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# 2021 Indiana EECO Program EM&V Report

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## 1. Introduction

This report addresses the measuring, verifying and evaluating of energy savings and demand reductions that resulted from the implementation by Indiana Michigan Power Company (I&M) in 2021 of its Electric Energy Consumption Optimization (EECO) Program. I&M implemented this program in conjunction with Utilidata, Inc.

#### 1.1 Description of Program

Under ANSI Standard C84.1 Electric Power Systems and Equipment, a utility system is to deliver electricity to end-users at a voltage within the range of  $120 \pm 5\%$  volts (i.e., 114 - 126). With the usual system design, customers close to a substation receive voltages closer to 126 volts and customers farther from the substation receive lower voltages. Voltage regulating equipment is applied as necessary to ensure the required minimum voltages are provided.

The EECO program is based on implementing Conservation Voltage Reduction (CVR), which is a process by which the utility systematically reduces voltages in its distribution network, resulting in a proportional reduction of load on the network. Because most devices operated by electricity (especially motors) are designed to operate most efficiently at 115 volts, any "excess" voltage is typically wasted, usually in the form of heat. Tighter voltage regulation allows end-use devices to operate more efficiently without any action on the part of consumers. Consumers receive a lower but still acceptable voltage and use less energy to accomplish the same tasks.

Voltage is controlled for the circuits at the substations using Utilidata's AdaptiVolt Volt/VAR Optimization (VVO) platform. AdaptiVolt uses secure digital communications to implement a closed-loop control system. Using AdaptiVolt allows I&M to dispatch voltage-based demand control within seconds. The system measures end-of-line voltage and sends the voltage information back to the controller at the substation in real time.

Using the AdaptiVolt<sup>TM</sup> system, voltages were controlled for each of the three phases being distributed to the circuits served by the substation. Thus, the voltage for Phase A was the same for all three circuits, and similarly for Phases B and C.

#### 1.2 Impact Evaluation Findings

Table 1-1 below presents the total aggregated annual gross and net energy (kWh) savings achieved by the EECO Program during PY2021. Table 1-1 also provides an estimate of the annual net kWh savings that might have been achieved if VVO had been operated continuously during a full year.

		2 0	·	0		0	
Ex Ante Annual k Wh Savings	Gross Audited k Wh Savings	Gross Verified k Wh Savings	Ex Post Annual Gross k Wh Savings	Gross Realization Rate	Ex Post Annual Net k Wh Savings	Net-to- Gross Ratio	Counterfactual Estimated AnnualkWh Savings-100% CVR On Time
19,965,301	19,965,301	19,965,301	20,774,846	104%	20,774,846	100%	30,172,875

Table 1-1. Summary of Ex Post and Counterfactual PY2021 kWh Savings

Table 1-2 presents the total gross and net peak demand (kW) impacts achieved by the EECO Program during PY2021.

Table 1-2. Summary of Ex Post PY2021 kWPeak Demand Impacts

Ex Ante Gross kW Savings	Gross Audited kWSavings	Gross Verified kWSavings	Ex Post Gross kWSavings	Gross Realization Rate	Ex Post Net kWSavings	Net-to-Gross Ratio
1,792.44	1,792.44	1,792.44	1,365.10	76%	1,365.10	100%

#### 1.3 Organization of Report

This report is organized as follows:

- Chapter 2: Data Collection
- Chapter 3: Method for Determining Energy Savings
- Chapter 4: Daily Energy Savings and CVR Factors
- Chapter 5: Aggregate Energy Savings
- Chapter 6: Peak Reduction
- Appendix: Transition Tests

## 2. Data Collection

The effects of voltage optimization for 2021 were analyzed using data on voltage and power extracted from I&M's SCADA system.

I&M and Utilidata used an "on/off" procedure for voltage reductions during various parts of 2021.<sup>1</sup> This procedure provides data sets with measurements of voltages and energy use that include both regular voltages (measured on "Off" 'days) and reduced voltages (measured on "on" days).

Table 2-1 shows the number of "on" and "off" days during 2021 by station by season.

<sup>&</sup>lt;sup>1</sup> For discussion of "on / off" testing, see, for example, Pacific Northwest Regional Technical Forum, *Standard Protocol* #1 for Automated CVR, November 2011.

		_			
Station <sup>2</sup>	Heating	Season	Cooling	gSeason	Total Days
	VVO On	VVO Off	VVO On	VVO Off	Duys
Daleville	165	78	39	83	365
East Side - 4093121, 4093122, 4093123	207	36	57	65	365
East Side- 4093124, 4093125, and 4093126	185	58	85	37	365
Elcona	172	71	95	27	365
Farmland	194	49	53	69	365
Grabill	188	55	90	32	365
Hacienda - 4933521, 4933523, 4933524	138	105	91	31	365
Hacienda - 4933625, 4933626, 4933627	184	59	88	34	365
Harper	67	176	74	48	365
Lincoln	108	135	67	55	365
McKinley - 40559B123, 40559B124, 40559B125	168	75	45	77	365
McKinley - 40559B221, 40559B222, 40559B226	173	70	86	36	365
Northland - 4933421, 4933422, 4933423	178	65	54	68	365
Northland - 4933524, 4933525, 4933526	189	54	79	43	365
Osolo - 4058021, 4058022, 4058024	199	44	92	30	365
Osolo - 4059023, 4059025, 4059026	190	53	86	36	365
Pettit	208	35	84	38	365
South Bend	180	63	76	46	365
Southside	191	52	97	25	365
SouthsideSB	163	80	36	86	365
Spyrun	0	244	0	122	366
State Street	129	114	0	122	365

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During 2021, data were collected for regulated source voltages by phase and power by circuit. Voltage and power were measured at 30 second intervals, giving 120 data-points per hour for each element. Voltages were measured at the substation level for three phases.

 $<sup>^2</sup>$  Values in table are applicable to all circuits in a station except for McKinley, for which number of CVR days varied across circuits.

Hourly temperature readings were available from the quality controlled local climatological data program of the National Climatic Data Center<sup>3</sup> for 2021 for the Fort Wayne, Indiana airport. This temperature data was used for the analysis.

<sup>&</sup>lt;sup>3</sup> For information on the QCLCD data, see <u>http://www.ncdc.noaa.gov/data-access/land-based-station-data/land-based-datasets/quality-controlled-local-climatological-data-qclcd</u>

## 3. Method for Determining Energy Savings

This chapter discusses the method used for analysis of data to determine energy savings from voltage reduction.

#### 3.1 Protocols for CVR Analysis

Methods for using circuit-level data on voltages and power usage to measure and verify savings from voltage reductions are set out in several existing protocols. Because much of the early work on voltage reduction was performed in the Pacific Northwest, the Northwest Regional Technical Forum (RTF) managed a process to prepare a protocol for estimating savings from automated CVR. This protocol (Automated CVR Protocol No. 1) was approved by the RTF in 2004. The RTF approved a second protocol (Simplified Voltage Optimization Protocol) in 2010.

With the RTF protocols, savings resulting from voltage reduction are estimated by multiplying a change in voltage level by a CVR factor that reflects the estimated relationship between voltage reduction and energy reduction. For application of the protocols in the Pacific Northwest, load research data were used to develop a series of lookup tables with CVR values for participating utilities. However, these CVR values depend on load and weather conditions and end-use equipment saturations (e.g., air conditioning use) that are specific to the Pacific Northwest.

An enhanced version of the RTF protocols has been developed by a CVR working group in Pennsylvania. Using data collected for utility distribution circuits in Pennsylvania, the working group developed a Conservation Voltage Reduction (CVR) Custom Measurement Protocol for Demand Reduction. (Revised version was published September 21, 2011.)

#### 3.2 Method for Determining kWh Savings

As shown by Equation 3-1, the kWh savings that result from voltage reduction can be quantified as the difference between a baseline energy use (when voltage is not reduced) and actual energy use when voltage is reduced.

#### Equation 3-1

#### $kWh \ savings = kWh_{Baseline} - kWh_{Actual \ when \ VVO \ is \ "On"}$

The energy use when VVO is "on" can be measured. However, baseline energy use is essentially "counterfactual": what the energy use would have been during the given time period were VVO "off".

#### 3.2.1 Determining Baseline Voltages

Baseline voltages for hours when VVO was "on" were imputed using mean values of voltages when VVO was "off". These mean values were calculated for each circuit for cells defined by season (i.e., heating, cooling) and hour of day. For each hour that VVO was "on", the baseline

voltage was imputed to be the "off" voltage from the cell similarly defined by season and hour of day. For example, the baseline voltage for 1 PM during the heating season when VVO was "on" was imputed to be the mean voltage calculated from voltage readings for the 1 PM hour in the heating season when VVO was "off".

#### 3.2.2 Determining Baseline Power

Power for a circuit is not completely independent from voltage changes because not all loads react in the same way to a voltage change. Various studies have shown that the energy savings that result from voltage reduction depend on the characteristics and loads of a feeder.

- Some loads are characterized by constant impedance, where power consumed is proportional to voltage squared. Examples of such loads include resistive water heaters, stovetop and oven cooking loads, for instance.
- Other loads are constant power, where demand is constant regardless of voltage. Examples of constant power loads include electric motors and regulated power supplies.
- A relatively small percentage of loads are constant current, where demand is proportional to voltage. Examples of constant current loads include welding units, smelting, and electroplating processes.

The overall load on a feeder will be a mix of the different load types. Rules of thumb for the split between constant power and constant impedance loads are as follows<sup>4</sup>:

- For summer peak loads, 60% constant power and 40% constant impedance
- For winter peak loads, 40% constant power and 60% constant impedance
- For industrial loads, 80% constant power and 20% constant impedance
- For summer peaking residential loads, 70% constant power and 30% constant impedance
- For winter peaking residential loads, 30% constant power and 70% constant impedance
- For commercial loads, the split between constant power and constant impedance is generally 50%/50% or 60%/40%

Regression analysis was used to relate circuit power data to month of year, EECO operating state and weather. The regression model used is given in Equation 3-2 below.

#### Equation 3-2

$$Power_{i} = \alpha + \beta_{l,j}CVR_{j} + \beta_{2}CDD_{i} + \beta_{3}HDD_{i} + \beta_{4}Hour_{i} + \beta_{5}Day_{Type_{i}} + e_{i}$$

Key model variables are identified in Table 3-1.

<sup>&</sup>lt;sup>4</sup> Willis, H. Lee, *Power Distribution Planning Reference Book*.

Variable Name	Variable Description
Power	Dependent variable; hourly power (kW).
CVR	1 if EECO is on; otherwise 0.
CDD	MAX (Outdoor Temperature - 65°F, 0)
HDD	MAX (65°F - Outdoor Temperature, 0)
Hour	Group of dummy variables for hour of the day.
Day_Type	1 if weekday; otherwise 0.

Table 3-1	Analysis	Model	Variables	
<i>i ubie 5-i</i> .	Analysis	mouei	variables	

Correlations of power data with temperatures on a month-by-month basis showed positive correlations for six months (i.e., May through October) and negative correlations for the other six (i.e., January through April, November, December). Based on the evidence from the heating and cooling degree day data and the power-temperature correlations, two seasons were defined for the analysis. The heating season includes the months of January through May and October through December. The cooling season includes the months of June through September.

For each circuit, regression models using the specification in Equation 3-2 were estimated. Separate models were estimated for two seasons (heating and cooling). Regression models were performed using a randomly selected subset of data meeting the requirement of balance between weekday and weekend observations and minimizing weather differences between "on" and "off" observations.

The value for  $\beta_1$  estimated through the regression analysis shows how power on a circuit changes in response to EECO being operated, controlling for month of year, weather, day type, and hour of day.

#### 3.2.3 Determining Energy Savings

The results from studies of voltage reduction are often summarized in terms of a conservation voltage reduction factor ( $CVF_f$ ). A  $CVR_f$  measures the relationship between changes in energy in response to changes in voltage effected under the CVR program. Mathematically,  $CVR_f$  is calculated as the ratio between the percentage change in energy and the percentage change in voltage, as shown below in Equation 3-3.

Equation 3-3

$$\textit{CVR}_f = \frac{\% \Delta \, \textit{in energy}}{\% \Delta \, \textit{in voltage}}$$

where  $\&\Delta in \, energy = \Delta kWh/kWh_{Base}$  and  $\&\Delta in \, voltage = \Delta Volts/Volts_{Base}$ .  $\Delta kWh$  is kWh savings and  $\Delta Volts$  is the voltage reduction.

#### 3.3 Method to Calculate Aggregate Annual kWh Savings

The method described in section 3.2 provides hourly circuit/phase/season-level estimates of the average daily kWh savings that result from VVO voltage reduction. Multiplying that daily estimate of savings by the number of days voltage was reduced during the season provides an aggregate estimate of kWh savings. These savings are those that occurred on the days when VVO was "on". As shown in Table 2-1, VVO was not "on" during all hours of the year. An additional calculation is therefore made to determine what kWh savings would have been had VVO been "on" for all days during the program year. This calculation is made by multiplying the daily circuit/phase/season-level estimates by the total number of those days in the season and then summing these kWh savings across seasons.

Discussion regarding an alternative analytical approach is presented in an appendix on page 70.

## 4. Daily Energy Savings and CVR Factors

This chapter presents and discusses the results from the analysis of data for the Indiana EECO program in 2021 to determine kWh savings and CVR factors associated with voltage reduction for the various circuits and phases.

For each circuit, kWh savings and CVR factors were calculated for each hour-of-the-day for weekdays and for weekend days for both heating and cooling seasons. For each of the two voltage conditions (i.e., VVO "on" or "off"), the 24 hour-of-the-day power demand values were aggregated to give daily totals for power usage. The percentage savings from reducing voltage was calculated and divided by the percentage reduction in voltage to provide the estimate of the daily CVR factor for a day. The resulting estimates of daily kWh savings and CVR factors for the various phases of the circuits and phases of the substation are reported in Table 4-1 through Table 4-62. The resulting estimates of daily kWh savings and CVR factors for the various circuits / phases of the stations are reported in this section.

The estimated CVR factors show a range of values, which is consistent with evidence from previous studies of the voltage reduction strategy.

Results reported from previous studies show the range of CVR factors that have been estimated.

