Georgia Tech NEETRAC
National Electric Energy Testing, Research and Applications Center

Conservation Voltage Reduction – CVR
Current Picture of the Industry

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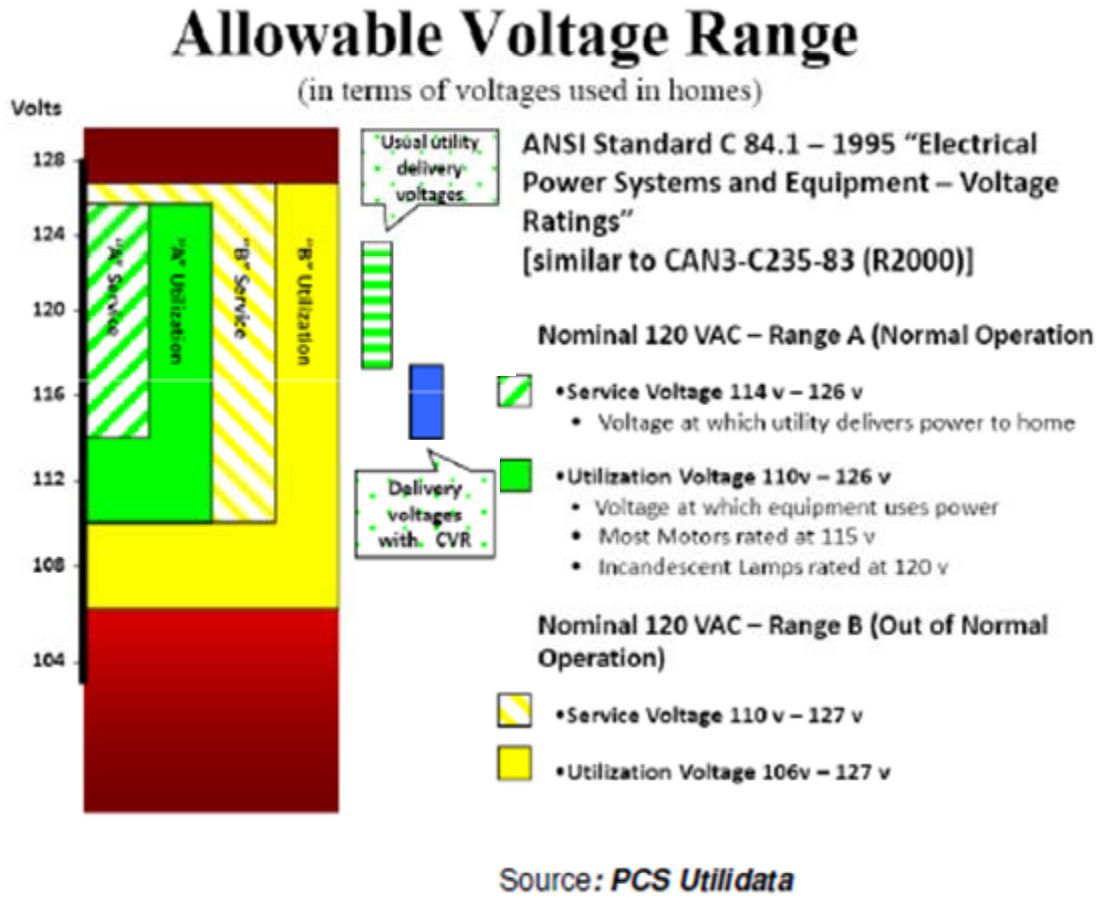
Concept of CVR

