2022 DEP MYRP T&D Technical Conference

July 25, 2022

Today's speakers

Justin Brown

Director, Planning & Regulatory Support

Brent Guyton

Director, Distribution Asset Management

Dan Maley

Director, Transmission Compliance Coordination

Agenda

Topic	Presenter
Context and external trends	**Justin Brown**
Distribution projects	Brent Guyton
Transmission projects	Dan Maley
Closing remarks	Justin Brown

Plan for today

Plan for the day

- Update on context and external trends that impact grid improvement planning
- Share summary of planned work and expected benefits for Distribution and Transmission systems
- Give examples of planned work during the Multiyear Rate Plan (MYRP) period
- Q & A

Documents shared in advance

✓ Detailed description for each planned improvement program and/or project, including:

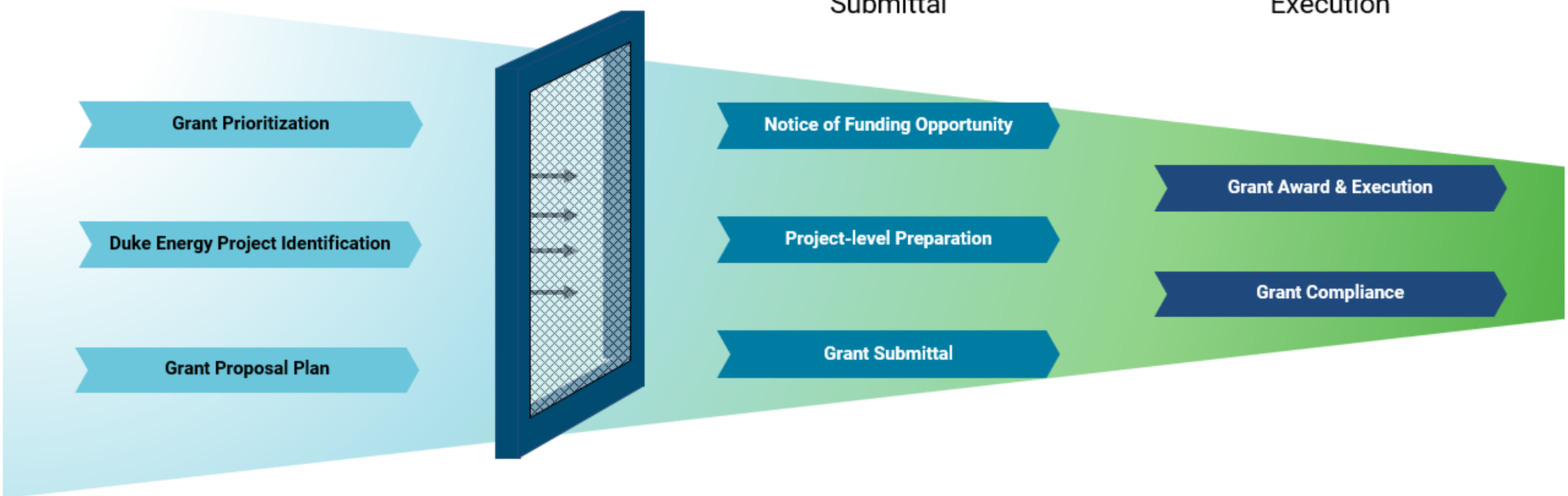
- Purpose and description of work to be completed
- Summary of expected benefits
- Estimated total costs across all work

✓ Complete list of all planned projects, including:

- Projected in-service dates
- Estimated total cost for each project
- Expected benefits for each project

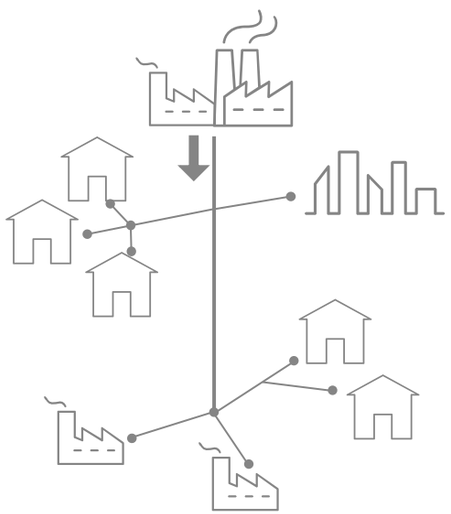
✓ Cost-benefit analyses

Infrastructure Investment Jobs Act (IIJA) grant process

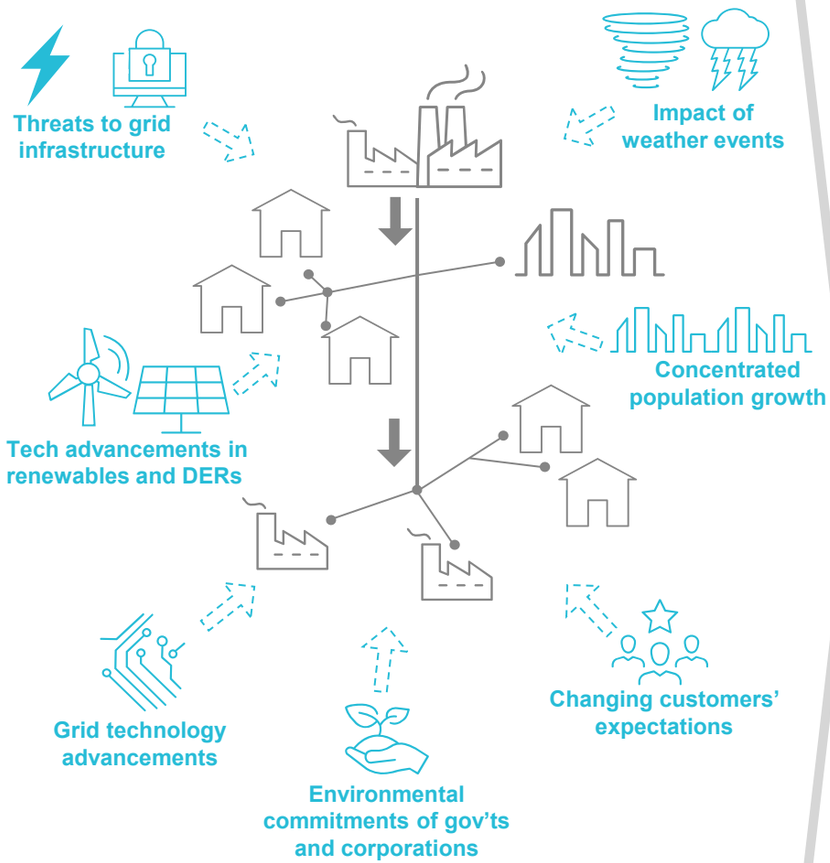


Journey to develop the grid of the future

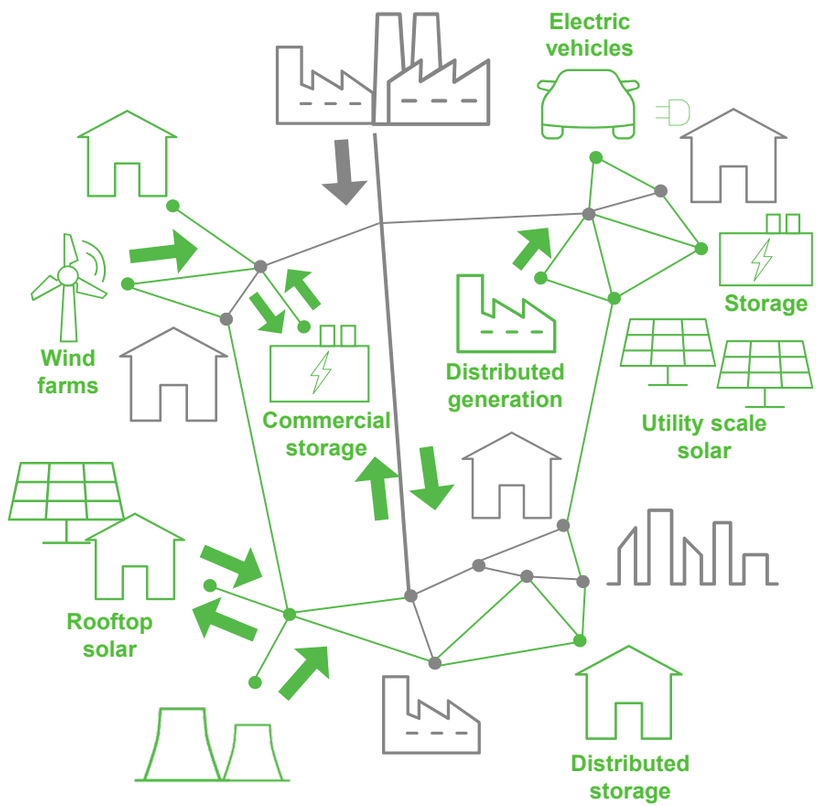
The past
The grid as a supplier



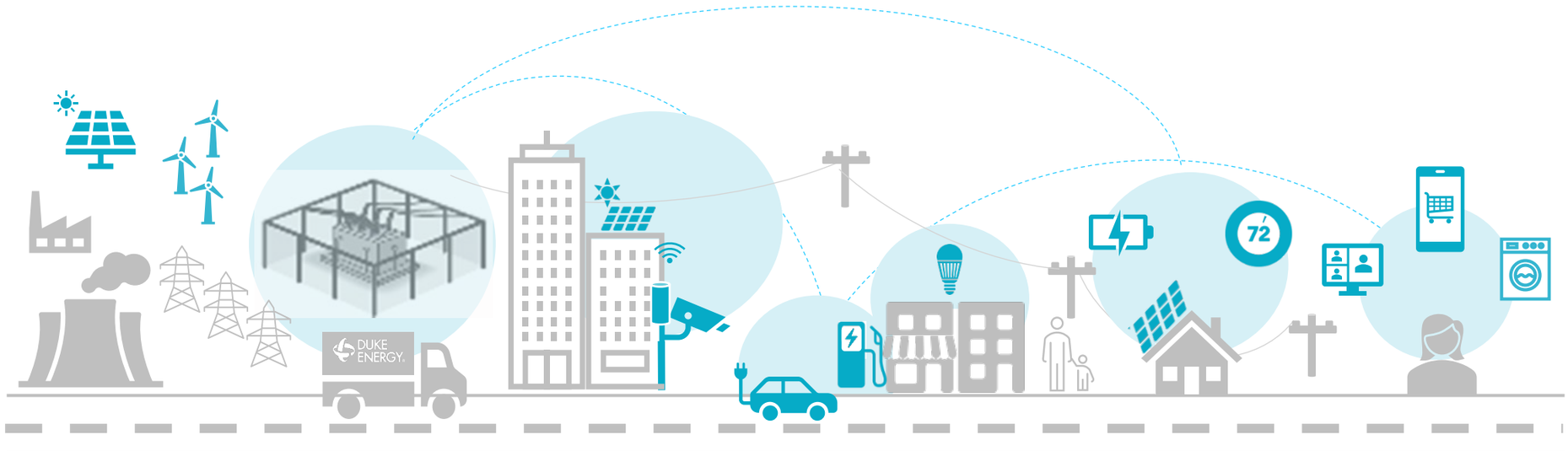
The present
Increasing impact of Megatrends



The future
The grid as an enabler



Three objectives for improvement work to address the megatrends and ready the grid for the future



Grid resiliency

Increase the grid's ability to withstand and recover from more frequent intense weather and external events

