❶ INTEGRATED PLANNING

NEMEPA's first activity related to integrated planning is to investigate and deploy hourly and distributed energy resources (DER) forecasting. This will provide valuable insight into energy usage as well as anticipated DER production at the hourly level. NEMEPA is working to identify and deploy grid analytic tools, such as hosting capacity studies and system-wide load analyses, while also overlaying weather data and usage data to illustrate daily usage and communicate energy limit information.

All these tools will play a part in NEMEPA's RGT-focused integrated planning, which will be done holistically in collaboration with other members of the LPC Working Team and TVA. Integrated planning is used as a long-term planning tool for electric utilities to predict electricity and resource needs for the future.

❷ ENHANCED TRANSMISSION & DISTRIBUTION OPERATIONS

NEMEPA is deploying distribution automation to improve reliability on their grid as part of their tactical roadmap. In the latter years of this roadmap, NEMEPA intends to investigate and deploy a distribution management system (DMS) and asset analytics. DMS can help in many ways, including the ability to help reduce outage lengths and manage critical loads.

Asset analytics will provide NEMEPA with asset health monitoring and predictive maintenance analyses, to help adjust proactively to problems on the grid and more effectively plan ahead for capital improvements and software implementation.

NEMEPA intends to deploy a distributed energy resources management system (DERMS) and a demand response management system (DRMS) in future years. DERMS will permit NEMEPA to have better control over DER on their grid while DRMS will provide the ability to control, operate and monitor energy-consuming assets. This is important because balancing load needs with new technologies can help ensure that members have reliable power, which is a high priority.

❸ REGIONAL GUIDELINES

Similar to other LPCs participating in RGT, NEMEPA is working to align itself with both smart city benefits and TVA's Connected Communities initiative. NEMEPA is also planning to implement the DER interconnection standards that come from the pilot project on interconnection standards conducted by TVA and other LPCs. These DER interconnection standards will create uniformity across TVA's service region for NEMEPA customers who choose to install their own DER.

❹ EXCEPTIONAL END-USER EXPERIENCE

NEMEPA already has a special rate intended for electric vehicle (EV) charging by business

members. Over the next two years, they also plan to investigate time of use (TOU) and EV charging rates for residential customers. By using a specific rate for residential EV charging, homeowners can take advantage of charging their EV at times when electricity is less expensive.

In the latter years of this roadmap, NEMEPA intends to research demand response (DR) programs for residential members. DR programs allow the LPC to work together with residential members through smart devices, such as smart thermostats, to reduce overall load on the grid during periods of high usage.

⑤ GRID TRANSFORMATION ENABLING

NEMEPA plans to evaluate data governance, an activity that is common among the other tactical roadmaps. Specifically, they will look for areas of improvement regarding governance of usage, member and planning related data.

NEMEPA already has a cybersecurity team and is evaluating areas for improving cybersecurity risks. This is similar to other LPCs participating in the RGT roadmap process, many of which have identified a desire to strengthen their cybersecurity departments.

With the various new technologies, software systems and devices on the grid NEMEPA plans to investigate a workforce-uplift strategy to ensure they have qualified and trained employees knowledgeable about the new technologies needed to operate a transformed grid.

⑥ CURRENT PRIORITIES BASELINE

In addition to the identified RGT-focused work, NEMEPA is continuing work on other priorities that include building a new substation, converting internal systems to align with new meter data management (MDM) software and deploying a platform that will create real-time data dashboards and graph data visuals.

Summary

NEMEPA recognizes there are benefits to working together with other LPCs in this planning effort. By integrating knowledge and learnings from the experience of other LPCs, NEMEPA can make well-informed decisions on new technologies and member programs that will bring value to their member base.

NEMEPA Tactical Roadmap*

CAPABILITY AREA	2022	2023	2024	2025	2026
① INTEGRATED PLANNING	Investigate Workplan Study	Investigate and Deploy Forecasting (8760 load and DER) / Deploy Grid Analytics		★ Implement RGT Integrated Planning	
② ENHANCED TRANSMISSION & DISTRIBUTION OPERATIONS	Deploy Targeted Distribution Automation				
		Investigate Distribution Batteries	★ Investigate and Deploy DMS / Investigate and Deploy Asset Analytics	Deploy DERMS / Deploy DRMS	
③ REGIONAL GUIDELINES	Deploy Fiber / Align with Smart City and Connected Communities			★ Implement DER Interconnection Standards	
④ EXCEPTIONAL END-USER EXPERIENCE	★ Investigate and Implement EV Charging and Rates / Implement Advanced Customer Interactions	Investigate TOU Rates (EV + R) / Investigate Add. Advanced Customer Interactions		★ Investigate Customer DR Programs	
⑤ GRID TRANSFORMATION ENABLING	Evaluate Data Governance	Evaluate Cybersecurity Risk / Investigate Workforce Uplift Strategy			
⑥ CURRENT PRIORITIES BASELINE	Deploy New Substation	Deploy Real-Time Data Visualization / Deploy Software Conversion (MDMS, CIS, GIS)			

★ **RGT High-Priority Initiative**   ▮ **RGT Initiative**   ▯ **Pilot**   ▮ **Baseline Initiative**   ⬚ **Internal Initiative**

*Each tactical roadmap is subject to change due to the fluid nature of the tools and technologies used in this industry.

HIGH
customer density

BrightRidge

Overview

BrightRidge, located in Johnson City, Tennessee, is an energy authority that provides electricity and broadband services to Washington County, Tennessee and parts of Carter, Greene and Sullivan counties. With over 81,000 residential, business and industrial customers served by more than 2,000 miles of distribution lines, BrightRidge employs about 195 employees.

BrightRidge is focused on optimizing its current electric infrastructure. Capital upgrades cost less overall when the loads and distribution are managed more efficiently. This allows funds to be spent when and where they are needed most, such as workforce development, a distributed management system and customer focused programs and offerings.

Capability Areas

❶ INTEGRATED PLANNING

Deploying load forecasts at a sub-system level by feeder or zone is the first planned initiative in the integrated planning capability area for BrightRidge. During this initiative, BrightRidge plans to identify and deploy grid analytics, leveraging AMI data to better understand distribution system loads and identify system vulnerabilities. BrightRidge is interested in performing distribution analytics on transformer, fuse, feeder and line section levels daily.

Following these initiatives, BrightRidge intends to implement RGT-focused integrated planning, as both grid analytics information and load forecasting provide valuable information required for grid transformation. By adding a Regional Grid Transmission (RGT) focus to the integrated planning process, BrightRidge will be able to work collaboratively with TVA and other members of the LPC Working Team to better align its vision to the needs of the community and the region.

❷ ENHANCED TRANSMISSION & DISTRIBUTION OPERATIONS

BrightRidge is currently implementing distribution automation, having deployed 110 InteliRupters with 10 more planned to be deployed by mid-2023. InteliRupters are a unique alternative to conventional automatic circuit reclosers and are designed to accommodate advanced distribution automation functions, provide supervisory control and data acquisition (SCADA) functionality and offer significant benefits for radial line protection.

An RGT high-priority initiative, BrightRidge plans on investigating if a distribution management system (DMS) is needed and, if it is, select a vendor to deploy the technology.

Following this initiative, the intent is to simultaneously deploy grid automation to BrightRidge substations and investigate and deploy asset analytics by incorporating an assessment of asset data trends, such as system health monitoring and predictive/risk-based maintenance analysis.

❸ REGIONAL GUIDELINES

BrightRidge is participating in the distributed energy resources (DER) Interconnection Standards pilot, a joint initiative between TVA and several LPCs to standardize DER interconnection rules across TVA's service region.

Following the results of that pilot project, BrightRidge intends to implement those standards in their territory to create consistency across TVA's service region for DER interconnection requests.

BrightRidge is also working with stakeholders to align the benefits of smart cities with all community residents and engage with TVA's Connected Communities initiative. As part of this initiative, BrightRidge is implementing Wi-Fi and smart streetlights in partnership with the City of Johnson City.

④ EXCEPTIONAL END-USER EXPERIENCE

As more electric vehicles (EVs) become available to more drivers, there are opportunities for BrightRidge to create home EV charging programs and specialized rates for EV charging. BrightRidge is planning to investigate EV charging programs and rates for its residential customers.

BrightRidge also intends to further investigate additional demand response (DR) and/or energy efficiency programs for residential, business and industrial customers.

⑤ GRID TRANSFORMATION ENABLING

BrightRidge is evaluating its workforce-uplift strategy by defining future skill needs and investigating and developing a pipeline of new employees with these skills.

Additionally, BrightRidge plans to identify improvement areas for data governance, specifically usage, customer and planning data, and to continue to identify areas for cybersecurity improvements.

⑥ CURRENT PRIORITIES BASELINE

In addition to RGT-focused activities, BrightRidge is continuing to dedicate resources to existing initiatives for general grid maintenance and operation. Each year, BrightRidge's engineering team performs a system review to identify capital improvement needs. These activities include evaluating and analyzing estimated load growth and ongoing substation maintenance to discover emerging problems sooner.

Summary

Understanding BrightRidge's current priorities and initiatives is key in seeing how RGT can bolster efforts to achieve grid transformation. There is immense opportunity and value for BrightRidge, LPCs and TVA in collaborative planning, deployment and coordination across TVA's service region.

BrightRidge Tactical Roadmap*

CAPABILITY AREA	2022	2023	2024	2025	2026
① INTEGRATED PLANNING		Deploy Load Forecasts at Sub-System Level	(Deploy Load Forecasts cont.) / Deploy Grid Analytics	★ Implement RGT Integrated Planning	(cont.)
② ENHANCED TRANSMISSION & DISTRIBUTION OPERATIONS	Implement Distribution Automation (IntelliRupter)	★ Investigate DMS	(Investigate DMS cont.)	Deploy Grid Automation / Investigate and Deploy Asset Analytics	(cont.)
③ REGIONAL GUIDELINES	Deploy Fiber to IntelliRupters / Deploy Fiber to the Home / ★ Pilot DER Interconnection Standards / Investigate and Align with Smart City and Connected Communities	Deploy Fiber to Distribution System / ★ Implement DER Interconnection Standards	(Deploy Fiber cont.)		
④ EXCEPTIONAL END-USER EXPERIENCE	Continue to Improve AMI System / Implement Advanced Customer Interactions	★ Investigate EV Charging Program and Rate for Residential	Investigate Energy Storage and Solar Plus Programs for C&I	★ Investigate Residential and C&I DR (EE) / Pilot Home Energy Management Program	(cont.)
⑤ GRID TRANSFORMATION ENABLING	Evaluate Data Governance / Investigate Workforce Uplift Strategy	Evaluate Cybersecurity Risk / Augment Team	(cont.)	(cont.)	
⑥ CURRENT PRIORITIES BASELINE	Deploy Distribution Automation / System Review to Identify Capital Improvement Needs / Study Fleet Electrification	(cont.)	Deploy 14MW of New Solar Generation	(cont.)	(cont.)

Legend:
- ★ RGT High-Priority Initiative
- RGT Initiative
- Pilot
- Baseline Initiative
- Internal Initiative

*Each tactical roadmap is subject to change due to the fluid nature of the tools and technologies used in this industry.

Capability Areas

① INTEGRATED PLANNING

Like other LPCs, BGMU plans to identify and deploy grid analytics. This technology is the foundation to better understand the operation of the electric grid that will provide valuable data needed for insights into real-time grid information.

BGMU is also part of the LPC Working Team that will work with TVA to implement RGT-focused integrated planning. Integrated planning will help both BGMU and TVA better plan for a future with new technologies and resources that will enhance grid planning.

② ENHANCED TRANSMISSION & DISTRIBUTION OPERATIONS

BGMU has deployed more advanced distribution technologies, such as targeted distribution automation, power quality meters at substations and reclosers — all of which provide more reliable service to their customers. BGMU also plans to research a distribution management system (DMS) to determine if this technology is needed and when it should be implemented to best serve BGMU and its customers.

