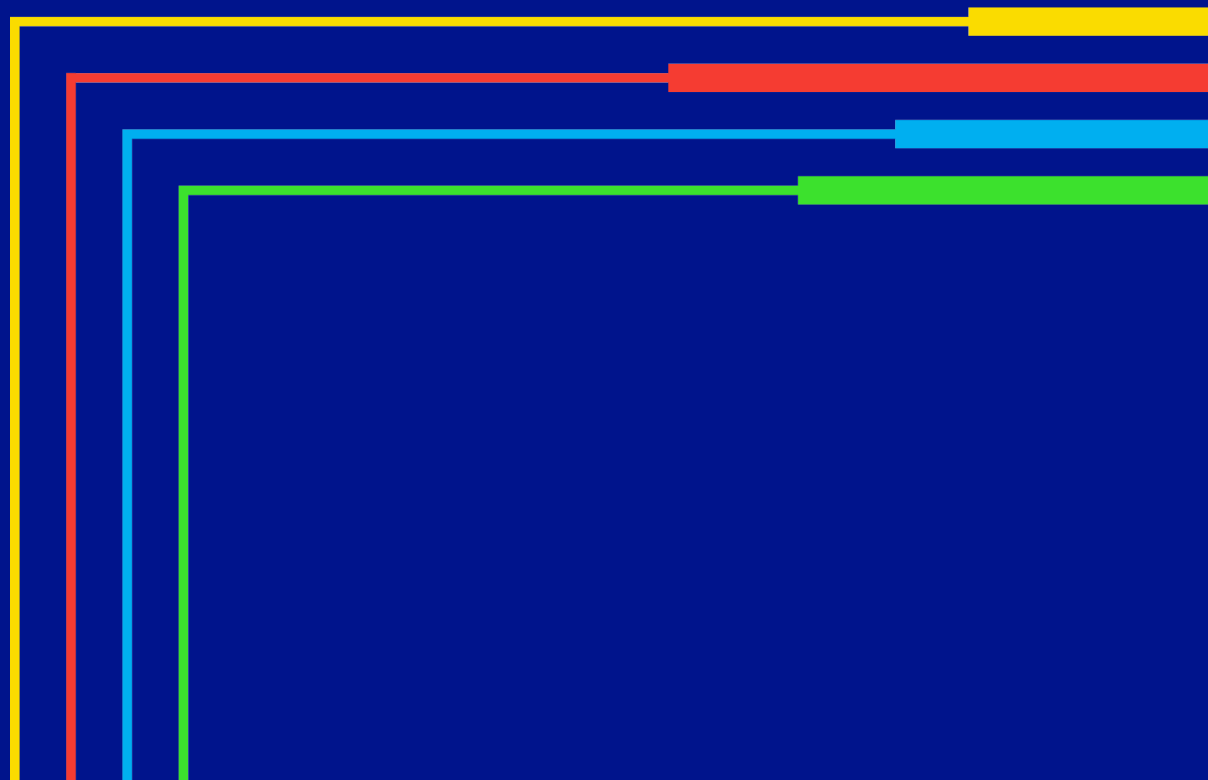
# Distribution Planning Overview

**2022**



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# What is Distribution Planning?

- Distribution planning is the analysis of historical data with forecasting information to prepare recommendations for National Grid to provide safe, reliable, and efficient electric service
  - Historical Data
    - Physical Characteristics = Asset Condition
    - Electrical Characteristics = Current, Voltage, and Power
  - Analysis
  - Recommendation
    - Infrastructure
    - System modifications or operational guidelines

# Why do we plan?

- **SAFE**
  - Maximize safety of workers, equipment, and the public
- **RELIABLE**
  - Proactive (Predictive)
  - Reactive (Historical)
- **EFFICIENT**
  - Maximize use of existing assets
  - Economic expansion
  - Minimize environmental impacts
  - Minimize societal impacts

# Planning Analysis Concepts

- Should apply criteria and strategies reviewed by regulatory entity
  - System Performance Criteria (including Asset Condition)
    - Acceptable = Continue to analyze and plan
    - Not Acceptable = Infrastructure Investment or System Modification
- Should allow customer choice – Plan for most significant impact to the system
- Status of System Monitoring
- Comprehensive Plans
- Distribution Planning addresses Capacity, not Energy
  - Discrete and Large
  - Familiarity with cost, schedule, and capabilities