Expanded renewables and DERs

Enable the grid to meet customer demand for DERs while maintaining reliable service

Equitable access to benefits

Achieve balanced outcomes for customers across geographies, promoting access to emerging technologies and energy solutions

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Planned work will result in significant customer benefits

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Significant customer benefits expected from projects

- Maintain **reliable power** with **fewer and shorter outages**
- Protect against **physical and cyber attacks and severe weather events** to drive resiliency
- Expand **access to renewables and distributed energy resources (DERs)**
- Enable the grid to **support future technologies**
- Operate **efficiently** and support programs that give **energy control** and **affordability**
- Provide **equitable access** to benefits

Our strategy will serve customers into the future

- Add **flexible capabilities** that can adapt to changes in technology, population, external threats, and DERs
- Continue to **improve decision-making** with advanced **data analytics tools**
- Integrate **new solutions** to address changing customer needs

Customer benefits based on building several critical grid capabilities

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Reliability

Improve resiliency by increasing grid strength and ability to rapidly restore power

Promote DER adoption by providing consistent power flow

Capacity

Promote DER adoption by enabling 2-way power flow capability in more circuits

Address changing demand by outfitting circuits to meet increasing load

Automation & Communication

Improve resiliency by detecting faults and rerouting power to self-heal, reducing impact from outages

Promote DER adoption by enabling more efficient resource management

Voltage Regulation

Promote DER adoption by optimizing voltage levels to protect customers from disruptive supply spikes or sags

Improve resiliency by better managing dynamic power flows from distributed resources

Distribution grid improvements are planned across a variety of programs

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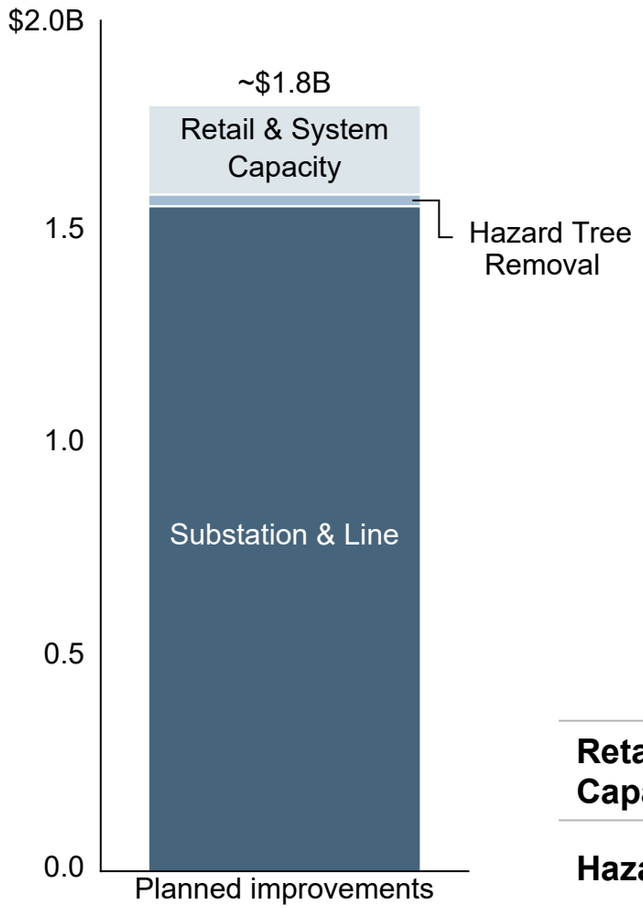
Planned grid improvements*
Oct. '23 - Sep. '26
DEP NC (in $B)



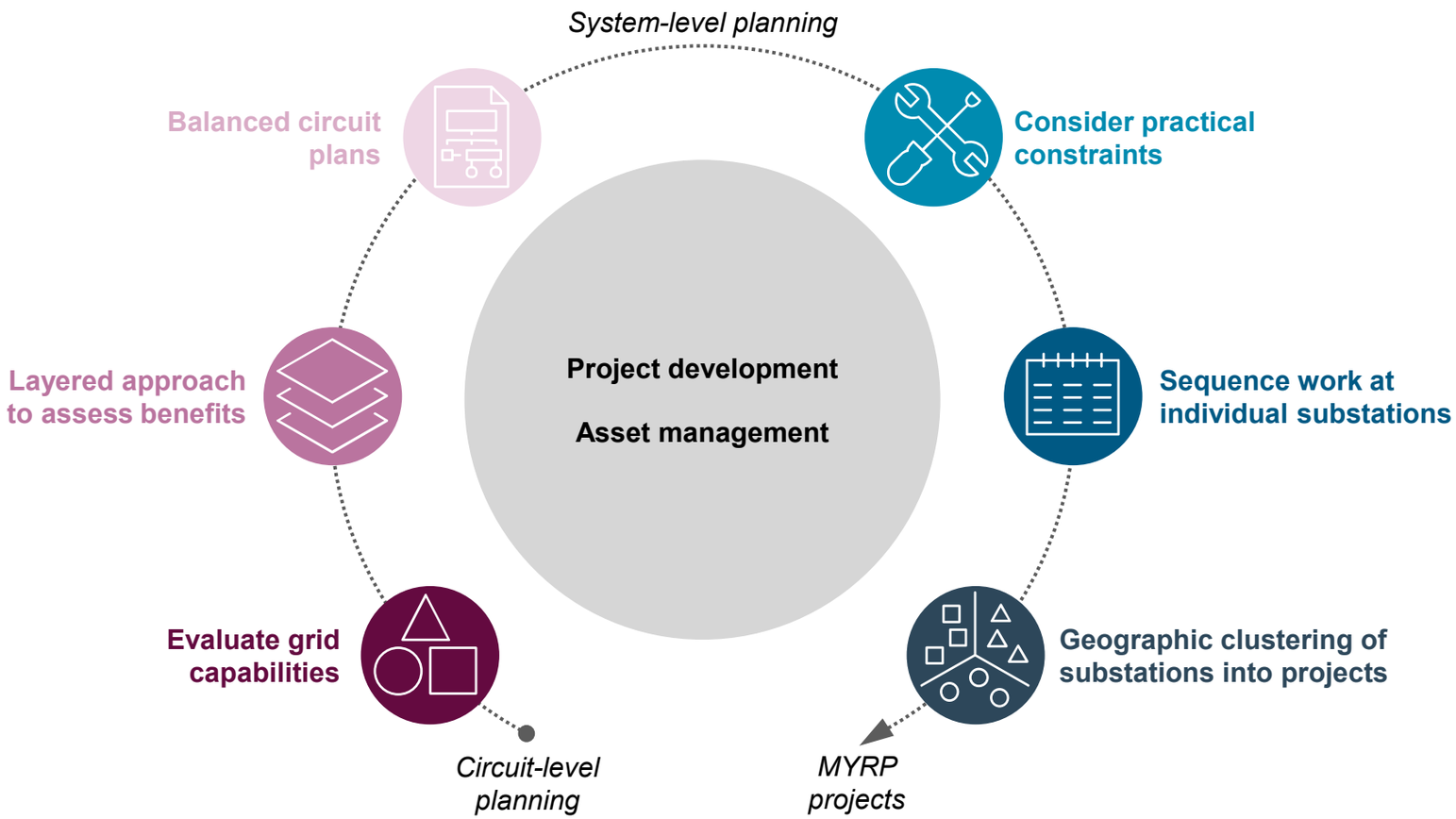
Improvement category	Improvement program details
Substation and Line	**Capacity:** Increase line capacity to support DERs and EVs and traditional loads
	Self-Optimizing Grid (SOG): Build new ties, install sectionalizing / automation devices
	Voltage Regulation / SCADA: Add / upgrade devices to support DG, EVs, and PVs
	Hardening & Resiliency (H&R): Upgrade, strengthen, and underground event-prone infrastructure
	Distribution Automation: Add automated restoration capabilities
	Equipment Retrofit: Upgrade low performance transformers, arrestor stations, and riser poles
	Long Duration Interruption: Re-route feeder / bring to road to increase accessibility
	Targeted Undergrounding: Place outage-prone line segments underground to improve performance
	Hazard Tree Removal: Take down at-risk trees outside of right of ways
	Infrastructure Integrity: Review, identify, and complete work for existing infrastructure
Retail & System Capacity	Expand capacity to support population growth and increased system functionality
Hazard Tree Removal	Take down at-risk trees outside of right of ways

Note: Costs as shown include capital expenditure, AFUDC, and contingency; additional costs for one-time O&M associated with installation are not included

Distribution project planning approach to maximize customer benefits

DISTRIBUTION

Project planning approach



Process overview

- Circuit-level planning used to identify optimal mix of improvement programs to be deployed
- At system level, practical constraints and sequencing requirements considered for selection of circuit plans to implement
- MYRP project plans compiled to include work at geographically clustered circuits

Sample Distribution MYRP project

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Project-based approach

- For Distribution system, projects are planned for a set of substations in a clustered geographic region (e.g., Coastal-282 area)
- Select improvement programs are deployed across each substation in the project, based on its specific needs
- Improvement programs at individual substations are executed geographically to maximize resource efficiency, minimize disruption and deliver customer benefits across a broad customer footprint/area

Sample Distribution MYRP project: Coastal-282 Area Project

Project includes work at 21 geographically clustered substations

Substations included	Improvement programs deployed within the project									
	Capacity	Self-Optimizing Grid	Voltage Regulation	Hardening & Resiliency	Distribution Automation	Equipment Retrofit	Long Duration Interruption	Targeted Undergrounding	Hazard Tree Removal	Infrastructure Integrity
Burgaw			✓	✓	✓				✓	✓
Carolina Beach	✓		✓	✓	✓	✓			✓	✓
Castle Hayne	✓		✓	✓	✓				✓	✓
Eagle Island	✓	✓	✓	✓	✓	✓			✓	✓
Delco	✓	✓		✓	✓	✓				✓
Holly Ridge		✓	✓	✓	✓	✓			✓	✓
Leland	✓	✓	✓	✓	✓	✓		✓	✓	✓
Masonboro		✓	✓	✓	✓	✓			✓	✓
Murraysville			✓	✓	✓			✓	✓	✓
Rocky Point			✓	✓	✓	✓			✓	✓
Rose Hill		✓	✓	✓	✓	✓		✓	✓	✓
Scotts Hill	✓		✓		✓	✓		✓	✓	✓
Southport		✓				✓			✓	✓
Topsail			✓	✓	✓				✓	✓
Vista		✓	✓	✓	✓				✓	✓
Wilmington Cedar Ave	✓	✓	✓	✓	✓	✓			✓	✓
Wilmington East	✓		✓	✓	✓	✓		✓	✓	✓
Wilmington Ogden	✓	✓	✓	✓	✓	✓		✓	✓	✓
Wilmington River Road	✓	✓			✓	✓		✓		
Wilmington Winter Park	✓	✓	✓	✓	✓	✓			✓	✓
Wrightsville Beach		✓	✓	✓	✓	✓		✓	✓	✓

Example: Planned work at Murraysville substation includes Voltage Regulation, Hardening & Resiliency, Distribution Automation, Targeted Undergrounding, Hazard Tree Removal, and Infrastructure Integrity

Capacity
Program overview

DISTRIBUTION

Program purpose:

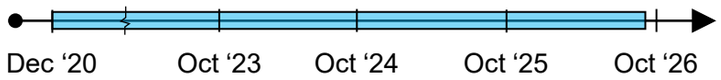
Capacity upgrades and improvements enhance reliability of service for our new and existing customers, and support future load growth from electrification and integration of distributed energy resources (DERs), such as rooftop solar and battery storage.