ANSI standards have some flexibility in the allowable delivery voltage

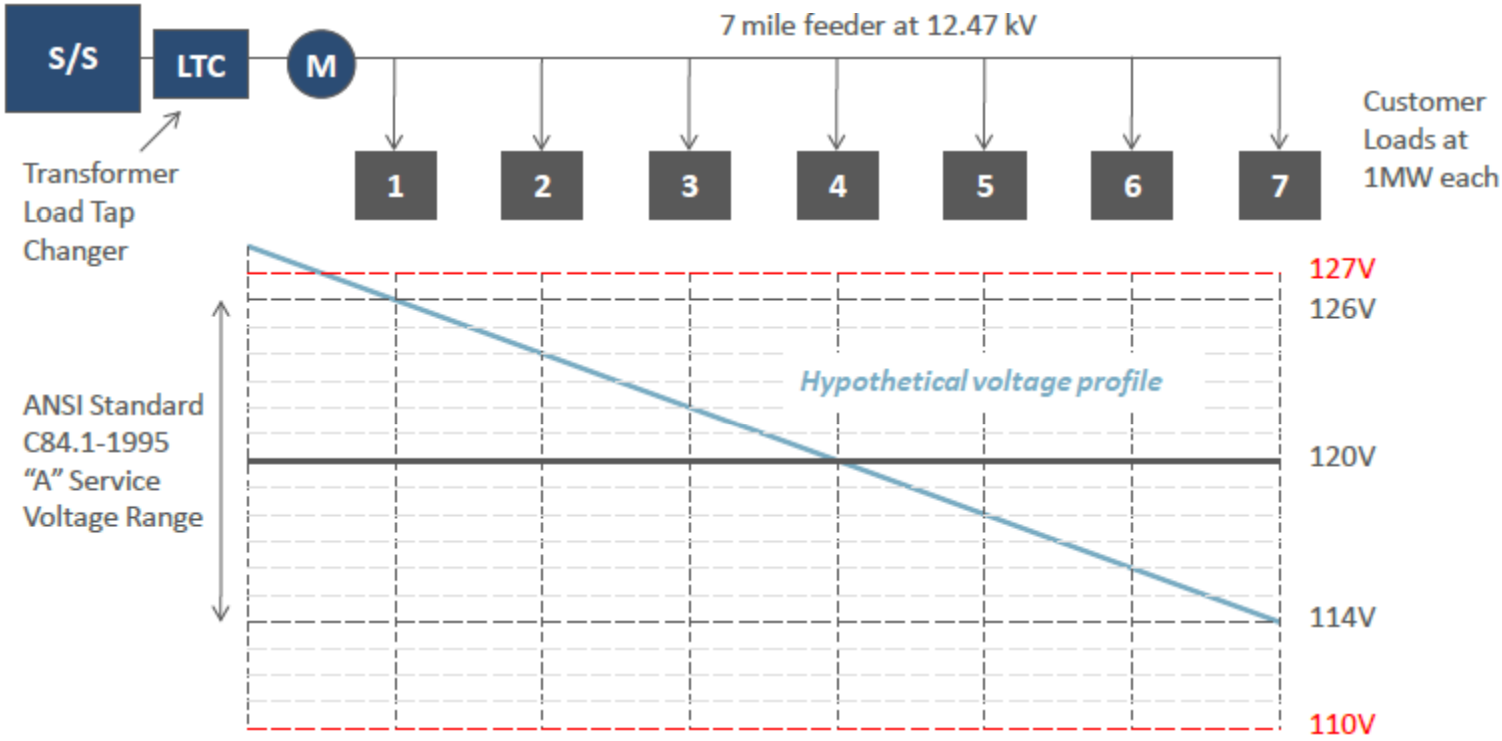
Utilities typically have delivery voltage in the upper portion of the range

Concept of CVR: Maintain voltage delivered to final customers in the lower portion of the acceptable range



CVR Implementation (1)