# Distribution Planning Overview

- Distribution Planning Criteria
- Distribution Planning process
  - Forecasting
  - Annual capacity reviews
  - Area studies
  - Other planning studies
- Grid Modernization
- Planning Challenges

# Distribution Planning Criteria

- Planning criteria is applied in all distribution planning studies
- Sets thresholds and limits intended to identify system needs and initiate investments to address these issues under Normal and Contingency (N-1) conditions
  - Asset condition
  - Thermal loading
  - Voltage
  - Non Wires Alternative Criteria
  - Fault Duty, Protection & Arc flash
  - Reliability
  - Resilience
  - Reactive Power
  - Load Balancing
  - Hosting Capacity

# Load Forecasting

- The Company's Electric Forecasting team uses a regression-based core model to forecast summer and winter peak loads on an annual basis
  - 15-year projections
  - Variables considered include historical and forecasted economic conditions, historical peak load data, annual energy sales, and weather conditions based on historical data
  - Predicts forecasted peak demand under a normal and extreme weather scenario
  - The extreme weather scenario is used in planning analyses
  - The forecast of peak load incorporates distributed energy resources (DER), including:
    - energy efficiency (EE) savings
    - solar-photovoltaics (PV) reductions
    - electric vehicle (EV) increases
    - electric heat pumps (EH) decrease in summer and increase in winter
    - demand response (DR) reduction achieved through the prior year
  - Numerous DER scenarios are developed – System planning uses the load with base DER scenario for planning purposes