Program description:

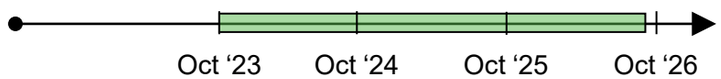
- Capacity work is driven by customer load growth, including the expansion of electric vehicles and other distributed technologies.
- **Retail substation upgrades** focus on work needed within the retail substations that serve distribution customers. Work includes installation of transformers, substation upgrades, and extension of transmission lines to new substation property. Improvements like transformer upgrades increase the capacity available at that substation to meet current and future customer demand for electricity.
- **Distribution system capacity upgrades** focus on work needed to add capacity on distribution lines. Improvements include new distribution lines and equipment (e.g., regulators, reclosers) or upgrades to existing equipment to increase the maximum current that can be delivered. The use of advanced data analysis, like Morecast and the Advanced Distribution Planning (ADP) toolsets, help to forecast locations where capacity upgrades are most needed. As demand for electricity increases, either from customer growth or installation of large quantities of distributed energy resources, it increases pressure on the system from the points of use upstream to the substation. Upgrading the line to a larger conductor (Figure 1 in the diagram below) by replacing conductors, adding a new circuit, or transferring some load to an adjacent circuit (Figure 2), can help better distribute electricity and provide a reliable experience for all customer needs. This improvement program will drive planners to choose the best and most cost-effective solution for targeted line upgrades to enable sustainable customer load growth and expansion of distributed resources.

Key details:

Estimated construction timeline:*



Estimated in-service dates:*



Projected costs:

DEP NC	Oct'23 - Sept'24	Oct'24 - Sept'25	Oct'25 - Sept'26
Capital costs**	$220.3M	$121.7M	$121.3M
Installation O&M**	$3.5M	$2.4M	$2.8M

Grid capabilities enabled:

- **Capacity**: promote DER adoption by enabling 2-way power flow and address changing demand by equipping circuits with capacity needed to meet increasing load

HB951 Policy Considerations addressed:

- Encourages utility-scale renewable energy and storage
- Encourages DERs
- Encourages beneficial electrification including electric vehicles
- Promotes resilience and security of the grid
- Maintains adequate levels of reliability and customer service

Note: * Timelines are for discrete and identifiable projects proposed to be included in MYRP filing; **Capital and Installation O&M costs based on in-service dates and include AFUDC and contingency

Capacity
Program benefits

DISTRIBUTION

Improved reliability

- Reduce potential outages due to overloaded conductors associated with DER penetration and customer load growth. Upgrades will also help improve resiliency by allowing for additional switching scenarios to address outages and high demand scenarios. Added capacity and connectivity can be leveraged by the self-healing teams that are lessening the impact of outages on the system

Improved resiliency

- Higher capacity lines improve voltage quality and make it easier to troubleshoot outages and restore service. Additional capacity and connectivity can also support self-healing networks in the area to lessen the duration and scope of outages on the system.

Expands solar and renewables

- Strategically upgrading capacity supports more efficient DER connection

Self-Optimizing Grid
Program overview

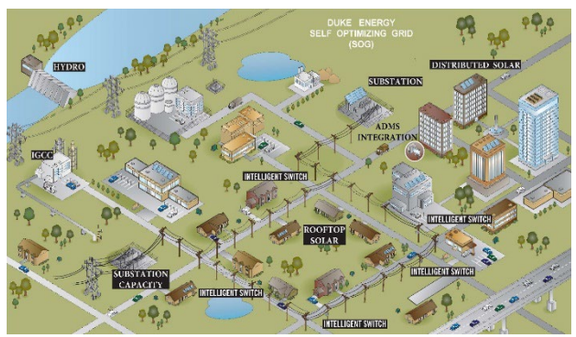
DISTRIBUTION

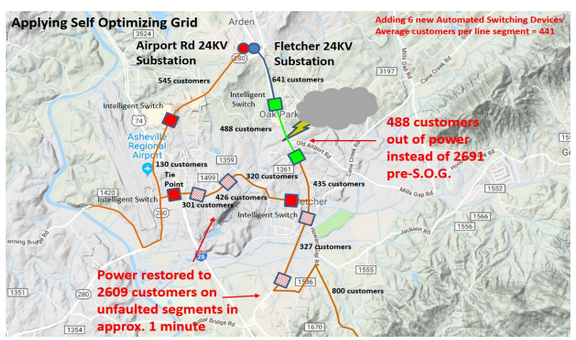
Program purpose:

The Self-Optimizing Grid (SOG) program, also known as the smart-thinking grid, redesigns key portions of the distribution system and transforms it into a dynamic self-healing network with the purpose of improving system reliability.

Program description:

- Consists of three major components:
  - **Capacity:** expands line capacity
  - **Connectivity:** creates tie points between circuits to allow for automatic reconfiguration
  - **Automation:** provides intelligence and control
- Reduces circuits into switchable segments to minimize number of customers affected by outages, expands capacity to support an integrated grid, and ensures the necessary connectivity to allow for rerouting options
- Detects potential faults and fixes power outages in real time using sensors, switches, and controls to recognize power outages, automatically isolate the faulted portions, and reconfigure to minimize customer impact
- Reduces number of outages, decreases duration of outages, and restores power in minutes
- Once installed, incremental annual savings of 81,000 customer interruptions (CI) and over 15 million customer minutes interrupted (CMI) are expected.





Key details:

Estimated construction timeline:*

Dec '20 — Oct '23 — Oct '24 — Oct '25 — Oct '26

Estimated in-service dates:*

Oct '23 — Oct '24 — Oct '25 — Oct '26

Projected costs:

DEP NC	Oct'23 - Sept'24	Oct'24 - Sept'25	Oct'25 - Sept'26
Capital costs**	$73.4M	$57.2M	$82.1M
Installation O&M**	$1.0M	$0.8M	$1.1M

Grid capabilities enabled:

- **Reliability:** improve resiliency to increase grid strength and ability to rapidly restore power
- **Capacity:** promote DER adoption by enabling 2-way power flow and address changing demand by increasing capacity;
- **Automation & Communication:** improve resiliency by detecting faults and rerouting power; promote DER adoption with efficient resource management

HB951 Policy Considerations addressed:

- Encourages DERs
- Encourages beneficial electrification including electric vehicles
- Promotes resilience and security of the grid
- Maintains adequate levels of reliability and customer service

Note: * Timelines are for discrete and identifiable projects proposed to be included in MYRP filing; **Capital and Installation O&M costs based on in-service dates and include AFUDC and contingency

Self-Optimizing Grid
Program benefits

DISTRIBUTION

Improve reliability and resiliency

- SOG creates a network of interconnected circuits that are split into smaller automatically switchable segments that can isolate faults and reconfigure, thus greatly reducing the number of customers affected by sustained outages; the program also reduces the number of outages and decreases the duration of those outages if they do occur

Expand solar and renewables

- SOG creates a network of interconnected circuits with more capacity and two-way power flow which is more accommodative to renewable energy resources including rooftop solar, battery storage, electric vehicles, and microgrids

Demonstrably positive net financial benefits

Total benefits	Total costs	Benefit-Cost ratio
$1,128.7M	$206.4M	5.5

Voltage Regulation & Management
Program overview

DISTRIBUTION

Program purpose:

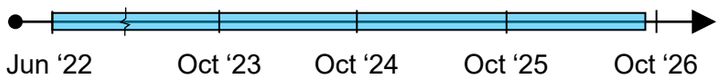
Distributed energy resources (DER) and electric vehicles (EV) are expected to have a significant impact on the distribution system around voltage and reactive power (VAR) support. Furthermore, the distribution system is rapidly becoming dynamic with two-way power flow, driving the need for additional VAR and voltage management capabilities compared to the current state. This program will modernize the grid by installing devices that will improve voltage management and power quality for all customers, while supporting DER growth.

Program description:

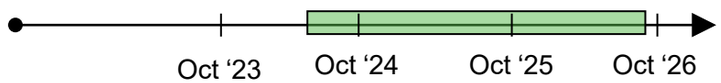
- Establishes control of equipment on the distribution grid to optimize delivery voltages to customers and to prepare for two-way power flows on the grid.
- Improves the grid's ability to address intermittency and fluctuations caused by DERs, enable DER adoption and improve power quality to customers
- Three levels to the program
  - Installation of new voltage regulators on circuits help maintain a constant voltage level by creating "regulation zones". Improves voltage management on the circuit by adjusting voltage conditions and reducing intermittency caused by solar DER sites.
  - Installation of new capacitors on circuits. Improves voltage management and allows electricity to be efficiently distributed across the distribution circuits by automatically adjusting the reactive power on the circuits
  - Installation of new specialized equipment like power electronics in areas of higher levels of DER penetration. These devices better equip the distribution system to manage power quality issues associated with increasing DER penetration.

Key details:

Estimated construction timeline:*



Estimated in-service dates:*



Projected costs:

DEP NC	Oct'23 - Sept'24	Oct'24 - Sept'25	Oct'25 - Sept'26
Capital costs**	$77.8M	$59.0M	$67.9M
Installation O&M**	$0M	$0M	$0M

Grid capabilities enabled:

- **Voltage Regulation:** promote DER adoption by optimizing voltage levels to protect customers from voltage deviation due to disruptive supply spikes or sags and improve resiliency by better managing dynamic power flows from distributed resources

HB951 Policy Considerations addressed:

- Encourages peak load reduction or efficient use of the system
- Encourages utility-scale renewable energy and storage
- Encourages DERs
- Encourages beneficial electrification, including electric vehicles;
- Promotes resilience and security of the electric grid
- Maintains adequate levels of reliability and customer service

Note: * Timelines are for discrete and identifiable projects proposed to be included in MYRP filing; **Capital and Installation O&M costs based on in-service dates and include AFUDC and contingency

Voltage Regulation & Management
Program benefits

DISTRIBUTION

Improved voltage experience for customers

- Advanced technologies will help maintain proper voltage levels to customers by keeping voltages in the proper range
- Integrating advanced equipment on the grid helps reduce power quality issues associated with increasing DER penetration

Expands solar and renewables

- Increasing the level of distributed energy resources that can be accommodated on the distribution grid reduces the need to curtail or issue moratoriums on customer-owned interconnections

Gives customers more options and control

- Increasing the grid's ability to integrate more renewables and electric vehicles provides customers more options to meet their individual needs

Transforms the grid to prepare for a cleaner, lower-carbon future

- Technologies that enable two-way power flows for increased DER on the grid will allow more customers to interconnect clean forms of renewable generation. This helps North Carolina continue to be attractive to businesses with environmental commitments

Distribution Hardening & Resiliency: Laterals

Program overview

DISTRIBUTION

Project purpose:

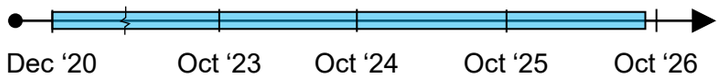
Duke Energy has an obligation to provide reliable service to customers in every community that we serve. Proactively replacing and upgrading damaged, deteriorated or at-risk lateral distribution lines that can lead to unplanned outages is essential for providing safe and reliable service to customers and supports the reliable expansion of distributed resources.