③ REGIONAL GUIDELINES

BGMU is reviewing distributed energy resources (DER) interconnection standards for systems of less than 1 megawatt (MW). BGMU is also participating in a pilot project with other LPCs to create DER interconnection standards across TVA's service region.

Since BGMU has started using interconnection standards, they hope to provide valuable insight for this pilot project. The outcome will be adoption of DER interconnection standards by LPCs to ensure continuity for customers across the region who decide to install DER.

LPC TACTICAL ROADMAP

HIGH customer density

Bowling Green Municipal Utilities

Overview

Bowling Green Municipal Utilities (BGMU) is a municipal-owned utility company located in Bowling Green, Kentucky. BGMU serves more than 30,000 customers and has over 350 miles of distribution power lines.

BGMU joined the LPC Working Team of the Regional Grid Transformation (RGT) initiative to provide the best service possible to its customers by working with TVA and other LPCs to better prepare for industry changes. BGMU is a smaller utility with high customer density – its participation on the LPC Working Team and its perspective on grid transformations helps ensure RGT is reflective of all LPCs. Local leadership is interested and supportive of these new technologies and programs that support BGMU taking part in this collaborative effort to share ideas, learn from their peers and pursue grid modernization.

"Our industry is changing and we need to adapt to provide the best service possible to our customers. Participation in this initiative allows us the opportunity to share ideas, discuss experiences and to learn from our peers." — BOWLING GREEN MUNICIPAL UTILITIES

4 EXCEPTIONAL END-USER EXPERIENCE

BGMU completed deployment of advanced metering infrastructure (AMI) across its service territory. Implementation of this technology is necessary for future programs that rely on the capabilities of AMI, including advanced features such as hourly customer data and power quality monitoring. These capabilities will enable more customer offerings by providing valuable insights into energy usage through AMI data.

BGMU also intends to offer customers more focused programs on energy efficiency and electric vehicles (EV). Energy efficiency programs will be reviewed by BGMU and may become available to residential, business and industrial customers. EVs are becoming more common in the area, and there may be opportunities for BGMU to participate in this emerging field. For EV charger programs and rates, BGMU plans to collaboratively work with customers and follow market trends to create programs that benefit both the LPC and customers.

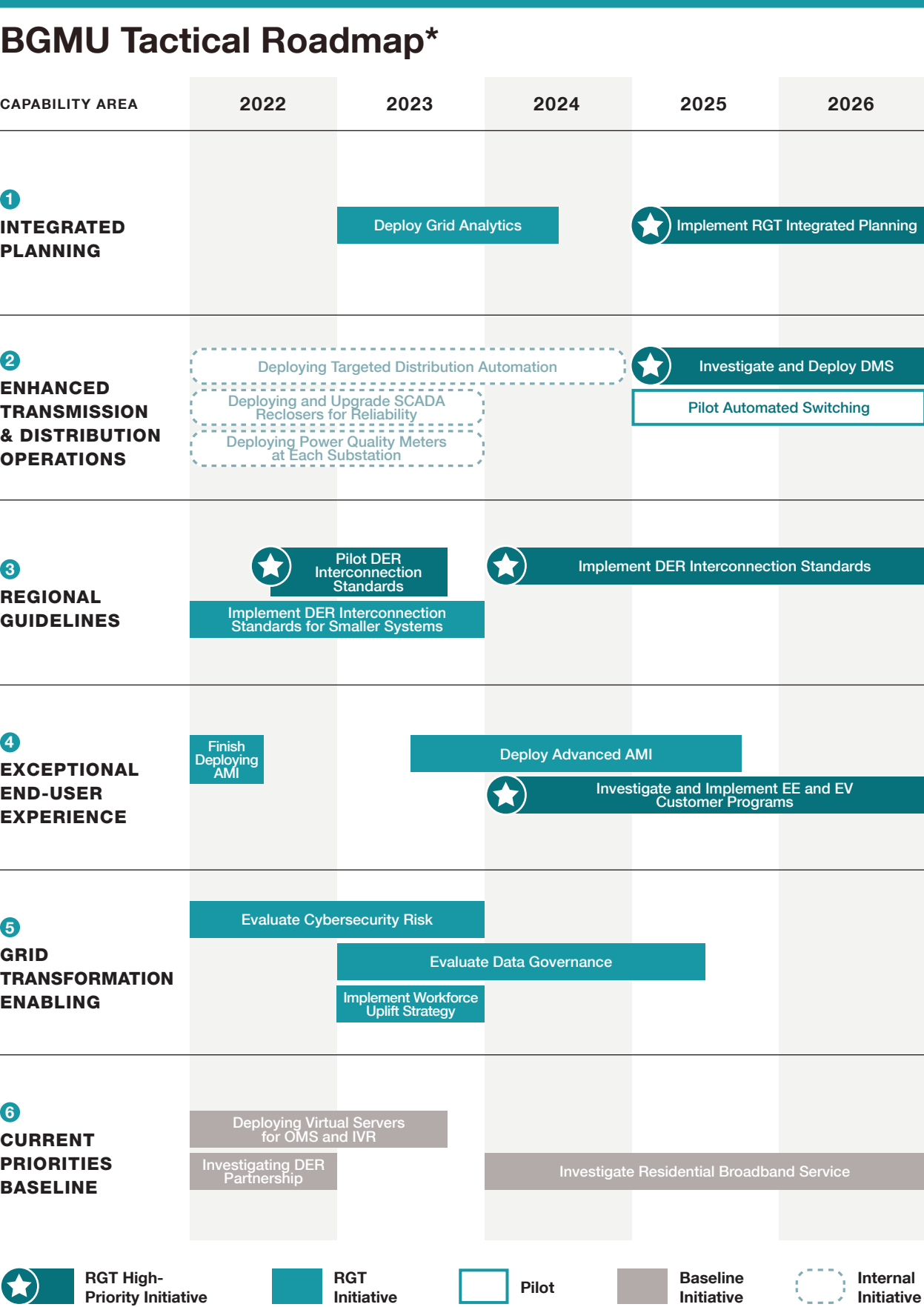### 5 GRID TRANSFORMATION ENABLING

With the prevalence of increased cybersecurity threats, BGMU has created a cybersecurity team to address these challenges and recognize areas that need improvement. Additionally, BGMU aims to identify improvement areas for data governance — specifically of usage, customer and planning data. BGMU, like other members of the LPC Working Team, plans to implement a workforce uplift program to ensure that they employees trained on the various new technologies now present on the grid.

6 CURRENT PRIORITIES BASELINE

BGMU has other, more traditional priorities, such as meeting load growth and addressing storm damage, that they will focus on over the next several years. BGMU is investigating DER partnerships for reliability and plans to work with another LPC in the region to explore additional DER opportunities and initiatives. This LPC is also deploying virtual servers for an outage management system (OMS) and an interactive voice response system (IVR).

Summary

BGMU is committed to modernizing its system. As a smaller LPC, BGMU may have fewer resources than larger LPCs but can work with other, similar LPCs to strategize and plan solutions that best fit its size and customer base. BGMU recognizes the value in working with TVA and other LPCs to plan for a regional grid and to implement RGT- focused initiatives that work best for its customers.

BGMU Tactical Roadmap*

CAPABILITY AREA	2022	2023	2024	2025	2026
1 INTEGRATED PLANNING		Deploy Grid Analytics		⭐ Implement RGT Integrated Planning	
2 ENHANCED TRANSMISSION & DISTRIBUTION OPERATIONS	Deploying Targeted Distribution Automation / Deploying and Upgrade SCADA Reclosers for Reliability / Deploying Power Quality Meters at Each Substation			⭐ Investigate and Deploy DMS / Pilot Automated Switching	
3 REGIONAL GUIDELINES	⭐ Pilot DER Interconnection Standards / Implement DER Interconnection Standards for Smaller Systems		⭐ Implement DER Interconnection Standards		
4 EXCEPTIONAL END-USER EXPERIENCE	Finish Deploying AMI	Deploy Advanced AMI / ⭐ Investigate and Implement EE and EV Customer Programs			
5 GRID TRANSFORMATION ENABLING	Evaluate Cybersecurity Risk / Evaluate Data Governance / Implement Workforce Uplift Strategy				
6 CURRENT PRIORITIES BASELINE	Deploying Virtual Servers for OMS and IVR / Investigating DER Partnership	Investigate Residential Broadband Service			

⭐ **RGT High-Priority Initiative**   ▇ **RGT Initiative**   ▢ **Pilot**   ▇ **Baseline Initiative**   ⬚ **Internal Initiative**

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EPB

HIGH
customer density

Overview

EPB, formerly known as the Electric Power Board of Chattanooga, is a municipally owned electric and telecommunications utility serving the city of Chattanooga and surrounding areas. With over 180,000 residential and business customers in a territory of roughly 600 square miles, EPB employs about 600 people throughout the Chattanooga area.

EPB is working collaboratively with regional partners to determine what the power system of the future looks like and evaluate best practices for modernizing the electric grid. As a part of the LPC Working Team, EPB is learning from other LPCs' experiences and ideas, understanding the direction TVA is moving and applying lessons from the necessary initiatives to benefit their customers and the environment. EPB puts a strong focus on grid analytics as this data will help define and prioritize the activities within Regional Grid Transformation (RGT) that make the most sense for their territory.

Capability Areas

① INTEGRATED PLANNING

Deploying grid analytics and deploying load and distributed energy resources (DER) forecasting are the first RGT-focused initiatives in the integrated planning capability area for EPB. Grid analytics allows EPB to gain greater insight into grid planning, while load and DER forecasting will provide a longer-term estimate of resources necessary for grid operations in the future. Both activities are needed before implementing RGT-focused integrated planning, since grid analytics information and DER forecasting provide valuable information required to accomplish grid transformation. By adding an RGT focus to the integrated planning process, EPB will work collaboratively with TVA and other Working Team LPCs to align its vision to the needs of the community and the region.

② ENHANCED TRANSMISSION & DISTRIBUTION OPERATIONS

EPB has been a leader in the deployment and utilization of distribution automation. More recently, EPB has focused in the areas of DER and microgrids. EPB has deployed a simplified distributed energy resources management system (DERMS) inside the supervisory control and data acquisition (SCADA) software on its system for system operations, battery operations and potential enablement of third-party DER connections. Utilizing DERMS, EPB manages various DER to support grid operational needs. EPB plans to deploy asset analytics to gain greater insight into the performance of various assets, such as transformers, breakers and regulators along its distribution system.

③ REGIONAL GUIDELINES

EPB plans to align the benefits of smart cities with all community residents by working with various stakeholders who can play a role in implementing smart city actions across EPB's service territory. EPB also aims to implement the DER interconnection standards created through the RGT Interconnection Standards pilot project, a joint initiative to standardize

> **"We were interested in participating in the RGT initiative to work with other distributors to determine what the power system of the future looks like and determine strategies to move toward that future."** — EPB

DER interconnection rules across TVA's service region between TVA and several LPCs. EPB sees the value in standardizing the process of connecting distributed resources, such as solar, to the electrical grid to introduce consistency and improve the customer experience across TVA's service region.

④ EXCEPTIONAL END-USER EXPERIENCE

Over five years, EPB plans to implement various programs and products to better serve its customers. As electric vehicles (EVs) have become increasingly accessible, EPB has started investigating programs and developing new rates for EV charging. Programs will target residential, business and industrial customers. Additionally, EPB aims to install EV charging stations and establish a comprehensive charging network to support increased EV use across its territory. EPB is also evaluating an expansion to its existing demand response (DR) and energy efficiency programs for residential, business and industrial customers. During this same time, EPB will add outage notification alerts either via text or an app for customers. Towards the end of current roadmap planning,

EPB intends to investigate and deploy analytics from AMI data to detect EVs on the system. This will help with future grid planning and forecasting effects of EVs on the grid.