- Kirshner and Giorsetto<sup>5</sup> analyzed trials of voltage reduction at several utilities in the early 1980s. Their analysis showed that most test circuits had energy savings of between 0.5 and 1% for each 1% voltage reduction, implying CVR factors of 0.5 to 1. Their regression analysis showed that each 1% reduction in voltage resulted in energy savings of 0.76% for residential loads, of 0.99% for commercial loads, and of 0.41% for industrial loads.
- More recently, a study conducted for the Northwest Energy Efficiency Alliance (NEEA) evaluated voltage reduction at several utilities in the Pacific Northwest.<sup>6</sup> Evaluation of voltage changes at the circuit level, using temperature adjusted regressions, gave an average CVR factor of 0.69 based on a voltage change of 2.5%. The range of CVR factors was -0.11 to 1.98.
- In EPRI's Green Circuits collaborative project<sup>7</sup>, 42 distribution circuits across different utilities were modeled in detail using an open-source distribution system electrical simulation package (OpenDSS). This modeling was augmented with historical circuit-measurement data, allowing the hourly resolution simulation of circuit operation for actual load patterns for each hour in a calendar year (8760 hours). As part of the study, the effects of voltage reduction were modeled using a consistent approach to control an end-of-line primary bus of 118 V. The results showed a median reduction in energy consumption across all circuits of 2%, with upper and lower quartiles of 1.3% and 2.8%.

<sup>&</sup>lt;sup>5</sup> Kirshner, D. and Giorsetto, P., "Statistical Tests of Energy Savings Due to Voltage Reduction," IEEE Transactions on Power Apparatus and Systems, vol. PAS-103, no. 6, pp. 1205-10, June 1984.

<sup>&</sup>lt;sup>6</sup> NEEA 1207, Distribution Efficiency Initiative, Northwest Energy Efficiency Alliance, 2007.

<sup>&</sup>lt;sup>7</sup> Electric Power Research Institute (EPRI), *Green Circuit: Distribution Efficiency Case Studies*, Technical Report, 2011.

- In the study that was sponsored by the Northwest Energy Efficiency Alliance (NEEA), it was found that there are differences between seasons in the effectiveness of voltage reduction. The study determined that the CVR factor at the feeder level was 0.74 for the summer and 0.66 for the winter. At the customer level, the CVR factor was 0.78 for the summer and 0.51 for the winter.
- As part of the EPRI Green Circuit project, extensive field testing was conducted for nine distribution circuits in the southeast United States. The analysis in this study showed that most energy savings from voltage reduction were achieved from summer-peaking residential customers, while winter heating loads showed the least energy savings. The estimated CVR factors were 0.77 for the summer and 0.33 for the winter.

Table 4-1 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: DalevilleCircuit 4927921

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	125.19	121.68	135	29,954	0.45%	0.16
Heating	В	126.11	122.55	394	24,832	1.56%	0.55
Treating	С	125.93	122.47	802	29,638	2.63%	0.96
	Total/Average	125.91	122.41	1,332	84,424	1.55%	0.56
	А	125.21	121.41	(568)	27,665	-2.10%	-0.69
Cooling	В	125.91	122.03	(292)	25,296	-1.17%	-0.38
Cooling	С	125.85	122.00	155	27,728	0.56%	0.18
	Total/Average	125.36	121.54	(706)	80,689	-0.88%	-0.29
Total/Average		125.80	122.25	947	83,719	1.12%	0.40

Table 4-2 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: DalevilleCircuit 4927922

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	125.21	121.70	118	18,102	0.65%	0.23
Heating	В	126.11	122.54	172	16,430	1.03%	0.37
incating	С	125.93	122.47	96	15,965	0.60%	0.22
	Total/Average	125.79	122.27	385	50,498	0.76%	0.27
Cooling	А	125.22	121.41	(381)	18,483	-2.10%	-0.69
	В	125.89	122.01	(330)	18,104	-1.86%	-0.60
	С	125.85	122.00	(348)	17,889	-1.98%	-0.65

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	Total/Average	125.63	121.79	(1,059)	54,476	-1.98%	-0.65
Total/Average		125.76	122.18	112	51,249	0.22%	0.08

# Table 4-3 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: Daleville Circuit 4927923

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	125.23	121.71	(124)	18,356	-0.68%	-0.24
Heating	В	126.14	122.57	(112)	23,582	-0.48%	-0.17
Theating	С	125.95	122.49	(47)	29,644	-0.16%	-0.06
	Total/Average	125.71	122.18	(283)	71,582	-0.40%	-0.14
	А	125.27	121.46	(444)	12,912	-3.56%	-1.17
Cooling	В	125.93	122.05	(632)	17,716	-3.70%	-1.20
Cooling	С	125.87	122.01	(570)	24,273	-2.40%	-0.78
	Total/Average	125.73	121.88	(1,646)	54,901	-3.09%	-1.01
Total/Average		125.71	122.13	(540)	68,432	-0.80%	-0.28

Table 4-4 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: East SideCircuit 4093121

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	125.04	120.81	155	8,899	1.71%	0.51
TT /'	В	125.13	120.73	220	8,547	2.51%	0.71
Heating	С	125.32	120.69	198	8,378	2.30%	0.62
	Total/Average	125.17	120.73	573	25,824	2.17%	0.61
	А	125.10	121.54	89	7,946	1.11%	0.39
Casting	В	125.19	121.29	138	9,191	1.48%	0.48
Cooling	С	125.33	121.17	119	8,442	1.39%	0.42
	Total/Average	125.21	121.31	347	25,579	1.34%	0.43
Total/Average		125.18	120.86	524	25,771	1.99%	0.58

Table 4-5 Daily PY2021 Energy Savings and CVR Factors by Phase and Season:	East Side
<i>Circuit 4093122</i>	

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	125.04	120.81	377	22,724	1.63%	0.48
TT (	В	125.13	120.72	477	18,818	2.47%	0.70
Heating	С	125.31	120.68	460	20,145	2.23%	0.60
	Total/Average	125.17	120.73	1,314	61,687	2.09%	0.59
	А	125.10	121.54	476	30,867	1.52%	0.53
Casting	В	125.19	121.28	490	25,198	1.91%	0.61
Cooling	С	125.32	121.17	505	27,361	1.81%	0.55
	Total/Average	125.21	121.33	1,471	83,425	1.73%	0.56
Total/Average		125.18	120.86	1,348	66,391	1.99%	0.58

Table 4-6 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: East SideCircuit 4093123

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	125.02	120.78	272	22,399	1.20%	0.35
Heating	В	125.10	120.69	532	22,587	2.30%	0.65
Heating	С	125.29	120.66	455	24,143	1.85%	0.50
	Total/Average	125.15	120.70	1,259	69,130	1.79%	0.50
	А	125.08	121.51	925	30,365	2.96%	1.04
Cooling	В	125.16	121.25	1,145	31,143	3.55%	1.14
Cooling	С	125.30	121.15	1,003	31,561	3.08%	0.93
	Total/Average	125.18	121.30	3,073	93,069	3.20%	1.03
Total/Average		125.16	120.83	1,651	74,310	2.17%	0.63

Table 4-7 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: East Side
<i>Circuit 4093124</i>

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	125.27	120.71	552	18,524	2.90%	0.80
II. stin s	В	125.36	120.76	645	18,836	3.31%	0.90
Heating	С	125.41	120.96	794	18,673	4.08%	1.15
	Total/Average	125.35	120.83	1,991	56,033	3.43%	0.95
	А	125.27	120.83	1,072	24,469	4.20%	1.18
	В	125.14	120.83	832	23,780	3.38%	0.98
Cooling	С	125.23	121.14	1,035	24,700	4.02%	1.23
	Total/Average	125.22	120.94	2,938	72,949	3.87%	1.13
Total/Average		125.31	120.86	2,290	61,364	3.60%	1.01

Table 4-8 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: East SideCircuit 4093125

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	125.29	120.73	414	18,093	2.24%	0.62
Heating	В	125.38	120.78	453	19,364	2.29%	0.62
Heating	С	125.43	120.98	341	18,529	1.81%	0.51
	Total/Average	125.36	120.82	1,209	55,986	2.11%	0.58
	А	125.29	120.84	944	25,303	3.60%	1.01
Capling	В	125.17	120.85	1,022	26,977	3.65%	1.06
Cooling	С	125.26	121.16	972	25,989	3.60%	1.10
	Total/Average	125.23	120.95	2,938	78,268	3.62%	1.06
Total/Average		125.32	120.86	1,754	63,008	2.71%	0.76

Table 4-9 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: East 2	Side
<i>Circuit 4093126</i>	

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	125.15	120.68	85	12,789	0.66%	0.18
II. stin s	В	125.16	121.27	78	9,567	0.81%	0.26
Heating	С	125.26	121.75	73	9,702	0.75%	0.27
	Total/Average	125.19	121.21	236	32,058	0.73%	0.23
	А	124.96	120.54	394	9,809	3.86%	1.09
Centing	В	125.00	121.10	311	8,087	3.71%	1.19
Cooling	С	125.09	121.57	382	8,591	4.26%	1.51
	Total/Average	125.01	121.06	1,087	26,487	3.94%	1.25
Total/Average		125.15	121.18	419	30,857	1.34%	0.42

Table 4-10 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: ElconaCircuit 4938121

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	125.29	121.01	1,521	23,631	6.05%	1.77
Uppting	В	125.37	121.00	1,720	25,676	6.28%	1.80
neating	С	125.50	121.11	1,367	23,512	5.49%	1.57
	Total/Average	125.38	121.04	4,608	72,819	5.95%	1.72
	А	125.22	121.32	1,162	25,761	4.32%	1.38
Casting	В	125.26	120.80	1,485	27,873	5.06%	1.42
Cooling	С	125.28	121.24	774	25,840	2.91%	0.90
	Total/Average	125.25	121.08	3,421	79,474	4.13%	1.24
Total/Average		125.33	121.05	4,185	75,191	5.27%	1.54

Table 4-11 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: Elcona
<i>Circuit</i> 4938122

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	125.31	121.03	461	14,281	3.13%	0.92
II. stin s	В	125.39	121.02	659	16,179	3.91%	1.12
Heating	С	125.48	121.10	576	16,221	3.43%	0.98
	Total/Average	125.40	121.05	1,696	46,681	3.51%	1.01
	А	125.25	121.34	372	14,740	2.46%	0.79
Centing	В	125.29	120.83	599	16,271	3.55%	1.00
Cooling	С	125.27	121.24	271	17,492	1.53%	0.47
	Total/Average	125.28	121.07	1,242	48,503	2.50%	0.74
Total/Average		125.36	121.06	1,534	47,330	3.14%	0.92

Table 4-12 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: ElconaCircuit 4938123

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	125.29	121.01	1,409	39,356	3.46%	1.01
Uppting	В	125.36	120.99	1,517	38,992	3.75%	1.08
neating	С	125.48	121.10	1,290	40,507	3.09%	0.88
	Total/Average	125.37	121.03	4,216	118,855	3.43%	0.99
	А	125.22	121.31	1,841	50,191	3.54%	1.13
Castina	В	125.26	120.80	2,277	48,946	4.45%	1.25
Cooling	С	125.27	121.23	1,550	50,761	2.96%	0.92
	Total/Average	125.25	121.08	5,667	149,898	3.64%	1.10
Total/Average		125.33	121.05	4,733	129,916	3.52%	1.03

Table 4-13 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: Farmland
<i>Circuit 4927321</i>

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	125.15	120.68	85	12,789	0.66%	0.18
II. stin s	В	125.16	121.27	78	9,567	0.81%	0.26
Heating	С	125.26	121.75	73	9,702	0.75%	0.27
	Total/Average	125.19	121.21	236	32,058	0.73%	0.23
	А	124.96	120.54	394	9,809	3.86%	1.09
Centine	В	125.00	121.10	311	8,087	3.71%	1.19
Cooling	С	125.09	121.57	382	8,591	4.26%	1.51
	Total/Average	125.01	121.06	1,087	26,487	3.94%	1.25
Total/Average		125.15	121.18	419	30,857	1.34%	0.42

Table 4-14 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: FarmlandCircuit 4927322

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	125.20	120.72	78	2,130	3.52%	0.99
Heating	В	125.17	121.28	29	1,616	1.76%	0.57
Heating	С	125.29	121.78	87	3,126	2.71%	0.97
	Total/Average	125.24	121.28	194	6,871	2.74%	0.87
	А	125.00	120.59	103	1,640	5.90%	1.67
Capling	В	125.00	121.11	40	1,374	2.83%	0.91
Cooling	С	125.10	121.59	91	2,713	3.25%	1.16
	Total/Average	125.04	121.07	234	5,726	3.93%	1.23
Total/Average		125.19	121.23	203	6,624	2.97%	0.94

Table 4-15 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: Farmland
<i>Circuit 4927323</i>

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	Α	125.18	120.71	121	9,371	1.28%	0.36
II. stin s	В	125.20	121.31	(135)	15,143	-0.90%	-0.29
Heating	С	125.31	121.80	(142)	12,892	-1.12%	-0.40
	Total/Average	125.32	122.23	(155)	37,406	-0.42%	-0.17
	А	124.99	120.57	459	9,339	4.68%	1.32
Centing	В	125.03	121.14	407	13,822	2.86%	0.92
Cooling	С	125.12	121.61	115	11,750	0.97%	0.35
	Total/Average	125.02	120.93	980	34,911	2.73%	0.83
Total/Average		125.25	121.95	89	36,868	0.24%	0.09

Table 4-16 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: GrabillCircuit 4935221

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	124.40	121.66	370	19,214	1.89%	0.86
Heating	В	124.66	121.91	552	16,878	3.16%	1.44
meating	С	125.53	122.79	544	22,512	2.36%	1.08
	Total/Average	124.92	122.17	1,466	58,604	2.44%	1.11
	А	124.35	122.48	(59)	21,040	-0.28%	-0.19
Casting	В	125.03	123.07	39	18,525	0.21%	0.13
Cooling	С	125.72	123.75	123	24,355	0.50%	0.32
	Total/Average	126.24	124.22	103	63,920	0.16%	0.10
Total/Average		125.34	122.84	1,025	60,325	1.67%	0.83

Table 4-17 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: Grab	vill
Circuit 4935222	

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	Α	124.42	121.68	344	37,842	0.90%	0.41
TT (*	В	124.64	121.89	450	32,004	1.39%	0.63
Heating	С	125.51	122.77	288	32,250	0.88%	0.40
	Total/Average	124.80	122.06	1,082	102,096	1.05%	0.48
	А	124.39	122.51	1,047	48,984	2.09%	1.39
Casting	В	125.01	123.06	754	37,313	1.98%	1.27
Cooling	С	125.71	123.74	593	41,681	1.40%	0.89
	Total/Average	124.91	122.99	2,393	127,978	1.84%	1.19
Total/Average		124.84	122.36	1,506	110,475	1.35%	0.68

Table 4-18 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: GrabillCircuit 4935223