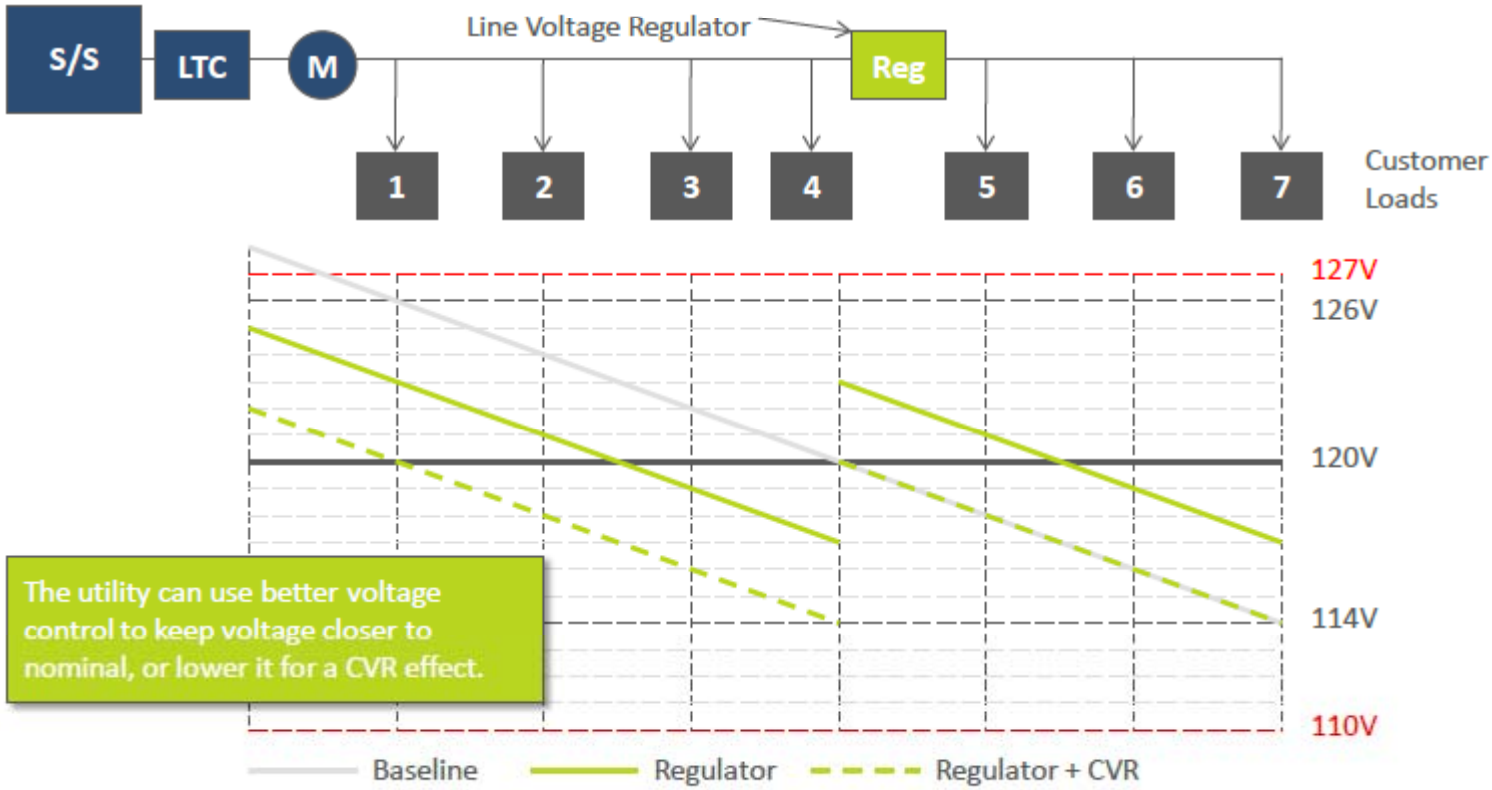
Line voltage drops from the LTC at the head of the distribution line to customers farther out on the line.



* Source: US Department of Energy

CVR Implementation (2)

A voltage regulator can boost (raise) or buck (lower) voltage at a point on the distribution line and regulate down-line voltage.



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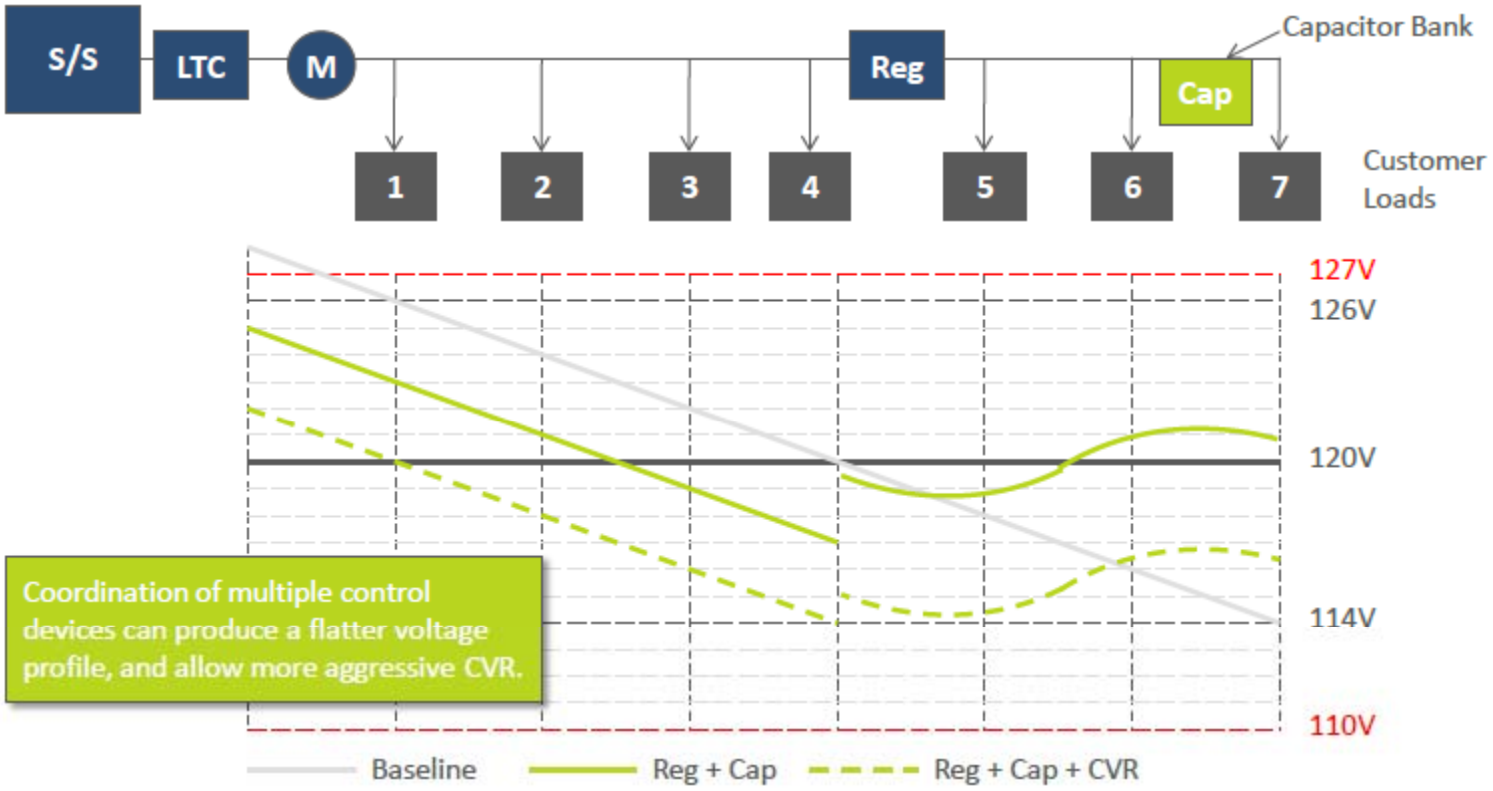
CVR Implementation (3)