⑤ GRID TRANSFORMATION ENABLING

EPB plans to investigate improvements to data governance that include usage, customer and planning data to help identify areas that may need new processes or programs for increased data availability. EPB will also continue to evaluate risk and make improvements as needed in the area of cybersecurity.

⑥ CURRENT PRIORITIES BASELINE

The current baseline priorities indicate that in addition to the various pilot projects, initiatives and activities EPB is pursuing for RGT, they are also working on other, business-as-usual projects. These activities include an EV impact study that will focus on the effects to the grid of an increase in EVs in EPB's service territory, the addition of battery storage to solar, conversion of overhead power lines to underground as a resiliency measure and studying the future impacts of DER on its system.
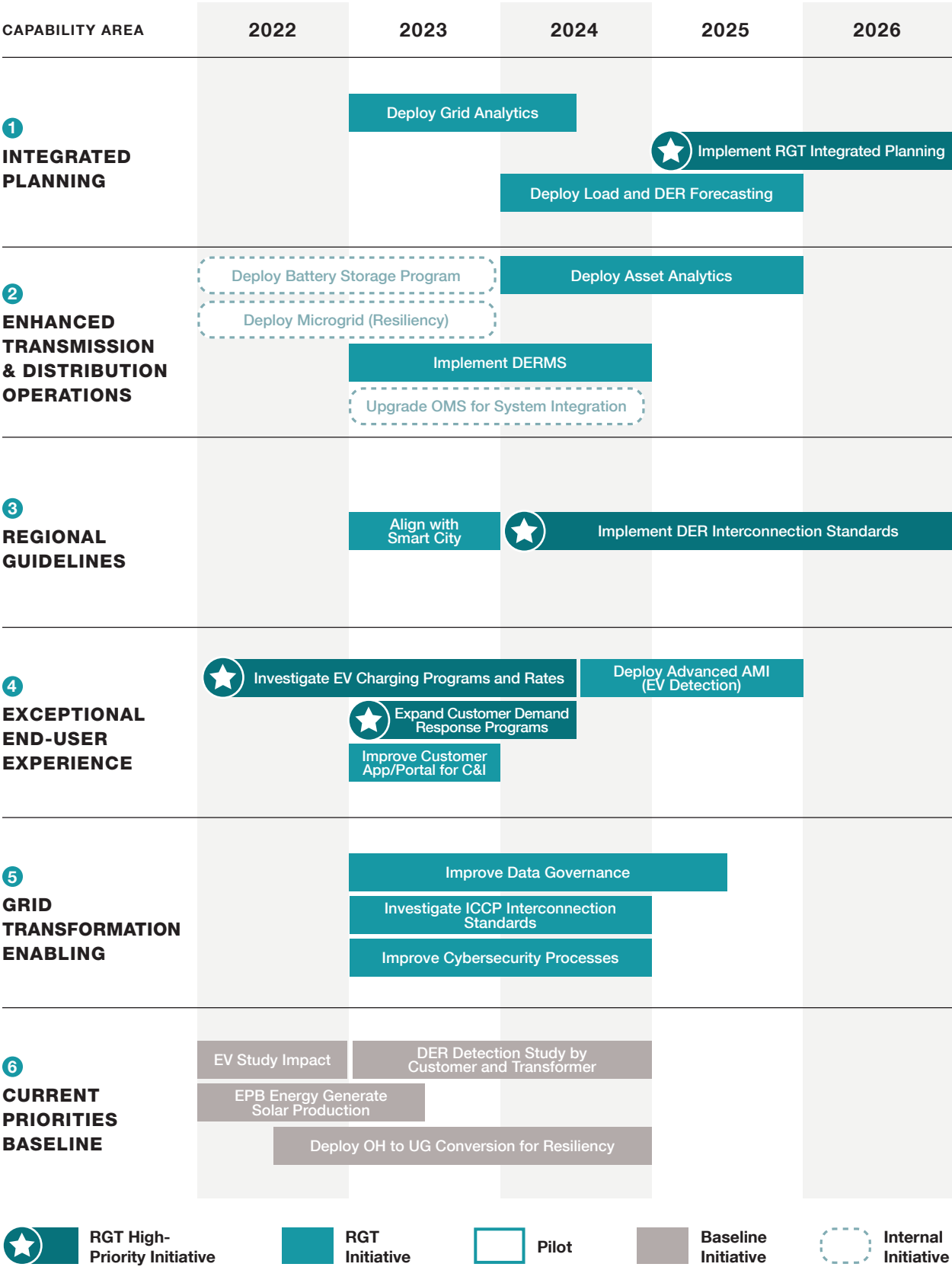
Summary

Many changes, such as EVs and new technologies specifically for the electric grid, are already here that are changing customer interests, and RGT helps EPB plan for these changes. By working on both regularly planned actions as well as those with an RGT-focus, EPB is preparing for a future with an upgraded grid. This transformed grid will provide benefits to everyone in the region.

EPB Tactical Roadmap*

CAPABILITY AREA	2022	2023	2024	2025	2026
① INTEGRATED PLANNING		Deploy Grid Analytics		⭐ Implement RGT Integrated Planning	
			Deploy Load and DER Forecasting		
② ENHANCED TRANSMISSION & DISTRIBUTION OPERATIONS	Deploy Battery Storage Program	Deploy Asset Analytics			
	Deploy Microgrid (Resiliency)				
		Implement DERMS			
		Upgrade OMS for System Integration			
③ REGIONAL GUIDELINES		Align with Smart City	⭐ Implement DER Interconnection Standards		
④ EXCEPTIONAL END-USER EXPERIENCE	⭐ Investigate EV Charging Programs and Rates		Deploy Advanced AMI (EV Detection)		
		⭐ Expand Customer Demand Response Programs			
		Improve Customer App/Portal for C&I			
⑤ GRID TRANSFORMATION ENABLING		Improve Data Governance			
		Investigate ICCP Interconnection Standards			
		Improve Cybersecurity Processes			
⑥ CURRENT PRIORITIES BASELINE	EV Study Impact	DER Detection Study by Customer and Transformer			
	EPB Energy Generate Solar Production				
		Deploy OH to UG Conversion for Resiliency			

⭐ **RGT High-Priority Initiative**　　◼ **RGT Initiative**　　▢ **Pilot**　　◼ **Baseline Initiative**　　⬚ **Internal Initiative**

*Each tactical roadmap is subject to change due to the fluid nature of the tools and technologies used in this industry.

HIGH
customer density

Huntsville Utilities

Overview

Huntsville Utilities is a midsized electric, water and gas utility provider in Alabama serving 209,000 residential, business and industrial customers. Huntsville Utilities is municipally owned, covering over 800 square miles in its territory and employing more than 700 people.

Huntsville Utilities' desire to increase reliability and resiliency for their customers led to their participation in the Regional Grid Transformation (RGT) initiative. To meet current and future customer expectations, Huntsville Utilities plans to prioritize grid and operational improvements while maintaining electric rates at an affordable level. It is also evaluating other drivers, such as local business development, new load growth and environmental considerations, when assessing overall needs for grid improvements.

Capability Areas

❶ INTEGRATED PLANNING

Huntsville Utilities is working directly with TVA to pilot integrated planning. The results of this pilot project will allow Huntsville Utilities to include RGT considerations in their integrated planning in future years. Other members of the LPC Working Team intend to do the same with their own planning efforts.

Huntsville Utilities is also deploying grid analytics tools that can examine advanced metering infrastructure (AMI) data and make meter, substation and regional observations actionable. This may include identifying existing load issues, projecting future load and assessing distributed energy resources (DER) impacts across the entire distribution grid, with a focus on specific locations.

Finally, Huntsville Utilities plans to implement load and DER forecasting that will be part of the RGT-focused integrated planning and will help Huntsville Utilities better prepare for future needs of the distribution grid.

❷ ENHANCED TRANSMISSION & DISTRIBUTION OPERATIONS

Huntsville Utilities is currently deploying voltage optimization on its system — specifically, centralized voltage monitoring by controlling load tap changers (LTC), voltage regulators and station and line capacitors. This is in addition to existing low voltage alarms, power quality monitoring and a conservation voltage reduction (CVR) program. Huntsville Utilities also intends to deploy distribution automation that will reroute power around issues on its electrical grid system in the event of an outage.

Huntsville Utilities is also looking to deploy a distribution management system (DMS)/advanced distribution management system (ADMS) in the future. These systems allow

> "Too often, what's important is pushed aside by what's urgent, but the RGT process has provided a structured way for us to remain focused on the innovations coming our way." — HUNTSVILLE UTILITIES

utilities to automate outage restoration processes and optimize the electrical grid's performance. To manage DER, Huntsville Utilities will also assess the need for a distributed energy resources management system (DERMS) and its integration of this into their operational software.

③ REGIONAL GUIDELINES

TVA is working collaboratively with a group of LPCs to refine DER interconnection standards across TVA's service region to help streamline the process of connecting distributed resources, such as solar, to the electrical grid.

By participating in the pilot project for interconnection standards, Huntsville Utilities can create the necessary internal processes to move to full program implementation. Standardization of DER interconnection processes will introduce consistency and improve the customer experience across TVA's service region.

Huntsville Utilities is further planning to implement advanced smart city integration, including electric vehicle (EV) charging and autonomous vehicles. Smart city initiatives will grow as the foundational infrastructure is developed and community needs arise.

④ EXCEPTIONAL END-USER EXPERIENCE

Huntsville Utilities has implemented centralized remote connect and disconnect

> **"We owe it to our customers — present and future — to understand the technologies and solutions that will help us meet evolving customer expectations."**
>
> — HUNTSVILLE UTILITIES

functionality in their AMI system, as most self-contained meters have been installed with remote connect and disconnect functionality. This functionality reduces truck rolls for some meter work and can get services working faster in some cases, saving both Huntsville Utilities and all customers money.

Huntsville Utilities also is working on improving the customer mobile app and online portal that will allow all customers to see their monthly AMI data readings.

During this time, Huntsville Utilities will also work on expanding energy efficiency and demand response (DR) programs

Huntsville Utilities is working on improving the customer mobile app and online portal that will customers to see their monthly AMI data readings.

for residential, business and industrial customers.

In the future, Huntsville Utilities anticipates a need to implement more advanced customer functions such as home energy management tools, outage notifications and energy usage or energy cost data that will allow all customers to better manage and understand their energy use and cost.

5 GRID TRANSFORMATION ENABLING

Huntsville Utilities is identifying improvement areas for data governance — specifically customer, usage and planning data — with the expectation that the plan for fiscal year 2023 will designate resources for developing a tool for data governance.

At the same time, Huntsville Utilities continues its work with its cybersecurity division to pinpoint areas of improvement and to strengthen cybersecurity defenses.

With the various new program offerings and additional technology deployments, Huntsville Utilities is moving forward in developing a workforce uplift strategy. This will provide current and future employees with the training and the tools to gain the skills necessary to help the LPC reach its goals.

6 CURRENT PRIORITIES BASELINE

While Huntsville Utilities has a large list of current and future programs and plans focused on RGT, it also continues with existing plans for a variety of initiatives.

This includes identifying improvement areas and modernizing the grid through transmission and substation optimization, integrating GIS data into the OMS system, building a new operations control center and upgrading business systems starting with their customer information system.

