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Conservation Voltage Reduction potential in California

Varentec commends the CEC for producing this rigorous IEPR report and for conducting a robust stakeholder engagement process along the way. We appreciate this opportunity to share our comments.

We are pleased to see that Conservation Voltage Reduction (CVR) finally has been included in the AAEE scenarios. We recommend that the CEC take note that CVR uniquely and equitably benefits ALL customers served by CVR-upgraded circuits, regardless of language, education, income, ethnicity, and homeownership status. As a grid-side resource, CVR complements, rather than displaces, conventional demand-side energy efficiency without requiring customer engagement, behavioral change, or end-user investment.

Varentec is concerned that the top-down assessment of potential described in the SB350 Doubling Energy Savings by 2030 By 2030 Methodology Report (19-IEPR-06, TN#229992) is limited to using outdated results from old pilot projects and studies from within California alone. We encourage the CEC to consider using A) more updated information about CVR from projects beyond California and/or B) a bottom-up approach built upon actual voltage data obtained from CA smart meters to more accurately estimate the potential of CVR to contribute to SB350's goal of doubling efficiency by 2030. As described on page 116 of the Methodology report, the CEC could obtain this AMI voltage data under Title 20 authority.

Furthermore, we feel that the three implementation scenarios used in the Methodology report to forecast CVR adoption - "reference" 3%, "conservative" 5%, & "aggressive" 8% of estimated total potential - are overly conservative. Unlike demand-side efficiency, CVR requires no customer engagement, behavioral change, investment, action, or other efforts that typically limits DSM. Accordingly, we propose that more realistic adoption scenarios for CVR reflect the circuit-level nature of CVR deployment. Independent analysis from Navigant Research (attached) has estimated that 60% of circuits in CA could be cost-effectively upgraded with traditional primary-voltage CVR. This figure rises to 80% with the addition of modern secondary-voltage CVR. We recommend that the CVR adoption scenarios be "reference" 40%, "conservative" 60%, and "aggressive" 80%.

For the CEC's reference, we have attached an analysis of CA CVR potential by Navigant Research. We appreciate the agency's consideration of our comments and concerns.

Additional submitted attachment is included below.

Executive Summary

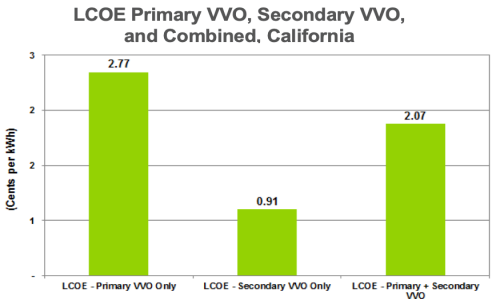
California VVO/CVR Potential Study

This 2018 Navigant Research analysis examined the potential for Volt-VAr Optimization (VVO) to contribute to California's energy savings goals by delivering Conservation Voltage Reduction (CVR). VVO/CVR is a supply-side approach that reduces service voltage at customer meter to save energy usage and reduce demand. Navigant's key findings show that VVO-CVR is:

- **Affordable**: VVO/CVR saves energy for less than 3 cents/kWh and as little as <1 cent/kWh
- **Cost-Effective**: VVO/CVR benefits exceed costs by at least 1.35X and by as much as over 4X
- **Equitable**: At least 60% and as much as 80%+ of CA's circuits are eligible for VVO/CVR upgrades
- **Sizable**: VVO/CVR could achieve 30%+ of CA's SB-350 goal of doubling energy efficiency by 2030