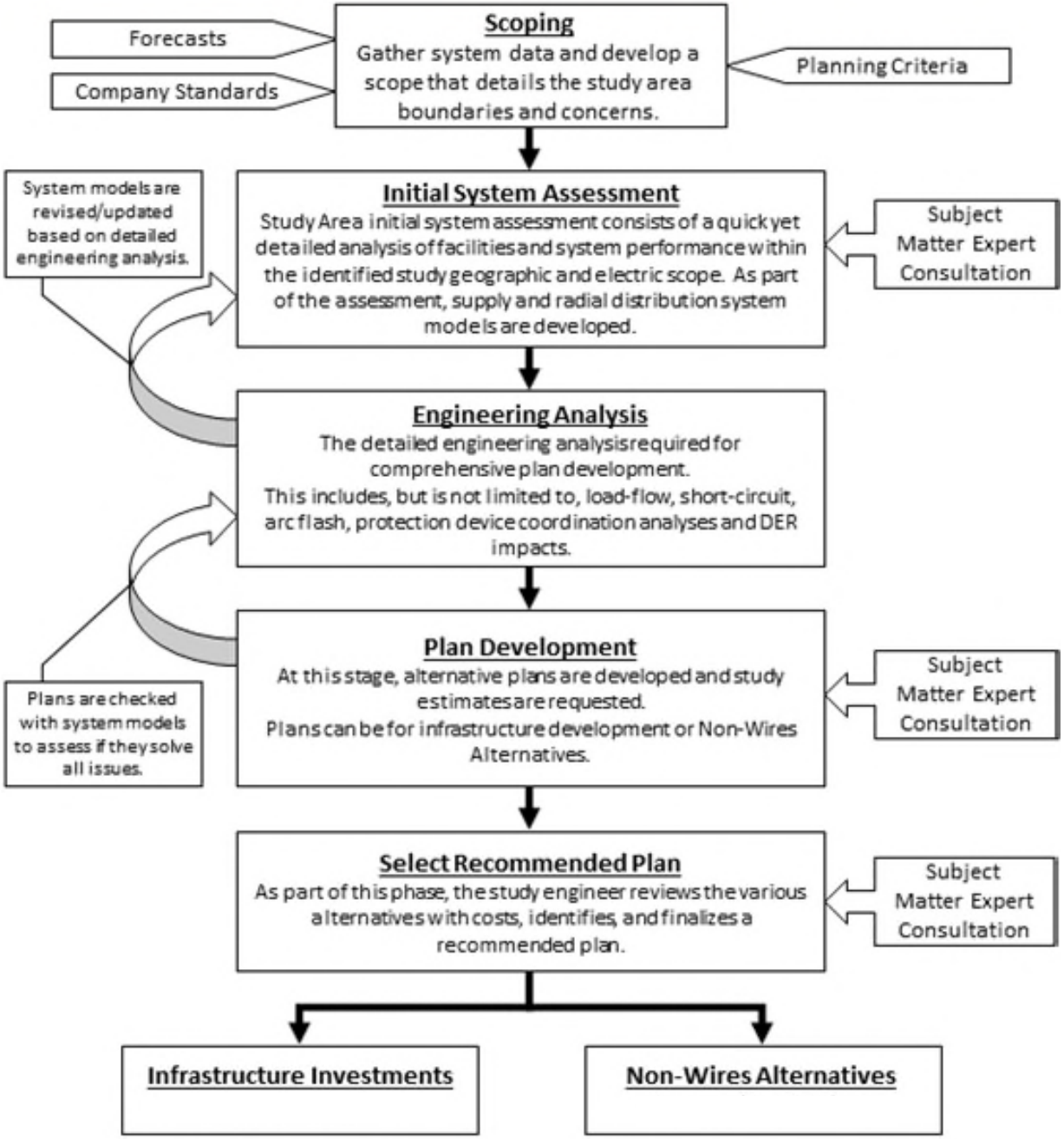
# Annual Capacity Review

- Upon completion of the electric annual forecast report, Distribution Planning performs annual capacity reviews on all feeders, transformers and subtransmission lines.
- Analysis uses actual peak load data from the prior year with the forecast information provided in the forecast report.
- Incorporates known “spot loads” – large load customers with a service request or anticipated though community/customer engagement
- Reviews identify thermal capacity constraints and assess the capability of the network to respond to contingencies.
- Results can prompt the need for new projects to address planning criteria violations
- Results inform the prioritization of area planning studies or other existing projects

# Area Studies

- Area studies are comprehensive reviews of areas within the Company's service territory that result in long-term infrastructure development recommendations that solve system issues identified over a 10-15 year period
- Area study plans address all issues identified in the study including but not limited to the following issues: asset condition, capacity, protection, voltage, reliability, operational, arc flash, etc.
- Process involves input from subject matter experts across the company
- Alternatives are developed to solve all known issues and the "least cost fit for purpose" option progresses to implementation
- Non Wires Alternatives
  - Screening criteria included in the planning criteria
  - All recommended projects are screened for Non-wires Alternatives