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	124.50	121.76	88	9,328	0.94%	0.43
Heating	В	124.72	121.98	28	11,467	0.24%	0.11
meaning	С	125.59	122.84	97	9,773	0.98%	0.45
	Total/Average	125.02	122.28	213	30,568	0.69%	0.32
	А	124.48	122.60	145	10,338	1.38%	0.92
Caalina	В	125.13	123.17	174	11,588	1.48%	0.95
Cooling	С	125.79	123.82	195	11,830	1.62%	1.03
	Total/Average	125.20	123.26	514	33,757	1.50%	0.97
Total/Average		125.08	122.60	311	31,600	0.97%	0.49

Table 4-19 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: Hacienda
<i>Circuit</i> 4933521

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	125.22	120.40	29	1,700	1.68%	0.44
II. stin s	В	125.35	119.94	49	1,888	2.51%	0.58
Heating	С	125.11	119.67	31	1,109	2.69%	0.62
	Total/Average	125.25	119.99	108	4,697	2.25%	0.54
	А	125.09	120.59	98	2,337	4.04%	1.12
Casting	В	125.26	120.03	125	2,478	4.79%	1.15
Cooling	С	125.14	119.60	84	1,475	5.40%	1.22
	Total/Average	125.17	120.09	307	6,290	4.66%	1.15
Total/Average		125.22	120.03	187	5,328	3.39%	0.82

Table 4-20 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: HaciendaCircuit 4933523

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	125.20	120.38	18	1,650	1.09%	0.28
Heating	В	125.33	119.92	30	1,313	2.21%	0.51
meaning	С	125.08	119.64	23	1,311	1.74%	0.40
	Total/Average	125.22	119.95	71	4,274	1.64%	0.39
	А	125.07	120.57	91	2,261	3.87%	1.07
Casting	В	125.24	120.01	91	1,826	4.76%	1.14
Cooling	С	125.11	119.58	100	1,927	4.95%	1.12
	Total/Average	125.14	120.03	283	6,014	4.49%	1.10
Total/Average		125.19	119.98	155	4,963	3.03%	0.73

Table 4-21 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: Hacienda
<i>Circuit 4933524-1</i>

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	Α	125.22	120.39	24	1,615	1.45%	0.38
TT (*	В	125.33	119.91	27	1,411	1.91%	0.44
Heating	С	125.10	119.66	29	1,268	2.23%	0.51
	Total/Average	125.21	119.96	80	4,293	1.83%	0.44
	А	125.09	120.59	106	2,230	4.52%	1.26
Centing	В	125.24	120.01	111	2,059	5.12%	1.23
Cooling	С	125.13	119.59	117	1,838	5.97%	1.35
	Total/Average	125.16	120.05	334	6,127	5.16%	1.26
Total/Average		125.19	120.00	181	5,020	3.47%	0.84

Table 4-22 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: HaciendaCircuit 4933625

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	123.81	122.06	(72)	22,967	-0.31%	-0.22
TT (*	В	124.36	120.87	233	22,531	1.02%	0.36
Treating	С	124.66	120.79	217	22,429	0.96%	0.31
	Total/Average	124.64	120.60	378	67,927	0.55%	0.17
	А	123.81	120.85	341	29,306	1.15%	0.48
Casting	В	123.93	120.63	571	28,283	1.98%	0.74
Cooling	С	124.56	120.65	607	27,905	2.13%	0.68
	Total/Average	124.15	120.69	1,519	85,495	1.75%	0.63
Total/Average		124.48	120.63	746	73,596	1.00%	0.32

Table 4-23 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: Haci	ienda
Circuit 4933626	

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	123.87	122.12	125	19,325	0.64%	0.46
II. stin s	В	124.44	120.95	142	23,250	0.61%	0.22
Heating	С	124.68	120.81	222	19,673	1.11%	0.36
	Total/Average	124.40	121.19	489	62,249	0.78%	0.30
	А	123.88	120.92	726	24,121	2.92%	1.22
Casting	В	124.00	120.71	929	33,539	2.69%	1.01
Cooling	С	124.59	120.69	982	27,706	3.42%	1.09
	Total/Average	124.19	120.76	2,637	85,365	3.00%	1.08
Total/Average		124.33	121.05	1,182	69,708	1.67%	0.63

Table 4-24 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: HaciendaCircuit 4933627

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	123.78	122.04	159	24,846	0.64%	0.45
TT (*	В	124.35	120.88	822	30,115	2.66%	0.95
neating	С	124.64	120.79	548	21,710	2.46%	0.80
	Total/Average	124.40	120.97	1,529	76,671	1.95%	0.71
	А	123.78	120.81	281	31,559	0.88%	0.37
Casting	В	123.92	120.63	488	31,723	1.52%	0.57
Cooling	С	124.55	120.65	516	25,895	1.95%	0.62
	Total/Average	124.14	120.68	1,286	89,178	1.42%	0.51
Total/Average		124.32	120.87	1,450	80,707	1.77%	0.64

Table 4-25 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: Harper
<i>Circuit 4928821</i>

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	124.39	120.87	960	27,758	3.34%	1.18
TT (	В	124.53	121.13	942	25,099	3.62%	1.32
Heating	С	124.43	121.07	1,020	28,586	3.45%	1.28
	Total/Average	124.45	121.02	2,922	81,442	3.46%	1.26
	А	124.30	121.26	739	35,284	2.05%	0.84
Centine	В	124.48	120.99	896	30,981	2.81%	1.00
Cooling	С	124.30	121.09	682	35,151	1.90%	0.74
	Total/Average	124.37	121.10	2,317	101,416	2.23%	0.85
Total/Average		124.41	121.07	2,604	91,939	2.75%	1.03

Table 4-26 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: HarperCircuit 4928822

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	124.38	120.85	260	25,231	1.02%	0.36
TT (	В	124.51	121.10	387	36,407	1.05%	0.38
meaning	С	124.43	121.06	446	31,947	1.38%	0.51
	Total/Average	124.44	121.03	1,092	93,585	1.15%	0.42
	А	124.29	121.25	378	30,211	1.24%	0.51
Casting	В	124.46	120.97	706	42,392	1.64%	0.58
Cooling	С	124.32	121.10	528	35,161	1.48%	0.57
	Total/Average	124.37	121.08	1,612	107,764	1.47%	0.56
Total/Average		124.41	121.05	1,366	101,036	1.33%	0.49

Table 4-27 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: Lincoln
<i>Circuit 4051821</i>

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	124.43	122.45	46	37,419	0.12%	0.08
II. stin s	В	125.09	123.04	90	37,505	0.24%	0.15
Heating	С	125.18	123.23	231	36,102	0.64%	0.41
	Total/Average	125.06	123.09	367	111,026	0.33%	0.21
	А	124.39	123.08	790	43,792	1.77%	1.68
Centing	В	125.06	123.66	846	43,665	1.90%	1.69
Cooling	С	125.34	124.05	681	43,595	1.54%	1.50
	Total/Average	124.92	123.58	2,317	131,052	1.74%	1.62
Total/Average		125.01	123.27	1,114	118,699	0.93%	0.67

Table 4-28 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: LincolnCircuit 4051822

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	124.43	122.45	298	31,137	0.95%	0.59
TT /:	В	125.09	123.04	509	31,108	1.61%	0.98
Heating	С	125.18	123.23	396	31,296	1.25%	0.80
	Total/Average	124.96	122.95	1,202	93,541	1.27%	0.79
	А	124.39	123.08	406	35,137	1.14%	1.08
Capling	В	125.06	123.66	386	34,134	1.12%	0.99
Cooling	С	125.34	124.05	347	33,519	1.02%	1.00
	Total/Average	124.91	123.57	1,138	102,790	1.10%	1.02
Total/Average		124.94	123.19	1,177	97,085	1.20%	0.86

Table 4-29 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: McKinley
<i>Circuit 40559B123</i>

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	123.48	119.94	127	20,444	0.62%	0.21
II. stin s	В	123.44	119.94	132	14,857	0.88%	0.31
Heating	С	123.47	119.94	116	14,293	0.80%	0.28
	Total/Average	123.46	119.94	375	49,594	0.75%	0.26
	А	123.31	119.82	479	27,670	1.70%	0.60
Casting	В	123.65	120.05	242	20,026	1.20%	0.41
Cooling	С	123.30	119.94	296	18,751	1.55%	0.57
	Total/Average	123.39	119.91	1,018	66,448	1.51%	0.53
Total/Average		123.45	119.93	510	53,150	0.95%	0.33

Table 4-30 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: McKinleyCircuit 40559B124

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	123.46	119.91	258	22,854	1.12%	0.39
Heating	В	123.40	119.90	447	22,332	1.96%	0.69
Heating	С	123.36	119.84	415	24,295	1.68%	0.59
	Total/Average	123.40	119.88	1,120	69,481	1.59%	0.56
	А	123.29	119.79	(1,676)	16,924	-10.99%	-3.88
Capling	В	123.60	120.00	(2,410)	15,811	-17.98%	-6.17
Cooling	С	123.20	119.83	(1,530)	17,373	-9.66%	-3.54
	Total/Average	123.40	119.89	(5,616)	50,109	-12.62%	-4.44
Total/Average		123.40	119.88	(302)	65,393	-0.46%	-0.16

Table 4-31 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: McKinley
<i>Circuit 40559B125</i>

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	123.43	119.91	631	22,769	2.69%	0.95
	В	123.32	119.89	519	17,629	2.86%	1.03
Heating	С	123.22	119.83	570	20,594	2.69%	0.98
	Total/Average	123.33	119.88	1,720	60,992	2.74%	0.98
	А	123.29	119.80	54	20,352	0.27%	0.09
Casting	В	123.60	120.00	(162)	18,386	-0.89%	-0.31
Cooling	С	123.18	119.82	51	20,767	0.24%	0.09
	Total/Average	124.27	120.36	(57)	59,505	-0.10%	-0.03
Total/Average		123.53	119.98	1,345	60,678	2.17%	0.76

Table 4-32 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: McKinleyCircuit 40559B221

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	123.53	121.06	859	40,746	2.06%	1.03
TT (	В	124.39	121.88	981	43,437	2.21%	1.10
Treating	С	124.81	122.39	1,270	46,854	2.64%	1.36
	Total/Average	124.32	121.86	3,110	131,037	2.32%	1.17
	А	123.16	121.67	(293)	44,122	-0.67%	-0.55
Casting	В	123.77	122.22	(445)	47,524	-0.94%	-0.75
Cooling	С	124.80	123.22	(180)	50,931	-0.35%	-0.28
	Total/Average	123.77	122.24	(917)	142,577	-0.65%	-0.52
Total/Average		124.14	121.99	1,778	134,856	1.30%	0.75

Table 4-33 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: McKinley
<i>Circuit 40559B222</i>

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
Heating	А	123.48	121.05	375	19,967	1.84%	0.94
	В	124.45	121.89	412	17,914	2.25%	1.09
	С	124.92	122.46	218	14,391	1.49%	0.75
	Total/Average	124.19	121.70	1,005	52,272	1.89%	0.94
Cooling	А	123.16	121.66	279	26,226	1.05%	0.87
	В	123.77	122.22	196	23,533	0.83%	0.66
	С	124.87	123.28	330	19,295	1.68%	1.33
	Total/Average	124.01	122.47	806	69,054	1.15%	0.93
Total/Average		124.13	121.95	939	57,825	1.60%	0.91

Table 4-34 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: McKinleyCircuit 40559B226

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
Heating	А	123.53	121.06	332	39,885	0.83%	0.41
	В	124.40	121.90	339	39,323	0.85%	0.42
	С	124.79	122.38	329	38,057	0.86%	0.44
	Total/Average	124.24	121.78	1,000	117,264	0.85%	0.43
Cooling	А	123.16	121.67	(241)	43,403	-0.56%	-0.46
	В	123.78	122.23	(65)	42,098	-0.15%	-0.12
	С	124.79	123.21	(131)	41,544	-0.32%	-0.25
	Total/Average	123.74	122.21	(437)	127,045	-0.35%	-0.28
Total/Average		124.08	121.92	525	120,501	0.43%	0.25

Table 4-35 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: Northland
<i>Circuit 4933421</i>

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
Heating	А	124.55	121.57	843	23,968	3.40%	1.42
	В	125.01	122.03	931	24,023	3.73%	1.57
	С	124.90	121.92	888	21,461	3.98%	1.67
	Total/Average	124.83	121.85	2,663	69,452	3.69%	1.55
Cooling	А	124.59	121.91	997	26,387	3.64%	1.69
	В	125.07	122.39	1,045	26,771	3.76%	1.75
	С	125.05	122.31	937	23,553	3.82%	1.75
	Total/Average	124.91	122.21	2,978	76,711	3.74%	1.73
Total/Average		124.84	121.93	2,737	71,145	3.70%	1.59

Table 4-36 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: NorthlandCircuit 4933422

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
Heating	А	124.59	121.61	63	12,227	0.51%	0.21
	В	125.05	122.07	126	11,312	1.10%	0.46
	С	124.94	121.95	135	11,007	1.21%	0.51
	Total/Average	124.91	121.93	324	34,546	0.93%	0.39
Cooling	А	124.64	121.97	172	16,279	1.05%	0.49
	В	125.10	122.43	303	14,927	1.99%	0.93
	С	125.09	122.35	307	15,167	1.98%	0.91
	Total/Average	125.00	122.30	781	46,373	1.66%	0.77
Total/Average		124.93	122.02	430	37,305	1.14%	0.49
## Table 4-37 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: NorthlandCircuit 4933423

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	124.58	121.60	839	26,366	3.08%	1.29
TT (*	В	125.02	122.04	1,030	27,006	3.67%	1.54
Heating	С	124.89	121.91	1,066	26,806	3.83%	1.60
	Total/Average	124.85	121.87	2,935	80,178	3.53%	1.48
	А	124.62	121.95	643	29,148	2.16%	1.00
Centing	В	125.07	122.40	755	28,940	2.54%	1.19
Cooling	С	125.05	122.31	638	29,514	2.12%	0.97
	Total/Average	124.92	122.23	2,037	87,602	2.27%	1.05
Total/Average		124.87	121.95	2,726	81,910	3.22%	1.38

Table 4-38 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: NorthlandCircuit 4933424

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	125.16	120.73	1,172	30,845	3.66%	1.03
Heating	В	125.20	120.64	1,458	30,399	4.58%	1.26
meating	С	125.16	120.73	1,272	33,201	3.69%	1.04
	Total/Average	125.18	120.70	3,902	94,444	3.97%	1.11
	А	125.06	120.43	1,235	34,162	3.49%	0.94
Castina	В	125.15	120.21	1,572	32,686	4.59%	1.16
Cooling	С	125.04	120.51	1,333	36,967	3.48%	0.96
	Total/Average	125.09	120.37	4,140	103,815	3.83%	1.02
Total/Average		125.15	120.60	3,972	97,203	3.93%	1.08