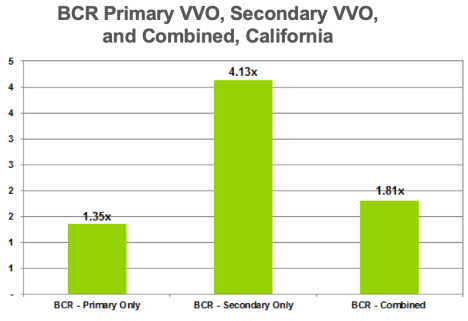
CVR has been used in the field for decades and is widely recognized as one of the most affordable and cost-effective approaches to reducing electric consumption and demand. CVR is specifically identified in CA SB350 as an eligible resource to achieve energy savings. Traditional CVR is accomplished through VVO controls at the medium-voltage level, referred to here as "Primary VVO". More modern Grid Edge Control technologies complement traditional CVR by enabling dynamic voltage control at the low-voltage level. This advanced approach is referred to here as "Secondary VVO".

FIGURE 1. PRICE PER KWH SAVED



Navigant's analysis shows that Primary VVO can deliver energy savings at a Levelized Cost of Electricity (LCOE) of 2.77 cents/kWh saved (Figure 1). Secondary VVO offers a lower standalone LCOE of 0.91 cents/kWh saved, and they together reach 2.07 cents/kWh saved.

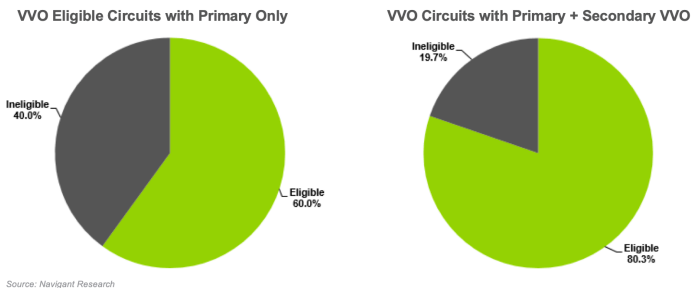
FIGURE 2. BENEFIT-COST RATIO (BCR)



Navigant concludes that VVO/CVR's low cost and high performance enables it to deliver energy savings benefits that exceed costs by a factor between 1.35 (Primary VVO) and 4.13X (Secondary VVO). When deployed together, benefits exceed costs by 1.81X.

This study calculates that the number of VVO/CVR-eligible circuits across CA utilities ranges is 60% for Primary VVO but rises to over 80% with the addition of Secondary VVO (Figure 3). Navigant estimates that VVO/CVR could achieve as much as 31.5% of the utility energy savings necessary for utilities to meet CA SB350's goal of doubling energy efficiency by 2030.

FIGURE 3. VVO/CVR-ELIGIBLE CIRCUITS



VOLT/VAR OPTIMIZATION AND CONSERVATION VOLTAGE REDUCTION: MARKET POTENTIAL ASSESSMENT & ECONOMIC METRICS

STATE OF CALIFORNIA

June 18, 2018

varentec

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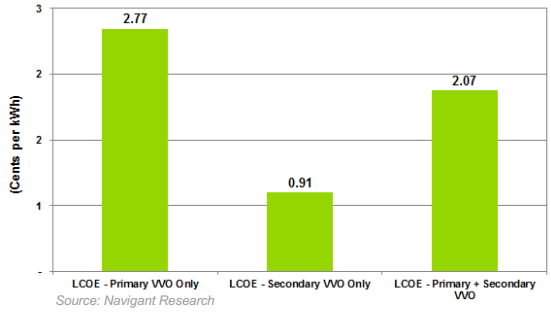
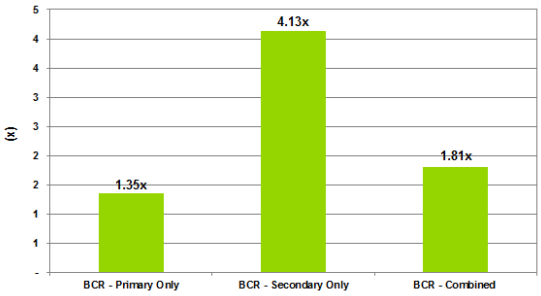
CALIFORNIA:
TRC BCR AND LCOE MODEL RESULTS