A capacitor bank can help regulation by compensating for the lagging power factor of load and the line itself.



* Source: US Department of Energy

Benefits of CVR

- Energy Efficiency:
  - By reducing the voltage the power consumption is also reduced (many electrical devices operate more efficiently with reduced voltage)
- Peak Load Reduction:
  - Reduced voltage during peak demand enables reduced rates for purchasing bulk energy (energy costs are projected to increase)
- Reduced Losses:
  - Losses are a quadratic function of the voltage
- Reliability:
  - Avoids overload on critical circuits
- Defer generation:
  - Improves long term planning including environmental considerations (uncertainty of carbon reduction requirements)

Challenges of CVR

- Deployment:
  - What is the available experience ?
  - Where should I deploy CVR?
  - Which are the required upgrades?
- Available technology:
  - How to perform an effective technology integration?
  - How to cope with algorithm/analytics uncertainties?
- Quantification of benefits:
  - How much energy can I save?
  - How much loss mitigation does it do?

NEETRAC Baseline Project on CVR

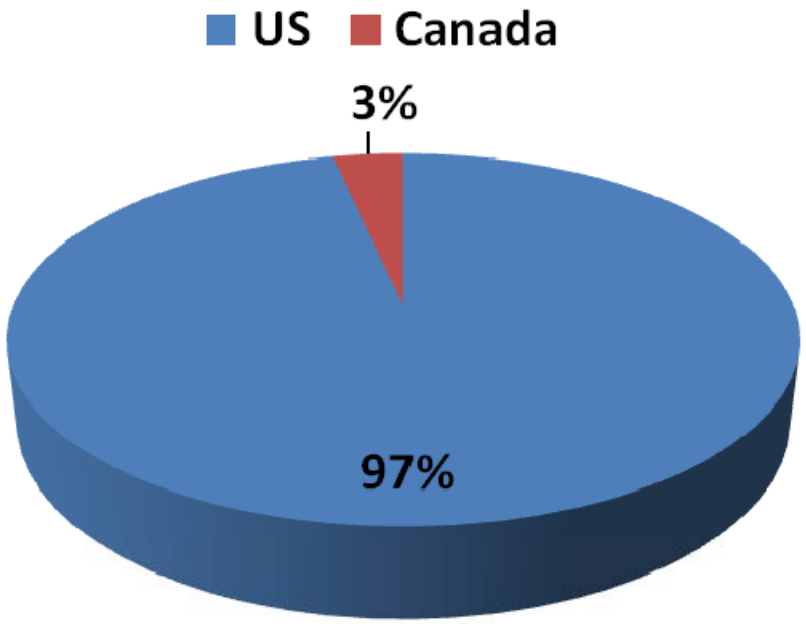
- Collaborative project among NEETRAC members and non-member including utilities and EPRI
- Intended to capture the current picture of the industry and to develop real time algorithms for CVR factor calculations