### Table 4-39 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: NorthlandCircuit 4933525

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	125.16	120.74	536	18,698	2.79%	0.79
II. stin s	В	125.21	120.65	574	16,126	3.44%	0.94
Heating	С	125.15	120.72	425	21,670	1.93%	0.54
	Total/Average	125.18	120.70	1,536	56,493	2.65%	0.74
	А	125.06	120.44	871	26,913	3.14%	0.85
Casting	В	125.16	120.22	600	22,617	2.59%	0.66
Cooling	С	125.02	120.50	1,038	30,187	3.32%	0.92
	Total/Average	125.07	120.41	2,509	79,717	3.05%	0.82
Total/Average		125.15	120.62	1,822	63,328	2.80%	0.77

Table 4-40 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: NorthlandCircuit 4933526

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	125.16	120.73	170	15,226	1.10%	0.31
Heating	В	125.20	120.65	242	13,769	1.72%	0.47
Heating	С	125.14	120.71	213	12,104	1.73%	0.49
	Total/Average	125.17	120.69	625	41,100	1.50%	0.42
	А	125.06	120.43	665	14,401	4.42%	1.20
Cooling	В	125.15	120.21	767	18,156	4.05%	1.03
Cooling	С	125.02	120.49	607	15,918	3.67%	1.01
	Total/Average	125.08	120.37	2,039	48,475	4.04%	1.07
Total/Average		125.15	120.60	1,041	43,271	2.35%	0.65

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3.56%

0.37%

3.02%

1.02%

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30,408

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С

Total/Average

А

В

С

Total/Average

Cooling

Total/Average

	·		405802	21			
Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVRFactor
	A	125.40	122.22	753	26,062	2.81%	1.11
11	В	125.41	121.40	1,184	26,989	4.20%	1.32
Heating		125 45	121 42	007	22.012	2 660/	1 1 1

907

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Table 4-41 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: Osolo Circuit

Table 4-42 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: Osolo Circuit 4058022

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	125.44	122.26	640	21,178	2.93%	1.16
II the s	В	125.40	121.40	1,066	20,026	5.05%	1.58
Heating	С	125.45	121.43	835	23,439	3.44%	1.07
	Total/Average	125.42	121.63	2,540	64,644	3.78%	1.25
	А	125.42	123.08	327	25,251	1.28%	0.69
Casting	В	125.35	121.80	977	23,727	3.96%	1.40
Cooling	С	125.43	121.89	713	29,182	2.38%	0.85
	Total/Average	125.39	122.04	2,017	78,159	2.52%	0.94
Total/Average		125.41	121.76	2,374	68,926	3.33%	1.14

Table 4-43 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: Osolo Circuit
4058024

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	125.44	122.26	1,152	35,111	3.18%	1.25
<b>TT</b>	В	125.42	121.42	1,375	31,174	4.22%	1.32
Heating	С	125.49	121.47	745	26,489	2.74%	0.85
	Total/Average	125.44	121.73	3,272	92,774	3.41%	1.15
	А	125.41	123.08	183	38,747	0.47%	0.25
Casting	В	125.36	121.81	925	37,304	2.42%	0.85
Cooling	С	125.47	121.93	302	31,426	0.95%	0.34
	Total/Average	125.39	122.00	1,410	107,476	1.30%	0.48
Total/Average		125.43	121.81	2,682	97,432	2.68%	0.93

Table 4-44 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: Osolo Circuit4059023

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	125.34	121.09	554	30,323	1.79%	0.53
Heating	В	125.48	121.29	751	26,631	2.74%	0.82
neating	С	125.45	121.95	362	25,646	1.39%	0.50
	Total/Average	125.43	121.36	1,667	82,600	1.98%	0.61
	А	125.28	121.18	306	34,474	0.88%	0.27
Capling	В	125.41	121.24	400	32,779	1.21%	0.36
Cooling	С	125.36	122.33	(273)	32,399	-0.85%	-0.35
	Total/Average	125.35	120.52	433	99,652	0.43%	0.11
Total/Average		125.40	121.10	1,283	87,900	1.44%	0.42

1.05%

0.54%

1.13%

2.21%

0.32

0.22

0.36

0.69

14,106

16,517

43,903

36,477

149

89

500

824

А

В

С

Total/Average

Cooling

Total/Average

125.36

125.28

125.29

125.34

			405902	25			
Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	125.31	121.06	387	9,722	3.83%	1.13
Heating	В	125.43	121.24	340	11,751	2.81%	0.84
neating	С	125.38	121.88	242	11,654	2.03%	0.73
	Total/Average	125.37	121.32	970	33,127	2.84%	0.88
	А	125.25	121.15	262	13,280	1.93%	0.59

### Table 4-45 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: Osolo Circuit

Table 4-46 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: Osolo Circuit 4059026

121.19

122.25

121.36

121.34

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	125.31	121.06	1,158	23,018	4.79%	1.41
Heating	В	125.47	121.27	781	22,195	3.40%	1.02
Heating	С	125.43	121.93	493	24,587	1.97%	0.70
	Total/Average	125.39	121.30	2,432	69,800	3.37%	1.03
	А	125.24	121.15	1,399	28,160	4.73%	1.45
Capling	В	125.40	121.23	970	26,870	3.49%	1.05
Cooling	С	125.34	122.31	408	29,148	1.38%	0.57
	Total/Average	125.31	121.35	2,778	84,178	3.19%	1.01
Total/Average		125.36	121.32	2,539	74,270	3.31%	1.02

Table 4-47 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: Pettit Circuit
4917221

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	124.30	122.78	316	22,087	1.41%	1.16
<b>TT</b>	В	124.31	122.91	192	21,732	0.88%	0.78
Heating	С	124.52	122.99	290	17,964	1.59%	1.29
	Total/Average	124.38	122.89	798	61,783	1.28%	1.06
	А	124.20	120.72	477	26,198	1.79%	0.64
Casting	В	124.20	121.09	267	26,906	0.98%	0.39
Cooling	С	124.38	121.20	315	22,813	1.36%	0.53
	Total/Average	124.25	120.96	1,059	75,917	1.38%	0.52
Total/Average		124.34	122.33	873	65,837	1.31%	0.81

Table 4-48 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: Pettit Circuit4917222

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	124.24	122.72	282	20,938	1.33%	1.09
Heating	В	124.29	122.89	270	23,221	1.15%	1.02
Heating	С	124.43	122.90	301	25,285	1.17%	0.95
	Total/Average	124.32	122.84	853	69,444	1.21%	1.02
	А	124.15	120.65	476	26,654	1.75%	0.62
Capling	В	124.18	121.07	438	29,921	1.44%	0.58
Cooling	С	124.29	121.11	557	33,917	1.61%	0.63
	Total/Average	124.21	120.95	1,470	90,492	1.60%	0.61
Total/Average		124.29	122.30	1,030	75,480	1.35%	0.84

### Table 4-49 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: Pettit Circuit4917223

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	124.24	122.73	175	11,894	1.45%	1.19
	В	124.28	122.89	198	10,706	1.81%	1.61
Heating	С	124.46	122.93	227	8,037	2.74%	2.23
	Total/Average	124.34	122.86	600	30,636	1.92%	1.61
	А	124.14	120.66	133	12,867	1.02%	0.37
Casting	В	124.16	121.07	134	11,446	1.16%	0.46
Cooling	С	124.31	121.14	147	9,538	1.51%	0.59
	Total/Average	124.21	120.96	414	33,850	1.21%	0.46
Total/Average		124.30	122.31	546	31,558	1.70%	1.06

Table 4-50 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: South BendCircuit 4050321

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	125.56	120.82	566	35,263	1.58%	0.42
Heating	В	125.28	120.18	1,105	35,934	2.98%	0.73
Heating	С	125.42	120.30	1,039	32,920	3.06%	0.75
	Total/Average	125.39	120.36	2,710	104,116	2.54%	0.63
	А	125.54	120.89	569	40,557	1.38%	0.37
Casting	В	125.20	120.40	631	41,160	1.51%	0.39
Cooling	С	125.29	120.53	806	39,348	2.01%	0.53
	Total/Average	125.34	120.59	2,006	121,064	1.63%	0.43
Total/Average		125.37	120.43	2,500	109,174	2.24%	0.57

### Table 4-51 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: South BendCircuit 4050322

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	125.54	120.81	419	22,399	1.84%	0.49
TT (	В	125.25	120.17	424	25,872	1.61%	0.40
Heating	С	125.42	120.31	298	15,014	1.94%	0.48
	Total/Average	125.40	120.44	1,141	63,284	1.77%	0.45
	А	125.53	120.87	513	28,219	1.78%	0.48
Centing	В	125.18	120.38	658	30,155	2.14%	0.56
Cooling	С	125.30	120.54	323	19,433	1.63%	0.43
	Total/Average	125.33	120.59	1,494	77,807	1.88%	0.50
Total/Average		125.38	120.49	1,246	67,618	1.81%	0.46

Table 4-52 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: South BendCircuit 4050323

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	125.53	120.79	337	14,182	2.32%	0.62
Heating	В	125.24	120.14	524	17,506	2.91%	0.71
Heating	С	125.41	120.29	422	13,493	3.03%	0.74
	Total/Average	125.37	120.36	1,284	45,181	2.76%	0.69
	А	125.51	120.86	438	20,473	2.09%	0.56
Capling	В	125.15	120.36	801	22,755	3.40%	0.89
Cooling	С	125.28	120.53	350	20,243	1.70%	0.45
	Total/Average	125.28	120.53	1,589	63,471	2.44%	0.64
Total/Average		125.34	120.41	1,375	50,639	2.64%	0.67

Table 4-53 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: Southside
<i>Circuit 4099921</i>

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	125.08	120.81	399	16,125	2.41%	0.71
**	В	124.99	120.68	678	25,524	2.59%	0.75
Heating	С	125.23	120.84	575	18,167	3.07%	0.88
	Total/Average	125.09	120.77	1,651	59,816	2.69%	0.78
	А	125.06	120.89	123	18,858	0.65%	0.19
Casting	В	125.00	120.77	140	27,272	0.51%	0.15
Cooling	С	125.23	120.87	227	21,225	1.06%	0.30
	Total/Average	125.12	120.85	490	67,355	0.72%	0.21
Total/Average		125.10	120.79	1,259	62,362	1.98%	0.57

Table 4-54 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: SouthsideCircuit 4099922

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	125.10	120.82	615	25,116	2.39%	0.70
TT (	В	125.00	120.70	669	26,284	2.48%	0.72
neating	С	125.26	120.87	703	26,199	2.61%	0.75
	Total/Average	125.12	120.80	1,988	77,599	2.50%	0.72
	А	125.07	120.91	378	28,016	1.33%	0.40
Cooling	В	125.01	120.79	298	28,557	1.03%	0.31
Cooling	С	125.26	120.90	433	27,959	1.52%	0.44
	Total/Average	125.13	120.87	1,109	84,532	1.29%	0.38
Total/Average		125.12	120.82	1,691	79,941	2.07%	0.60

Table 4-55 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: Souths	ide
<i>Circuit 4099923</i>	

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	125.09	120.81	433	12,610	3.32%	0.97
	В	124.99	120.69	623	17,168	3.50%	1.02
Heating	С	125.24	120.85	515	15,748	3.17%	0.90
	Total/Average	125.10	120.78	1,572	45,527	3.34%	0.97
	А	125.06	120.90	314	13,020	2.36%	0.71
Casting	В	125.00	120.78	377	16,700	2.21%	0.65
Cooling	С	125.24	120.88	249	16,843	1.46%	0.42
	Total/Average	125.08	120.84	940	46,563	1.98%	0.58
Total/Average		125.09	120.80	1,359	45,877	2.88%	0.84

Table 4-56 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: SouthsideSBCircuit 4094621

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	124.94	120.73	37	1,381	2.63%	0.78
Heating	В	126.36	122.06	80	2,745	2.82%	0.83
Heating	С	125.97	121.58	65	1,931	3.28%	0.94
	Total/Average	125.93	121.62	183	6,058	2.92%	0.85
	А	125.10	119.94	129	1,465	8.10%	1.97
Cooling	В	125.40	120.55	180	3,130	5.45%	1.41
Cooling	С	125.44	120.30	183	2,078	8.11%	1.98
	Total/Average	125.33	120.30	493	6,673	6.88%	1.71
Total/Average		125.82	121.38	238	6,168	3.72%	1.05

Table 4-57 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: SouthsideSB
<i>Circuit 4094622</i>

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	124.95	120.74	732	26,624	2.67%	0.79
Season Ph Heating I Heating I Cooling I Total/A Total/A	В	126.39	122.08	556	23,418	2.32%	0.68
Heating	С	125.99	121.60	764	27,556	2.70%	0.77
	Total/Average	125.73	121.42	2,052	77,598	2.58%	0.75
	А	125.11	119.96	2,499	27,991	8.20%	1.99
Casting	В	125.42	120.57	2,238	26,785	7.71%	2.00
Cooling	С	125.46	120.32	2,658	27,834	8.72%	2.13
	Total/Average	125.33	120.27	7,396	82,610	8.22%	2.04
Total/Average		125.66	121.22	3,009	78,495	3.69%	1.05

Table 4-58 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: SouthsideSBCircuit 4094623

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	124.92	120.73	308	12,998	2.32%	0.69
Heating	В	126.25	122.09	429	14,395	2.89%	0.88
Heating	С	125.85	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	2.89%	0.87		
	Total/Average	125.75	121.56	1,125	40,426	2.71%	0.81
	А	125.10	119.94	1,068	14,994	6.65%	1.61
Capling	В	125.43	120.58	1,204	16,471	6.81%	1.76
Cooling	С	125.52	120.37	874	15,243	5.42%	1.32
	Total/Average	PhaseBaseline Off VoltageOn State VoltageOn State Daily Average kWh SavingsOn State Daily Average ConsumptionA124.92120.7330812,998B126.25122.0942914,395C125.85121.6538813,033al/Average125.75121.561,12540,426A125.10119.941,06814,994B125.43120.581,20416,471C125.52120.3787415,243al/Average125.34120.313,14646,707125.68121.341,48741,551	6.31%	1.57			
Total/Average		125.68	121.34	1,487	41,551	3.46%	1.00

Table 4-59 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: SouthsideSB
<i>Circuit</i> 4094624

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	124.92	120.71	114	3,590	3.07%	0.91
Heating	В	126.35	122.05	198	5,229	3.65%	1.07
Heating	С	125.99	121.60	215	5,974	3.48%	1.00
	Total/Average	125.90	121.58	527	14,793	3.44%	1.00
	А	125.10	119.92	23	3,989	0.57%	0.14
Capling	В	125.37	120.55	179	5,422	3.20%	0.83
Cooling	С	125.44	120.32	222	6,791	3.17%	0.78
	Total/Average	125.39	120.39	425	16,201	2.55%	0.64
Total/Average		125.81	121.37	509	15,045	3.27%	0.93

