IEEE / NIST Innovative Smart Grid 2010

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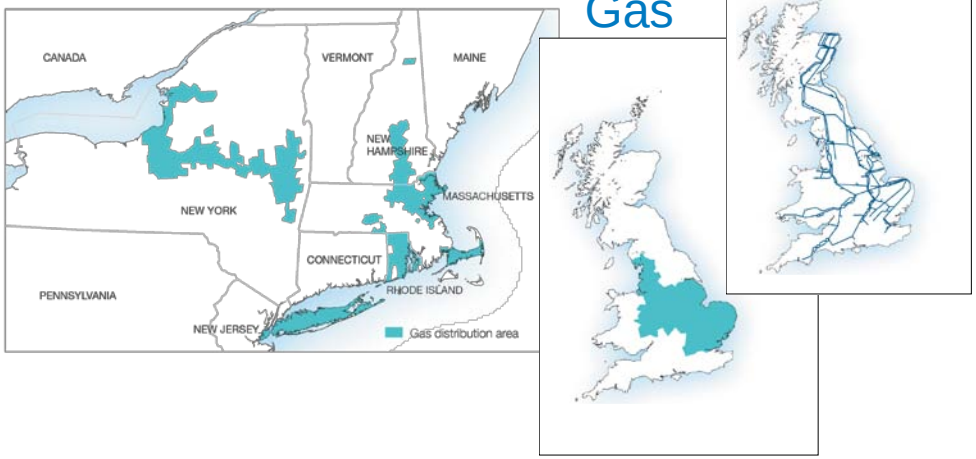
Smart Grid at National Grid

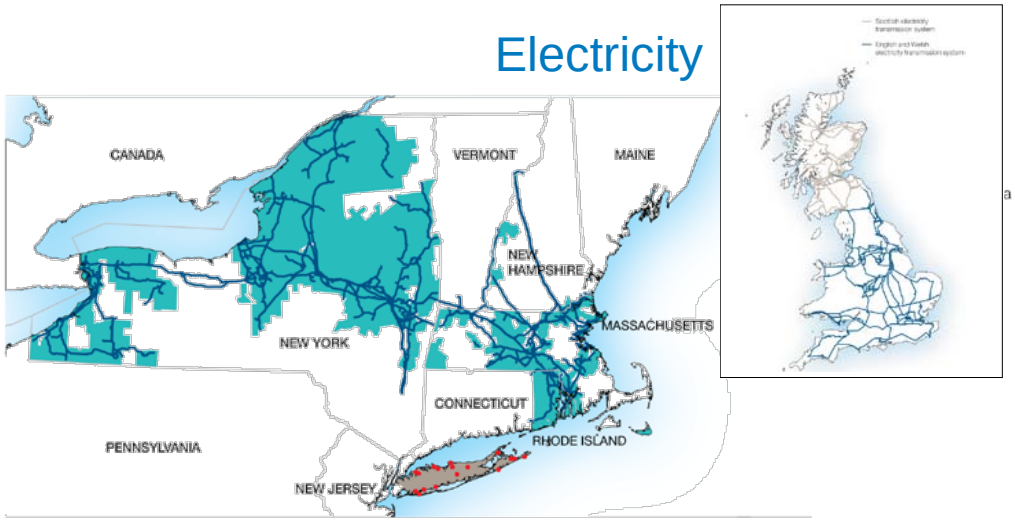
National Grid

- 50% US, 50% UK
- 27,000 employees
- Distributes electricity to 3.3 million and gas to 3.5 million US customers
- Services 1.1 million customers of Long Island Power Authority (LIPA)
- Currently owns over 4,000MW of generation
- Distributes gas to over 20 million UK customers and owns the high pressure gas transmission system in Britain.
- Owns electric transmission system in England and Wales and operates across Britain.