Project description:

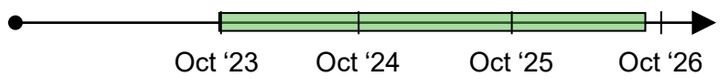
- This work is focused on the lateral sections, also known as tap lines, which branch from the main feeder lines and feed neighborhoods, businesses, industrial customers.
- Targeted work is identified through a data-driven approach based on factors such as historical data and observed condition of the line. Risk factors that are considered when identifying candidates for this program are:
  - power lines that have a history of prior outages due to deteriorated wire,
  - evidence of prior damage (fraying, multiple splices, pitting etc.), and
  - small wire that has been identified with a steel core that presents a risk of deterioration.
- This work includes replacing at-risk steel core conductor with new all-aluminum segments of conductor, which is extremely rust resistant, and increasing the size in some cases, to accommodate more load. These improvements will help to improve reliability on the line, deliver a better experience for customers and support the high level of performance needed to grow distributed technologies in the area.

Key details:

Estimated construction timeline:*



Estimated in-service dates:*



Projected costs:

DEP NC	Oct'23 - Sept'24	Oct'24 - Sept'25	Oct'25 - Sept'26
Capital costs**	$65.9M	$25.3M	$80.4M
Installation O&M**	$1.2M	$0.5M	$1.5M

Grid capabilities enabled:

- **Reliability:** Improve resiliency by increasing grid strength and ability to rapidly restore power and promote DER adoption by providing consistent power flow

HB951 Policy Considerations addressed:

- Encourages DERs
- Encourages beneficial electrification including electric vehicles
- Maintains adequate levels of reliability and customer service

Note: * Timelines are for discrete and identifiable projects proposed to be included in MYRP filing; **Capital and Installation O&M costs based on in-service dates and include AFUDC and contingency

Distribution Hardening & Resiliency: Laterals
Program benefits

DISTRIBUTION

Improved reliability

- Eliminate the risk of overhead conductor failures by upgrading the size and quality of the wire. This improvement will help increase reliability for customers served by the line.

Improved resiliency

- More robust design and construction standards can help to avoid outages, but also help crews restore power faster in these areas
- Upgrades that help shorten outages can also free up line and tree crews sooner to help with outage restoration in other areas

Outage cost avoidance

- Fewer and shorter outages resulting from grid strengthening work helps avoid recurring trips to the same locations to restore power after severe weather and can also make line and tree crews available faster to assist with power restoration in other areas

Improved customer experience

- Improving the overall reliability of the line, increasing the resiliency of the line and decreasing restoration times improves the overall customer experience and establishes an operational environment that is more resilient and more conducive to distributed technologies in that area

Demonstrably positive net financial benefits

Total benefits	Total costs	Benefit-Cost ratio
$1,372.0M	$146.2M	9.4

Distribution H&R: Public Interference
Program overview

DISTRIBUTION

Project purpose:

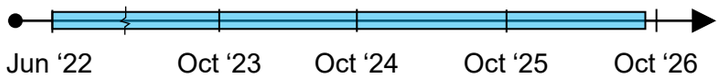
This distribution work improves reliability by targeting the Company's most outage prone overhead backbone power line sections most impacted by vehicle accidents and determining the proper hardening & resiliency solution to reduce the number of outages experienced by customers.

Project description:

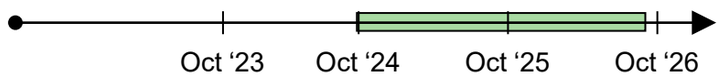
- Public interference outages, typically cars hitting overhead power line poles, are outside of the company's control. When these accidents occur, it often results in a long-duration outage due to the severity of the damage caused by the incident.
- Historical outage data is used to identify the locations where vehicles have been prone to strike poles. Criteria for consideration in the selection of targeted communities include:
  - Service location (i.e. lines must be located on three-phase portions of the circuit)
  - Frequency of outages from vehicle accidents
- Lines targeted to be hardened will receive a custom solution which may include undergrounding of the overhead line, relocating the line, or changing the design of the infrastructure at the location of the repeat occurrences.

Key details:

Estimated construction timeline:*



Estimated in-service dates:*



Projected costs:

DEP NC	Oct'23 - Sept'24	Oct'24 - Sept'25	Oct'25 - Sept'26
Capital costs**	$7.1M	$7.3M	$3.7M
Installation O&M**	$0.1M	$0.1M	$0.1M

Grid capabilities enabled:

- **Reliability:** Improve resiliency by increasing grid strength and ability to rapidly restore power and promote DER adoption by providing consistent power flow

HB951 Policy Considerations addressed:

- Encourages DERs
- Encourages beneficial electrification including electric vehicles
- Maintains adequate levels of reliability and customer service

Note: * Timelines are for discrete and identifiable projects proposed to be included in MYRP filing; **Capital and Installation O&M costs based on in-service dates and include AFUDC and contingency

Distribution H&R: Public Interference
Program benefits

DISTRIBUTION

Improved reliability

- A stronger grid is more resistant to outage from public interference. Reducing the risk of outages on overhead lines improves reliability and provides a better experience for customers.

Improved resiliency

- More robust design and construction standards in outage prone areas helps avoid outages and reduces the need for crews to return to the same outage prone areas, freeing up line and tree crews sooner to help with outage restoration in other areas

Outage cost avoidance

- Fewer and shorter outages resulting from grid strengthening work helps avoid recurring trips to the same locations to restore power

Improved customer experience

- Improving the overall reliability of the line, increasing the resiliency of the line and decreasing restoration times improves the overall customer experience and establishes an operational environment that is more resilient and more conducive to distributed technologies in that area

Demonstrably positive net financial benefits

Total benefits	Total costs	Benefit-Cost ratio
$8.4M	$15.7M	0.5

Distribution Hardening & Resiliency: Storm
Program overview

DISTRIBUTION

Project purpose:

These distribution improvements strengthen the grid in areas vulnerable to severe weather, and in other high-impact areas. Assets will be engineered to better withstand high winds and impacts from snow and ice to help reduce outages and restoration time in areas prone to physical damage during severe storms. Strengthening the grid in these areas improves reliability and can also help free up resources faster to assist with outage restoration in other areas.

Project description:

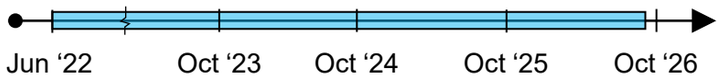
- Distribution hardening and resiliency improvements are targeted to locations of the distribution grid that have been identified, through analysis of historical outage data, as being more vulnerable to outage impacts from extreme weather events. Examples are poles and wires in coastal areas prone to hurricanes, lines in heavily vegetated areas that experience impacts from downed trees, or areas where an outage could potentially impact essential services or large numbers of customers for an extended period of time.

- Poles and wires in these areas are being replaced with an upgraded, more robust standard that includes larger poles, shorter spans, and additional guy wiring which helps provide a hardened, more reliable grid during extreme weather events.
  - Planning will assume Grade B & NESC 250B-D loading for solutioning downstream of the targeted devices. The grades of construction (B/C/N) determine the different safety factors for design, with Grade B providing the highest margin of safety. For example, Grade B is required for spans crossing limited access highways, railroads, and waterways. NESC 250B-D defines required wind and ice loading for design.

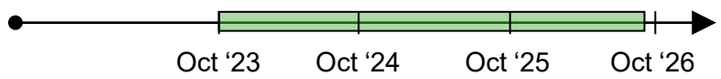
- The distribution grid across North Carolina was historically built to withstand the typical weather types that are most commonly experienced in the state (e.g., smaller winter storms, an occasional tropical system, summer afternoon thunderstorms). Increasingly, though, we are seeing a rise in frequency and severity of outages in many parts of the state. This trend can become even more pronounced in areas that are more exposed to these extreme conditions.

Key details:

Estimated construction timeline:*



Estimated in-service dates:*



Projected costs:

DEP NC	Oct'23 - Sept'24	Oct'24 - Sept'25	Oct'25 - Sept'26
Capital costs**	$19.2M	$18.7M	$39.3M
Installation O&M**	$0.3M	$0.3M	$0.7M

Grid capabilities enabled:

- **Reliability:** Improve resiliency by increasing grid strength and ability to rapidly restore power and promote DER adoption by providing consistent power flow

HB951 Policy Considerations addressed:

- Encourages DERs
- Encourages beneficial electrification including electric vehicles
- Promotes resilience and security of the electric grid
- Maintains adequate levels of reliability and customer service

Note: * Timelines are for discrete and identifiable projects proposed to be included in MYRP filing; **Capital and Installation O&M costs based on in-service dates and include AFUDC and contingency

Distribution Hardening & Resiliency: Storm
Program benefits

DISTRIBUTION

Improved reliability

- A stronger grid is more resistant to power outages from severe weather. This helps reduce the frequency of long-duration power outages caused by storms

Improved hardening & resiliency

- More robust design and construction standards in storm-vulnerable areas can help to avoid outages, but also help crews restore power faster in these areas. Upgrades that help shorten outages can also free up line and tree crews sooner to help with outage restoration in other areas

Outage cost avoidance

- Fewer and shorter outages resulting from grid strengthening work helps avoid recurring trips to the same locations to restore power after severe weather and can also make line and tree crews available faster to assist with power restoration in other areas

Improved customer experience

- Improving the overall reliability of the line, increasing the resiliency of the line and decreasing restoration times improves the overall customer experience and establishes an operational environment that is more resilient and more conducive to distributed technologies in that area

Demonstrably positive net financial benefits

Total benefits	Total costs	Benefit-Cost ratio
$565.2M	$64.9M	8.7

Distribution Automation
Program overview

DISTRIBUTION

Program purpose:

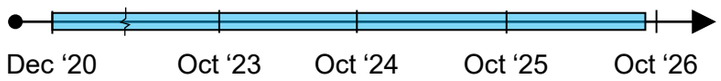
The Distribution Automation program focuses on modernizing single-use fuses with devices capable of intelligently resetting themselves for reuse, restoring power faster for customers and eliminating unnecessary use of resources (inventory, labor, gasoline, etc.) to reset them. The program seeks to improve reliability and minimize customer interruption when an outage occurs, turning what would have been a sustained outage into a momentary blink.

Program description:

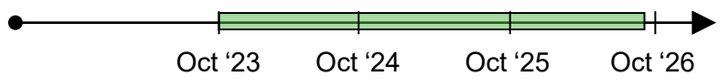
- Replaces fuses on a distribution line with automated lateral devices (ALD) like small reclosers. Currently, distribution line fuses are designed to open in the event of a fault, resulting in a sustained outage. Line fuses are one-operation devices, meaning that once a fuse interrupts a fault, the fuse melts and must be manually replaced. Most interruptions on the distribution grid are temporary, such as a tree limb falling on a power line before falling to the ground. But due to the use of fuses, those temporary faults often become sustained outages.
- ALD opens during a temporary fault, resetting and attempting to close and restore power after a short period of time. If the fault source is cleared, power is restored without manual intervention.
- Capable of attempting self-restoration multiple times. If the fault source is sustained, the ALD opens to protect the circuit until a manual intervention is completed
- Larger reclosing devices sense faults downstream of line fuses and open and reclose in an attempt to clear faults without a sustained outage. By introducing the ALD, the remaining customers on the circuit will not experience a momentary outage.
- Reclosing capability can be applied to smaller segments of the circuit traditionally protected by fuses.
- Focuses on segments of the distribution system where line protections are less robust and where it is likely that even a temporary fault will result in a fuse melting and a sustained outage.