- The LCOE of energy saved via Secondary volt-VAR optimization (VVO) technologies is just **0.91 cents/kWh**, vs. 2.77 cents/kWh for Primary VVO only deployments. The addition of Secondary VVO reduces overall LCOE to 2.07 cents/kWh.
- Assuming a 1.35x total resource cost (TRC) benefit cost ratio (BCR) for Primary VVO deployments, the implied **BCR for Secondary VVO exceeds 4x** and raises the overall BCR for combined deployments to 1.8x.
- *Key Assumptions: 60% of total circuits eligible, accounting for 65% of load; 3.0% average voltage reduction with Primary VVO and 1.8% with Secondary VVO, CVR factor 0.70. 100% of Primary VVO circuits deploy Secondary VVO.*

LCOE Primary VVO, Secondary VVO, and Combined, California



BCR Primary VVO, Secondary VVO, and Combined, California



Source: Navigant Research

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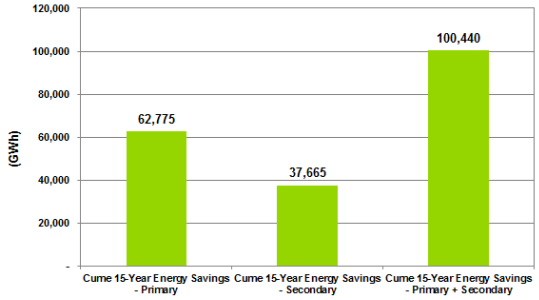
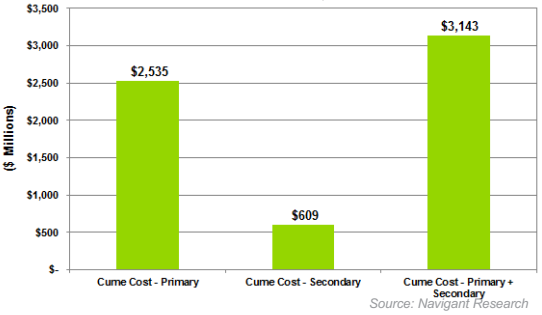
CALIFORNIA:
TOTAL POTENTIAL ENERGY SAVINGS AND COSTS WITH VVO

- Deployment of Primary VVO to all eligible circuits (60% of total) would save 62.8 TWh of energy over 15 years, at a cost of $2.5 billion.
- The addition of Secondary VVO to all eligible circuits saves an additional 37.7 TWh of energy over 15 years, with an incremental cost of $609 million.
- Combined, California could **cut energy consumption by 100.4 TWh over 15 years**, for ~$3.1 billion. This is based on projected load for 2032. *This is the equivalent of 94 million tons of coal generation.*
- *The **average annual potential energy savings of 6.3 TWh** is more than one-fourth of California's new SB-350 2x Energy Efficiency target savings of **27.6 TWh by 2030 for IOUs and public utilities**. (The total new EE target is 82.9 TWh)*

Cume 15-Year Energy Savings with Primary VVO, Secondary VVO and Combined, California



Cume 15-Year Costs for Primary VVO, Secondary VVO and Combined, California



Source: Navigant Research

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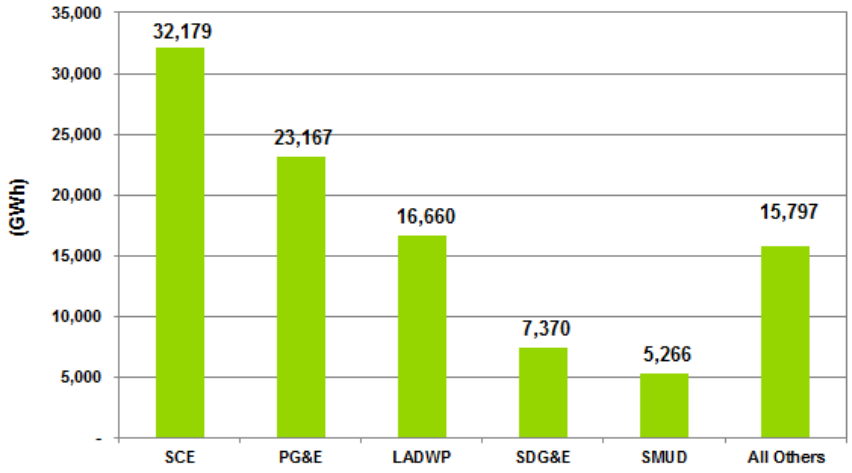
CALIFORNIA:
POTENTIAL ENERGY SAVINGS BY MAJOR UTILITY