Gas



Electricity



Smart

- New industry platform
- A work in progress

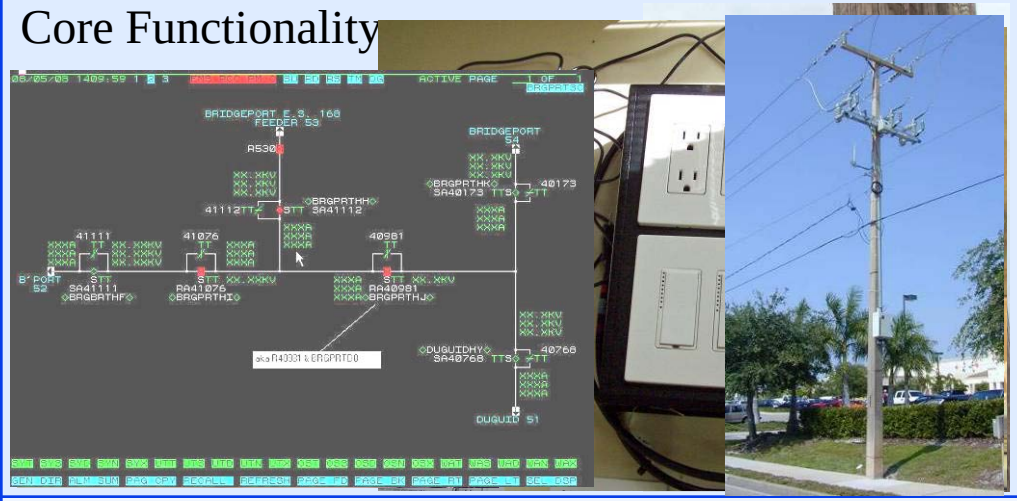
- It is in the industry's interest to discuss
  - Achievements
  - Vision for this new platform
  - Collectively develop industry norms

- I will describe National Grid's vision for Smart Grid
  - implementation to date
  - achievements to date

Vision

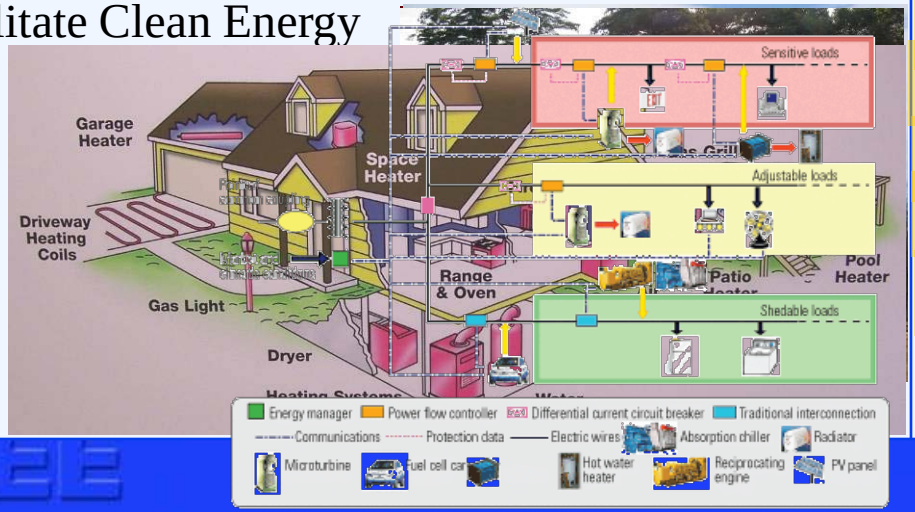
Components

Core Functionality



- **Common two-way communication system**
- **Automated metering**
- **In-Home energy management**
- **Intelligent distribution control, advanced sensors, and specialized computers**

Facilitate Clean Energy



- **Photovoltaic's (PV)**
- **PHEV/EV**
- **Energy Storage**
- **Microgrid**
- **Holistic Homes**

Vision

- Smart Grid should achieve
  - Enhance reliability performance
    - Substation feeder breakers part of line schemes
    - Line reclosers and automated switches
    - Fault indicators
  - Enhance customer awareness and choice
    - Timely price information and Interval measurements
  - Encourage greater efficiency decisions
    - Customer
    - Utility
      - Switched capacitor banks and line voltage regulators
      - Remote monitoring

Vision

- Business Case Issues
  - implement Smart Grid in a unified manner rather than in incremental steps
  - measure the integrated benefits
  - share the cost of common infrastructure across the benefits derived from various applications
  - reduce the risk of selecting common technologies that may be limiting to future applications