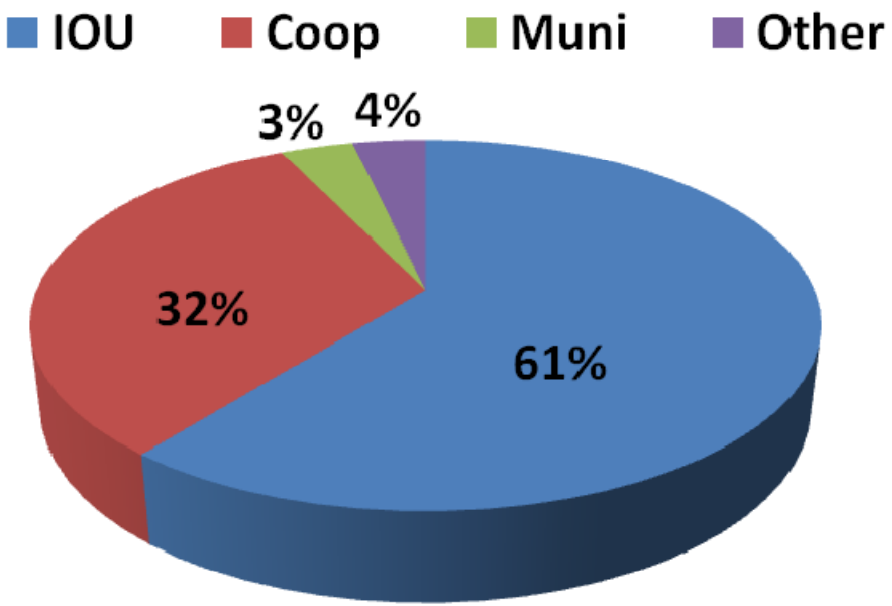
Current picture of the industry - methodology

- Survey utilities for general information and case studies
- One to one calls to learn details of the programs including:
  - History and drivers
  - CVR implementation
  - CVR data
  - Evaluation and program results

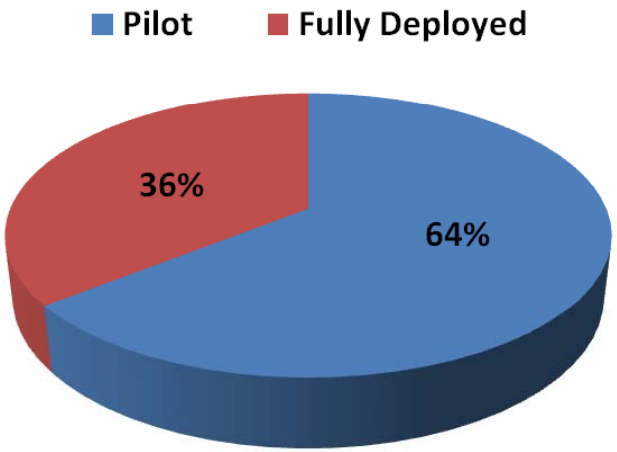
Survey Results -1

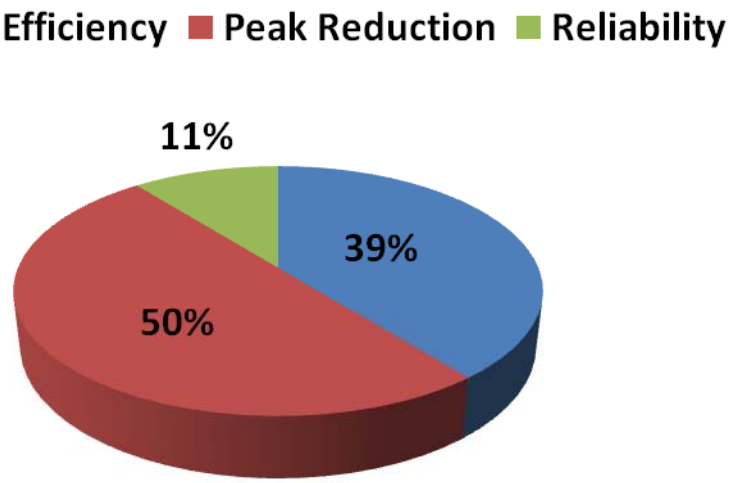
- Open survey to NEETRAC members and non-members
- Responses from 27 utilities/service territories