Table 4-60 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: State StreetCircuit 4928721

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	122.74	120.93	276	31,868	0.86%	0.58
Heating	В	124.44	122.49	224	28,815	0.77%	0.49
neating	С	124.12	122.16	239	29,302	0.81%	0.51
	Total/Average	123.70	121.80	739	89,985	0.81%	0.53
	Α	122.49	120.89	307	36,304	0.84%	0.64
Capling	В	123.60	122.06	312	37,573	0.82%	0.66
SeasonPhaseBaseline Off VoltageOn State Daily Average kWh SavingsOn State Daily Average ConsumptHeatingA122.74120.9327631,868B124.44122.4922428,815C124.12122.1623929,302Total/Average Cooling123.70121.8073989,985B123.60122.0631237,573CoolingB123.60122.0730435,597Total/Average123.25121.67923109,477Total/Average123.60121.7778294,572	35,597	0.85%	0.66				
	Total/Average	123.25	121.67	923	109,473	0.84%	0.65
Total/Average		123.60	121.77	782	94,572	0.82%	0.55

### Table 4-61 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: State StreetCircuit 4928722

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	122.74	120.93	123	19,997	0.61%	0.41
Season Heating Cooling Total/Average	В	124.43	122.49	219	19,450	1.11%	0.71
Heating	С	124.12	122.16	223	21,253	1.04%	0.66
	Total/Average	123.94	122.02	564	60,699	0.92%	0.59
	А	122.49	120.89	276	23,624	1.16%	0.88
Casting	В	123.60	122.06	296	23,658	1.24%	0.99
Cooling	С	123.67	122.07	247	23,913	1.02%	0.79
	Total/Average	123.25	121.67	820	71,194	1.14%	0.89
Total/Average		123.78	121.93	625	63,170	0.98%	0.66

Table 4-62 Daily PY2021 Energy Savings and CVR Factors by Phase and Season: State StreetCircuit 4928723

Season	Phase	Baseline Off Voltage	On State Voltage	On State Daily Average kWh Savings	On State Daily Average Consumption	Percent Savings	CVR Factor
	А	122.74	120.93	130	14,489	0.89%	0.60
Season Heating T Cooling T Total/Average	В	124.44	122.49	138	14,239	0.96%	0.61
Heating	С	124.11	122.16	147	14,780	0.98%	0.62
	Total/Average	123.79	121.88	415	43,508	0.94%	0.61
	А	122.49	120.89	136	11,631	1.16%	0.88
Cooling	В	123.60	122.06	151	11,850	1.26%	1.01
Coomig	С	123.67	122.07	223	11,989	1.83%	1.42
	Total/Average	123.33	121.75	510	35,470	Percent Savings   0.89%   0.96%   0.98%   0.94%   1.16%   1.26%   1.83%   1.42%   1.04%	1.11
Total/Average		123.68	121.85	437	41,616	1.04%	0.70

### 5. Aggregate Energy Savings

As discussed in Section 3.3, two sets of aggregate energy savings were calculated for the Indiana circuits.

- One set of aggregate savings applies to savings calculated over those days in 2021 when VVO was "on". These savings are reported in Section 5.1.
- A second set of aggregate savings was calculated to show the savings that would have resulted if VVO had been continually "on" during all of 2021. These savings are reported in Section 5.2.

#### 5.1 kWh Savings in 2021 When VVO was "On"

The ex-post kWh savings for 2021 were calculated for days when VVO was "on". Circuit-level and total results are presented for each circuit in Table 5-1 though Table 5-17. Total kWh savings by substation are presented in Table 5-18.

			k Wh S	avings	
Circuit ID	Season	Phase A	Phase B	Phase C	Sum of Phases
Daleville	Heating	22,403	65,196	132,656	220,255
Substation,	Cooling	-21,877	-11,256	5,961	-27,172
4927921 Circuit	Total	526	53,940	138,618	193,083
Daleville	Heating	19,438	28,368	15,867	63,673
Substation,	Cooling	-14,663	-12,720	-13,387	-40,769
4927922 Circuit	Total	4,775	15,648	2,480	22,904
Daleville	Heating	-20,495	-18,589	-7,713	-46,796
Substation,	Cooling	-17,097	-24,343	-21,943	-63,384
4927923 Circuit	Total	-37,592	-42,932	-29,656	-110,180
Daleville	Heating	21,346	74,975	140,811	237,132
Substation, All	Cooling	-53,638	-48,319	-29,369	-131,325
Circuits	Total	-32,291	26,656	111,442	105,807

Table 5-1 PY2021 kWh Savings with VVO On by Season and Circuit: Daleville

			k Wh S	'avings	
Circuit ID	Season	Phase A	Phase B	Phase C	Sum of Phases
East Side	Heating	32,147	45,605	40,918	118,671
Substation,	Cooling	5,083	7,917	6,821	19,821
4093121 Circuit	Total	37,231	53,522	47,739	138,492
East Side	Heating	78,047	98,892	95,267	272,206
Substation,	Cooling	27,214	28,048	28,890	84,152
4093122 Circuit	Total	105,261	126,940	124,156	356,358
East Side	Heating	56,387	110,130	94,218	260,735
Substation,	Cooling	52,908	65,500	57,359	175,766
4093123 Circuit	Total	109,294	175,630	151,577	436,501
East Side	Heating	102,368	119,503	147,139	369,011
Substation,	Cooling	91,397	70,946	88,231	250,574
4093124 Circuit	Total	193,765	190,449	235,371	619,585
East Side	Heating	76,729	84,023	63,279	224,031
Substation,	Cooling	80,499	87,179	82,887	250,565
4093125 Circuit	Total	157,229	171,203	146,165	474,597
East Side	Heating	46,825	75,923	87,139	209,887
Substation,	Cooling	46,233	43,302	51,497	141,032
4093126 Circuit	Total	93,058	119,225	138,637	350,920
East Side	Heating	392,504	534,077	527,960	1,454,541
Substation, All	Cooling	303,335	302,892	315,684	921,911
Circuits	Total	695,839	836,969	843,644	2,376,452

Table 5-2 PY2021 kWh Savings with VVO On by Season and Circuit: East Side

Table 5-3 PY2021 kWh Savings with VVO On by Season and Circuit: Elcona

			k Wh S	avings	
Circuit ID	Season	Phase A	Phase B	Phase C	Sum of Phases
Elcona	Heating	262,132	296,404	235,636	794,173
Substation,	Cooling	110,862	141,731	73,867	326,460
4938121 Circuit	Total	372,994	438,135	309,504	1,120,633
Elcona	Heating	79,453	113,519	99,330	292,302
Substation,	Cooling	35,460	57,149	25,884	118,494
4938122 Circuit	Total	114,913	170,668	125,215	410,796
Elcona	Heating	242,780	261,541	222,291	726,612
Substation,	Cooling	175,656	217,257	147,855	540,769
4938123 Circuit	Total	418,436	478,798	370,146	1,267,381
Elcona Substation, All	Heating	584,365	671,464	557,258	1,813,087
	Cooling	321,979	416,137	247,607	985,723
Circuits	Total	906,344	1,087,602	804,864	2,798,810

			k Wh S	avings	
Circuit ID	Season	Phase A	Phase B	Phase C	Sum of Phases
Farmland	Heating	16,398	15,195	14,127	45,721
Substation,	Cooling	21,006	16,591	20,362	57,959
4927321 Circuit	Total	37,404	31,786	34,490	103,680
Farmland	Heating	15,074	5,624	16,918	37,615
Substation,	Cooling	5,476	2,136	4,860	12,471
4927322 Circuit	Total	20,549	7,759	21,777	50,086
Farmland	Heating	23,550	-26,127	-27,586	-30,162
Substation,	Cooling	24,436	21,667	6,153	52,256
4927323 Circuit	Total	47,986	-4,460	-21,432	22,094
Farmland	Heating	55,022	-5,308	3,459	53,173
Substation, All	Cooling	50,918	40,393	31,375	122,686
Circuits	Total	105,940	35,085	34,834	175,860

Table 5-4 PY2021 kWh Savings with VVO On by Season and Circuit: Farmland

Table 5-5 PY2021 kWh Savings with VVO On by Season and Circuit: Grabill

		k Wh Savings					
Circuit ID	Season	Phase A	Phase B	Phase C	Sum of Phases		
Grabill	Heating	69,583	103,678	102,302	275,564		
Substation,	Cooling	-5,280	3,495	11,069	9,284		
4935221 Circuit	Total	64,304	107,173	113,372	284,848		
Grabill	Heating	64,673	84,585	54,081	203,339		
Substation,	Cooling	94,193	67,838	53,323	215,354		
4935222 Circuit	Total	158,865	152,423	107,404	418,692		
Grabill	Heating	16,616	5,265	18,233	40,114		
Substation,	Cooling	13,060	15,633	17,546	46,239		
4935223 Circuit	Total	29,676	20,898	35,779	86,353		
Grabill	Heating	150,872	193,529	174,616	519,017		
Substation, All Circuits	Cooling	101,973	86,965	81,939	270,877		
	Total	252,845	280,494	256,555	789,894		

		k Wh Savings					
Circuit ID	Season	Phase A	Phase B	Phase C	Sum of Phases		
Hacienda	Heating	4,006	6,709	4,236	14,951		
Substation,	Cooling	8,900	11,290	7,619	27,809		
4933521 Circuit	Total	12,905	17,998	11,856	42,759		
Hacienda	Heating	2,520	4,102	3,202	9,824		
Substation,	Cooling	8,232	8,259	9,088	25,579		
4933523 Circuit	Total	10,752	12,361	12,289	35,402		
Hacienda	Heating	3,291	3,783	3,996	11,069		
Substation,	Cooling	9,554	10,068	10,567	30,189		
Circuit	Total	12,845	13,851	14,563	41,258		
Hacienda	Heating	-13,203	42,839	39,942	69,578		
Substation,	Cooling	29,877	50,121	53,285	133,283		
4933625 Circuit	Total	16,674	92,960	93,227	202,861		
Hacienda	Heating	23,074	26,234	40,823	90,131		
Substation,	Cooling	63,700	81,464	86,172	231,336		
4933626 Circuit	Total	86,774	107,698	126,995	321,467		
Hacienda	Heating	29,241	151,359	100,884	281,484		
Substation,	Cooling	24,689	42,836	45,292	112,817		
4933627 Circuit	Total	53,930	194,195	146,176	394,301		
Hacienda	Heating	48,929	235,024	193,084	477,037		
Substation, All	Cooling	144,952	204,038	212,023	561,012		
Circuits	Total	193,881	439,062	405,107	1,038,049		

Table 5-6 PY2021 kWh Savings with VVO On by Season and Circuit: Hacienda

Table 5-7 PY2021 kWh Savings with VVO On by Season and Circuit: Harper

Circuit ID		k Wh Savings					
	Season	Phase A	Phase B	Phase C	Sum of Phases		
Harper	Heating	64,554	63,323	68,606	196,482		
Substation, 4928821 Circuit	Cooling	54,999	66,755	50,804	172,557		
	Total	119,553	130,078	119,410	369,040		
Harper	Heating	17,475	26,013	29,968	73,457		
Substation,	Cooling	28,184	52,591	39,290	120,065		
4928822 Circuit	Total	45,659	78,604	69,258	193,521		
Harper Substation, All Circuits	Heating	82,029	89,336	98,574	269,939		
	Cooling	83,183	119,346	90,093	292,622		
	Total	165,212	208,682	188,667	562,561		

		kWh Savings					
Circuit ID	Season	Phase A	Phase B	Phase C	Sum of Phases		
Lincoln	Heating	4,910	9,732	24,876	39,518		
Substation,	Cooling	52,754	56,535	45,486	154,774		
4051821 Circuit	Total	57,664	66,267	70,362	194,293		
Lincoln	Heating	32,002	54,698	42,578	129,278		
Substation,	Cooling	27,098	25,767	23,166	76,032		
4051822 Circuit	Total	59,101	80,465	65,745	205,310		
Lincoln	Heating	27,676	22,936	18,054	68,666		
Substation,	Cooling	11,818	2,276	12,067	26,161		
4051824 Circuit	Total	39,493	25,212	30,121	94,827		
Lincoln	Heating	64,588	87,365	85,509	237,462		
Substation, All Circuits	Cooling	91,670	84,579	80,719	256,968		
	Total	156,257	171,944	166,228	494,430		

Tabla	58	DV2021	Ь Wh	Savinas	with	VVO	On h	Season	and	Circuit	Linco	In
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		kWh Savings					
Circuit ID	Season	Phase A	Phase B	Phase C	Sum of Phases		
McKinley	Heating	21,277	22,183	19,462	62,922		
Substation,	Cooling	21,522	10,880	13,295	45,696		
Circuit	Total	42,799	33,062	32,757	108,618		
McKinley	Heating	43,388	74,964	69,591	187,943		
Substation,	Cooling	-75,234	-108,204	-68,698	-252,137		
Circuit	Total	-31,846	-33,240	892	-64,194		
McKinley	Heating	105,850	87,183	95,636	288,669		
Substation,	Cooling	2,444	-7,273	2,277	-2,552		
Circuit	Total	108,294	79,911	97,913	286,118		
McKinley	Heating	148,907	170,056	220,174	539,136		
Substation,	Cooling	-25,092	-38,112	-15,432	-78,636		
Circuit	Total	123,815	131,944	204,741	460,500		
McKinley	Heating	65,049	71,372	37,761	174,182		
Substation, 40559B222	Cooling	23,896	16,834	28,327	69,057		
Circuit	Total	88,945	88,205	66,088	243,239		
McKinley	Heating	57,617	58,777	56,966	173,360		
Substation, 40559B226	Cooling	-20,646	-5,548	-11,253	-37,447		
Circuit	Total	36,971	53,229	45,713	135,913		
McKinley	Heating	442,088	484,534	499,590	1,426,212		
Substation, All	Cooling	-73,110	-131,423	-51,485	-256,018		
Circuits	Total	368,978	353,111	448,105	1,170,194		