Summary

Huntsville Utilities believes that a collective vision is key for a solid grid foundation for the next 20 years. By participating in this initiative and implementing the various RGT-focused technologies and plans, Huntsville Utilities is preparing its grid for the inevitable changes that are coming to TVA's service region. Preparing now gives Huntsville Utilities the opportunity to meet the needs of current and future customers.
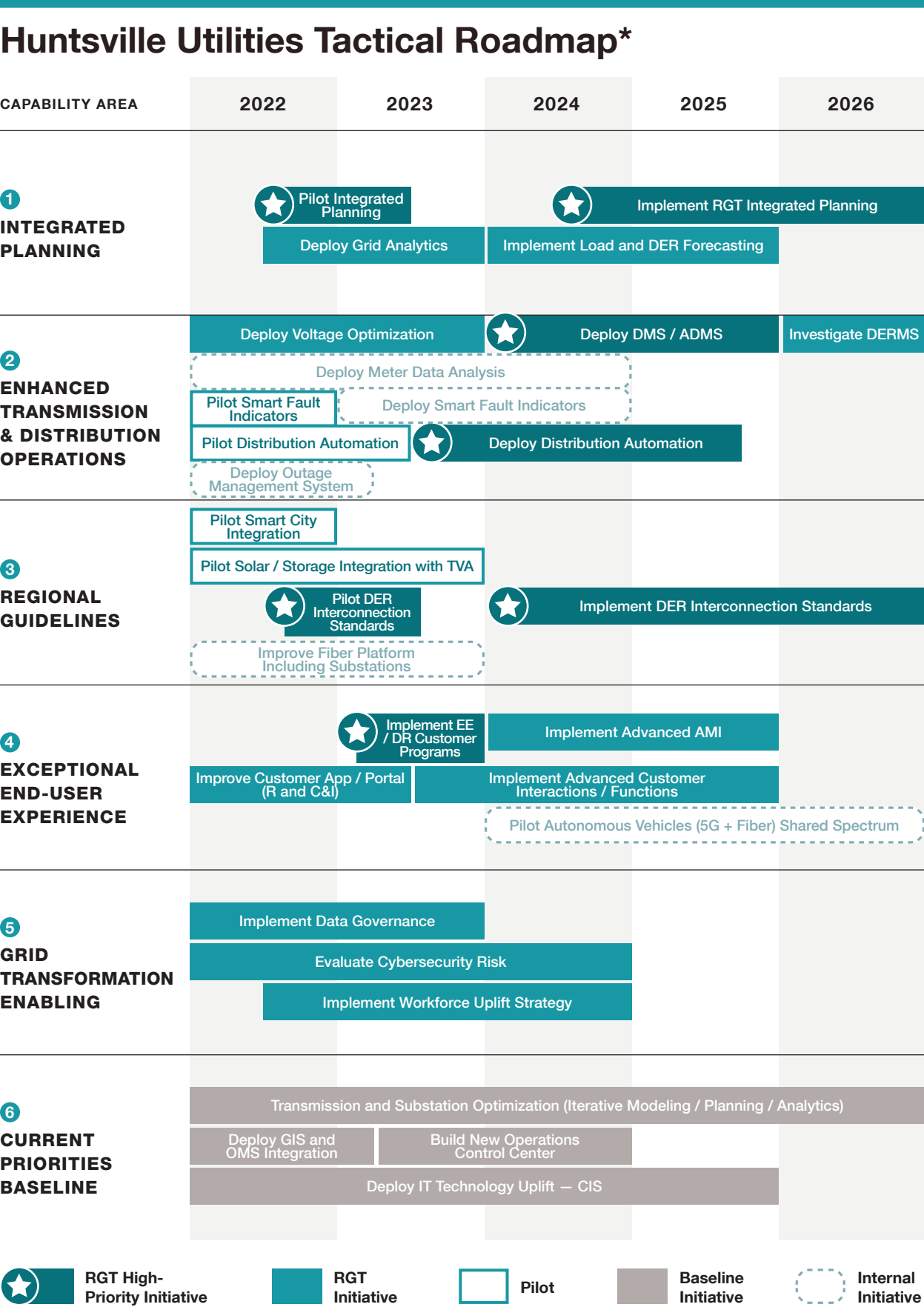
Huntsville Utilities Tactical Roadmap*

*Each tactical roadmap is subject to change due to the fluid nature of the tools and technologies used in this industry.

HIGH
customer density

Jackson Energy Authority

Overview

Jackson Energy Authority (JEA) is a municipally owned utility that provides electric, gas, water, wastewater and broadband utilities to residents of Jackson, Tennessee. JEA has a high-density service territory and serves over 37,000 customers through more than 650 miles of lines.

Collective effort and mutual benefit are among the top reasons JEA is participating in the Regional Grid Transformation (RGT) initiative. The many opportunities for shared learning among LPCs of varying size presents a unique opportunity to utilize those efforts across TVA's service region. Working together, JEA and other utilities can stay current with new, emerging technologies that will bring benefits to other LPCs and customers.

Capability Areas

1 INTEGRATED PLANNING

JEA is deploying basic load and electric vehicle (EV) forecasting that will provide insights into future electricity needs of its service territory. When this basic forecasting is complete, JEA plans to deploy more advanced forecasting — specifically around load and distributed energy resources (DER) at the system and sub-system levels. These two activities will provide valuable information to help JEA with RGT-focused integrated planning, an activity in alignment with other members of the LPC Working Team and in partnership with TVA.

JEA also has plans to advance planning practices by using a geographic information system (GIS) model, as well as to identify and deploy grid analytics. These two activities will help JEA understand exactly where to focus efforts to ensure reliability, where to best spend funds for capital upgrades and how to support a more integrated planning process in the future.

2 ENHANCED TRANSMISSION & DISTRIBUTION OPERATIONS

JEA is implementing targeted distribution automation to improve reliability and will continue with that activity over five years. JEA is also investigating if it needs to replace the supervisory control and data acquisition (SCADA) system with plans to use this investigation as an opportunity to assess overall system suitability for an advanced distribution management system (ADMS). The result of the information gathered from investigating ADMS and strategic need evaluation results will help JEA to decide on deploying ADMS.

3 REGIONAL GUIDELINES

Along with other LPCs, JEA is participating in the distributed energy resources (DER) interconnection standards pilot project with plans to use the results to create consistency across the region for customers who may wish to install DER on their property.

> **"We are motivated to participate in the RGT because we see a collective effort involving more LPCs working in unison on technical projects to be better than working independently."** — JACKSON ENERGY AUTHORITY

JEA is also working with stakeholders to align the benefits of smart cities with all residents of the community. In fact, JEA is already working with the City of Jackson and the police department to install gunshot sensors. JEA is also looking to engage with TVA's Connected Communities initiative.

4 EXCEPTIONAL END-USER EXPERIENCE

JEA plans to implement more advanced customer interactions, such as the option to calculate monthly peak demand and to offer energy management tools to residential, business and industrial customers. These tools will help customers of all sizes gain a better understanding of their energy usage and have more control over how much energy they use.

JEA plans to investigate EV charging programs and rates for customers. This is an area of growing interest from customers as EVs become more prevalent on the road.

In the latter years of this roadmap, JEA plans to research time of use (TOU) rates for residential customers. Currently JEA

offers these rates to business and industrial customers and may wish to offer specific TOU rates for residential customers to shift power consumption away from peak demand and drive savings for both customers and JEA.

5 GRID TRANSFORMATION ENABLING

JEA plans to identify improvement areas for data governance, including usage, customer and planning data. Cybersecurity improvements are becoming more important as the risks from these threats continue to grow. In response, JEA has created a cybersecurity team to address challenges with plans to identify areas for improvement. JEA also intends to investigate and then develop a workforce program that will provide trained and knowledgeable employees for the various new technologies deployed across their business.

6 CURRENT PRIORITIES BASELINE

In addition to RGT initiatives, JEA is currently implementing a meter data management system (MDMS) to support AMI retention data.
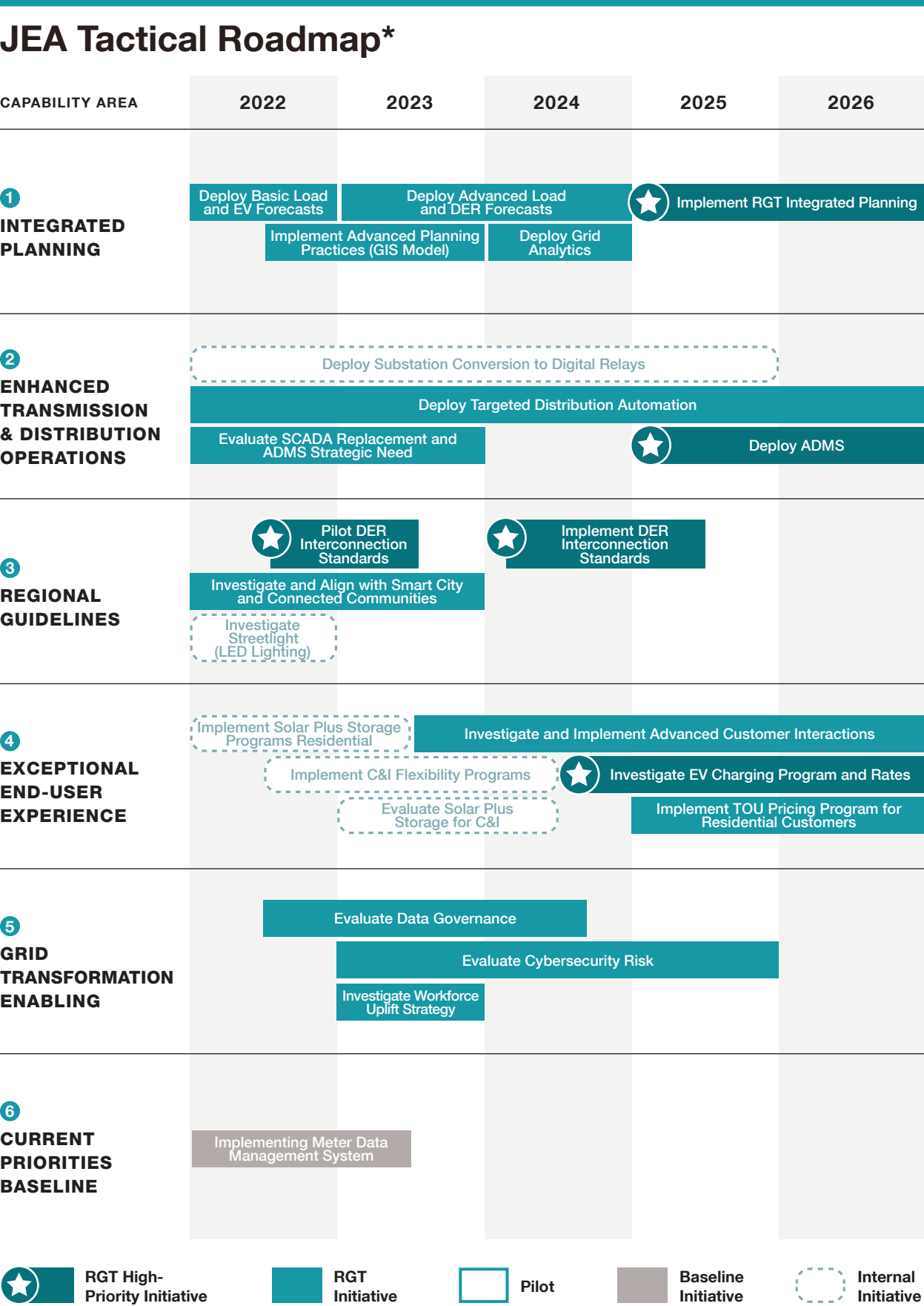
Summary

With the understanding that grid modernizing initiatives are necessary, JEA is taking part in this working group so it can continue offering reliable and affordable energy to its customers by addressing rapid, upcoming changes. JEA is committed to working in unison with other LPCs and TVA on these initiatives and pilot projects that will lead to success at a faster pace for everyone who lives and works in TVA's service region.