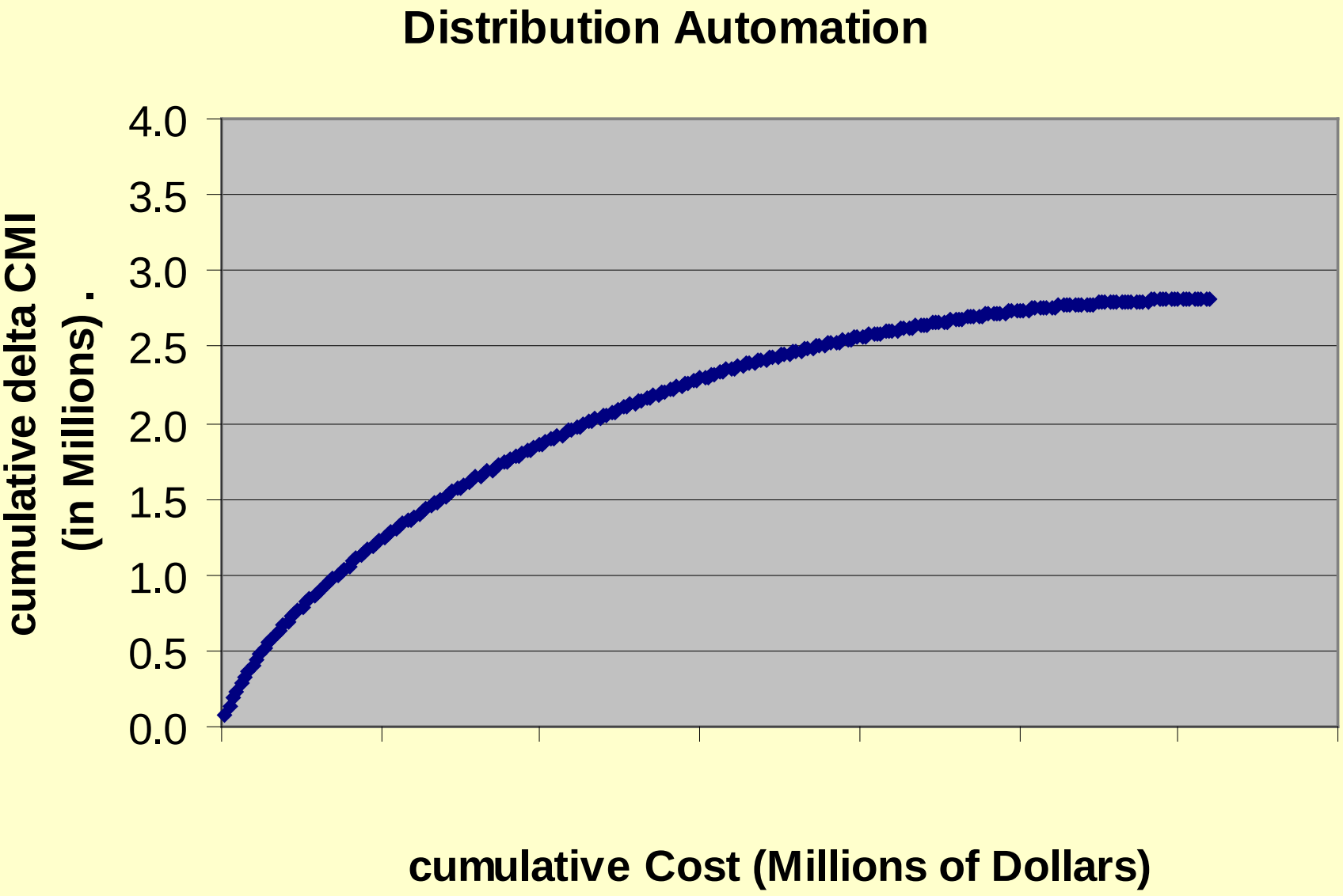
National Grid's Process

- National Grid began with an incremental approach
  - In the late 1990's a distribution level SCADA pilot was conducted.
    - used analog and later digital cell phone for Communications
    - gathered limited data from line reclosers only which operated through their traditional local controls
    - centralized control (SCADA)
- In 2003 through 2006 DA was investigated and a pilot begun in mid 2007.
  - In January 2009 the first DA was activated.
  - The DA pilot used 900 MHz spread spectrum radio for peer to peer communications between line devices and for its back haul to the nearest substation with existing SCADA communication

National Grid's Process

- In late 2008 Smart Grid was investigated.
  - incremental approach would provide the value relationship of component applications but not the value relationship of the integrated whole.
  - The integration of Smart Grid components creates a cost / benefit ratio that will be more accurate to disaggregate should roll out beyond the pilot need to be implemented in steps rather than to aggregate the step value for a full roll out.