# PLANNING STUDY PROCESS

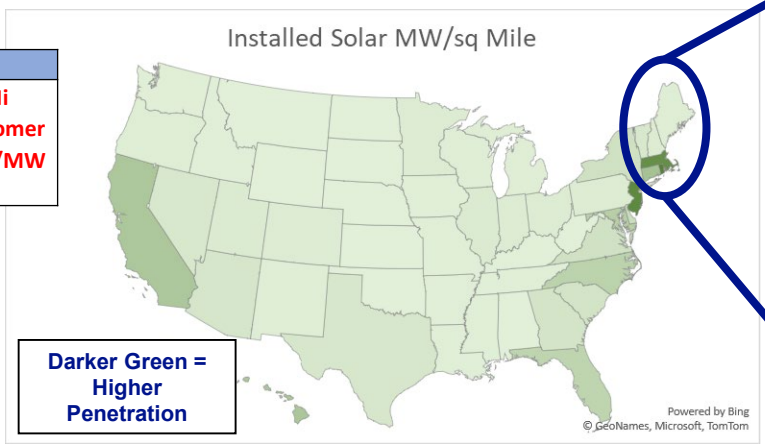


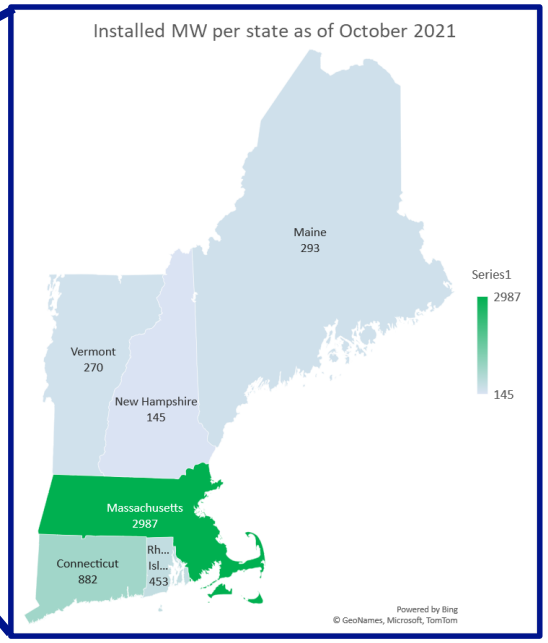
# Other planning studies

- Load Interconnection studies
- Generator and Energy Storage System (ESS) Interconnection studies
  - Group studies
  - Transmission Affected System Operator (ASO) studies
- Special Studies/Programs such as new technology assessments, system wide targeted programs etc.
- Annual reliability reviews of distribution circuits

# New England Distributed Generation Benchmarking

| 2021 totals | | |
|---|---|---|
| NGrid Sq Mi | 3870 | 469.5 kW/Sq Mi |
| kW installed | 1817 | 1.4 kW/customer |
| NG customers | 1.3M | 10.2 ckt mile /MW |
| NG ckt miles | 18451 | |



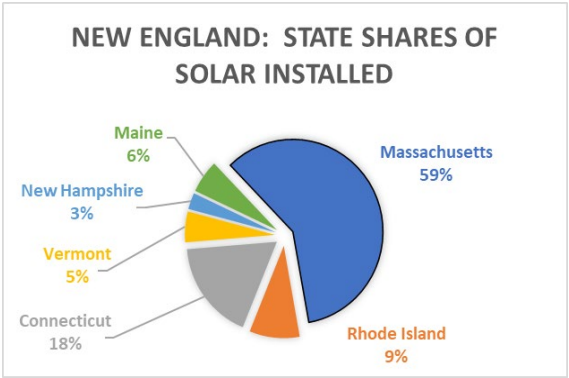

## Total Solar Installations between 2010 and Q2-2020

### Residential

| Rank | Utlity | MWdc |
|---|---|---|
| 1 | PGE | 2,530 |
| 2 | SCE | 1,861 |
| 3 | SDGE | 1,028 |
| 4 | APS | 869 |
| 5 | PSEG | 750 |
| 6 | Duke | 500 |
| 7 | National Grid | 482 |
| 8 | Southern Nevada | 380 |
| 9 | Xcel Energy | 372 |
| 10 | Eversource | 358 |

### Non-Residential

| Rank | Total Non-residential Solar PV Installed by Utility Territory | MWdc |
|---|---|---|
| 1 | PGE | 1,763 |
| 2 | National Grid | 1581 |
| 3 | Xcel Energy | 1,132 |
| 4 | SCE | 934 |
| 5 | Eversource | 831 |
| 6 | PSEG | 650 |
| 7 | JCP&L | 480 |
| 8 | SDGE | 322 |
| 9 | APS | 291 |
| 10 | New York State Electric and Gas | 253 |



# Grid Modernization

## 1. Why are we doing this?

- To improve system reliability, efficiency, and outage response
- To enable an expanding portfolio of sustainable energy resources delivering on National Grid's Northeast 80x50 Pathway
- To increase network visibility and share key information with customers and market participants

## 2. What are we doing?

- Enabling increased integration of Distribution Energy Resources (DERs)
- Improving the quality of power delivered through voltage optimization
- Developing new systems and tools for Distribution Control Centers
- Leveraging devices to improve Field Operations situational awareness capabilities
- Improving distribution system planning

## 3. How will this benefit customers?

- Cleaner, most cost-effective, consistently reliable energy
- More timely and accurate customer service information
- New technologies to track and manage outages
- Increased capacity for interconnection of customers' renewable energy resources

# Advanced Grid Technologies

## 1. Feeder Monitors

- Power quality data will improve the timing of equipment upgrades, validate and improve modelling tools for load types and possibly support real-time ratings.