JEA Tactical Roadmap*

CAPABILITY AREA	2022	2023	2024	2025	2026
1 INTEGRATED PLANNING	Deploy Basic Load and EV Forecasts	Deploy Advanced Load and DER Forecasts		★ Implement RGT Integrated Planning	
		Implement Advanced Planning Practices (GIS Model)	Deploy Grid Analytics		
2 ENHANCED TRANSMISSION & DISTRIBUTION OPERATIONS		Deploy Substation Conversion to Digital Relays			
		Deploy Targeted Distribution Automation			
	Evaluate SCADA Replacement and ADMS Strategic Need		★ Deploy ADMS		
3 REGIONAL GUIDELINES	★ Pilot DER Interconnection Standards	★ Implement DER Interconnection Standards			
	Investigate and Align with Smart City and Connected Communities				
	Investigate Streetlight (LED Lighting)				
4 EXCEPTIONAL END-USER EXPERIENCE	Implement Solar Plus Storage Programs Residential	Investigate and Implement Advanced Customer Interactions			
		Implement C&I Flexibility Programs	★ Investigate EV Charging Program and Rates		
		Evaluate Solar Plus Storage for C&I	Implement TOU Pricing Program for Residential Customers		
5 GRID TRANSFORMATION ENABLING		Evaluate Data Governance			
		Evaluate Cybersecurity Risk			
		Investigate Workforce Uplift Strategy			
6 CURRENT PRIORITIES BASELINE	Implementing Meter Data Management System				

★ RGT High-Priority Initiative   **RGT Initiative**   **Pilot**   **Baseline Initiative**   **Internal Initiative**

*Each tactical roadmap is subject to change due to the fluid nature of the tools and technologies used in this industry.

HIGH
customer density

Knoxville Utilities Board

Overview

Knoxville Utilities Board (KUB) is a municipally owned utility providing electric, natural gas, fiber, water and wastewater services to Knoxville and parts of seven surrounding counties. It has over 473,000 customers, including 213,000 electric customers, and a territory of 688 square miles with 5,200 miles of service line.

KUB recognizes there are many steps required as part of the Regional Grid Transformation (RGT) initiative. This work includes identifying and prioritizing the activities that will best serve TVA's service region and its people, businesses and environment. Partnering with other members of the LPC Working Team and TVA will help KUB anticipate and plan for the evolution of the electric utility industry and the regional grid.

Capability Areas

1 INTEGRATED PLANNING

KUB is improving customer analytics by using advanced metering infrastructure (AMI) information for advanced distribution management system (ADMS), outage details and loading profiles. The goal is to use hourly data to see the impacts of various events across the system. They will also begin deploying grid analytics to conduct system-wide hosting capacity for customer-owned distributed energy resources (DER), impacts of electric vehicle (EV) charging and to evaluate system improvement options. KUB plans to deploy DER and EV adoption forecasts at the system and sub-system level.

With the information from more detailed forecasts, KUB can implement RGT-focused integrated planning capability to align with other members of the LPC Working Team and TVA. By adding an RGT focus to the integrated planning process, KUB can work collaboratively to align its vision to the needs of the community and region.

2 ENHANCED TRANSMISSION & DISTRIBUTION OPERATIONS

For enhanced transmission and distribution operations, KUB is currently deploying a system-wide high-speed fiber network.

As the fiber network is expanded, KUB is deploying a fault location, isolation and system restoration (FLISR) system to improve reliability performance. FLISR will help reduce the system average interruption duration index (SAIDI), which is a reliability index used by electric utilities to measure the average outage duration for each customer over a set time.

> "Partnering with others — including TVA and other LPCs — to better understand, anticipate, and plan for the evolution of the electric utility industry and the region's grid has been very enlightening for us... Learning what others have and are doing has been helpful in building our plan to address the grid evolution." — KNOXVILLE UTILITIES BOARD

Shortly after implementing grid analytics and fiber deployment, KUB will evaluate battery storage and microgrids in preparation for leveraging their current ADMS to deploy new system modules. This will help KUB with items like voltage support, power quality, peak shaving and resiliency to the portions of the grid where these technologies are deployed.

KUB intends to deploy grid automation for voltage optimization — initially in targeted areas before moving system wide. As the grid transforms and becomes more complex, voltage optimization is becoming increasingly important as it allows for a more efficient grid by reducing energy consumption, system losses and even peak demand for short periods.

3 REGIONAL GUIDELINES

KUB is deploying broadband fiber to its substations to enhance its supervisory control and data acquisition (SCADA) deployment. Currently, broadband fiber is being installed at substations, KUB is also extending broadband fiber to residential homes to offer broadband internet as an option for customers.

Additionally, KUB is participating in the distributed energy resources (DER) Interconnection Standards pilot project, a joint initiative between TVA and several LPCs to standardize DER interconnection rules. Following the results of that pilot project, KUB plans to implement those standards in their territory as part of the initiative to create

> **"TVA and their partners have been able to assist us with developing the framework to incorporate the evolving grid needs into our planning processes."**
>
> **— KNOXVILLE UTILITIES BOARD**

consistency across TVA's service region for DER interconnection requests.

KUB is also planning on working with stakeholders to align the benefits of smart cities with all residents of the community. For example, KUB is a partner in a pilot project in Knoxville through TVA's Connected Communities initiative that will focus on expanding access to connected devices and the internet at Knoxville parks and recreation centers across the city.

4 EXCEPTIONAL END-USER EXPERIENCE

KUB is simultaneously running a community-based solar pilot project and

KUB is running a community-based solar pilot project for residential customers to gain insight on development of meaningful tools and service offerings.

demand response management system (DRMS) pilot project for residential customers to gain insight on development of meaningful tools and service offerings. A DRMS pilot project for residents will allow KUB to monitor, control, schedule and manage future demand response (DR) programs. DR programs have the potential to help lower customer bills by reducing overall peak demand charges on the grid.

For community-based solar pilot projects, KUB plans to create a program using the results of the pilot project for residential, business and industrial customers.

Additionally, KUB is exploring EV programs, strategies and rates as vehicle electrification becomes more prevalent across the Valley. KUB intends to install two fast-charging electric vehicle charging stations to gain initial insights into fast EV charging and to help provide a charging resource for EV drivers in its service territory.
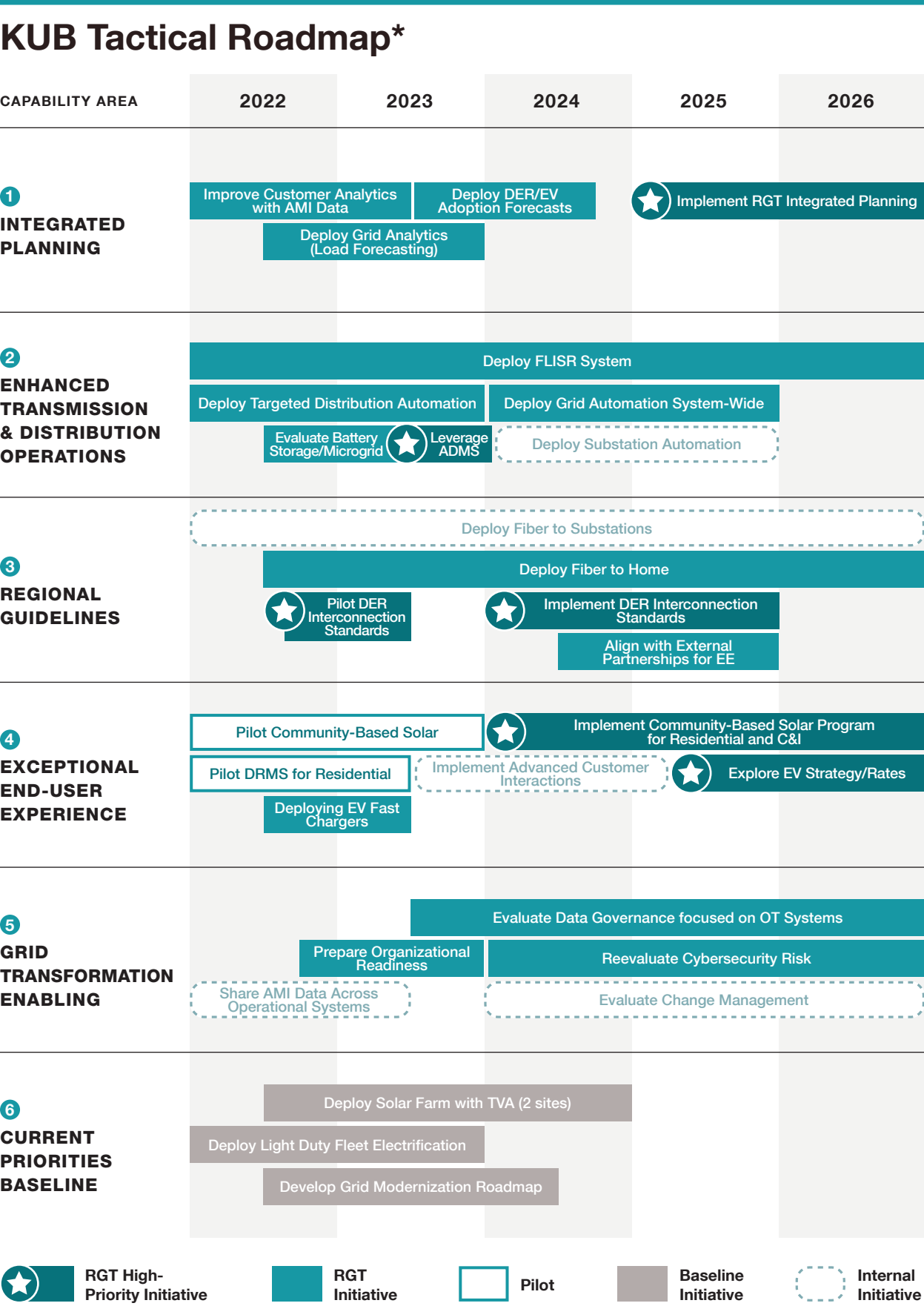
5 GRID TRANSFORMATION ENABLING

To enable grid transformation progress, KUB will help prepare its organization for change with a specific focus on people and processes. To support customers and TVA, KUB has plans to evaluate improvement areas for the governance of data that includes usage, customer and planning data. Additionally, KUB expects to identify areas for improvements in cybersecurity, with a focus on DER and SCADA.

6 CURRENT PRIORITIES BASELINE

In addition to initiatives that support RGT capabilities, KUB has baseline priorities that will continue progress in other business areas. Foundational activities include developing two solar farm sites in collaboration with TVA, deploying a light-duty EV fleet and developing a granular grid modernization roadmap. Working on both regularly planned actions and with TVA to implement and plan for RGT-focused initiatives, KUB is progressing toward a future with a modern grid.

Summary

Learning best practices and sharing ideas across the region are two of the key benefits of this initiative. KUB has the opportunity to work with both urban and rural LPCs of varying sizes, as well as with TVA to discuss potential solutions to the real world changes the region's grid will see in the future.

KUB Tactical Roadmap*

CAPABILITY AREA	2022	2023	2024	2025	2026
1 INTEGRATED PLANNING	Improve Customer Analytics with AMI Data	Deploy DER/EV Adoption Forecasts		★ Implement RGT Integrated Planning	
	Deploy Grid Analytics (Load Forecasting)				
2 ENHANCED TRANSMISSION & DISTRIBUTION OPERATIONS	Deploy FLISR System				
	Deploy Targeted Distribution Automation	Deploy Grid Automation System-Wide			
	Evaluate Battery Storage/Microgrid	★ Leverage ADMS	Deploy Substation Automation		
3 REGIONAL GUIDELINES	Deploy Fiber to Substations				
	Deploy Fiber to Home				
	★ Pilot DER Interconnection Standards	★ Implement DER Interconnection Standards			
		Align with External Partnerships for EE			
4 EXCEPTIONAL END-USER EXPERIENCE	Pilot Community-Based Solar	★ Implement Community-Based Solar Program for Residential and C&I			
	Pilot DRMS for Residential	Implement Advanced Customer Interactions	★ Explore EV Strategy/Rates		
	Deploying EV Fast Chargers				
5 GRID TRANSFORMATION ENABLING	Evaluate Data Governance focused on OT Systems				
	Prepare Organizational Readiness	Reevaluate Cybersecurity Risk			
	Share AMI Data Across Operational Systems	Evaluate Change Management			
6 CURRENT PRIORITIES BASELINE	Deploy Solar Farm with TVA (2 sites)				
	Deploy Light Duty Fleet Electrification				
	Develop Grid Modernization Roadmap				

★ **RGT High-Priority Initiative**   ▮ **RGT Initiative**   ▢ **Pilot**   ▮ **Baseline Initiative**   ⬚ **Internal Initiative**

*Each tactical roadmap is subject to change due to the fluid nature of the tools and technologies used in this industry.