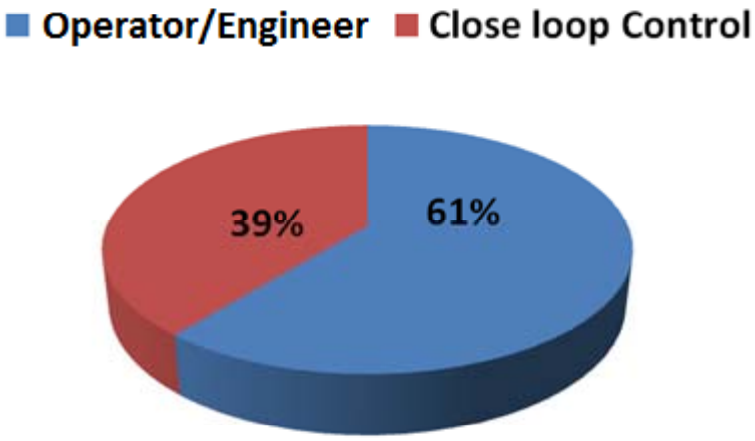


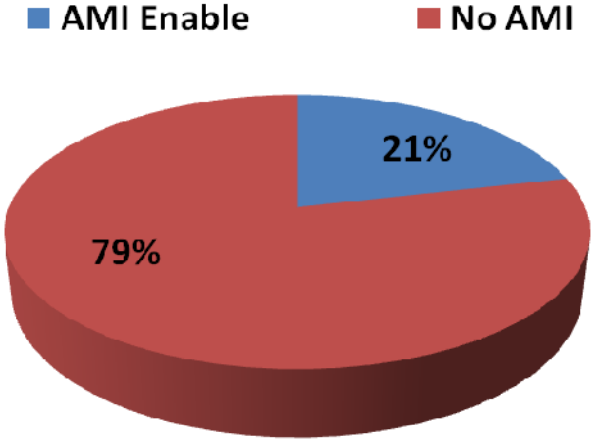


Survey Results -2









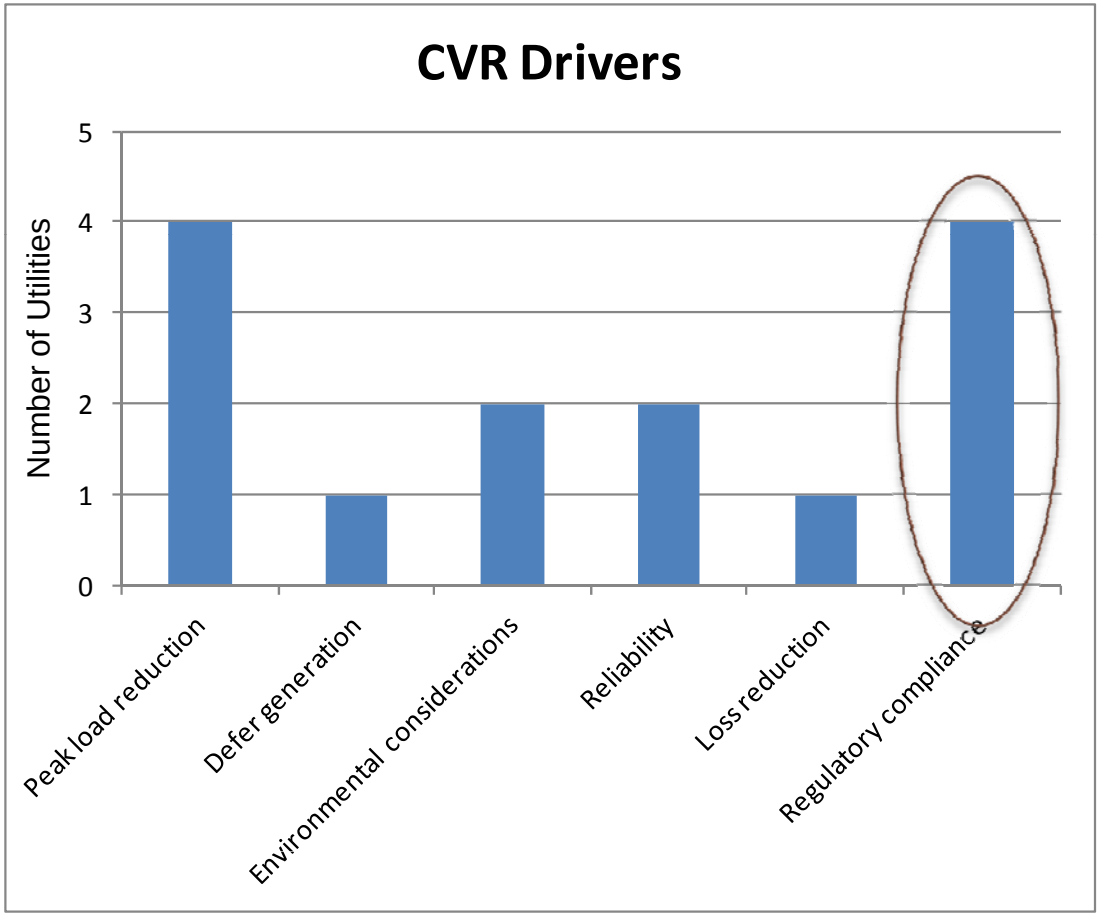
Detailed information – History and drivers