Table 5-9 PY2021 kWh Savings with VVO On by Season and Circuit: McKinley

		k Wh Savings				
Circuit ID	Season	Phase A	Phase B	Phase C	Sum of Phases	
Northland	Heating	150,059	165,772	158,121	473,952	
Substation,	Cooling	53,996	56,569	50,719	161,284	
4933421 Circuit	Total	204,055	222,341	208,840	635,236	
Northland	Heating	11,199	22,480	23,948	57,627	
Substation,	Cooling	9,315	16,383	16,599	42,298	
4933422 Circuit	Total	20,515	38,863	40,547	99,925	
Northland	Heating	149,329	183,330	189,765	522,425	
Substation,	Cooling	34,834	40,911	34,541	110,286	
4933423 Circuit	Total	184,164	224,241	224,306	632,711	
Northland	Heating	221,644	275,671	240,517	737,832	
Substation,	Cooling	97,406	123,959	105,151	326,516	
Circuit	Total	319,050	399,630	345,668	1,064,348	
Northland	Heating	101,434	108,500	80,446	290,381	
Substation,	Cooling	68,726	47,336	81,849	197,911	
4933525 Circuit	Total	170,160	155,837	162,296	488,292	
Northland	Heating	32,135	45,691	40,364	118,190	
Substation,	Cooling	52,482	60,506	47,856	160,844	
4933526 Circuit	Total	84,618	106,196	88,220	279,034	
Northland	Heating	665,801	801,444	733,161	2,200,406	
Substation, All	Cooling	316,760	345,664	336,715	999,139	
Circuits	Total	982,561	1,147,108	1,069,877	3,199,545	

Table 5	-10 PY20	21 kWh	Savinos with	VVO On h	v Season	and Circuit	Northland
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		k Wh Savings				
Circuit ID	Season	Phase A	Phase B	Phase C	Sum of Phases	
Osolo	Heating	149,454	235,195	180,208	564,857	
Substation,	Cooling	10,239	87,108	25,725	123,073	
4058021 Circuit	Total	159,693	322,303	205,933	687,929	
Osolo	Heating	127,106	211,629	165,741	504,476	
Substation,	Cooling	30,089	89,991	65,641	185,721	
4058022 Circuit	Total	157,195	301,620	231,382	690,197	
Osolo	Heating	228,757	273,064	147,979	649,801	
Substation,	Cooling	16,858	85,162	27,856	129,876	
4058024 Circuit	Total	245,615	358,227	175,836	779,677	
Osolo	Heating	105,447	142,997	68,911	317,354	
Substation,	Cooling	26,279	34,354	-23,460	37,174	
4059023 Circuit	Total	131,726	177,351	45,451	354,528	
Osolo	Heating	73,756	64,792	46,094	184,643	
Substation,	Cooling	22,488	12,819	7,651	42,958	
4059025 Circuit	Total	96,245	77,611	53,745	227,601	
Osolo	Heating	220,404	148,763	93,867	463,034	
Substation,	Cooling	120,166	83,335	35,070	238,571	
4059026 Circuit	Total	340,570	232,097	128,937	701,605	
Osolo	Heating	904,924	1,076,439	702,801	2,684,165	
Substation, All	Cooling	226,120	392,770	138,483	757,372	
Circuits	Total	1,131,044	1,469,209	841,284	3,441,537	

Table 5-11 PY2021 kWh Savings with VVO On by Season and Circuit: Osolo

Table 5-12 PY2021 kWh Savings with VVO On by Season and Circuit: Pettit

		k Wh Savings					
Circuit ID	Season	Phase A	Phase B	Phase C	Sum of Phases		
Pettit	Heating	65,727	40,014	60,341	166,082		
Substation,	Cooling	39,952	22,355	26,334	88,642		
4917221 Circuit	Total	105,679	62,369	86,676	254,724		
Pettit	Heating	58,706	56,187	62,526	177,419		
Substation,	Cooling	39,817	36,616	46,575	123,008		
4917222 Circuit	Total	98,523	92,803	109,101	300,427		
Pettit	Heating	36,506	41,131	47,129	124,766		
Substation,	Cooling	11,134	11,233	12,262	34,628		
4917223 Circuit	Total	47,640	52,364	59,391	159,395		
Pettit	Heating	160,938	137,333	169,997	468,268		
Substation, All	Cooling	90,903	70,204	85,171	246,279		
Circuits	Total	251,841	207,537	255,168	714,546		

		kWh Savings					
Circuit ID	Season	Phase A	Phase B	Phase C	Sum of Phases		
South Bend	Heating	101,579	198,475	186,694	486,748		
Substation,	Cooling	43,442	48,216	61,610	153,268		
4050321 Circuit	Total	145,021	246,691	248,304	640,016		
South Bend	Heating	75,322	76,177	53,466	204,965		
Substation,	Cooling	39,176	50,285	24,645	114,106		
4050322 Circuit	Total	114,498	126,463	78,111	319,072		
South Bend	Heating	60,598	94,157	75,838	230,594		
Substation,	Cooling	33,436	61,209	26,752	121,397		
4050323 Circuit	Total	94,035	155,366	102,590	351,991		
South Bend	Heating	237,499	368,810	315,999	922,307		
Substation, All	Cooling	116,055	159,710	113,006	388,771		
Circuits	Total	353,553	528,520	429,005	1,311,078		

Table 5-13 PY2021 kWh Savings with VVO On by Season and Circuit: South Bend

Table 5-14 PY2021 kWh Savings with VVO On by Season and Circuit: Southside

		k Wh Savings					
Circuit ID	Season	Phase A	Phase B	Phase C	Sum of Phases		
Southside	Heating	76,126	129,482	109,684	315,293		
Substation,	Cooling	11,932	13,606	22,133	47,670		
4099921 Circuit	Total	88,058	143,088	131,817	362,963		
Southside	Heating	117,479	127,789	134,237	379,505		
Substation,	Cooling	36,831	29,028	42,113	107,972		
4099922 Circuit	Total	154,310	156,817	176,350	487,477		
Southside	Heating	82,724	119,069	98,397	300,190		
Substation,	Cooling	30,611	36,702	24,240	91,554		
4099923 Circuit	Total	113,335	155,771	122,638	391,744		
Southside	Heating	276,329	376,340	342,319	994,988		
Substation, All Circuits	Cooling	79,374	79,336	88,487	247,196		
	Total	355,703	455,676	430,805	1,242,184		

		k Wh Savings				
Circuit ID	Season	Phase A	Phase B	Phase C	Sum of Phases	
SouthsideSB	Heating	6,076	13,015	10,676	29,766	
Substation,	Cooling	4,597	6,416	6,520	17,533	
4094621 Circuit	Total	10,673	19,431	17,196	47,300	
SouthsideSB	Heating	119,307	90,746	124,650	334,703	
Substation,	Cooling	88,919	79,633	94,555	263,108	
4094622 Circuit	Total	208,227	170,379	219,205	597,811	
SouthsideSB	Heating	50,268	69,958	63,294	183,520	
Substation,	Cooling	37,998	42,836	31,076	111,909	
4094623 Circuit	Total	88,265	112,794	94,370	295,429	
SouthsideSB	Heating	18,539	32,297	35,123	85,960	
Substation,	Cooling	818	6,376	7,914	15,108	
4094624 Circuit	Total	19,357	38,673	43,037	101,067	
SouthsideSB	Heating	194,190	206,016	233,743	633,949	
Substation, All	Cooling	132,332	135,260	140,065	407,658	
Circuits	Total	326,522	341,277	373,808	1,041,607	

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Table 5-16 PY2021 kWh Savings with VVO On by Season and Circuit: Spy Run

		k Wh Savings				
Circuit ID	Season	Phase A	Phase B	Phase C	Sum of Phases	
Spyrun	Heating	0	0	0	0	
Substation, 4923321 Circuit	Cooling	0	0	0	0	
	Total	0	0	0	0	
Spyrun	Heating	0	0	0	0	
Substation,	Cooling	0	0	0	0	
4923322 Circuit	Total	0	0	0	0	
Spyrun Substation, All	Heating	0	0	0	0	
	Cooling	0	0	0	0	
Circuits	Total	0	0	0	0	

		kWh Savings				
Circuit ID	Season	Phase A	Phase B	Phase C	Sum of Phases	
State Street	Heating	35,770	28,963	30,908	95,640	
Substation,	Cooling	12,236	12,440	12,121	36,797	
4928721 Circuit	Total	48,005	41,403	43,029	132,437	
State Street Substation,	Heating	15,886	28,310	28,903	73,099	
	Cooling	11,014	11,813	9,854	32,680	
4928722 Circuit	Total	26,899	40,123	38,757	105,780	
State Street	Heating	16,892	17,816	19,018	53,726	
Substation,	Cooling	5,418	6,028	8,903	20,350	
4928723 Circuit	Total	22,311	23,844	27,921	74,076	
State Street	Heating	68,548	75,089	78,829	222,466	
Substation, All	Cooling	28,667	30,282	30,877	89,827	
Circuits	Total	97,215	105,371	109,706	312,292	

Table 5-17 PY2021 kWh .	Savings with	VVO On by Sea	ison and Circuit:	State Street
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Station	k Wh
Daleville	105,807
East Side	2,376,452
Elcona	2,798,810
Farmland	175,860
Grabill	789,894
Hacienda	1,038,049
Harper	562,561
Lincoln	494,430
McKinley	1,170,194
Northland	3,199,545
Osolo	3,441,537
Pettit	714,546
South Bend	1,311,078
Southside	1,242,184
SouthsideSB	1,041,607
Spyrun	0
State Street	312,292
Total	20,774,846

Table 5-18	PY2021	kWh	Savings with	VVO On	by Station
14010 5 10	1 12021	10 / / / /	Savings with	,,000	by Similon

5.2 Counterfactual kWh Savings had VVO Always Been "On"

The kWh savings determined for 2021 were used to project kWh savings associated with the counterfactual scenario of continuous "on" VVO operation during 2021. The results for this calculation are reported for each circuit in Table 5-19 through Table 5-35.<sup>8</sup> Counterfactual kWh savings by substation are presented in Table 5-36.

<sup>&</sup>lt;sup>8</sup> Estimates were not developed for circuits-season combinations for which no CVR factors were determined.

Circuit ID		k Wh Savings				
	Season	Phase A	Phase B	Phase C	Sum of Phases	
Daleville	Heating	32,911	95,778	194,882	323,571	
Substation,	Cooling	-69,323	-35,667	18,890	-86,100	
4927921 Circuit	Total	-36,412	60,111	213,772	237,471	
Daleville Substation,	Heating	28,556	41,675	23,310	93,541	
	Cooling	-46,463	-40,305	-42,418	-129,187	
4927922 Circuit	Total	-17,907	1,370	-19,109	-35,646	
Daleville	Heating	-30,109	-27,308	-11,330	-68,747	
Substation,	Cooling	-54,176	-77,137	-69,532	-200,845	
4927923 Circuit	Total	-84,285	-104,445	-80,862	-269,592	
Daleville	Heating	31,359	110,144	206,861	348,365	
Substation, All	Cooling	-169,963	-153,108	-93,061	-416,132	
Circuits	Total	-138,604	-42,964	113,801	-67,767	

# Table 5-19 Counterfactual PY2021 kWh Savings Has VVO Always Been On by Season and<br/>Circuit: East Side

			k Wh S	avings	
Circuit ID	Season	Phase A	Phase B	Phase C	Sum of Phases
East Side	Heating	37,717	53,506	48,008	139,232
Substation,	Cooling	10,844	16,888	14,550	42,281
Circuit	Total	48,561	70,394	62,558	181,513
East Side	Heating	91,569	116,025	111,773	319,367
Substation,	Cooling	58,053	59,829	61,626	179,508
Circuit	Total	149,622	175,854	173,399	498,875
East Side	Heating	66,156	129,210	110,544	305,910
Substation,	Cooling	112,862	139,717	122,355	374,934
4093123 Circuit	Total	179,018	268,928	232,899	680,844
East Side	Heating	134,236	156,707	192,945	483,889
Substation,	Cooling	130,742	101,487	126,213	358,442
Circuit	Total	264,978	258,194	319,158	842,330
East Side	Heating	100,616	110,182	82,978	293,777
Substation,	Cooling	115,152	124,708	118,568	358,428
Circuit	Total	215,769	234,891	201,545	652,205
East Side	Heating	61,402	99,559	114,266	275,227
Substation, 4093126 Circuit	Cooling	66,135	61,942	73,666	201,744
	Total	127,538	161,501	187,932	476,971
East Side	Heating	491,698	665,190	660,514	1,817,402
Substation, All	Cooling	493,787	504,572	516,977	1,515,336
Circuits	Total	985,485	1,169,762	1,177,491	3,332,738

# Table 5-20 Counterfactual PY2021 kWh Savings Has VVO Always Been On by Season and<br/>Circuit: East Side

Circuit ID		k Wh Savings				
	Season	Phase A	Phase B	Phase C	Sum of Phases	
Elcona	Heating	369,561	417,878	332,205	1,119,644	
Substation,	Cooling	141,750	181,217	94,448	417,415	
4938121 Circuit	Total	511,310	599,096	426,652	1,537,058	
Elcona Substation,	Heating	112,015	160,042	140,038	412,094	
	Cooling	45,340	73,071	33,096	151,507	
Circuit	Total	157,355	233,113	173,134	563,602	
Elcona	Heating	342,277	368,728	313,390	1,024,395	
Substation,	Cooling	224,596	277,785	189,050	691,431	
Circuit	Total	566,873	646,513	502,440	1,715,826	
Elcona	Heating	823,853	946,647	785,632	2,556,132	
Substation, All	Cooling	411,686	532,074	316,593	1,260,353	
Circuits	Total	1,235,539	1,478,721	1,102,226	3,816,486	

Table 5-21 Counterfactual PY2021 kWh Savings Has VVO Always Been On by Season and<br/>Circuit: Elcona

Table 5-22 Counterfactual PY2021 kWh Savings Has VVO Always Been On by Season and<br/>Circuit: Farmland

		kWh Savings					
Circuit ID	Season	Phase A	Phase B	Phase C	Sum of Phases		
Farmland	Heating	20,542	19,035	17,697	57,273		
Substation,	Cooling	48,085	37,977	46,612	132,675		
4927321 Circuit	Total	68,627	57,012	64,309	189,948		
Farmland Substation,	Heating	18,882	7,045	21,192	47,119		
	Cooling	12,535	4,889	11,124	28,548		
4927322 Circuit	Total	31,417	11,934	32,316	75,667		
Farmland	Heating	29,501	-32,728	-34,556	-37,784		
Substation,	Cooling	55,937	49,598	14,086	119,620		
4927323 Circuit	Total	85,438	16,869	-20,470	81,836		
Farmland	Heating	68,924	-6,649	4,333	66,609		
Substation, All	Cooling	116,557	92,464	71,822	280,843		
Circuits	Total	185,482	85,815	76,155	347,451		