DA Pilot

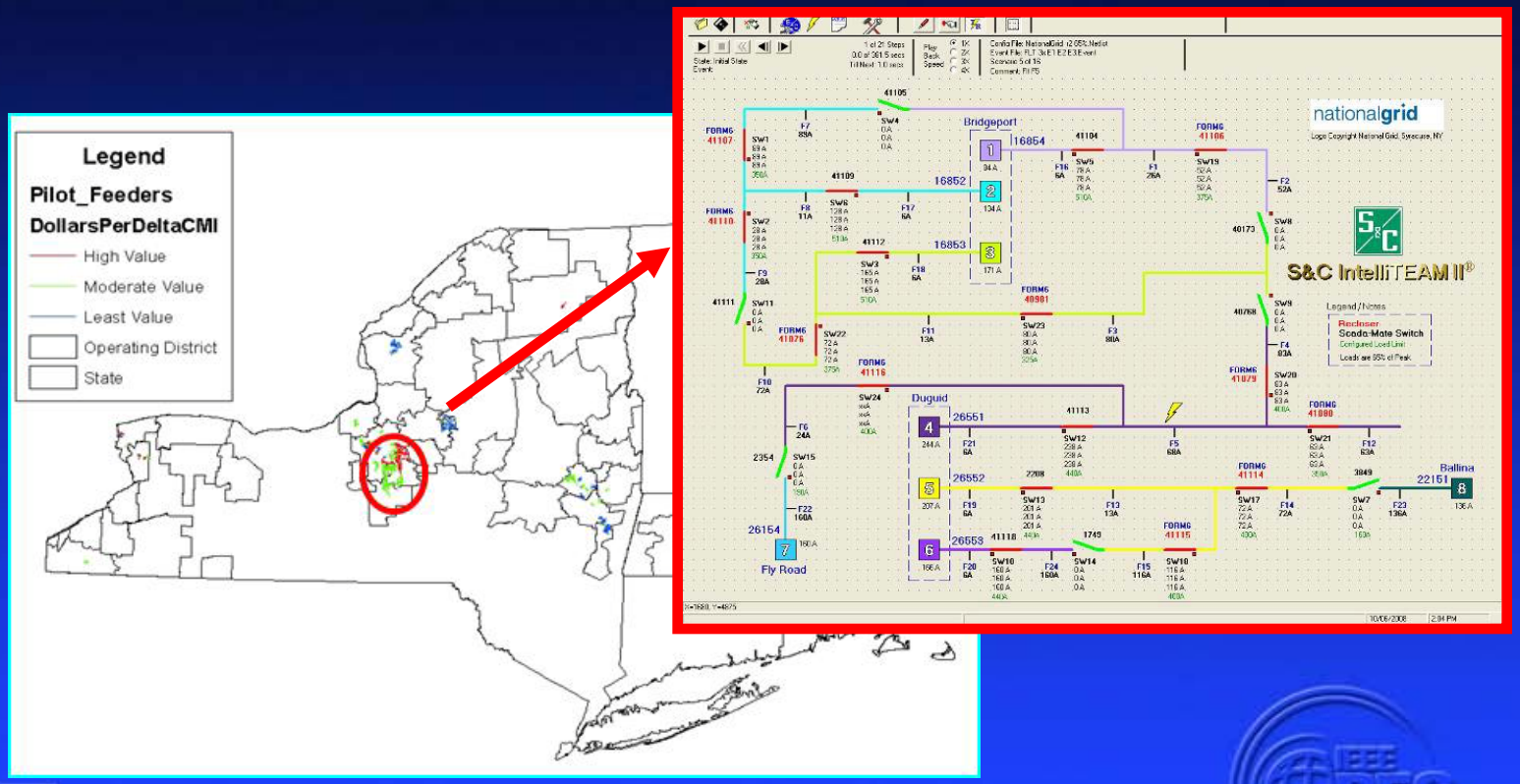

Distribution Automation
cumulative delta CMI (in Millions) .
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
cumulative Cost (Millions of Dollars)