HIGH
customer density

Middle Tennessee Electric

Overview

Middle Tennessee Electric (MTE) is a large, 500-employee, member-owned electrical cooperative primarily serving four counties in Tennessee. It serves over 330,000 members with more than 14,000 miles of electrical distribution lines.

Looking ahead to the needs of the future has motivated MTE to participate with the LPC Working Team and TVA in Regional Grid Transformation (RGT). Innovation, regional partnership and shared benefits are key drivers in working toward meeting current and future member needs. MTE views the RGT initiative as an opportunity to provide support and knowledge for LPCs of all sizes. By adding an RGT focus to the integrated planning process, MTE will be able to work collaboratively with TVA and other LPCs to align their vision to the needs of the community as well as the region.

Capability Areas

1 INTEGRATED PLANNING

Identifying and deploying grid analytics is the first initiative for MTE in the integrated planning capability area. Analytics allow MTE to gain greater insight into grid operations and lay the groundwork for other RGT initiatives.

The second initiative MTE plans to implement is load and distributed energy resources (DER) forecasting tools and processes to help plan for new and proposed large loads and DER. Both initiatives will help provide MTE with more information regarding existing and planned resources on their electric grid. Upon completion of these two initiatives, MTE's RGT integrated planning will align in partnership with other members of the LPC Working Team and TVA.

2 ENHANCED TRANSMISSION & DISTRIBUTION OPERATIONS

MTE has a robust geographic information system (GIS) solution and is working to incorporate GIS data from an electric system acquired in a 2020 merger. Additionally, MTE uses an outage management system (OMS) that includes an automatic vehicle location (AVL) system to efficiently manage and report outages. The data from the OMS provides critical value for focusing system reliability efforts.

MTE also has completed upgrades to its supervisory control and data acquisition (SCADA) system to replace a previous system. The new SCADA system provides more flexibility for future needs and integrates system awareness to enable its voltage and VAR (VVO) initiative that replaces the old capacitor control system with a secure and economical solution.

Currently, MTE is researching high density coordination (HDC) and fault location, isolation and service restoration (FLISR) distribution automation solutions to reach its system reliability goals.

> "We're motivated to participate by our desire to be innovative. We continue to develop our own plans for our future grid, but recognize that there can be advantages to working together." — MIDDLE TENNESSEE ELECTRIC

❸ REGIONAL GUIDELINES

MTE is in the process of deploying fiber to field devices to offer faster speed and reliability over current radio communications. Concurrently, they are beginning to engage with two projects in the TVA Connected Communities initiative that focus on providing equitable access to services.

MTE is participating in the pilot project for DER interconnection standards. Upon completion and analysis of the pilot project, MTE plans to make appropriate modifications to their existing DER interconnection standards. This is a joint effort with TVA and other LPCs to collaboratively refine DER interconnection standards across TVA's service region to help streamline the process of connecting distributed resources, like solar, to the electrical grid. By participating in the pilot project for interconnection standards, MTE can create the necessary appropriate updates to its internal processes to move to full program implementation. Standardization of DER interconnection processes will introduce consistency and improve the member experience across TVA's service region. When DER interconnection standards are implemented, MTE plans to work with stakeholders to align benefits of smart cities with all community residents.

❹ EXCEPTIONAL END-USER EXPERIENCE

MTE is deploying advanced metering infrastructure (AMI) to members who joined after a merger with another LPC in 2020. This initiative includes deploying communications infrastructure and advanced metering equipment that will allow for these additional members to access the benefits of AMI, such as more accurate meter readings and faster response times to outages. After expanding AMI to more members, MTE will deploy more AMI capabilities to provide MTE the ability to implement power quality management that is important for members, particularly those with energy-intensive equipment, and will benefit MTE by identifying power quality issues on their system.

Starting in late 2023, MTE plans to implement several programs intended for all member types — residential, business and industrial members. For example, MTE intends to install public electric vehicle (EV) charging stations and offer time of use (TOU) rates. They also plan to implement demand response programs (DR) for business and industrial members. Finally, MTE will investigate further expansion of existing energy efficiency programs for residential, business and industrial members.

By leveraging new metering infrastructure and technology, MTE can conduct more advanced customer analytics, such as peak energy demand, detailed energy consumption and DER data, to provide insights into customer energy use that can be shared with customers as well as used by MTE in planning for future system needs. Additionally, MTE is planning to deploy other member program opportunities such

Starting in late 2023, MTE plans to implement several member programs, including installing public EV charging stations and offering TOU rates.

as community solar, energy storage and solar plus energy storage to business and industrial members.

⑤ GRID TRANSFORMATION ENABLING

MTE plans to simultaneously begin implementing workforce uplift strategy and reducing cybersecurity risk. The workforce uplift strategy includes investigating and developing a pipeline of new employees with required skills to ensure they can implement and maintain their grid transformation initiatives. With the transition from the current, legacy grid to the grid of the future, there is a need for a new workforce strategy to ensure that MTE has the employee skills and knowledge needed for these new technologies.

Additionally, as they deploy other technological and advanced data initiatives, identifying areas for improving cybersecurity is necessary. With the various new tools and technologies used within the transformed grid, there are new opportunities to strengthen cybersecurity measures. Later in the roadmap, MTE plans to identify areas for improvement in governance of usage, member and planning related data.
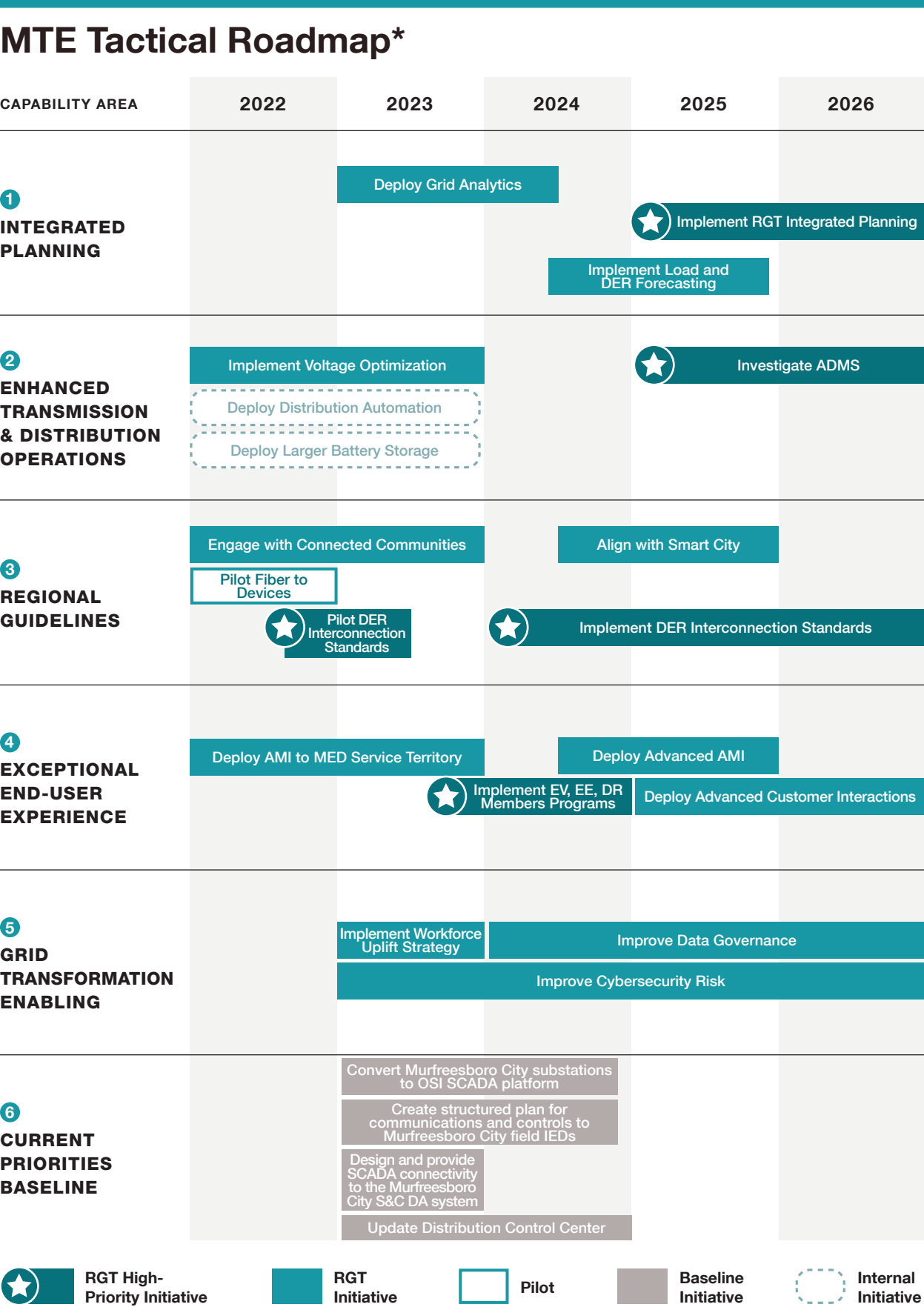
⑥ CURRENT PRIORITIES BASELINE

MTE is focused on matching the electric system acquired during the 2020 merger with MTE engineering, technology and operational standards. This project is a long-term commitment requiring a large-scale SCADA replacement, updating a local distribution automation scheme and implementing communications deployment to many field devices.

Additionally, MTE is deploying advanced secure communications to its field intelligent electronic device (IED) devices along with replacement of an outdated capacitor control system. In 2024, they anticipate an update to their distribution control center. This will help manage the various new technologies available for the grid and operations of MTE.

Summary

MTE is a larger LPC participating in the RGT initiative and is planning to investigate and implement a wide variety of RGT-focused initiatives. With the lessons learned and experience gained from the various pilot projects and initiatives, MTE will have the knowledge and technologies needed for a regionally integrated, future grid.

MTE Tactical Roadmap*

CAPABILITY AREA	2022	2023	2024	2025	2026
① INTEGRATED PLANNING		Deploy Grid Analytics	Implement Load and DER Forecasting	Implement RGT Integrated Planning	
② ENHANCED TRANSMISSION & DISTRIBUTION OPERATIONS	Implement Voltage Optimization / Deploy Distribution Automation / Deploy Larger Battery Storage			Investigate ADMS	
③ REGIONAL GUIDELINES	Engage with Connected Communities / Pilot Fiber to Devices / Pilot DER Interconnection Standards		Align with Smart City / Implement DER Interconnection Standards		
④ EXCEPTIONAL END-USER EXPERIENCE	Deploy AMI to MED Service Territory / Implement EV, EE, DR Members Programs		Deploy Advanced AMI / Deploy Advanced Customer Interactions		
⑤ GRID TRANSFORMATION ENABLING	Implement Workforce Uplift Strategy / Improve Data Governance / Improve Cybersecurity Risk				
⑥ CURRENT PRIORITIES BASELINE	Convert Murfreesboro City substations to OSI SCADA platform / Create structured plan for communications and controls to Murfreesboro City field IEDs / Design and provide SCADA connectivity to the Murfreesboro City S&C DA system / Update Distribution Control Center				

Legend:
- ⭐ **RGT High-Priority Initiative**
- **RGT Initiative**
- **Pilot**
- **Baseline Initiative**
- **Internal Initiative**

*Each tactical roadmap is subject to change due to the fluid nature of the tools and technologies used in this industry.

Nashville Electric Service

HIGH customer density

Overview

Nashville Electric Service (NES) provides electricity to Nashville and surrounding areas via more than 5,500 miles of electrical lines, covering a total of 700 square miles. As one of the 11 largest utilities in the nation, NES serves more than 420,000 residential, business and industrial customers.