Key details:

Estimated construction timeline:*



Estimated in-service dates:*



Projected costs:

DEP NC	Oct'23 - Sept'24	Oct'24 - Sept'25	Oct'25 - Sept'26
Capital costs**	$25.8M	$12.5M	$12.1M
Installation O&M**	$0.5M	$0.2M	$0.2M

Grid capabilities enabled:

- **Reliability:** Improve resiliency by increasing grid strength and ability to rapidly restore power and promote DER adoption by providing consistent power flow

HB951 Policy Considerations addressed:

- Encourages DERs
- Encourages beneficial electrification including electric vehicles
- Promotes resilience and security of the electric grid
- Maintains adequate levels of reliability and customer service

Note: * Timelines are for discrete and identifiable projects proposed to be included in MYRP filing; **Capital and Installation O&M costs based on in-service dates and include AFUDC and contingency

Distribution Automation
Program benefits

DISTRIBUTION

Improved reliability and resiliency

- Reduction in customer interruptions that benefit all customers where applied, including potential critical need customers

Demonstrably positive net financial benefits

Total benefits	Total costs	Benefit-Cost ratio
$223.7M	$43.8M	5.1

Equipment Retrofit
Program overview

DISTRIBUTION

Program purpose:

This distribution work improves reliability by targeting equipment prone to outages caused by animal interference, lightning, and clearance issues and upgrading the assets to modern design standards. Identifying these improvement opportunities in advance of an outage allows for the completion of the work with minimal customer disruptions. Additionally, the improvements strengthen the grid against unplanned interruptions.

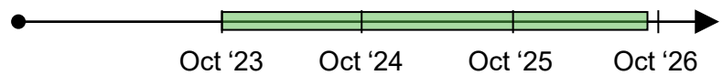
Program description:

- Specific assets targeted in this program are transformers and line arresters, as well as poles where conductor transitions from overhead to underground (i.e., riser poles) occur.
- Upgrading this equipment reduces the number of outages and customers impacted by animal interference, lightning, and equipment failure.
- When faults occur after improvements are completed, only customers served by the failed transformer are affected. Previously, all customers between the transformer and the closest upstream protective device experienced an outage.

Key details:

Estimated construction timeline:*

Estimated in-service dates:*



Projected costs:

DEP NC	Oct'23 - Sept'24	Oct'24 - Sept'25	Oct'25 - Sept'26
Capital costs**	$37.6M	$17.0M	$28.6M
Installation O&M**	$0.08M	$0.04M	$0.06M

Grid capabilities enabled:

- **Reliability:** Improve resiliency by increasing grid strength and ability to rapidly restore power and promote DER adoption by providing consistent power flow

HB951 Policy Considerations addressed:

- Encourages DERs
- Encourages beneficial electrification including electric vehicles
- Maintains adequate levels of reliability and customer service

Note: * Timelines are for discrete and identifiable projects proposed to be included in MYRP filing; **Capital and Installation O&M costs based on in-service dates and include AFUDC and contingency

Equipment Retrofit
Program benefits

DISTRIBUTION

Improved reliability

- By retrofitting these assets, failures are reduced at the local asset
- When a failure does occur, it is localized to a much smaller set of customers by the local fusing that is installed during the retrofit

Improved resiliency

- More robust design and construction standards can help to avoid outages, but also help crews restore power faster in these areas
- Upgrades that help shorten outages can also free up line and tree crews sooner to help with outage restoration in other areas

Outage cost avoidance

- Fewer outages resulting from grid strengthening work helps avoid recurring trips to the same locations to restore power

Improved customer experience

- Improving the overall reliability of the line, increasing the resiliency of the line and decreasing restoration times improves the overall customer experience and establishes an operational environment that is more resilient and more conducive to distributed technologies in that area

Demonstrably positive net financial benefits

Total benefits	Total costs	Benefit-Cost ratio
$209.5M	$70.7M	3.0

Long Duration Interruption (LDI)
Program overview

DISTRIBUTION

Project purpose:

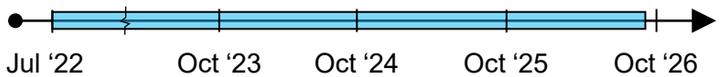
This distribution work reroutes segments of main overhead feeder lines in hard-to-access areas to improve accessibility for utility trucks. Improving crew accessibility reduces restoration time for outages in difficult to reach areas as well as reduces worker safety risk. Moving these line segments to road-accessible locations that are more easily maintained can also help reduce the risk of an outage, improving overall reliability for customers in these areas.

Project description:

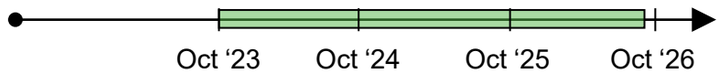
- Targeted areas for this program are radial distribution lines that serve entire communities or large groups of customers, as well as inaccessible line segments (i.e., off road, swamps, mountain gorges, extreme terrain, etc.)
- The areas targeted for improvement experience consistently higher-than-average outage durations and reduced power reliability and customer satisfaction
- During extreme weather events, vegetation, erosion, and flooding can create challenges and potentially unsafe conditions for restoration crews trying to restore power, resulting in longer outage times
- Addressing these challenges typically involves relocating the lines to road fronts which, often requires more line miles. Road accessibility helps improve the customer experience and provides positive benefits to the overall power restoration process as it allows more efficient access to lines and equipment from the road right of way.

Key details:

Estimated construction timeline:*



Estimated in-service dates:*



Projected costs:

DEP NC	Oct'23 - Sept'24	Oct'24 - Sept'25	Oct'25 - Sept'26
Capital costs**	$1.3M	$0M	$1.3M
Installation O&M**	$0.04M	$0M	$0.04M

Grid capabilities enabled:

- **Reliability:** Improve resiliency by increasing grid strength and ability to rapidly restore power and promote DER adoption by providing consistent power flow

HB951 Policy Considerations addressed:

- Encourages DERs
- Encourages beneficial electrification including electric vehicles
- Promotes resilience and security of the grid
- Maintains adequate levels of reliability and customer service

Note: * Timelines are for discrete and identifiable projects proposed to be included in MYRP filing; **Capital and Installation O&M costs based on in-service dates and include AFUDC and contingency

Long Duration Interruption (LDI)
Program benefits

DISTRIBUTION

Improved reliability

- Strategically relocating outage-prone line segments to more accessible and maintainable locations helps reduce outage risk

Improved resiliency

- Relocating the feeder segment to a more accessible and maintainable right of way helps improve resiliency by reducing outages and promoting faster responses when outages do occur

Reduced outage costs

- Relocating these feeder segments from hard to reach locations to more maintainable areas helps reduce outages and avoid the need for more specialized and expensive equipment and crew labor needed to repair outages

Improved customer experience

- Improving the overall reliability of the line, increasing the resiliency of the line and decreasing restoration times improves the overall customer experience and establishes an operational environment that is more resilient and more conducive to distributed technologies in that area

Demonstrably positive net financial benefits

Total benefits	Total costs	Benefit-Cost ratio
$31.4M	$2.2M	14.0

Targeted Undergrounding
Program overview

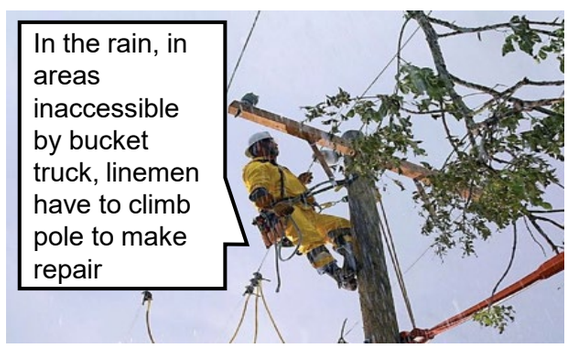
DISTRIBUTION

Project purpose:

The Targeted Undergrounding (TUG) program improves reliability by strategically identifying the company's most outage prone overhead power line sections and relocating them underground to reduce the number of outages experienced by customers.

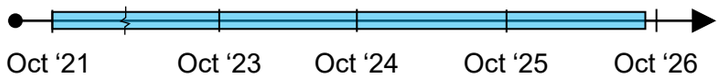
Project description:

- This program uses data analytics to identify overhead line segments with an unusually high frequency of historical outages and place those segments underground.
- Criteria for consideration in the selection of targeted communities include:
  - Performance of overhead lines
  - Age of assets
  - Service location (e.g., lines located in backyard where accessibility is limited)
  - Vegetation impacts (e.g., heavily vegetated are often costly and difficult to trim)

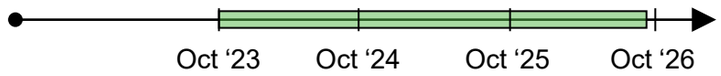


Key details:

Estimated construction timeline:*



Estimated in-service dates:*



Projected costs:

DEP NC	Oct'23 - Sept'24	Oct'24 - Sept'25	Oct'25 - Sept'26
Capital costs**	$33.7M	$23.0M	$47.1M
Installation O&M**	$0.02M	$0.02M	$0.03M

Grid capabilities enabled:

- **Reliability:** Improve resiliency by increasing grid strength and ability to rapidly restore power and promote DER adoption by providing consistent power flow

HB951 Policy Considerations addressed:

- Encourages DERs
- Encourages beneficial electrification including electric vehicles
- Promotes resilience and security of the grid
- Maintains adequate levels of reliability and customer service

Note: * Timelines are for discrete and identifiable projects proposed to be included in MYRP filing; **Capital and Installation O&M costs based on in-service dates and include AFUDC and contingency

Targeted Undergrounding
Program benefits

DISTRIBUTION

Improved reliability

- By undergrounding the overhead wires, the exposure to failures above ground will be eliminated and will lead to improved reliability experience for customers on that line

Improved hardening and resiliency

- Improved system resiliency by reducing repeated trips to the same line segments during storms and outage events, freeing up resources faster to restore power to other customers

Reduced outage costs

- Overhead conductor that is converted to underground will not require vegetation maintenance costs to maintain the right of way

Expands solar and renewables

- Improving the overall reliability of the line, increasing the resiliency of the line and decreasing restoration times improves the overall customer experience and establishes an operational environment that is more resilient and more conducive to distributed technologies in that area

Demonstrably positive net financial benefits

Total benefits	Total costs	Benefit-Cost ratio
$604.2M	$86.2M	7.0

Hazard Tree Removal
Program overview

DISTRIBUTION

Program purpose:

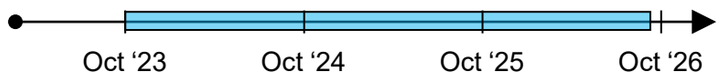
The purpose of the program is to maintain or improve reliability by identifying and taking down dead, structurally unsound, dying, diseased, leaning, or otherwise defective trees from outside the maintained right of way that could strike electrical lines or equipment of the distribution system. Reliability is maintained or improved by minimizing interruptions from tree-caused outages.