## 2. Volt Var Optimization (VVO)

- Control System that manages the quality of the energy delivered to customers
- Provides efficient delivery of power to the customer
- Equipment includes smart controls, voltage regulators, Load Tap Changers, Capacitors, Feeder monitors, and cellular modems

## 3. Fault Location Isolation & Service Restoration (FLISR)

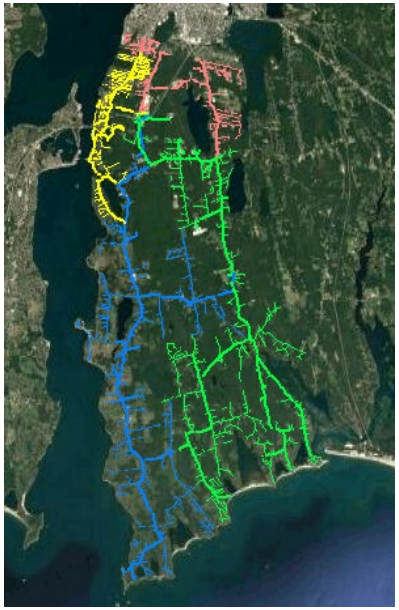
- Real-time scheme-based system that is able to respond to failure conditions on the distribution grid
- A FLISR scheme is between two or more feeders and is composed of local field devices known as Reclosers, Control Boxes, Radios, and Data Concentrators to achieve Distribution Automation
- Adjusts to changing loads and generation without operator intervention
- Minimizes effects of permanent faults

# Planning Challenges

- Emerging Issues
  - Distributed Generation (DG) saturation and increased number of Energy Storage System (ESS) applications
  - Need for 8760 forecasts and analysis
  - System Resiliency
  - Climate Change
  - Continued Operational Efficiency
  - Electrification

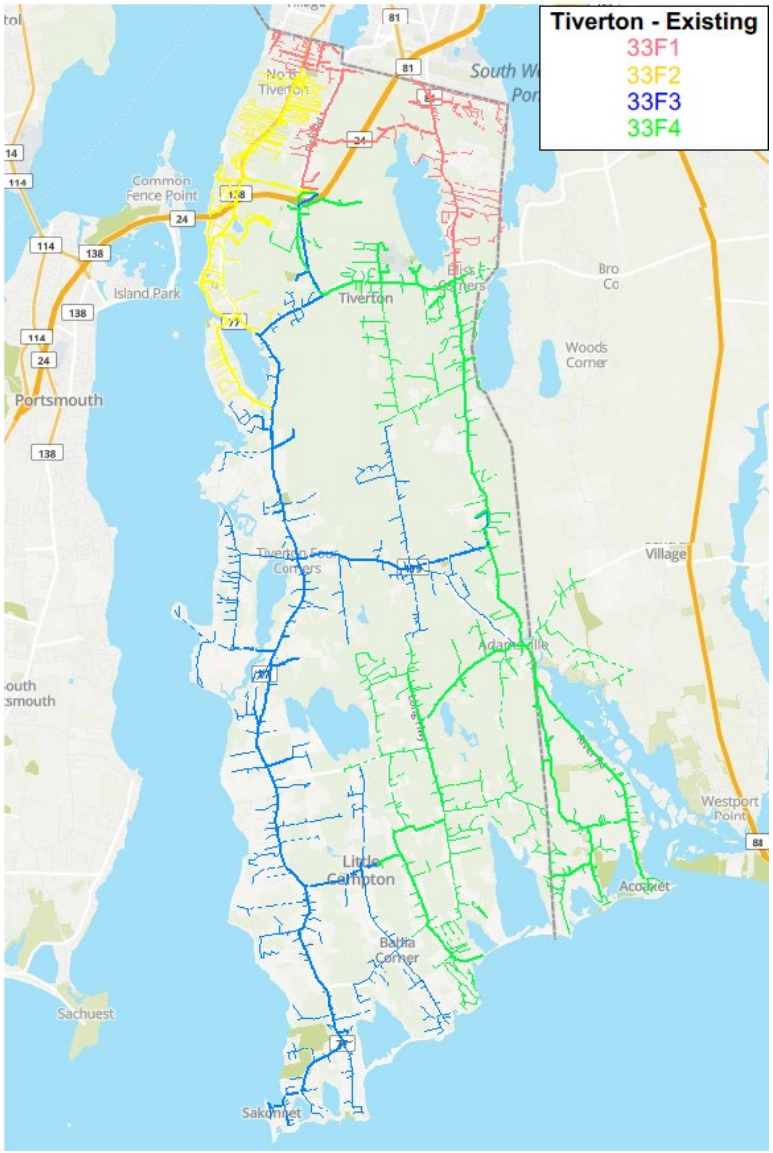
- Emerging Technologies
  - Distributed Energy Resources
  - Advanced Distribution Automation
  - Volt/Var Optimization
  - Advanced Distribution Monitoring
  - Time of use rates
  - Distributed Energy Resource Management System