DA Pilot

- Subtransmission Circuit Selection
  - Subtransmission review focused in our New York territory
    - it contains about 90% of our subtransmission mileage
    - has not performed as well as we would prefer
  - Protective device to protective device exposure greater than 10 miles
  - Our list of potential candidates reached seventeen circuits.
  - We then prioritized these circuits based on dollars per delta CMI expected.
  - As a final filter we eliminated those circuits where major remediation was in progress or budgeted.

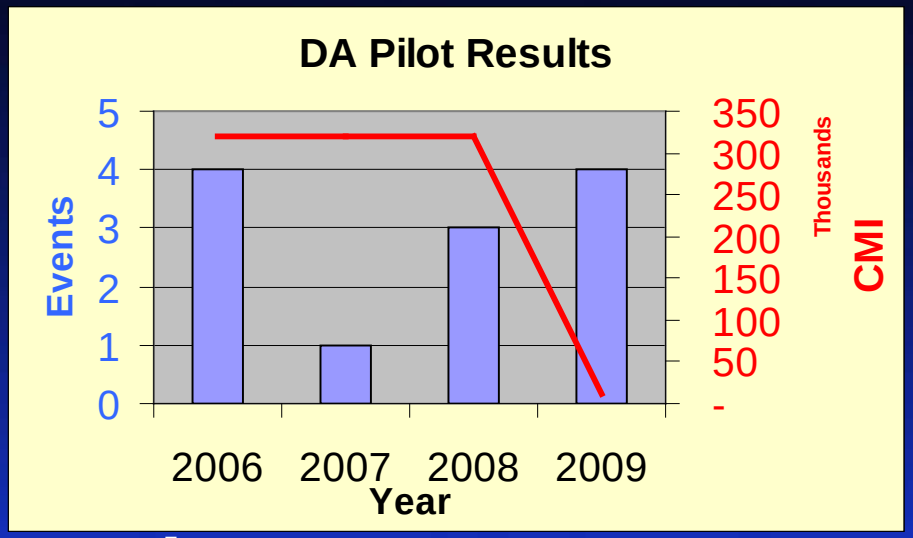
DA Pilot

- Pilot Circuits
  - Six 13.2 kV distribution feeders and two subtransmission lines (23 kV and 34.5 kV) were selected for the DA pilot.



DA Results to Date

- subtransmission circuits activated on January 26, 2009
- Actual results experienced to date



  - 3 yr avg CMI from 320k to 12k
  - 3 yr avg int duration from 100 min to 3 min
  - resulting cost/benefit ratios better than $10-12/ΔCMI.

Proof of Concept / Education

- The proof of concept (PoC) was conducted in a laboratory environment.
  - Equipment and software were assembled from the
    - head end computer systems, SCADA, DMS,MDMS,OMS,
    - communication hardware and monitoring software,
    - grid facing devices such as automated switches and line reclosers,
    - smart enabled meters, and
    - home automation network (HAN) hardware and software
  - demonstrated how well various vendors technologies and solutions will cooperate together and where care is required when integrating them