Cumulative 15-Year Energy Savings by Major Utility, Primary + Secondary VVO, California



Source: Navigant Research

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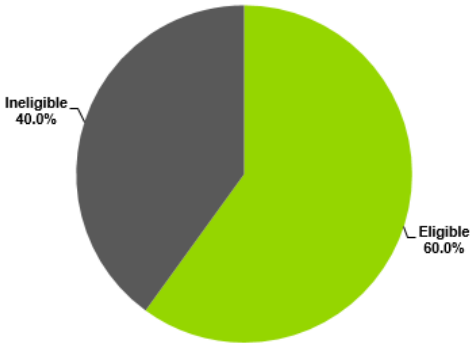
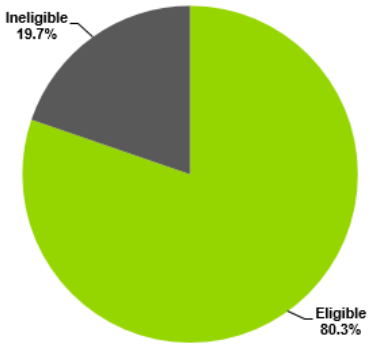
CALIFORNIA:
SECONDARY VVO RAISES THE NUMBER OF ELIGIBLE CIRCUITS

- The addition of Secondary VVO increased the BCR by 38% versus Primary only (1.81/1.35).
- In California, this means an additional ~3,100 circuits are eligible, or 20.3%.
- *The potential energy savings under this expanded deployment scenario would be another 36.3 TWh over 15 years, or 2.4 TWh per year on average. If all eligible circuits were built out under this expanded scenario, VVO (Primary + Secondary) could save ~8.7 TWh per year, or 31.5% of the 2x Energy Efficiency target savings of 27.6 TWh for IOUs and public utilities.*

VVO Eligible Circuits with Primary Only



VVO Circuits with Primary + Secondary VVO



Source: Navigant Research

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CALIFORNIA:
CIRCUITS BY UTILITY

- The **top five utilities** in California account for >84% of distribution circuits in the state.

Utility Name	Distribution Circuits	Percent of Total
Southern California Edison	**4,510**	**32.0%**
Pacific Gas & Electric	**3,247**	**23.1%**
Los Angeles Department of Water & Power	**2,335**	**16.6%**
San Diego Gas & Electric	**1,033**	**7.3%**
Sacramento Municipal Utility District	**738**	**5.2%**
Imperial Irrigation District	320	2.3%
Modesto Irrigation District	173	1.2%
City of Santa Clara, California	168	1.2%
City of Riverside, California	129	0.9%
City of Pasadena, California	126	0.9%
City of Burbank Water and Power	116	0.8%
Turlock Irrigation District	110	0.8%
City of Anaheim, California	109	0.8%
City of Glendale, California	108	0.8%
City of Roseville, California	100	0.7%
All Others	755	5.4%
Total California	**14,077**	**100.0%**

Source: EIA, December 2016 data.