NES is aware of the rapid changes to the industry and knows that as future technologies become more widely available, there will be opportunities to enhance grid operations while also meeting future customer needs. NES acknowledges the value of working with TVA and other LPCs by participating in the LPC Working Group to drive grid efficiency and innovation. Through Regional Grid Transformation (RGT) — sharing resources, knowledge and challenges — NES and other LPCs can meet the demands of the future.

Capability Areas

❶ INTEGRATED PLANNING

NES plans to deploy advanced load forecasting as a stepping stone for implementing RGT-focused integrated planning since it provides valuable insights into potential scenarios for differing loads on the electrical grid. This includes deployment of hourly load forecasting at a variety of levels on the electrical grid system including feeder and substation levels.

While advanced load forecasting is underway, NES plans to deploy distributed energy resource (DER) forecasts at the system and sub-system level with a focus on electric vehicle (EV) adoption. The ability to forecast available EV adoption across the NES territory allows for the incorporation of new, anticipated sources of load into future planning for the electrical grid.

Both tools will be helpful in the RGT-focused integrated planning pilot project NES and other members of the LPC Working Team plan with TVA. With more granular forecasts, these LPCs can plan together for the grid of the future.

❷ ENHANCED TRANSMISSION & DISTRIBUTION OPERATIONS

NES is deploying distribution automation to targeted areas of its system to improve reliability by enhancing switching and sectionalizing capabilities. NES has worked with numerous customers to install automatic throw-over schemes for customers who require a high reliability.

Distribution automation is effective in increasing reliability because it allows the grid to automatically reroute power in the event of a grid outage to these specific customers.

> **"Our industry is changing and changing rapidly. We believe it is through newly acquired knowledge that is going to help NES meet the challenges brought on by the changes all LPCs are experiencing. Participating in RGT is a way for us to gain the knowledge firsthand needed to meet the demands of the future."**
>
> — **NASHVILLE ELECTRIC SERVICE**

Building on an existing fault location, isolation and service restoration (FLISR) pilot, NES plans to use findings to align its long-term strategy for FLISR development that includes continuing to deploy FLISR to targeted areas along its electrical grid. FLISR is effective at lowering the frequency and duration of system interruptions by converting sustained outages into momentary outages through intelligent switching operations.

NES plans to evaluate different distribution management systems to provide more knowledge and capabilities on the electrical grid. First, NES aims to evaluate if distributed energy resources management system (DERMS) platform implementation is necessary within its system. DERMS may allow more control over distributed resources that exist on the grid and the ability to aggregate these resources that can be used at the larger system level.

Second, NES plans to evaluate a distribution management system (DMS) for its grid. A DMS provides data at a more granular level along the distribution system that can inform new programs and projects. NES will determine if DMS can provide necessary value to the grid and NES customers before selecting a vendor and implementing the technology. While NES does not control any third-party-owned DER, they can begin to investigate utilizing these types of resources for distribution grid services.

> **"Customer expectations and technological innovations are making it more important for there to be consistency in grid operations... We as LPCs need closer coordination with each other and with TVA."**
>
> **— NASHVILLE ELECTRIC SERVICE**

❸ REGIONAL GUIDELINES

NES is a participating LPC with TVA on piloting, and then implementing, DER interconnection standards. By first piloting this initiative, participating LPCs can learn and deploy best practices in the implementation of these new standards while all LPCs can benefit from the outcome of this pilot project and subsequent reporting of results. LPCs of all sizes benefit from standards across TVA's service region as they provide an easier customer

NES plans to evaluate a distribution management system (DMS) and determine if DMS can provide necessary value to the grid and its customers.

experience for those interested in adopting DER themselves.

NES intends to work with stakeholders to align benefits of smart cities with all community residents. By combining the new capabilities offered by its meter supplier and meter data management (MDM) systems, NES will better understand and serve their customers.

❹ EXCEPTIONAL END-USER EXPERIENCE

Similar to other utilities participating in RGT roadmap planning, NES plans to investigate more advanced energy efficiency and demand response (DR) programs for residential, business and industrial customers. This is in addition to existing programs or the potential to revise programs that already exist.

Additionally, NES plans to explore an EV charging program and charging rates to help EV drivers with more options for charging their vehicles, both at-home or on the road.

❺ GRID TRANSFORMATION ENABLING

With the prevalence of cybersecurity risks, NES is continuing to evaluate its own cybersecurity infrastructure and implement departments and programs to strengthen its response to cyber threats. NES will also evaluate and identify areas of improvement regarding data governance and usage information to support future plans and increase protections for customers in their territory.
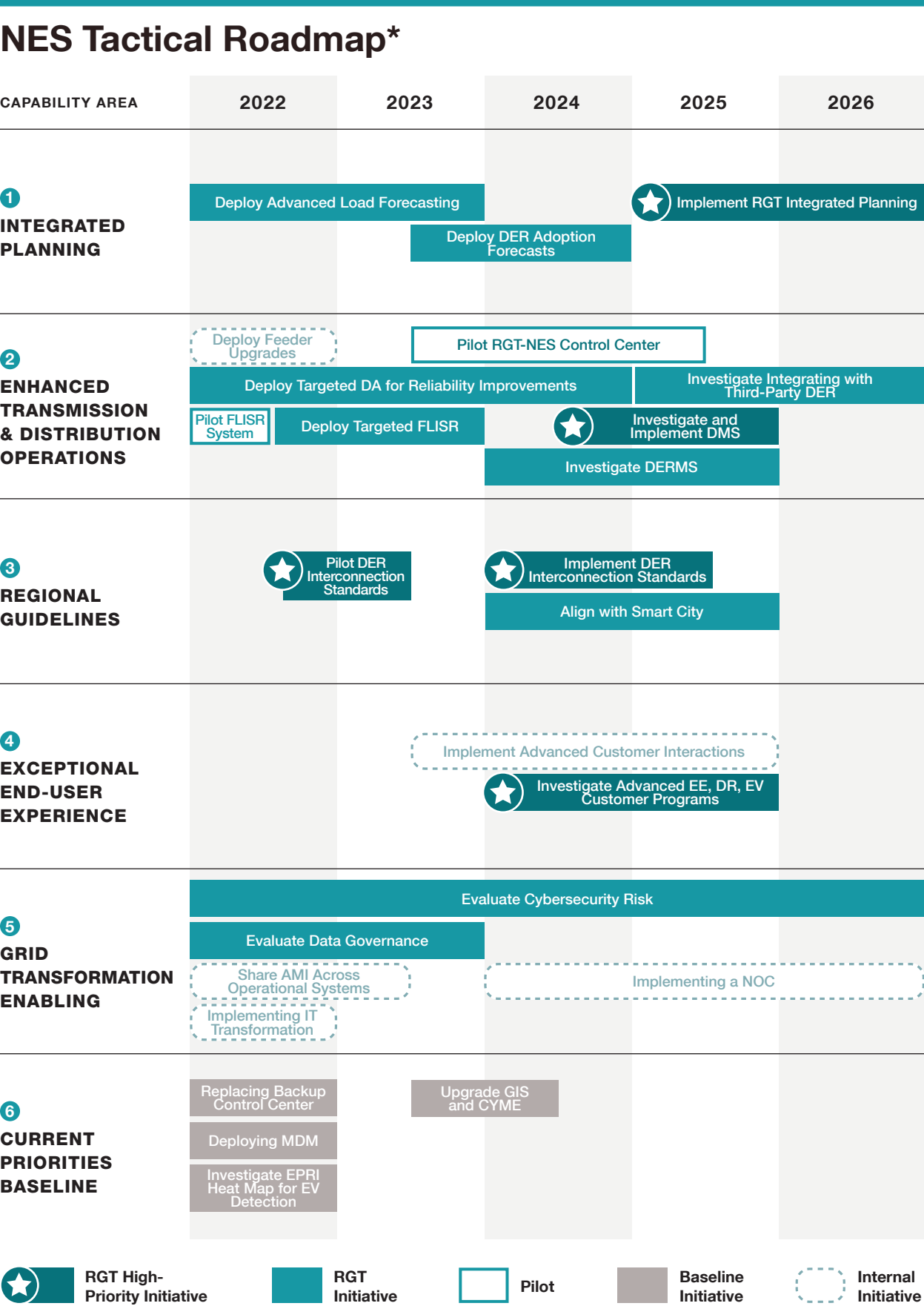
❻ CURRENT PRIORITIES BASELINE

NES is constructing a new backup control center which will help reduce response times and allow for improvements and upgrades with less potential disruption for customers. NES is also deploying MDM that will help implement pilot projects that require AMI or MDM data and using EPRI's EV heat maps to better forecast new EV adoption across the NES service.

In addition, NES plans to upgrade its existing GIS and load flow analysis systems to allow for more integrated IT across all systems.

Summary

Future plans for the NES electric grid include how new technologies can improve both the distribution of electricity and the evolving needs of customers. By working together with other LPCs and TVA, NES can learn about the various available options and make the right decision for the grid to benefit NES customers. This collaboration will help NES learn about the plans of other LPCs and help create a more regional view of the future electrical grid.

NES Tactical Roadmap*

CAPABILITY AREA	2022	2023	2024	2025	2026
❶ INTEGRATED PLANNING	Deploy Advanced Load Forecasting		Deploy DER Adoption Forecasts	★ Implement RGT Integrated Planning	
❷ ENHANCED TRANSMISSION & DISTRIBUTION OPERATIONS	Deploy Feeder Upgrades · Pilot FLISR System	Pilot RGT-NES Control Center · Deploy Targeted DA for Reliability Improvements · Deploy Targeted FLISR	★ Investigate and Implement DMS · Investigate DERMS	Investigate Integrating with Third-Party DER	
❸ REGIONAL GUIDELINES	★ Pilot DER Interconnection Standards	★ Implement DER Interconnection Standards · Align with Smart City			
❹ EXCEPTIONAL END-USER EXPERIENCE		Implement Advanced Customer Interactions · ★ Investigate Advanced EE, DR, EV Customer Programs			
❺ GRID TRANSFORMATION ENABLING	Evaluate Cybersecurity Risk · Evaluate Data Governance · Share AMI Across Operational Systems · Implementing IT Transformation		Implementing a NOC		
❻ CURRENT PRIORITIES BASELINE	Replacing Backup Control Center · Deploying MDM · Investigate EPRI Heat Map for EV Detection	Upgrade GIS and CYME			

★ **RGT High-Priority Initiative** ■ **RGT Initiative** □ **Pilot** ▨ **Baseline Initiative** ⬚ **Internal Initiative**

*Each tactical roadmap is subject to change due to the fluid nature of the tools and technologies used in this industry.

Tennessee Valley Authority Tactical Roadmap

Overview

The Tennessee Valley Authority (TVA) is a public corporation that generates power across the Southeast U.S., working with 153 local power companies (LPCs) to deliver power to more than 10 million people across seven states. TVA has a diverse generation asset mix that includes both traditional and newer technologies, such as solar and energy storage.

TVA works with LPCs to advance Regional Grid Transformation (RGT) because of the widespread benefits this initiative offers to everyone in its service region. As the electric utility industry adapts to new technologies and customer demands, TVA is preparing the transmission system for future changes. TVA and LPCs can impact both the transmission and distribution sides of the grid by working collaboratively to help plan each LPC's RGT-focused activities. Grid transformation does not include only physical equipment; preparing the grid for coming changes will require more work, such as detailed integrated planning, greater customer programs and enhanced cybersecurity measures, from everyone.

Some of the activities and technologies discussed here are partnership projects between TVA and one or several LPCs.