- Collated by having one to one calls with NEETRAC members

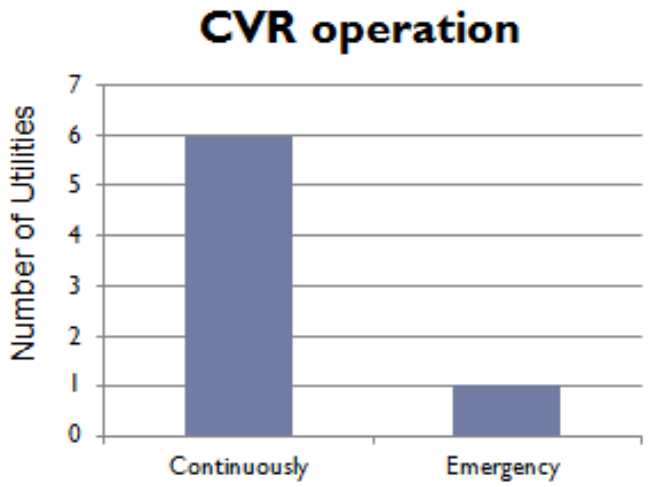
  - Calls: 7 members

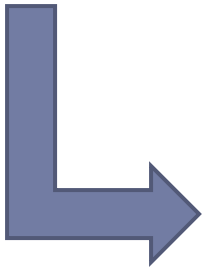
    (2 members with fully deployed programs and 5 members with experimental pilot programs)

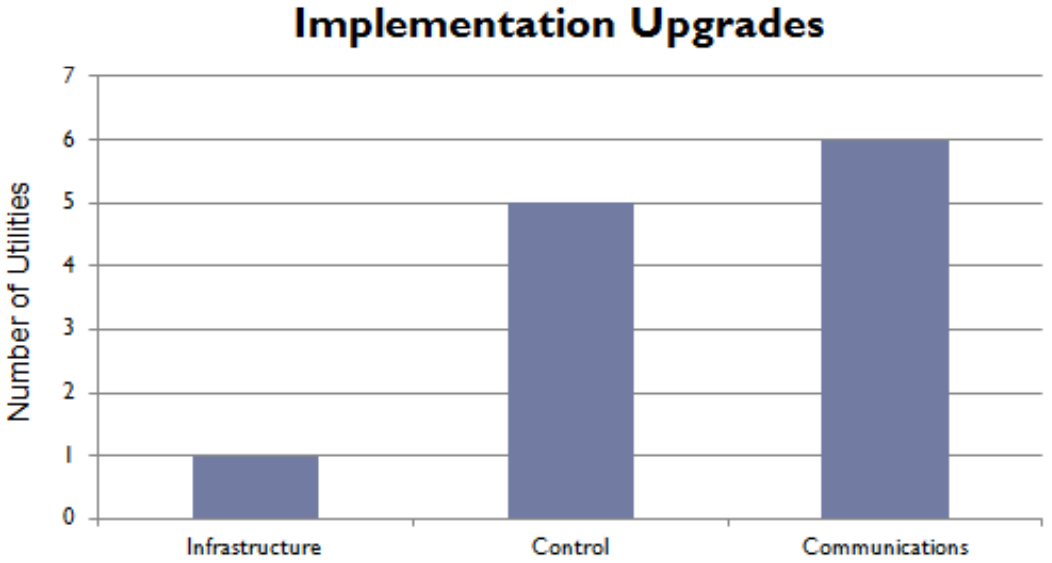
  - History: from recent pilots (still under development) to 25+ years of experience



