Major Findings from a DOE-Sponsored National Assessment of Conservation Voltage Reduction (CVR)

IEEE Volt-Var Task Force Panel Session
July 29, 2015

Ronald Willoughby
Willoughby Consulting on behalf of the
Applied Energy Group (AEG)
Project Objectives
Project Objectives

1. Assemble CVR knowledge base
2. Investigate CVR value proposition
3. Identify deployment barriers
4. Identify industry needs

Investigation 2013 – 2014
Report 2015
## 41 Projects Reviewed

### State # Projects

<table>
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<tr>
<th>State</th>
<th># Projects</th>
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<td>Alabama</td>
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<td>Connecticut</td>
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### Utility Type

<table>
<thead>
<tr>
<th>Utility Type</th>
<th>Pilots</th>
<th>System Deployment</th>
<th>Total CVR Projects</th>
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<tbody>
<tr>
<td>IOU</td>
<td>17</td>
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<td>Totals</td>
<td>26</td>
<td>15</td>
<td>41</td>
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</tbody>
</table>
CVR Market Taxonomy

Core CVR Components

Da

AMI

Software & Control

Communications

Devices

Commercial - Planning Tools - OPEN

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Project Organization
Project Team

- Department of Energy (DOE)
  - Joe Paladino - Sponsor
  - Rachna Handa - Project Manager
  - Steve Bossart - DOE/NETL Project Manager

- Booz Allen Hamilton (BAH)
  - Jesse Goellner - Program Manager

- Applied Energy Group (AEG)
  - Kelly Warner - Project Manager / Principal Investigator
  - Ron Willoughby - Deputy PM / Principal Investigator

- Power Grid Technology Consulting (PGTC)
  - Greg Reed - Technical Advisor
# Market Issues Group (MIG)

<table>
<thead>
<tr>
<th>Company</th>
<th>Name</th>
<th>Title</th>
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<tbody>
<tr>
<td>American Electric Power (AEP)</td>
<td>Tom Weaver</td>
<td>Mgr Dist System Planning</td>
</tr>
<tr>
<td>CRN/NRECA</td>
<td>Craig Miller</td>
<td>OMF Technical Lead</td>
</tr>
<tr>
<td></td>
<td>David Pinney</td>
<td></td>
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<tr>
<td>Duke Energy</td>
<td>Jay Oliver</td>
<td>Director Grid Automation</td>
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<tr>
<td>EPRI</td>
<td>Jeff Roark</td>
<td>Sr Project Mgr SG Economics</td>
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<tr>
<td>PNNL</td>
<td>Kevin Schneider</td>
<td>Sr Research Engineer</td>
</tr>
<tr>
<td>Sacramental Municipal District (SMUD)</td>
<td>Wayne Nakamoto</td>
<td>Distribution Planning Supv</td>
</tr>
</tbody>
</table>
Utility Participants

- Adams Columbia EMC
- Alabama Power Co
- Ameren - Illinois
- AEP - Ohio
- Avista Utilities
- BG&E
- BPA
- Central Hudson
- Central Lincoln PUD
- Clark County PUD
- Cowlitz County PUD
- Clinton Utilities Board
- ComEd
- Connecticut Lt & Pow
- Dickson Electric Sys
- Dominion Virginia Pow
- Duke Energy
- Fort Loudon EMC
- GPC
- Hydro Quebec
- Idaho Power Company
- Indianapolis P&L
- Inland P&L
- Iowa Lakes EMC
- Johnson City PUB
- Morristown Utility Systems
- NEEA
- OG&E
- Oneida-Madison EMC
- PacifiCorp
- Palmetto Electric Coop
- PECO
- Public Service Co of OK
- Ripley Power & Light
- SMUD
- Snohomish PUD
- West Penn Power
- Xcel Energy - PSCo
Data Collection
Data Collection Process

- Conduct Literature Search
- Categorize and Store Documents
- Populate CVR Data Sheets
- Request Missing Data from Individual Utilities
- Update CVR Data Sheets

Reference Library
- Business
- Regulatory
- Technology
- Operations
- Tools / Methods
- Case Studies
- Fundamentals/Standards

Excel Database
- Data Analysis
- Summary Tables / Figures

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Literature Search

581 References Cataloged (overlapping areas)

- 332 Business Model Information
- 115 Regulatory Support Materials
- 39 Regulatory Filings
- 181 Technology Application Information
- 124 Operating Models Information
- 117 Tools & Methods: Planning, M&V
- 120 Case Study Documentation
- 128 Fundamentals & Standards
Regulatory Filings - 19 States

1) Alabama
2) California
3) Colorado
4) Idaho
5) Illinois
6) Indiana
7) Louisiana
8) Maryland
9) Michigan
10) Missouri
11) North Carolina

12) Ohio
13) Oregon
14) Pennsylvania
15) South Carolina
16) Tennessee
17) Utah
18) Washington
19) Wyoming

**BOLD** = States where CVR counts as EE credit
CVR Project Database

Business Models
- Business Case Driver
- Key Risk Factors
- Benefit-Cost Metrics
- MWh/MW Savings
- Financial Metrics

Regulatory Strategy
- Lost Revenues
- Cost Recovery
- EE / Env Credits
- Enabling Regs / Laws

Technology Applications
- Voltage Regulation
- VAR Regulation
- Communications
- Control Type/Points
- Control System/Tech