Capability Areas

❶ INTEGRATED PLANNING

TVA plans to develop and implement an integrated planning process, a high-priority RGT initiative, across TVA's service region along with some members of the LPC Working Team. The overarching aim of this capability area is an integrated planning framework that incorporates inputs from generation, transmission and distribution systems and will lead to more holistic and cost-effective resource planning between TVA and LPCs. Integrated planning activities will include the modeling framework and data to be shared between TVA and LPCs, as well as outreach to LPCs to implement the new process. For example, one goal is for LPCs to provide more robust and regularly updated load forecasts on the distribution system along with distributed energy resources (DER) forecasts by type. TVA would provide each LPC with more detailed generation and transmission planning information (compared to the detail of historical integrated resource planning (IRP) information) to enable LPCs to better plan and target investment on the distribution grid, acquire advanced grid technologies and develop innovative customer programs.

❷ ENHANCED TRANSMISSION & DISTRIBUTION OPERATIONS

While TVA is responsible for the transmission side of the electric grid, it is also working on pilot projects to help enhance the distribution side of the grid. The first pilot project involves a battery energy storage system to support the bulk electric system in a specific area. This pilot project will help provide insights to TVA on the operation of this type of energy storage system for future storage projects. The learnings from this project can also be used to inform LPCs on beneficial use cases for energy storage.

Through the long-term partnership agreements, LPCs have the opportunity to own generation connected to the distribution systems. These DER can provide benefits both at the local, distribution system level and the regional, transmission system level. There are efforts underway to identify innovative models that can facilitate these shared values across TVA's service region, as a future phase of RGT and Grid of Tomorrow. This requires communication interfaces for visibility and control, systems and technologies such as distributed energy resources management systems (DERMS).

Additionally, the Grid of Tomorrow initiative is designed to enhance reliability and resiliency by deploying new asset health sensors, integrating new data sources, applying advanced analytics and taking advantage of the latest technologies in grid visibility and situational awareness. These implementations, the new system

operations center (SOC) and other cutting-edge technologies will position TVA to be an industry leader in transmission operations.

❸ REGIONAL GUIDELINES

TVA and members of the LPC Working Team are collaborating on a pilot project to standardize DER interconnection processes and requirements across the seven-state service region. This will help navigate new challenges raised by increasing DER grid connections, with a focus on understanding the application of new DER interconnection standards.

The project will also include alignment between practices for transmission and sub-transmission interconnections and distribution-connected DER. These standard processes and requirements will help ensure consistency for any customer who wishes to install DER on their property.

Consistency across various interconnection points will help all types of customers understand the requirements needed for interconnection that will also save time and money for LPCs, their customers and TVA.

Another component of this project is to establish a DER interconnection governance process to drive — and sustain — consistent application and practices of interconnection standards.

❹ EXCEPTIONAL END-USER EXPERIENCE

In working with several LPCs, technologies and offerings have been identified to enhance the end-user customer experience.

TVA plans to assemble a strategy that ensures cybersecurity concerns are consistently addressed and reduced across TVA and LPC operations.

First, TVA has developed a suite of powerful analytical tools that leverage advanced metering infrastructure (AMI) data. These tools can provide analytics and insights to LPCs that help inform planning, forecasting and operations. Data are also utilized to inform representative load profiles for LPCs' internal planning purposes.

Second, TVA plans to expand demand response (DR) programs to large business and industrial customers. By including these specific customers, TVA can have a larger impact when calling DR events.

⑤ GRID TRANSFORMATION ENABLING

A key component in enabling grid transformation is increasing attention on cybersecurity and data governance. Plans are in place to assemble a strategy that ensures cybersecurity concerns are consistently addressed and reduced across TVA and LPC operations. The entire
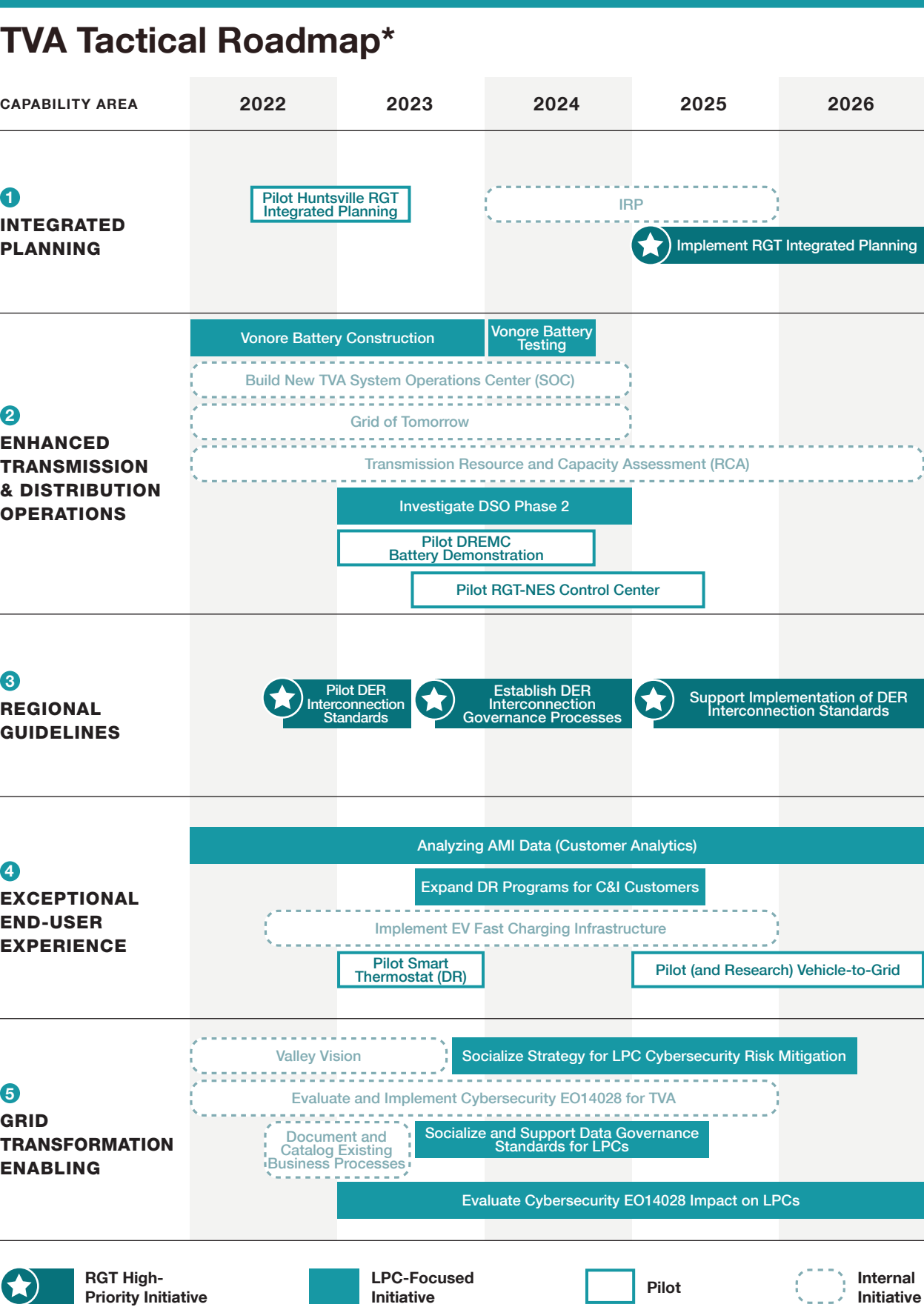
region benefits through strategic framing and consistent practices around cybersecurity and deliberate data management and governance.

To improve overall grid security, strong protections against cyber threats need to be enacted. TVA plans to evaluate cybersecurity best practices from Executive Order 14028 and explore how to share the information with LPCs to support interdependent platforms, including multi-factor authentication and cybersecurity threat protocols. TVA can work with LPCs to provide advisory services for cybersecurity and implementation best practices.

RGT identified the critical nature of data across future engineering, planning and operations, and is an example of where TVA can partner with LPCs toward adopting data standards and best practices in a consistent manner that benefits all stakeholders. TVA plans to engage with LPCs about data governance standards to enable the secure transfer of data, a necessary step for successful grid transformation.

Summary

RGT impacts all parts of the grid, and TVA and LPCs working together on grid transformation will benefit all stakeholders. While RGT initiatives at each LPC may look different, all parties are working toward a common goal. Collaboration, knowledge sharing and joint projects are important for TVA and LPCs as RGT is a joint effort requiring input and participation from all entities.

TVA Tactical Roadmap*

CAPABILITY AREA	2022	2023	2024	2025	2026
① INTEGRATED PLANNING	Pilot Huntsville RGT Integrated Planning		IRP	Implement RGT Integrated Planning	
② ENHANCED TRANSMISSION & DISTRIBUTION OPERATIONS	Vonore Battery Construction	Vonore Battery Testing			
	Build New TVA System Operations Center (SOC)				
	Grid of Tomorrow				
	Transmission Resource and Capacity Assessment (RCA)				
	Investigate DSO Phase 2				
	Pilot DREMC Battery Demonstration				
	Pilot RGT-NES Control Center				
③ REGIONAL GUIDELINES	Pilot DER Interconnection Standards	Establish DER Interconnection Governance Processes	Support Implementation of DER Interconnection Standards		
④ EXCEPTIONAL END-USER EXPERIENCE	Analyzing AMI Data (Customer Analytics)				
	Expand DR Programs for C&I Customers				
	Implement EV Fast Charging Infrastructure				
	Pilot Smart Thermostat (DR)		Pilot (and Research) Vehicle-to-Grid		
⑤ GRID TRANSFORMATION ENABLING	Valley Vision	Socialize Strategy for LPC Cybersecurity Risk Mitigation			
	Evaluate and Implement Cybersecurity EO14028 for TVA				
	Document and Catalog Existing Business Processes	Socialize and Support Data Governance Standards for LPCs			
	Evaluate Cybersecurity EO14028 Impact on LPCs				

Legend:
- ⭐ RGT High-Priority Initiative
- LPC-Focused Initiative
- Pilot
- Internal Initiative

*Each tactical roadmap is subject to change due to the fluid nature of the tools and technologies used in this industry.

Regional Grid Transformation and TVA

The benefits of this initiative will prepare the seven-state TVA service region for the changing technology the electricity sector is facing and position the region as a reliable, secure and innovative area for businesses and residents to call home.

The Opportunities

The varied possibilities for the future electric grid are inspiring! This transformed grid will allow for more sources of clean energy to be added, provide greater insight into distribution operations for LPCs and give end-use customers more control over their energy usage.

RGT-Focused Investments and Activities

TVA can provide subject matter experts and additional resources for LPCs interested in pursuing their own tactical roadmap.
Other supportive activities include:

Piloting DER interconnection standards with the LPC Working Team

Developing and implementing standardized protocols and requirements provide consistency for DER development and installation.

Increasing cybersecurity measures on the generation and transmission side of the grid

Safety and security requirements help ensure reliability and keep LPCs, their customers and TVA more secure.

Testing battery options to determine what works best for the regional grid

Energy storage can improve resiliency and assist in deployment of more renewables.

Other Investments in Grid Operations

Regional Grid Transformation is not the only initiative TVA has regarding grid upgrades and investments. While much of the focus is on actions and projects LPCs can take to transform the distribution side of the grid and create end-use customer programs, TVA is also dedicating funds to the transmission side of the grid.

Through the **Grid of Tomorrow program**, TVA is investing $2 billion over five years to provide clean, low-cost and reliable energy for the more than 10 million people in TVA's service region.

By implementing new technologies and programs, TVA has the information and ability to detect problems early and provide more accurate information to field personnel to help increase reliability. Investments include **strategic fiber deployment and DER integration** to help TVA have the resources needed for the changing grid.

Conclusion

Transforming the grid to enable technological advances, deploy more clean energy sources and meet changing customer needs requires input and action from both TVA and its LPC partners.

By connecting every community, the Regional Grid Transformation can:

✓ **Protect against cybersecurity threats**

✓ **Add more sources of clean energy**

✓ **Increase resilience**

✓ **Maintain reliability**

✓ **Keep costs affordable**

✓ **Benefit everyone we serve**

LEARN MORE
www.tva.com/energy/technology-innovation/
regional-grid-transformation