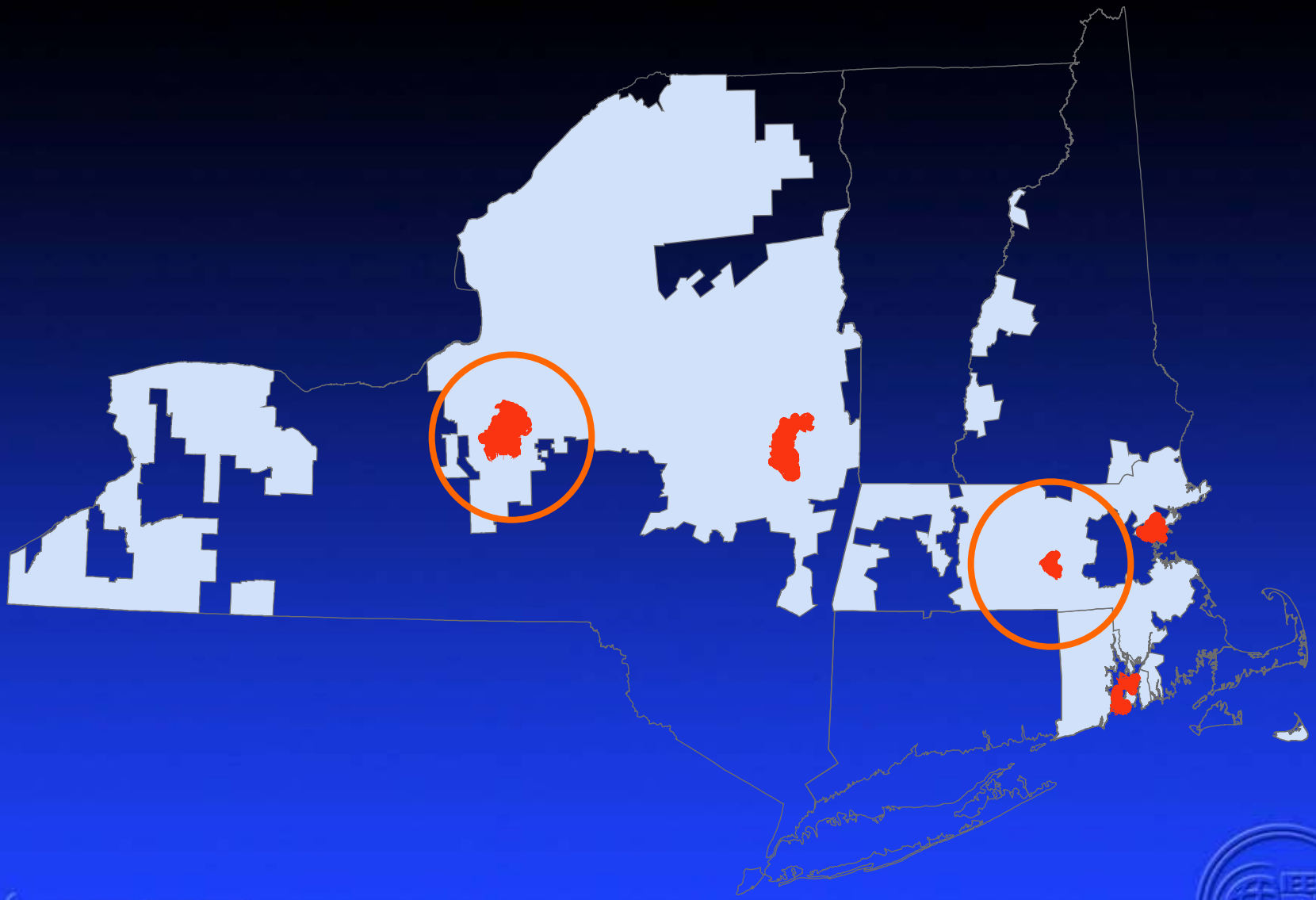
Proof of Concept / Education

- The PoC complex we constructed will be further developed into a Smart Grid Technology Center (STC).
  - Demonstration
  - training
  - future testing of new or upgraded equipment and software
- Education
  - National Grid is also reaching out to universities for new curriculum development and enhancement. The STC will also be used for this activity.

Smart Grid Feeder Selection

- Each application on the Smart Grid has a different set of drivers for pilot feeder selection.
  - The process for DA pilot feeder selection was used.
  - However, other factors were added.
    - the need to understand customer acceptance and desires required a customer demographic similar to the entire franchise area.
      - This resulted in some feeders not high in priority from a DA perspective being selected.
    - pilot areas would need to be compact contiguous areas for communication system to properly represent a full roll out
    - The number of feeders had to be large enough to be representative of the physical system.
- These factors and more were collaboratively discussed among the project team and the pilot areas developed by consensus.

Proposed pilot locations



Next Steps

- Detailed design
- STC will be further developed for continuous testing and education
- Develop customer outreach programs
- Purchasing
- Installation
- Assessment of results
- Strategy for full deployment