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CALIFORNIA:
CIRCUIT PENETRATION OF VOLTAGE OPTIMIZATION

- Upwards of 30% of California's distribution circuits have some level of voltage optimization technology installed today.
- Many of these are traditional hardware-based solutions.
- *Known/believed software-based solutions are in **bold**.*

Utility Name	Distribution Circuits	Circuits with Voltage Optimization	Penetration
City of Anaheim, California	109	109	100.0%
City of Healdsburg, California	4	4	100.0%
City of Lodi, California	29	29	100.0%
Merced Irrigation District	19	19	100.0%
City of Riverside, California	129	129	100.0%
Truckee Donner P U D	17	17	100.0%
City of Alameda	26	24	92.3%
Lassen Municipal Utility District	18	16	88.9%
City of Shasta Lake, California	8	6	75.0%
Los Angeles Department of Water & Power	2,335	1,693	72.5%
City of Lompoc, California	10	7	70.0%
San Diego Gas & Electric	1,033	605	58.6%
City of Banning, California	21	11	52.4%
Southern California Edison	**4,510**	**899***	19.9%
Sacramento Municipal Utility District	**738**	**118**	**16.0%**
City of Glendale, California	**108**	**13**	**12.0%**
Modesto Irrigation District	**173**	**11**	**6.4%**
Plumas-Sierra Rural Elec Coop	29	1	3.4%
Pacific Gas & Electric	**3,247**	**14**	**0.4%**
All Others	1,514	0	0.0%
Total California	**14,077**	**3,725**	**26.5%**

**SCE's VVO deployment covers a subset of these circuits.*

Source: EIA, December 2016 data.

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CALIFORNIA: KEY UTILITY VVO PROGRAMS

- PG&E intends to extend its conservation voltage reduction (CVR) trial to 510 circuits—out of 3,250 (16%).
  - The utility believes smart solar inverters and smart meters will provide adequate support for voltage optimization in a majority of circuits.
- SCE plans to deploy CVR, through its patented DVVC initiative, to a total of 313 substations by the end of 2018.
  - **This represents nearly half of SCE's 677 distribution substations.**
- SMUD is pursuing CVR and VVO for both peak demand reductions and electricity conservation.
  - Its project includes 109 feeders and uses 180 automated capacitor banks which cover about 18% of the system.
  - The CVR objective for peak demand reduction is 10.4 MW; the CVR objective for electricity conservation is 36,520 MWh per year of energy savings. The latter objective is achieved by implementing CVR over several additional hours during the days when the peak demand reduction capabilities have been activated.
  - The VVO objectives include peak demand reduction of 6.1 MW and energy savings of 11,150 MWh per year by improving the efficiency of the distribution feeders.
  - SMUD's method of implementing CVR is utilizing the voltage reduction feature of the LT control at the distribution substation. A command is issued to the LTC control by a distribution system operator via SMUD's energy management system, which implements one of three levels of voltage reduction available in the control. The percent reduction at each level is a configurable value which SMUD has initially set at 1%, 2%, and 3%, for evaluation purposes.
- Neither SDG&E nor Los Angeles Department of Water and Power have committed to significant VVO/CVR programs.

CALIFORNIA: FACTORS WHICH IMPACT VVO DEPLOYMENT

- In developing the market forecasts for California, for both Primary and Secondary VVO, Navigant Research reviewed utility data and filings, the outlook for solar installations and a variety of additional Secondary information.
- In addition to announced utility plans, Navigant Research considered the availability of:
  - **Smart Meters:** Penetration estimated at 83%
  - **Field Area Networks:** Widespread deployment of smart meters in California means that there are commonly field area networks in place to carry Primary/Secondary VVC data.
  - **Solar Penetration:** An estimated 328,000 solar installations could be found in California at the end of 2017, including 323,000 residential installations.
  - **Smart Solar Inverters:** Very low penetration today, but CA Rule 21 means that all new residential installations must employ a smart inverter. Navigant Research estimates that smart solar inverter penetration of solar installations will hit 28% by 2020.
  - **Connectivity at Distribution Substations:** D-Sub connectivity in California is estimated to be >50% (relatively high for the US).
  - **D-SCADA and Advanced Distribution Management Systems**

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