Program description:

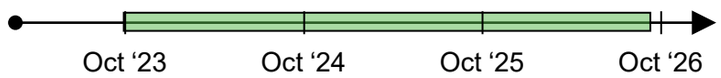
- All hazard trees are identified by a qualified Duke Energy representative per industry best management practices
- Any tree found to present an imminent risk to infrastructure is assigned to a supplier immediately to be taken down
- A Duke Energy Program Manager assigns remaining identified trees to a supplier for property owner/customer notification of pending work
- As schedule and mobilization allows, suppliers cut down trees following property owner/customer notification

Key details:

Estimated construction timeline:*



Estimated in-service dates:*



Projected costs:

DEP NC	Oct'23 - Sept'24	Oct'24 - Sept'25	Oct'25 - Sept'26
Capital costs**	$20.2M	$14.2M	$13.6M
Installation O&M**	$0M	$0M	$0M

Grid capabilities enabled:

- **Reliability:** Improve reliability through a better protected grid, improve resiliency by removing hazard trees that result in longer outage restorations, and improve power flow consistency and efficiency which supports promotion of DERs

HB951 Policy Considerations addressed:

- Encourages DERs
- Encourages beneficial electrification including electric vehicles
- Promotes resilience and security of the electric grid
- Maintains adequate levels of reliability and customer service

Note: * Timelines are for discrete and identifiable projects proposed to be included in MYRP filing; **Capital and Installation O&M costs based on in-service dates and include AFUDC and contingency

Hazard Tree Removal
Program benefits

DISTRIBUTION

Improved reliability and resiliency

- Managing trees and other vegetation to improve reliability and make the grid more resistant to vegetation-related outages

Infrastructure Integrity
Program overview

DISTRIBUTION

Project purpose:

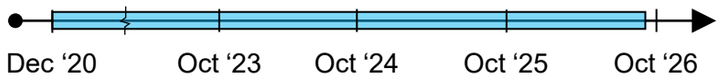
This infrastructure Integrity initiative seeks to continually improve and ensure a safe reliable electrical energy delivery system through identification and mitigation of risk factors such as end-of-service equipment, technology obsolescence, and removal of damaged distribution in-service equipment. Proactively identifying and planning these improvement opportunities can minimize impacts to customers, turn potential emergency outage response into a planned replacement, strengthen the overall grid against unplanned interruptions of service, and support the increased grid capabilities being implemented to promote DER adoption..

Project description:

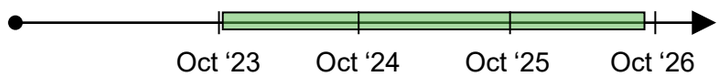
- As more automation is added to the system from grid improvements to improve reliability and support DER, the historical system integrity norms are changing to consider the dependency of distribution customer reliability on two-way power flow. Programs that were historically in place to address known risk factors now are evolving to support more devices on the system, changes in device operations due to power intermittency, and newer technologies that deliver new capabilities and challenges for the grid.
- Examples of infrastructure integrity work include:
  - Asset replacement – Inspection-based programs including poles
  - Oil mitigation – hydraulic-to-solid dielectric replacement, and replacement of live-front/end-of-life transformers
  - Greenhouse gas mitigation – replacement of SF6 switchgear with solid dielectric
  - Technological obsolescence – replacement of recloser control panels nearing end of life
  - System operability to serve dynamic power flows – replacing non-communicating hydraulic reclosers with new remote-accessible solid dielectric units.
  - Major outage root cause studies
- This work coincides with other distribution improvement work scheduled at the substation or circuit to optimize

Key details:

Estimated construction timeline:*



Estimated in-service dates:*



Projected costs:

DEP NC	Oct'23 - Sept'24	Oct'24 - Sept'25	Oct'25 - Sept'26
Capital costs**	$194.7M	$88.2M	$82.2M
Installation O&M**	$3.5M	$1.6M	$1.5M

Grid capabilities enabled:

- **Reliability:** Improve resiliency by increasing grid strength and ability to rapidly restore power and promote DER adoption by providing consistent power flow

HB951 Policy Considerations addressed:

- Encourages DERs
- Encourages beneficial electrification including electric vehicles
- Promotes resilience and security of the electric grid
- Maintains adequate levels of reliability and customer service

Note: * Timelines are for discrete and identifiable projects proposed to be included in MYRP filing; **Capital and Installation O&M costs based on in-service dates and include AFUDC and contingency

Infrastructure Integrity
Program benefits

DISTRIBUTION

Improved reliability

- Sustaining the integrity of the infrastructure through data-informed replacements will lead to a more reliable power quality experience for customers

Improved resiliency

- Sustaining the integrity of the infrastructure makes it easier to troubleshoot outages and restore service

Improved customer experience

- Coordinating infrastructure improvements with other planned work helps optimize crew travel, maximizes planned outage and switching procedures, and improves traffic control zone utilization on substation projects.

Agenda

Topic	Presenter
Context and external trends	Justin Brown
Distribution projects	Brent Guyton
Transmission projects	**Dan Maley**
Closing remarks	Justin Brown

Transmission capabilities and customer benefits

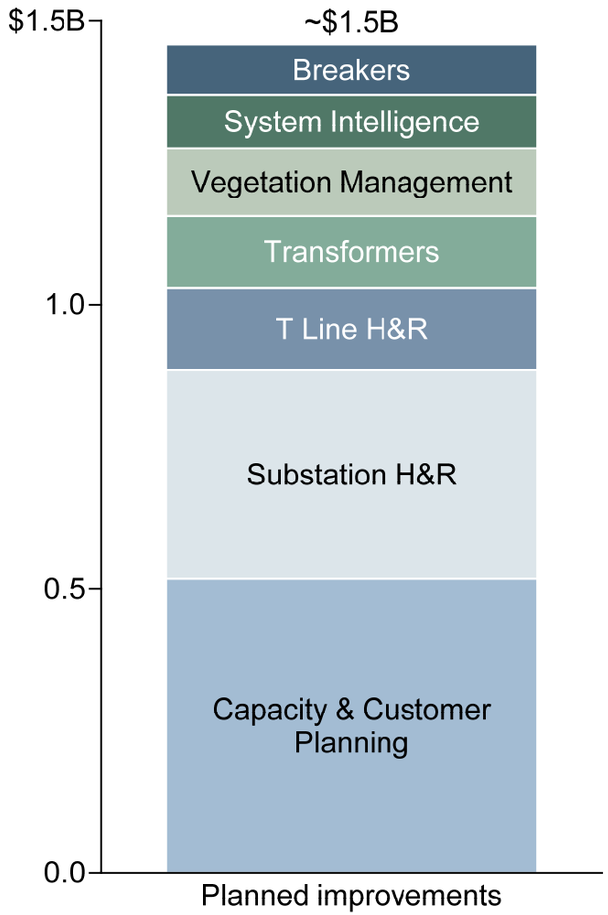
TRANSMISSION

	Characteristics enabled	Customer benefits created
System Intelligence	**Improved grid awareness** from modernized transmission system communication capabilities that increase operator and engineer visibility to system conditions	• Reduced risk of long duration outages • Reduced outage frequency
Hardening and Resiliency	**Stronger and more resilient** transmission grid by upgrading lines and substations	• Reduced system impact from external threats • Reduced outages caused by line component failures • Reduced / avoided emergency repairs
Transformer & Breaker Upgrades	**Improved reliability** and **increased renewables facilitation** from upgrades to transformers and circuit breakers that are beyond their useful life	• Reduced risk of long duration outages • Mitigation of potential environmental impact • Improved accommodation of variable energy sources
Capacity & Customer Planning	**Meeting customer** and **compliance obligations** as demand grows and renewable energy sources are added to the system	• Ensuring grid reliability and stability • Ability to meet evolving customer demand • Sustainable growth of renewable generation

Planned transmission improvements

TRANSMISSION

Planned transmission improvements*
Oct. '23 - Sep. '26
DEP System (in $B)



Improvement category	Improvement project areas
System Intelligence	**Intelligent Equipment** and upgrades that enhance system monitoring and response ability
Hardening & Resiliency	**Transmission Line Hardening & Resiliency***:* Transmission line upgrades that mitigate the effects of external events and extreme weather
	Substation Hardening & Resiliency: Substation upgrades that mitigate the effects of external events and extreme weather
	Vegetation Management: Targeted removal of hazard trees that could cause interruptions
Transformer & Breaker Upgrades	**Breakers:** Upgrading end-of-life circuit breakers
	Transformers: Upgrading end-of-life transformer banks
Capacity & Customer Planning	**Planning** for changing demand, new delivery points for customers, and transmission expansion for utility scale renewables

Note: Costs as shown include capital expenditure, AFUDC, and contingency; additional costs for one-time O&M associated with installation are not included

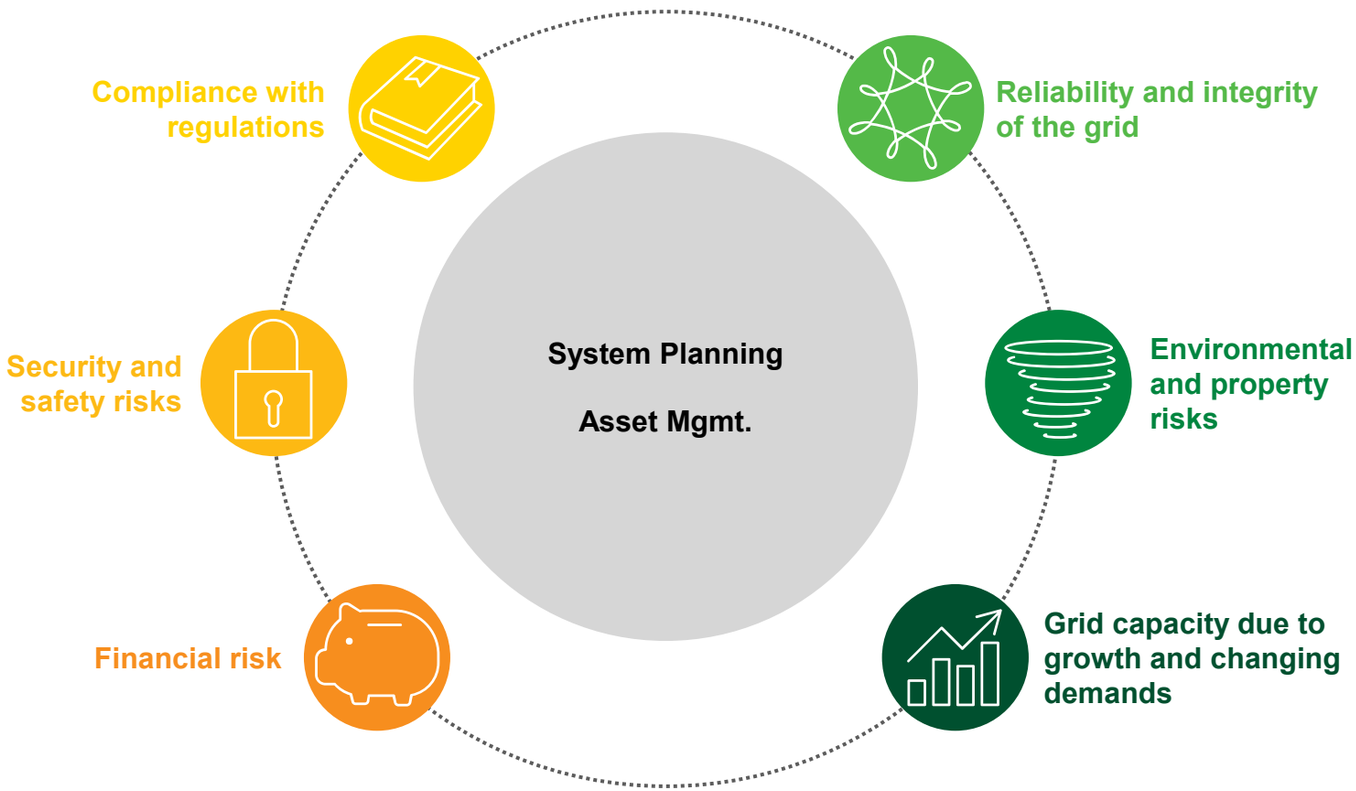
Systematic, risk-informed approach to prioritize opportunities

TRANSMISSION

Risk-informed approach

- Improvement opportunities are prioritized based on **avoided risks, benefits, and cost**
- **Environmental, safety, compliance, and financial risks** are considered
- **Impact modelling** is used to inform decision-making including:
  - Avoided customer outages
  - Improved redundancies / networking
  - Equipment failure probability / consequences

Project prioritization framework



System Intelligence
Project overview

TRANSMISSION

Project purpose:

This system intelligence project is critical to provide grid operators and engineers with enhanced information to respond to changing conditions that challenge reliability. Remote asset monitoring allows proactive decisions to be made when equipment health is threatened, and remote operated switches play a vital part in sectionalizing transmission lines to limit the customer impact of faults from external causes and equipment failures.