Circuit ID		k Wh Savings				
	Season	Phase A	Phase B	Phase C	Sum of Phases	
Grabill	Heating	89,948	134,021	132,242	356,211	
Substation,	Cooling	-7,158	4,738	15,008	12,588	
4935221 Circuit	Total	82,790	138,759	147,250	368,799	
Grabill Substation,	Heating	83,600	109,340	69,909	262,849	
	Cooling	127,707	91,975	72,296	291,978	
4935222 Circuit	Total	211,307	201,314	142,205	554,826	
Grabill	Heating	21,479	6,806	23,569	51,854	
Substation,	Cooling	17,706	21,195	23,789	62,691	
4935223 Circuit	Total	39,185	28,001	47,358	114,545	
Grabill	Heating	195,027	250,168	225,720	670,914	
Substation, All	Cooling	138,256	117,908	111,093	367,256	
Circuits	Total	333,282	368,075	336,813	1,038,170	

# Table 5-23 Counterfactual PY2021 kWh Savings Has VVO Always Been On by Season and<br/>Circuit: Grabill

			k Wh S	kWh Savings		
Circuit ID	Season	Phase A	Phase B	Phase C	Sum of Phases	
Hacienda	Heating	7,052	11,810	7,458	26,320	
Substation,	Cooling	11,999	15,218	10,270	37,487	
4933521 Circuit	Total	19,051	27,028	17,728	63,807	
Hacienda	Heating	4,436	7,221	5,636	17,294	
Substation,	Cooling	11,099	11,132	12,250	34,481	
4933523 Circuit	Total	15,535	18,354	17,886	51,775	
Hacienda	Heating	5,793	6,659	7,034	19,486	
Substation,	Cooling	12,881	13,571	14,244	40,696	
Circuit	Total	18,675	20,230	21,278	60,183	
Hacienda	Heating	-17,423	56,532	52,710	91,819	
Substation,	Cooling	41,551	69,706	74,106	185,362	
4933625 Circuit	Total	24,128	126,237	126,816	277,181	
Hacienda	Heating	30,450	34,619	53,872	118,941	
Substation,	Cooling	88,579	113,283	119,828	321,691	
4933626 Circuit	Total	119,029	147,902	173,700	440,632	
Hacienda	Heating	38,588	199,739	133,132	371,459	
Substation,	Cooling	34,331	59,567	62,982	156,880	
4933627 Circuit	Total	72,919	259,306	196,114	528,340	
Hacienda	Heating	68,897	316,580	259,842	645,319	
Substation, All	Cooling	200,440	282,478	293,680	776,598	
Circuits	Total	269,337	599,057	553,522	1,421,917	

Table 5-24 Counterfactual PY2021 kWh Savings Has VVO Always Been On by Season and Circuit: Hacienda

Table 5-25 Counterfactual PY2021 kWh Savings Has VVO Always Been On by Season and Circuit: Harper

Circuit ID		k Wh Savings				
	Season	Phase A	Phase B	Phase C	Sum of Phases	
Harper	Heating	233,296	228,859	247,943	710,098	
Substation,	Cooling	90,104	109,364	83,231	282,698	
4928821 Circuit	Total	323,400	338,223	331,174	992,796	
Harper	Heating	63,155	94,017	108,305	265,476	
Substation,	Cooling	46,173	86,159	64,368	196,700	
4928822 Circuit	Total	109,328	180,176	172,673	462,177	
Harper Substation, All Circuits	Heating	296,451	322,876	356,248	975,574	
	Cooling	136,277	195,523	147,599	479,399	
	Total	432,728	518,398	503,847	1,454,973	

		k Wh Savings				
Circuit ID	Season	Phase A	Phase B	Phase C	Sum of Phases	
Lincoln	Heating	11,093	21,987	56,202	89,282	
Substation,	Cooling	96,331	103,235	83,059	282,625	
4051821 Circuit	Total	107,423	125,222	139,261	371,906	
Lincoln	Heating	72,300	123,575	96,194	292,070	
Substation,	Cooling	49,483	47,052	42,303	138,838	
4051822 Circuit	Total	121,783	170,627	138,497	430,908	
Lincoln	Heating	62,526	51,817	40,789	155,132	
Substation,	Cooling	21,580	4,157	22,035	47,771	
4051824 Circuit	Total	84,105	55,974	62,824	202,903	
Lincoln Substation, All Circuits	Heating	145,919	197,379	193,186	536,483	
	Cooling	167,393	154,444	147,397	469,234	
	Total	313,312	351,823	340,582	1,005,718	

# Table 5-26 Counterfactual PY2021 kWh Savings Has VVO Always Been On by Season and<br/>Circuit: Lincoln

		k Wh Savings				
Circuit ID	Season	Phase A	Phase B	Phase C	Sum of Phases	
McKinley	Heating	68,208	27,661	34,566	130,435	
Substation,	Cooling	115,657	35,084	40,753	191,493	
Circuit	Total	183,865	62,745	75,318	321,928	
McKinley	Heating	66,638	104,975	86,674	258,287	
Substation,	Cooling	9,962	15,404	23,291	48,657	
Circuit	Total	76,600	120,379	109,966	306,944	
McKinley	Heating	85,397	120,242	108,340	313,980	
Substation,	Cooling	61,358	66,765	71,162	199,285	
Circuit	Total	146,755	187,008	179,503	513,265	
McKinley	Heating	-189,948	-192,906	-118,759	-501,613	
Substation,	Cooling	7,657	28,960	61,306	97,923	
Circuit	Total	-182,291	-163,947	-57,453	-403,691	
McKinley	Heating	39,540	49,107	20,473	109,119	
Substation, 40559B222	Cooling	10,412	4,713	3,069	18,193	
Circuit	Total	49,951	53,820	23,542	127,313	
McKinley	Heating	103,652	113,613	98,066	315,332	
Substation, 40559B226 Circuit	Cooling	70,458	98,065	70,847	239,371	
	Total	174,110	211,678	168,914	554,703	
McKinlev	Heating	173,486	222,692	229,361	625,540	
Substation, All	Cooling	275,504	248,991	270,428	794,923	
Circuits	Total	448,990	471,683	499,789	1,420,463	

Table 5-27 Counterfactual PY2021 kWh Savings Has VVO Always Been On by Season and
Circuit: McKinley

		k Wh Savings				
Circuit ID	Season	Phase A	Phase B	Phase C	Sum of Phases	
Northland	Heating	204,880	226,333	215,887	647,100	
Substation,	Cooling	121,652	127,447	114,270	363,369	
Circuit	Total	326,532	353,781	330,157	1,010,469	
Northland	Heating	15,291	30,692	32,697	78,680	
Substation,	Cooling	20,987	36,911	37,397	95,296	
Circuit	Total	36,278	67,603	70,094	173,975	
Northland	Heating	203,883	250,306	259,092	713,281	
Substation,	Cooling	78,481	92,170	77,820	248,472	
Circuit	Total	282,364	342,476	336,912	961,753	
Northland	Heating	284,839	354,270	309,092	948,201	
Substation,	Cooling	150,670	191,741	162,648	505,059	
Circuit	Total	435,509	546,011	471,740	1,453,260	
Northland	Heating	130,355	139,436	103,382	373,173	
Substation, 4933525	Cooling	106,307	73,220	126,605	306,132	
Circuit	Total	236,662	212,656	229,988	679,305	
Northland	Heating	41,298	58,718	51,872	151,888	
Substation, 4933526 Circuit	Cooling	81,182	93,591	74,023	248,795	
	Total	122,479	152,309	125,896	400,684	
Northland	Heating	880,546	1,059,755	972,022	2,912,324	
Substation, All	Cooling	559,279	615,081	592,763	1,767,122	
Circuits	Total	1,439,825	1,674,836	1,564,785	4,679,446	

# Table 5-28 Counterfactual PY2021 kWh Savings Has VVO Always Been On by Season and<br/>Circuit: Northland

		kWh Savings					
Circuit ID	Season	Phase A	Phase B	Phase C	Sum of Phases		
Osolo	Heating	182,860	287,776	220,494	691,131		
Substation,	Cooling	13,564	115,392	34,078	163,034		
Circuit	Total	196,424	403,169	254,572	854,165		
Osolo	Heating	155,518	258,941	202,793	617,252		
Substation,	Cooling	39,859	119,211	86,954	246,024		
Circuit	Total	195,376	378,153	289,747	863,276		
Osolo	Heating	279,890	334,112	181,061	795,063		
Substation,	Cooling	22,332	112,814	36,901	172,047		
Circuit	Total	302,222	446,926	217,961	967,110		
Osolo	Heating	134,571	182,492	87,944	405,007		
Substation,	Cooling	37,327	48,797	-33,322	52,802		
Circuit	Total	171,898	231,289	54,622	457,809		
Osolo	Heating	94,128	82,687	58,826	235,640		
Substation, 4059025	Cooling	31,942	18,208	10,867	61,017		
Circuit	Total	126,070	100,895	69,693	296,658		
Osolo	Heating	281,279	189,850	119,793	590,923		
Substation, 4059026 Circuit	Cooling	170,683	118,370	49,813	338,866		
	Total	451,962	308,220	169,606	929,788		
Osolo	Heating	1,128,246	1,335,859	870,911	3,335,015		
Substation, All	Cooling	315,706	532,793	185,291	1,033,790		
Circuits	Total	1,443,952	1,868,652	1,056,201	4,368,805		

Table 5-29 Counterfactual PY2021 kWh Savings Has VVO Always Been On by Season and
Circuit: Osolo

		k Wh Savings			
Circuit ID	Season	Phase A	Phase B	Phase C	Sum of Phases
Pettit	Heating	76,761	46,732	70,471	193,964
Substation,	Cooling	58,253	32,595	38,398	129,246
4917221 Circuit	Total	135,015	79,327	108,869	323,211
Pettit	Heating	68,561	65,619	73,023	207,204
Substation,	Cooling	58,056	53,389	67,910	179,355
4917222 Circuit	Total	126,617	119,009	140,933	386,559
Pettit	Heating	42,635	48,036	55,041	145,712
Substation,	Cooling	16,233	16,378	17,879	50,491
4917223 Circuit	Total	58,868	64,414	72,920	196,203
Pettit Substation, All Circuits	Heating	187,957	160,387	198,536	546,880
	Cooling	132,543	102,363	124,187	359,093
	Total	320,500	262,750	322,723	905,973

Table 5-30 Counterfactual PY2021 kWh Savings Has VVO Always Been On by Season andCircuit: Pettit

Table 5-31 Counterfactual PY2021 kWh Savings Has VVO Always Been On by Season and<br/>Circuit: South Bend

		k Wh Savings				
Circuit ID	Season	Phase A	Phase B	Phase C	Sum of Phases	
South Bend	Heating	137,431	268,521	252,587	658,539	
Substation,	Cooling	69,373	76,997	98,386	244,756	
4050321 Circuit	Total	206,804	345,518	350,973	903,296	
South Bend	Heating	101,907	103,062	72,337	277,306	
Substation,	Cooling	62,561	80,301	39,355	182,218	
4050322 Circuit	Total	164,468	183,363	111,692	459,524	
South Bend	Heating	81,987	127,388	102,605	311,979	
Substation,	Cooling	53,395	97,746	42,720	193,861	
4050323 Circuit	Total	135,382	225,133	145,325	505,840	
South Bend Substation, All	Heating	321,325	498,971	427,528	1,247,824	
	Cooling	185,330	255,044	180,462	620,835	
Circuits	Total	506,654	754,015	607,990	1,868,660	

		k Wh Savings				
Circuit ID	Season	Phase A	Phase B	Phase C	Sum of Phases	
Southside	Heating	96,900	164,757	139,615	401,273	
Substation,	Cooling	14,952	17,046	27,733	59,731	
4099921 Circuit	Total	111,852	181,804	167,348	461,004	
Southside	Heating	149,538	162,602	170,868	483,009	
Substation,	Cooling	46,154	36,370	52,768	135,291	
4099922 Circuit	Total	195,691	198,972	223,636	618,299	
Southside	Heating	105,299	151,507	125,249	382,054	
Substation,	Cooling	38,360	45,985	30,373	114,717	
4099923 Circuit	Total	143,658	197,491	155,622	496,771	
Southside	Heating	351,737	478,867	435,732	1,266,336	
Substation, All	Cooling	99,465	99,401	110,873	309,739	
Circuits	Total	451,201	578,267	546,606	1,576,075	

Table 5-32 Counterfactual PY2021 kWh Savings Has VVO Always Been On by Season and<br/>Circuit: Southside

Table 5-33 Counterfactual PY2021 kWh Savings Has VVO Always Been On by Season and<br/>Circuit: SouthsideSB

			k Wh Savings			
Circuit ID	Season	Phase A	Phase B	Phase C	Sum of Phases	
SouthsideSB	Heating	9,053	19,392	15,906	44,351	
Substation,	Cooling	15,765	22,002	22,361	60,128	
4094621 Circuit	Total	24,818	41,395	38,267	104,479	
SouthsideSB	Heating	177,765	135,210	185,725	498,701	
Substation,	Cooling	304,938	273,091	324,266	902,295	
4094622 Circuit	Total	482,703	408,301	509,992	1,400,995	
SouthsideSB	Heating	74,898	104,236	94,307	273,441	
Substation,	Cooling	130,308	146,900	106,571	383,779	
4094623 Circuit	Total	205,206	251,136	200,878	657,220	
SouthsideSB	Heating	27,623	48,122	52,332	128,078	
Substation,	Cooling	2,805	21,866	27,139	51,809	
4094624 Circuit	Total	30,429	69,988	79,471	179,887	
SouthsideSB Substation, All	Heating	289,340	306,960	348,272	944,571	
	Cooling	453,816	463,859	480,336	1,398,011	
Circuits	Total	743,155	770,818	828,608	2,342,582	
Circuit ID		kWh Savings				
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	Season	Phase A	Phase B	Phase C	Sum of Phases	
Spyrun	Heating	0	0	0	0	
Substation,	Cooling	0	0	0	0	
4923321 Circuit	Total	0	0	0	0	
Spyrun	Heating	0	0	0	0	
Substation, 4923322 Circuit	Cooling	0	0	0	0	
	Total	0	0	0	0	
Spyrun Substation, All Circuits	Heating	0	0	0	0	
	Cooling	0	0	0	0	
	Total	0	0	0	0	

### Table 5-34 Counterfactual PY2021 kWh Savings Has VVO Always Been On by Season and Circuit: Spy Run<sup>9</sup>

<sup>&</sup>lt;sup>9</sup> No primary data is available to support estimation of what the Spy Run CVR factors would have been had VVO been on.