Operating Models
- Operational Driver
- Static vs Dynamic
- CVR Factors
- Operational Issues
- Future Plans

Tools / Methods
- Planning Methods
- Planning Tools
- B-C for Methods
- B-C for Tools
- M&V Protocols

Case Studies & Open Format Data
- Capital and O&M Considerations
- B-C Templates
- ROI Targets
- Business Plans
- Smart Grid Plans
- Internal decision processes and key approval hurdles
- Regulatory Submittals
- Legislation
- EE Laws/Regulations
- Key regulatory hurdles
- Vendor / Technology Profiles
- F/F/B
- Application Guidelines
- Strengths and Weaknesses
- Market Surveys
- Research Projects
- Unit Costs
- Scalability
- Technology Risk
- Lessons Learned
- Staffing Impacts
- Operational Impacts
- O&M costs
- Equipment impacts
- Mid-course corrections
- Pilot –to –full scale deployment issues
- Future Directions
- CVR Factors
- Centralized/Decentralized
- Planning
- Screening
- Guidelines
- M&V Studies
- Model Development
- Data Management
- Performance Prediction
- Technology Application Guidelines

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Major Findings
Major Findings

1. Technology advancements enable greater savings without compromising PQ/Reliability

2. Deployments yield verifiable energy savings/peak reductions; however, cost-effectiveness thresholds still under development

3. Most states do not count CVR as qualified Energy Efficiency resource

4. Regulatory hurdles impede CVR adoption

5. Market barriers impede CVR deployment

6. Standardization needed for Planning and M&V

7. Industry focus group needed
Finding 1 – Advancements in CVR technologies enabling greater savings without compromising power quality or reliability.

- Observations
  - Manufacturers are building CVR/VVO functionality into core technology offerings
  - Included are innovative monitoring, control and analytic systems
  - Use of AMI data enables more precise voltage regulation.

- Recommendations
  - Technologies need to be evaluated, compared, and shared throughout the industry.
Finding 2 – CVR value proposition strong. There are many examples of project yielding 2% savings or more per feeder at cost below other supply and demand-side options.

• Observations
  – Many projects achieving energy savings and demand reductions of 2.0%.
  – Costs typically $0.03/kWh (or lower) on LCOE basis.
  – Many projects still in pilot/demonstration phase leading to shortage of full-scale deployment costs.

• Recommendations
  – CVR costs/benefits need to be captured/shared.
  – More data is needed on incremental costs/benefits.
  – Standards need to be developed to facilitate utility-to-utility results comparison.
Average Reductions

- 1.9% for Energy (kWh)
- 2.5% for Demand (kW)
Potential Savings and Costs

- Low-cost VO/CVR options exist.
- However, larger VO/CVR deployments offer significant savings at reasonable costs.
- Important regulatory considerations: 1) Cream-skimming. 2) Lost opportunities.

Comparison of Levelized Cost of Energy (LCOE) Conventional and Alternative Sources

Source: Adapted from Lazard. Levelized Cost of Energy Analysis – Version 8.0, September 2014. CVR costs: AEG analysis.
Finding 3 – Most States do not count CVR as qualified Energy Efficiency (EE) resource.

• Observations
  – Among the states who include CVR as EE portfolio option are OH, MD, WA, OR, NC, and PA. Under consideration are CO, CA, and IL.
  – NARUC’s 2012 resolution supporting CVR/VVO as an EE resource has been helpful, but no new States have incorporated CVR into their EE portfolios since the resolution was passed.

• Recommendations
  – Organizations like NARUC and ACEE can be a catalyst for educating regulators, policy makers, and EE stakeholders on the issues and benefits of CVR as EE option.
Finding 4 – Regulatory hurdles impeding adoption.

• Observations
  – CVR regulations are developed in ad hoc manner as part of utility-specific filing / rate case.
  – Lost margins, uncertain cost-recovery, and lack of incentives dilute CVR business case.
  – Lack of information permeates regulatory agencies.

• Recommendations
  – Promoting CVR regulatory constructs similar to what occurred in the EE industry would facilitate CVR adoption.
  – Including CVR into existing EE regulatory structures would provide an efficient mechanism for addressing CVR regulatory issues.
Finding 5 – Market Barriers must be addressed before CVR can reach full potential.

• Observations
  – Key market barriers include:
    • New technology and vendor risk
    • Resistance to change engineering/operating practices
    • Utility organizational silos
    • Competing investment priorities

• Recommendations
  – CVR performance data would help reduce utility adoption concerns.
  – Public policy and leadership needed to overcome market barriers.
Finding 6 – Planning methods and standardized M&V protocols needed.

• Observations
  – Recognized standards do not yet exist for developing CVR resource plans and measuring CVR impacts.
  – Research on M&V methods was one of the most requested topics.

• Recommendations
  – DOE, IEEE, EPRI, NEETRAC and other industry organizations can play vital role in helping develop/promote reliable planning/evaluation tools/protocols.
Finding 7 – An industry CVR focus group needed.

• Observations
  – There are vast amounts of continually changing and growing information.
  – New technologies, applications, lessons-learned from pilot installations, and financial support materials are difficult to track and understand.

• Recommendations
  – Form a self-sustaining and on-going industry focus group composed of utilities, vendors, industry groups, and universities.
  – Consider the GridWise Alliance under the leadership of CEO Becky Harrison as the organizational platform for CIG.
Thank You

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Applied Energy Group (AEG)

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