Project description:

The system intelligence project improves reliability for customers by helping avoid unplanned outages and reduce duration / impacts when outages occur. The scope of work includes:

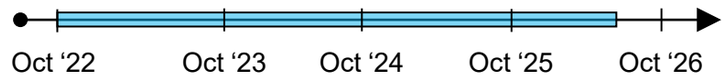
- **Electromechanical to digital relays** replace noncommunicating electromechanical and solid-state relays with digital relays.
- **Remote substation and asset monitoring** enables operators to remotely control equipment as well as monitor the health of equipment.
- **Remote control line switches** replaces manually operated switches with modern switches enabled with SCADA communication and remote-control capabilities.

Remote controlled line switch

Digital relays

Key details:

Estimated construction timeline:*



Estimated in-service dates:*

Projected costs:

DEP System	Oct'23 - Sept'24	Oct'24 - Sept'25	Oct'25 - Sept'26
Capital costs**	$53.4M	$27.1M	$13.5M

Grid capabilities enabled:

- Strengthened grid against outages
- Increased resiliency to recover from outages including during extreme weather & storm events
- Increased Grid operator visibility to system conditions
- Improved reliability
- Optimized ability to monitor the grid for variable conditions associated with DER deployments

HB951 Policy Considerations addressed:

- Encourages peak load reduction or efficient use of the system
- Encourages utility-scale renewable energy & storage
- Promotes resilience & security of the electric grid
- Maintains adequate levels of reliability & customer service

Note: * Timelines are for identified locations included in MYRP filing; **Capital and Installation O&M costs based on in-service dates and include AFUDC and contingency

System Intelligence
Project benefits

TRANSMISSION

Improve reliability

- Reduce outage duration and number of customers impacted from vegetation and line component failure events

Increase operational efficiency

- Improve grid operator and engineer visibility to system events and equipment health

Demonstrably positive net financial benefits

Total benefits	Total costs	Benefit-Cost ratio
$1,075.5M	$80.0M	13.4

Remotely Operated Line Switch

Example: Delco - Whiteville 115kV Remote Control Line Switch

- Coastal plains area susceptible to being impacted by storms with difficult to access line right-of-way (ROW)
- Improves the ability to sectionalize and restore; more than 11,000 customers served on this line, from four separate substations.

Delco-Whiteville ROW

Line Hardening & Resiliency
Project overview

TRANSMISSION

Project purpose:

The Transmission Line Hardening & Resiliency (H&R) project works to create a stronger and more resilient transmission grid capable of withstanding or quickly recovering from extreme external events, natural or man-made.

Project description:

Each of the Transmission H&R scopes of work address unique challenges in ways that harden the system, and not only minimize impacts to customers, but enhance their electric service experience.

- **Cathodic Protection** scope extends the life of the existing towers that provide the generating power to be transmitted to nearby substations.
- **Targeted Line Strengthening for Extreme Weather** scope protects some of the higher voltage transmission lines from extreme weather by addressing vulnerable wooden structures as well as metal towers.
- The **Animal Mitigation** scope hardens the 500kV transmission system by protecting v-string insulators from buzzard secretion, which can accumulate to the point of causing flashover outages resulting in significant voltage sags on the grid

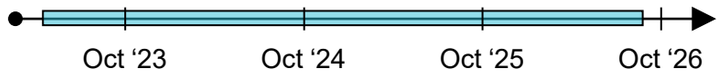
Failed tower due to ground-line corrosion

Upgraded Steel H-Frame

Transmission Tower

Key details:

Estimated construction timeline:*



Estimated in-service dates:*

Projected costs:

DEP System	Oct'23 - Sept'24	Oct'24 - Sept'25	Oct'25 - Sept'26
Capital costs**	$42.0M	$74.0M	$28.4M
O&M costs**	$0M	$0.4M	$0.4M

Grid capabilities enabled:

- Strengthened grid against outages from extreme weather and storm events, as well as other threats
- Increased resiliency to recover from outages
- Improved reliability

HB951 Policy Considerations addressed:

- Promotes resilience and security of the electric grid
- Maintains adequate levels of reliability and customer service

Note: * Timelines are for identified locations included in MYRP filing; **Capital and Installation O&M costs based on in-service dates and include AFUDC and contingency

Line Hardening & Resiliency
Project benefits

TRANSMISSION

Improve reliability

- Reduced outages caused by line component failures
- Reduced voltage spikes, sags, and momentary interruptions

Increase operational efficiency

- Reduce or avoid emergency repair or replacement or after-hours work

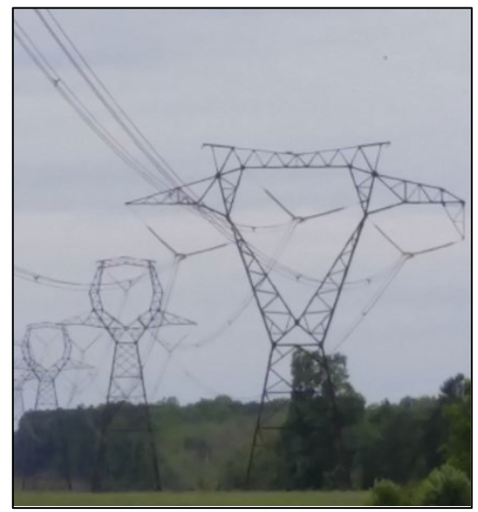
Demonstrably positive net financial benefits

Total benefits	Total costs	Benefit-Cost ratio
$656.6M	$161.5M	4.1

Mayo-Person Tower Joint Corrosion

Example: Mayo-Person 500 Targeted Line Strengthening

- Scope: Replace lattice towers on the Mayo Plant-Person 500kV Line
- Line supports approximately 500 MW of network flow
- Tower structure compromised due to long term corrosion degradation



DEP 500kV Tower Line

Substation Hardening & Resiliency
Project overview

TRANSMISSION

Project purpose:

The transmission substation hardening & resiliency (H&R) project works to create a stronger and more resilient transmission grid capable of withstanding or quickly recovering from extreme external events, natural or man-made.

Project description:

- **Substation Rebuild** scope primarily includes replacing degraded wooden structures along with transformers, breakers, regulators, circuit switchers, and ancillary equipment such as instrument transformers and switch upgrades
- **Substation Flood Mitigation** scope builds in protection for substations most vulnerable to flood damage
- **Animal Mitigation** scope installs equipment specifically designed to prevent animal induced events from impacting customers directly through an outage or indirectly through a system perturbation such as a voltage depression
- **Physical Security** scope focuses on hardening physical security controls at substations to reduce the risk of external attack by focusing on identification of threats, preventative measures, detection, and event monitoring.

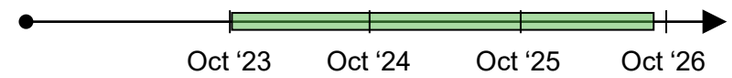
Animal Resistant Fence

Flooded Substation from Hurricane Florence

Key details:

Estimated construction timeline:*

Estimated in-service dates:*



Projected costs:

DEP System	Oct'23 - Sept'24	Oct'24 - Sept'25	Oct'25 - Sept'26
Capital costs**	$163.1M	$118.9M	$85.3M

Grid capabilities enabled:

- Strengthened grid against outages including during extreme weather and storm events
- Increased resiliency to recover from outages
- Improved physical security

HB951 Policy Considerations addressed:

- Promotes resilience and security of the electric grid
- Maintains adequate levels of reliability and customer service

Note: * Timelines are for identified locations included in MYRP filing; **Capital and Installation O&M costs based on in-service dates and include AFUDC and contingency

Substation Hardening & Resiliency
Project benefits

TRANSMISSION

Improve reliability

- Reduced outages caused by substation component failures; reduce impacts of extreme weather and external events

Increase operational efficiency

- Reduce or avoid emergency repair or replacement or after-hours work

Demonstrably positive net financial benefits

Total benefits	Total costs	Benefit-Cost ratio
$4,715.5M	$303.8M	15.5

Transformer at Raeford South

Example: Raeford South 115kV Substation Rebuild

- Rebuild substation including replacement of 1960s era transformer and deteriorated wood structures
- Station serves approximately 1,000 retail customers
- Transformer identified for replacement through our Health and Risk Management Program
- Wooden structures vulnerable to warpage and splintering which can lead to equipment failure

Wooden Bus Support Structure

Vegetation Management
Project overview

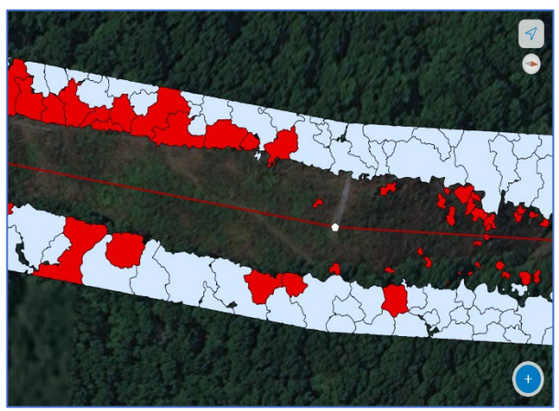
TRANSMISSION

Project purpose:

The Transmission vegetation management project works to create a hardened transmission grid capable of withstanding extreme weather events and reduce the frequency of outages impacting customers.

Project description:

- The Transmission Integrated Vegetation Management (IVM) program is focused on ensuring the safe and reliable operation of the transmission system by minimizing vegetation-related interruptions and maintaining adequate conductor-to vegetation clearances, while maintaining compliance with regulatory, environmental, and safety requirements and standards. Program activities focus on the removal of hazard trees along and outside of the right of way to minimize the risk of vegetation-related outages.



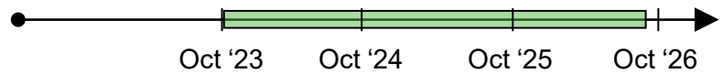
Tree canopy risk model

Transmission Right-of-Way

Key details:

Estimated construction timeline:*

Estimated in-service dates:*



Projected costs:

DEP System	Oct'23 - Sept'24	Oct'24 - Sept'25	Oct'25 – Sept'26
Capital costs**	$33.3M	$47.0M	$38.7M

Grid capabilities enabled:

- Strengthened grid against outages including during extreme weather and storm events
- Improved reliability

HB951 Policy Considerations addressed:

- Maintains adequate levels of reliability and customer service

Note: * Timelines are for identified locations included in MYRP filing ; **Capital and Installation O&M costs based on in-service dates and include AFUDC and contingency

Vegetation Management
Project benefits

TRANSMISSION

Reduced customer interruptions

- Reduced customer outages; vegetation is one of the leading cause of outages

Operational savings

- Proactive tree removal leads to less emergency work and less collateral equipment damage

Storm Hardening

- Reduce impact to the grid and customers during extreme weather/storms

Example: Harris Plant – Siler City 230kV

- 33-mile line connecting Harris Nuclear Plant to 3 Substations, 4 Transformer banks, nearly 20,000 customers
- 100’ ROW (50’ each side of center)
- LiDAR used to identify danger tree threats up to 30 feet outside ROW
- Vegetation falling from outside the ROW results in 25% of transmission customer minutes interrupted

Removal of incompatible vegetation along Transmission ROW

Breaker Upgrades
Project overview

TRANSMISSION

Project purpose:

The Breaker Replacement project involves replacing degraded transmission circuit breakers, including oil circuit breakers (“OCBs”), typically in conjunction with upgrading the associated protection and control relays. The new communication and control capabilities of this modern technology better positions the transmission and distribution systems to effectively respond to electric grid events. These reliable gas and vacuum breakers are also better suited for protecting circuits during high-frequency fault events such as winter storms and hurricanes.