Circuit ID	Season	k Wh Savings				
		Phase A	Phase B	Phase C	Sum of Phases	
State Street	Heating	67,120	54,348	57,998	179,465	
Substation,	Cooling	37,445	38,072	37,094	112,611	
4928721 Circuit	Total	104,565	92,419	95,091	292,076	
State Street	Heating	29,809	53,123	54,236	137,168	
Substation,	Cooling	33,706	36,153	30,155	100,014	
4928722 Circuit	Total	63,515	89,276	84,391	237,181	
State Street Substation, 4928723 Circuit	Heating	31,698	33,430	35,686	100,814	
	Cooling	16,582	18,449	27,246	62,277	
	Total	48,280	51,879	62,933	163,092	
State Street	Heating	128,627	140,901	147,920	417,447	
Substation, All Circuits	Cooling	87,733	92,674	94,496	274,902	

Table 5-35 Counterfactual PY2021 kWh Savings Has VVO Always Been On by Season and<br/>Circuit: State Street

Table 5-36 Counterfactual PY2021 kWh Savings Has VVO Always Been On by Station

Station	k Wh
Daleville	-67,767
East Side	3,332,738
Elcona	3,816,486
Farmland	347,451
Grabill	1,038,170
Hacienda	1,421,917
Harper	1,454,973
Lincoln	1,005,718
McKinley	1,389,300
Northland	4,679,446
Osolo	4,368,805
Pettit	905,973
South Bend	1,868,660
Southside	1,576,075
SouthsideSB	2,342,582
Spyrun	0
State Street	692,349
Total	30,172,875

## 6. Peak Reduction

This chapter presents the results of the analysis of demand reduction occurring during I&M 5CP hours. Demand reductions are presented Table 6-1, accounting for those circuits that were "on" during the events.

		5/28/2019	6/28/2019	7/15/2019	8/5/2019	9/11/2019
Substation	Circuit	1:00 PM-	3:00 PM-	3:00 PM-	3:00 PM-	3:00 PM-
D 1 11	1005001	2:00 PM	4:00 PM	4:00 PM	4:00 PM	4:00 PM
Daleville	4927921	0.00	-16.99	-16.95	-17.29	-17.06
Daleville	4927922	0.00	-24.43	-24.86	-26.39	-24.26
Daleville	4927923	0.00	-40.78	-37.83	-38.21	-38.57
East Side	4093121	7.91	7.25	7.20	0.00	0.00
East Side	4093122	34.60	32.97	32.63	0.00	0.00
East Side	4093123	72.56	74.31	72.95	0.00	0.00
East Side	4093124	71.65	69.18	67.56	74.04	69.07
East Side	4093125	68.00	66.24	64.51	70.99	66.35
East Side	4093126	29.16	31.01	30.49	32.47	31.75
Elcona	4938121	70.01	79.30	69.67	89.91	83.53
Elcona	4938122	23.41	26.71	24.61	27.19	25.19
Elcona	4938123	122.20	127.74	119.00	126.55	121.11
Farmland	4927321	25.99	0.00	0.00	0.00	0.00
Farmland	4927322	4.93	0.00	0.00	0.00	0.00
Farmland	4927323	21.42	0.00	0.00	0.00	0.00
Grabill	4935221	2.21	2.38	2.34	2.59	2.21
Grabill	4935222	54.65	54.78	55.40	58.79	48.30
Grabill	4935223	11.60	10.54	11.37	11.31	9.24
Hacienda	4933521	0.00	6.53	7.18	7.25	5.68
Hacienda	4933523	0.00	6.34	7.02	7.46	5.75
Hacienda	4933524-1	0.00	7.37	8.36	8.46	6.41
Hacienda	4933625	35.77	31.63	34.31	34.84	0.00
Hacienda	4933626	62.79	56.55	63.73	66.24	0.00
Hacienda	4933627	26.38	25.95	26.15	27.12	0.00
Harper	4928821	49.31	49.40	50.04	53.37	46.35
Harper	4928822	35.98	36.30	38.23	40.17	34.14
Lincoln	4051821	49.17	46.23	46.51	48.52	45.43
Lincoln	4051822	24.89	23.63	24.37	25.31	21.26
Lincoln	4051824	8.08	8.08	7.91	8.29	7.57
McKinley	40559B123	0.00	22.50	23.17	23.65	19.39
McKinley	40559B124	0.00	-183.28	-99.08	-98.02	-92.08
McKinley	40559B125	0.00	-1.00	-1.23	-1.28	-1.05
McKinley	40559B221	-11.94	-14.90	-13.11	-15.54	-12.19
McKinley	40559B222	17.57	17.53	18.02	18.61	16.08

Table 6-1. kW Reduction during PY2021 I&M 5CP

		5/28/2019	6/28/2019	7/15/2019	8/5/2019	9/11/2019
Substation	Circuit	1:00 PM-	3:00 PM-	3:00 PM-	3:00 PM-	3:00 PM-
		2:00 PM	4:00 PM	4:00 PM	4:00 PM	4:00 PM
McKinley	40559B226	-6.41	-7.64	-7.82	-7.65	-7.91
Northland	4933421	0.00	74.29	59.34	75.94	75.05
Northland	4933422	0.00	18.56	18.84	19.40	18.50
Northland	4933423	0.00	46.78	40.23	48.48	47.60
Northland	4933524-2	93.51	0.00	86.82	95.04	89.47
Northland	4933525	58.40	0.00	55.64	60.02	50.44
Northland	4933526	50.50	0.00	45.99	51.13	45.97
Osolo	4058021	27.45	29.37	26.19	29.84	27.31
Osolo	4058022	49.28	49.95	47.00	51.22	49.25
Osolo	4058024	31.19	31.30	29.24	31.15	29.74
Osolo	4059023	9.71	9.66	9.47	10.52	9.51
Osolo	4059025	11.66	11.04	10.99	11.97	11.09
Osolo	4059026	54.51	61.13	52.56	71.25	61.47
Pettit	4917221	24.85	23.82	24.85	0.00	0.00
Pettit	4917222	31.71	30.88	31.99	0.00	0.00
Pettit	4917223	9.31	8.76	9.26	0.00	0.00
South Bend	4050321	43.27	42.11	41.85	45.03	42.01
South Bend	4050322	31.17	29.97	34.18	36.84	33.83
South Bend	4050323	32.89	30.65	28.78	31.09	29.61
Southside	4099921	10.50	11.02	10.40	10.92	8.68
Southside	4099922	25.73	26.70	23.36	25.51	20.48
Southside	4099923	19.07	21.99	19.72	27.09	15.78
SouthsideSB	4094621	0.00	0.00	0.00	0.00	0.00
SouthsideSB	4094622	0.00	0.00	0.00	0.00	0.00
SouthsideSB	4094623	0.00	0.00	0.00	0.00	0.00
SouthsideSB	4094624	0.00	0.00	0.00	0.00	0.00
Spyrun	4923321	0.00	0.00	0.00	0.00	0.00
Spyrun	4923322	0.00	0.00	0.00	0.00	0.00
State Street	4928721	0.00	0.00	21.33	22.96	19.07
State Street	4928722	0.00	0.00	21.38	22.62	18.44
State Street	4928723	0.00	0.00	12.82	13.01	10.70
Total		1,526.59	1,189.40	1,474.08	1,449.79	1,185.66

The summarized results for each during I&M 5CP event are presented in Table 6-1 below.

Date	Hour Start	Hour End	Ex Post Net kW Savings
7/28/2021	3:00 PM	4:00 PM	1,526.59
8/10/2021	2:00 PM	3:00 PM	1,189.40
8/23/2021	3:00 PM	4:00 PM	1,474.08
8/24/2021	1:00 PM	2:00 PM	1,449.79
8/26/2021	2:00 PM	3:00 PM	1,185.66
Maximum Pea	1,526.59		
AveragePeak	1,365.10		

Table 6-2. Summa	ry of k W	Reductions	during	I&M5CP	Events
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# 7. Appendix: Transition Tests

Through the EECO Program, I&M uses a system of devices, controls, software, and communications equipment to manage reactive power flow and lower voltage levels for selected distribution circuits. Energy savings are achieved during time periods when Conservation Voltage Reduction (CVR) equipment is in "on" mode. Typically, CVR equipment is in "off" mode during a proportion of days, allowing for the development of a counterfactual baseline to facilitate estimation of energy savings achieved through operation of CVR equipment.

Transition tests are instances in which CVR operation mode is turned "off" for several short intervals throughout the day (rather than turning it off for a full day). The change in load during these intervals (transition tests) may be used to estimate EECO Program energy savings. Figure 7-1 shows an example of how voltage changes over time during a typical successful transition test.



Figure 7-1 A Typical Transition Test

In order to develop a savings estimate from transition tests, the following activities were performed:

- Conduct transition tests;
- Identify and resolve any problems associated with conducting transition tests; and
- Determine the validity of impact evaluation results reliant on data associated with transition tests.

During PY2021, I&M's program implementation vendor Utilidata, Inc., implemented a transition testing protocol on a sample of EastSide, Farmland, and Pettit substation circuits. Table 7-1 shows the time periods in which transition tests were scheduled for each substation.

Substation	<b>Transition Tests Date</b>
Substation	Range
EastSide	05/10/2021 - 05/30/2021
EastSide	08/02/2021 - 08/22/2021
EastSide	09/13/2021 - 10/03/2021
EastSide	10/25/2021 - 11/14/2021
EastSide	12/06/2021 - 12/26/2021
Farmland	05/10/2021 - 05/30/2021
Farmland	08/02/2021 - 08/22/2021
Farmland	09/13/2021 - 10/03/2021
Farmland	10/25/2021 - 11/14/2021
Farmland	12/06/2021 - 12/26/2021
Pettit	05/10/2021 - 05/30/2021
Pettit	08/02/2021 - 08/22/2021
Pettit	09/13/2021 - 10/03/2021
Pettit	10/25/2021 - 11/14/2021
Pettit	12/06/2021 - 12/26/2021

Table 7-1: Scheduled Transition Tests by Substation

### 7.1 Transition Test Results

ADM was only able to calculate savings estimates from transition tests for one substation, EastSide, during PY2021 from the transition tests. It was not possible to calculate results for the Farmland substation due to all scheduled tests failing. ADM was also unable to calculate savings estimates for the Pettit substation due to a low number of successful tests as well as abnormal behavior during many of the successful tests (see Section 7.2 for more details). Table 7-1 shows the number of successful transition tests that occurred during the scheduled time periods for each substation.

Substation	Successful Transition Tests				
Substation	Heating Season	Cooling Season			
EastSide	102	53			
Farmland	0	0			
Pettit	46	0			

Table 7-2: Number of Successful Transition Tests per Substation

Table 7-3 shows the calculated results of analysis of the transition tests on the EastSide substation's circuits, as well as a comparison of the transition testing analysis results and the On/Off testing analysis results. While results are similar between the two methodologies (especially during the heating season) the transition test estimates show much greater variability in results for phases within the same circuit. This may indicate a greater sensitivity to atypical data observations and/or

a lack of robustness and consistency when compared to the typical On/Off methodology. That said, it is not workable to draw any conclusions based on the test data accrued thus far.

Circuit	Phase	Season	Transition Tests CVR Factor	ON/OFF CVR Factor
EastSide-4093121	А	Cooling	1.03	0.39
EastSide-4093121	В	Cooling	0.32	0.48
EastSide-4093121	С	Cooling	1.32	0.42
EastSide-4093122	А	Cooling	0.87	0.53
EastSide-4093122	В	Cooling	0.85	0.61
EastSide-4093122	С	Cooling	0.80	0.55
EastSide-4093123	А	Cooling	0.26	1.04
EastSide-4093123	В	Cooling	0.83	1.14
EastSide-4093123	С	Cooling	0.28	0.93
EastSide-4093121	А	Heating	1.32	1.18
EastSide-4093121	В	Heating	1.01	0.98
EastSide-4093121	С	Heating	1.29	1.23
EastSide-4093122	А	Heating	1.15	1.01
EastSide-4093122	В	Heating	1.10	1.06
EastSide-4093122	С	Heating	1.10	1.10
EastSide-4093123	А	Heating	0.89	0.83
EastSide-4093123	В	Heating	1.17	0.71
EastSide-4093123	С	Heating	0.98	0.85

Table 7-3: Transition Testing vs. On/Off Testing Results Comparison – EastSide Substation

#### 7.2 Abnormal Test Results

As stated in Section 7.1, ADM also identified abnormal test results that prevented use of the transition testing to reliably estimate CVR impacts. Even when a transition test did occur, there were often cases in which turning off CVR for the test period caused little to no change in the substation's voltage. This is shown visually in Figure 7-1 and Figure 7-2. Figure 7-1 shows an example of this. Note that the black vertical lines indicate the determined start and end times of the test. As shown, voltage slowly declines after the transition test completes.

In contrast to the expected result, voltage remained largely unchanged after the transition test for some of the tests. Figure 7-2 shows an example of this. It is clear that the transition test does occur successfully, but no significant change in voltage occurs.



Figure 7-2 Transition Test with No Significant Voltage Change

Several other tests showed changes in voltage that were strange and unexplainable. An example of this from one the circuits in the Pettit substation during PY2021 is shown in Figure 7-3.



*Figure 7-3: Transition Test with Unexplainable Voltage Changes* 

While these types of behavior occurred occasionally for tests conducted on the EastSide substation, it occurred for most tests conducted on the Pettit substation during PY2021. This made it impossible to calculate transition test savings estimates for the Pettit substation. This could be due to technical issues but could also be due to the specific types of devices being fed energy from the Pettit substation not responding to such a short period of CVR being turned off. This idea could be explored further given more successful tests across more substations in future years.

#### 7.3 Recommendations

Given the small number of tests during PY2021, there are not enough successful, usable tests to calculate an accurate savings estimate. ADM recommends the following for future performance of EECO transition testing.

Schedule More Transition Tests Across More Circuits: Given the small number of substations performing transition tests and small proportion of scheduled tests being successful, it is difficult for ADM to provide any useful information from the current set of calculated results. Having more substations participate in transition tests, and having more scheduled transition tests succeed, will help us draw more useful information from the results.

*Investigate Test Quality Issues*: ADM observed unexpected results for several tests, namely, limited voltage changes during the test period (suggesting the test was not performed as scheduled) and other unexpected outcomes outlined in section 0. ADM recommends the performance of further investigation of the causes of abnormal transition test outcomes and identification of potential solutions.

*Distribution of Transition Tests Across Year*: A weakness of the PY2021 testing protocol was that it was concentrated primarily during the first three months of the year. Future testing should be distributed across the calendar year.

*Timing of Transition Tests*: To enhance the likelihood of accurate estimates of energy savings, ADM recommends that four separate transition tests occur during each transition test day. The four time periods during which transition test should include the times of minimum and maximum circuit load (where it is expected that the change in power is minimal; red dots in Figure 7-4) and the times of maximum circuit load rate of change (green dots in Figure 7-4).





<sup>&</sup>lt;sup>10</sup> Pacific Northwest National Laboratory. (2014). Development of Method for Evaluating Benefits of Volt VAR Control and Verification of Benefit to Customer for American Electric Power Public Service Company of Oklahoma. Richland, Washington: Williams, T.L., Schneider, K.P.