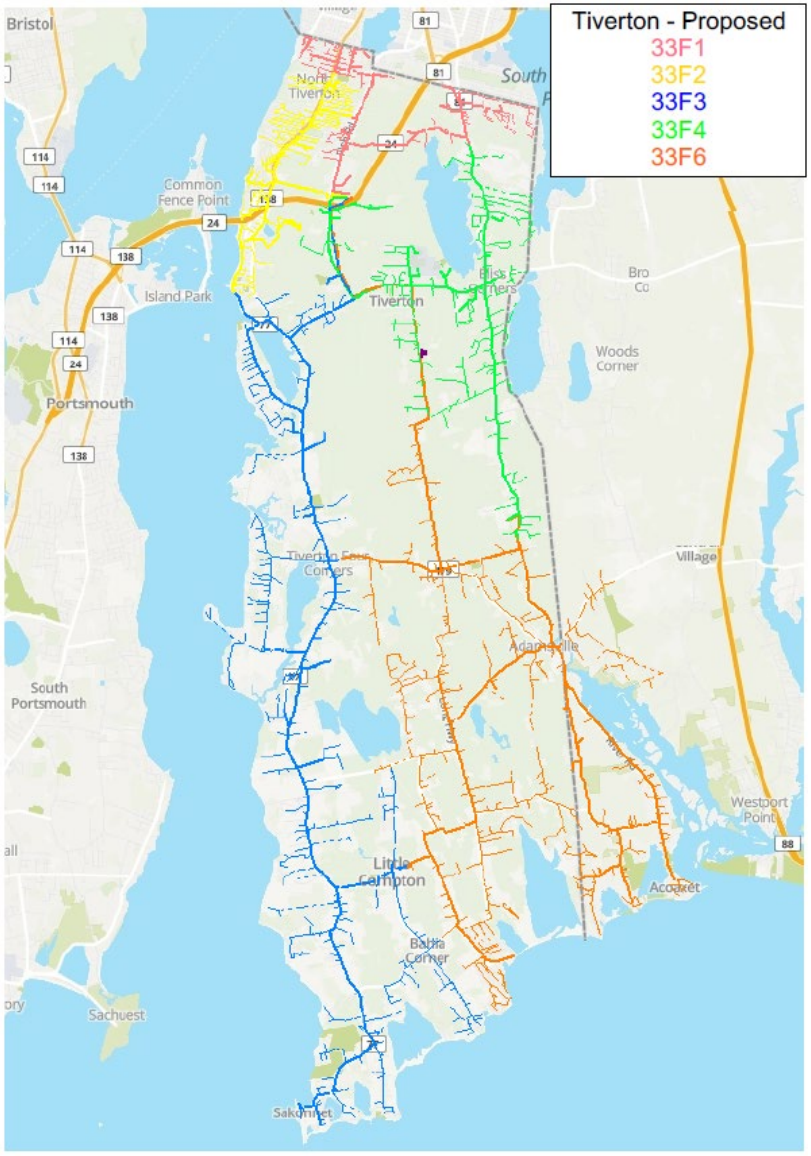
# Area Study Example – Tiverton, RI



- Tiverton substation has 4 12.47kV distribution circuits
- All 4 feeders violate our contingency load at risk criteria
- Study developed potential solutions to mitigate this issue
- Recommended plan includes installing a new 5th 12.47kV circuit at Tiverton Substation
  - There are two Distributed Generation (DG) projects currently in design that require the construction of a new 5th Tiverton circuit for interconnection.
  - If the DG project does not proceed, this 5th circuit will still be needed to address the area contingency loading concerns, and the same route would be followed as the least-cost solution. There will be an additional extension to address the contingency issue.
  - DG project is on a different schedule (earlier than the Company project), the DG developer will be responsible for the cost to construct the feeder serving their project.
  - Cost sharing will apply to the shared route portion of work once the 33F6 circuit is being used to serve load as per the Standards for Interconnecting Distributed Generation

# Tiverton Feeders Overload & Load-at-Risk



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