Project description:

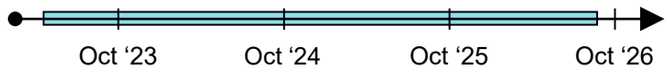
- The breaker replacement project ensures reliable equipment; this keeps electric faults isolated to the smallest section of the system to minimize customer impacts.
- Circuit breaker technologies are being transitioned from OCBs to SF6 Gas Circuit Breakers (“GCBs”) for 44 kV and higher applications, and Vacuum Circuit Breakers (“VCB”) for 35 kV and lower.

Transmission Gas Circuit Breaker (GCB)

Distribution Vacuum Circuit Breaker (VCB)

Key details:

Estimated construction timeline:*



Estimated in-service dates:*

Projected costs:

DEP System	Oct’23 - Sept’24	Oct’24 - Sept’25	Oct’25 - Sept’26
Capital costs**	$41.3M	$23.4M	$24.0M

Grid capabilities enabled:

- Allowed for additional capacity on the system
- Enhanced reliable fault interrupt capability
- Reduced environmental footprint
- Improved reliability
- Strengthened grid against outages
- Increased resiliency to recover from outages

HB951 Policy Considerations addressed:

- Promotes resilience and security of the electric grid
- Maintains adequate levels of reliability and customer service

Note: * Timelines are for identified locations included in MYRP filing ; **Capital and Installation O&M costs based on in-service dates and include AFUDC and contingency

Breaker Upgrades
Project benefits

TRANSMISSION

Improve reliability

- Minimize the number of customers impacted from an outage event, component failures, or slow to operate circuit breaker

Strengthen the grid and manage risk

- Reduce risk of a more extensive grid outage resulting from breaker mis-operation or failure

Increase operational efficiency

- Reduce or avoid emergency repair or replacement or after-hours work

Demonstrably positive net financial benefits

Total benefits	Total costs	Benefit-Cost ratio
$2,365.1M	$76.1M	31.1

Example: Milburnie 230kV Substation

- Scope: Replace five (5) 115 kV circuit breakers
- Station is critical to serving reliability needs of customers in the greater Raleigh area
- Five (5) 115kV lines connect to station, potential for over 77,000 customers to be affected by events

Typical Transmission Oil Circuit Breaker

Transformer Upgrades
Project overview

TRANSMISSION

Project purpose:

The objective of the Transformer Upgrade project is to anticipate future transformer failures and replace those transformers in a proactive manner, avoiding the cost and customer outages associated with these failures. Failures can result in significant customer outages, collateral damage, and oil release requiring environmental mitigation.

Project description:

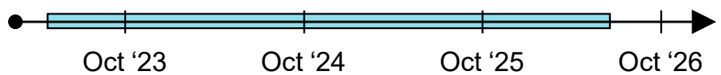
- The Transformer Upgrade project involves replacing degraded transmission transformers and regulators, typically in conjunction with upgrading the associated protection and control relays.
- Improved reliability and response to variable energy resources through the elimination of arc-in-oil load tab changers.

Typical T/D Transformer

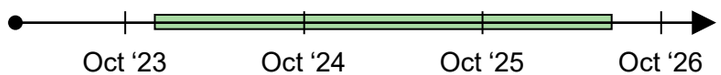
Transmission transformer

Key details:

Estimated construction timeline:*



Estimated in-service dates:*



Projected costs:

DEP System	Oct'23 - Sept'24	Oct'24 - Sept'25	Oct'25 - Sept'26
Capital costs**	$31.1M	$36.1M	$59.6M

Grid capabilities enabled:

- Strengthened grid against outages including during extreme weather and storm events
- Increased resiliency to recover from outages
- Improved reliability when accommodating variable conditions associated with DER deployments
- Improved performance from vacuum load tap changer (LTC) technology

HB951 Policy Considerations addressed:

- Encourages DERs
- Promotes resilience and security of the electric grid
- Maintains adequate levels of reliability and customer service

Note: * Timelines are for identified locations included in MYRP filing; **Capital and Installation O&M costs based on in-service dates and include AFUDC and contingency

Transformer Upgrades
Project benefits

TRANSMISSION

Improve reliability

- Reduced outages caused by transformer and regulator failures

Increase operational efficiency

- Avoid system loading contingencies due to loss of capacity from failed transformer

Strengthen the grid and manage risk

- Reduce risk of unplanned events, collateral damage from failed transformers, and environmental threats from oil spills

Demonstrably positive net financial benefits

Total benefits	Total costs	Benefit-Cost ratio
$2,391.0M	$101.8M	23.5

Example: Wilmington Ogden 230KV 3-Phase Regulator

- Scope: Replace 3-phase regulator
- Provides voltage regulation for four (4) circuits and over 8,500 customers.
- 3-phase regulators are the top outage cause category for equipment failures in DEP

3-phase regulator

Capacity and Customer Planning
Project overview

TRANSMISSION

Project purpose:

As demand on the transmission system grows and changes over time, new transmission projects and upgrades are needed to serve retail customer and keep the grid reliable and in compliance with NERC Standards. Transmission expansion projects also facilitate the connection of additional utility scale renewable generation sources.

Project description:

The Transmission System is required to meet NERC Standards and reliably serve customers. NERC and local standards set requirements for transmission system power flows, voltages, stability, and breaker capability to maintain a safe and reliable transmission grid and avoid widespread grid blackouts.

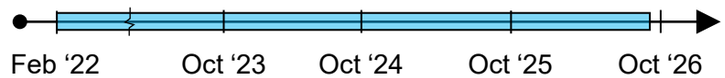
- After Transmission Planning identifies future overloads and network upgrades, the plan is screened by ISOP to identify projects that have the potential to be deferred or avoided by a non-traditional solution (NTS), such as energy storage.
- Transmission Expansion Plan projects uprate areas of the grid that are limited for additional generation interconnections. Projects are presented/approved through the NC Transmission Planning Collaborative.

500kV Breaker

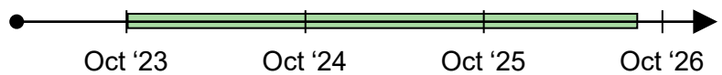
230/115kV Autotransformer

Key details:

Estimated construction timeline:*



Estimated in-service dates:*



Projected costs:

DEP System	Oct'23 - Sept'24	Oct'24 - Sept'25	Oct'25 - Sept'26
Capital costs**	$73.7M	$101.6M	$342.6M

Grid capabilities enabled:
- Served increased customer demand
- Maintained reliability
- Enabled connection of more solar generation

HB951 Policy Considerations addressed:
- Encourages utility-scale renewable energy and storage
- Encourage DERs
- Encourages beneficial electrification, including electric vehicles
- Promotes resilience and security of the electric grid
- Maintains adequate levels of reliability and customer service

Note: * Timelines are for identified locations included in MYRP filing; **Capital and Installation O&M costs based on in-service dates and include AFUDC and contingency

Capacity and Customer Planning
Project benefits

TRANSMISSION

Improve reliability

- Meet federal compliance mandates for grid reliability
- Maintain grid reliability and stability
- Provide capacity upgrades and new connections to serve customer needs

Societal benefit

- Facilitate clean energy transition

Demonstrably positive net financial benefits

Total benefits	Total costs	Benefit-Cost ratio
$697.1M	$444.6M	1.6

Future Craggy-Enka 230kV Line

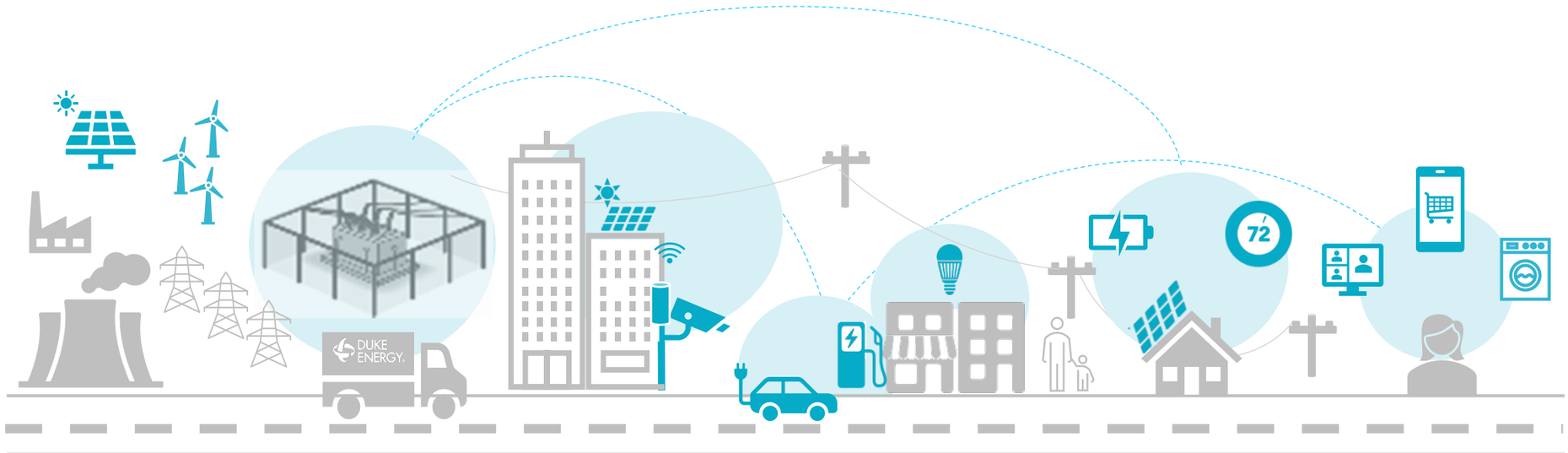
Example: Craggy-Enka 230kV – Construct New Line

- Nine miles of new line will be constructed to strengthen power flow in the DEP Western Region, providing a corridor between two existing segments of 230kV circuit
- Utilize existing 115kV ROW and rebuild this circuit on common structure as the 230kV
- Improves reliability for more than 30,000 existing customers and accommodate future growth in the greater Asheville area
- Avoids potential load shed outages by winter 2025 based on current Planning models

Agenda

Topic	Presenter
Context and external trends	Justin Brown
Distribution projects	Brent Guyton
Transmission projects	Dan Maley
Closing remarks	**Justin Brown**

Improvement work is designed to enable the grid for the future



Grid resiliency

Increase the grid's ability to withstand and recover from more frequent and intense weather

Expanded renewables and DERs

Enable the grid to meet customer demand for DERs while maintaining reliable service

Equitable access to benefits

Achieve balanced outcomes for customers across geographies, promoting access to emerging technologies and energy solutions