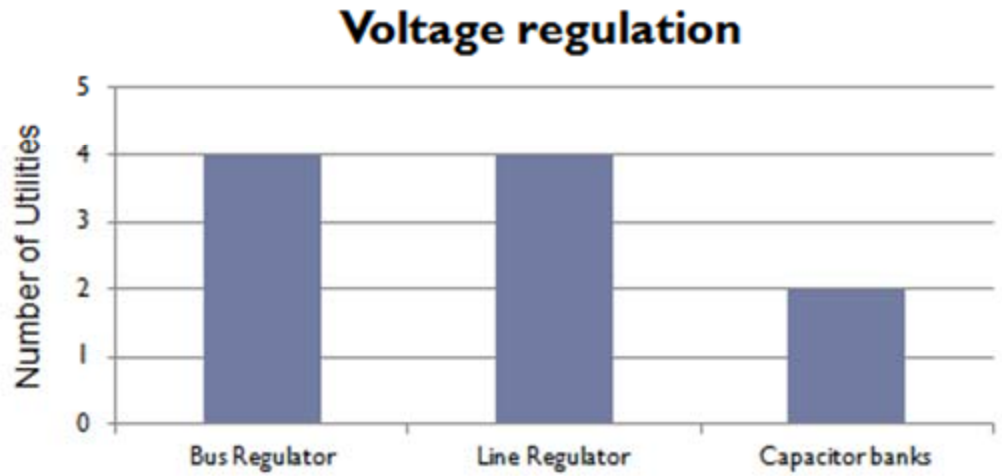
Detailed information – CVR Implementation

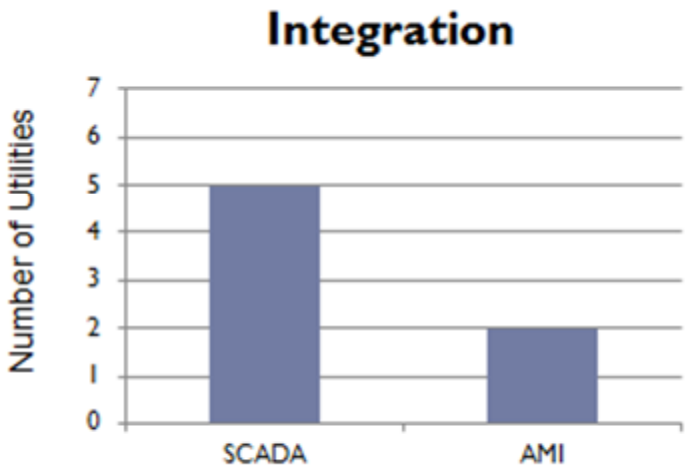


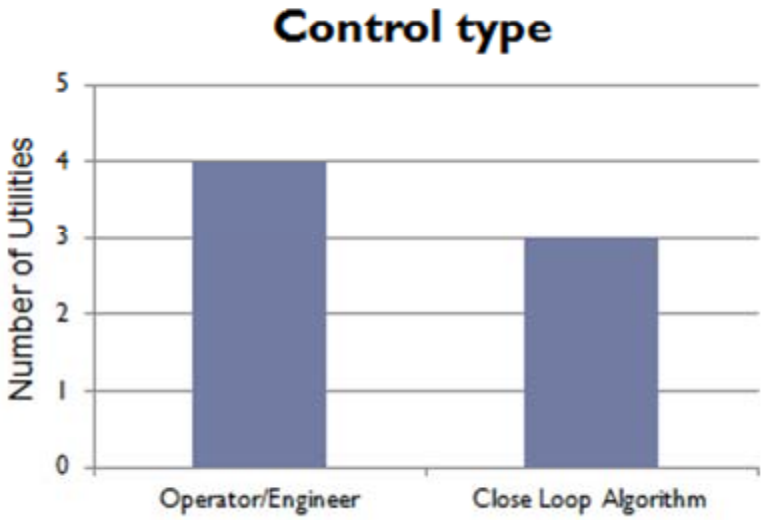




Detailed information – CVR Implementation







Detailed Information – CVR Data

- CVR Control Algorithms are "young":
  - More switching events of capacitors and regulators which need to be optimized
  - New technologies must be able to work with legacy and aging equipment (problem with equipment going back to default settings)
  - "Near Real Time Operation" for new technology requires highly stable and reliable communication

- AMI Integration:
  - Adding additional AMI meters can impact communications
  - Metering data could not be transferred in a timely manner due to protocol incompatibility

Detailed Information – Evaluation

- Customer perception:
  - No customer complaints
  - Only one case of adjustment for industrial load
- Extension of pilots to other substations:
  - Methodology for calculation of CVR factor and selection of feeders considering load profiles and seasonality
  - Consideration for system wide deployment depending on evaluation of current programs
- Evaluation of current programs:
  - Standard metrics for calculating benefits (need to include stochastic cost/benefit models)
  - Modeling short vs. long term benefits
  - Quantification of CVR effect (CVR factor) considering uncertainties (day on/day off vs. real time CVR)

More Interesting topics coming…

- CVR technology
- Real-world implementation at Palmetto Electric
- CVR Financial considerations