Lessons Learned – The EV Project Greenhouse Gas (GHG) Avoidance and Cost Reduction

Prepared for the U.S. Department of Energy Award #DE-EE0002194

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Initial Issue: 05/30/2012

Revision 1.2 dated 7/2/2012

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Publication / Revision History

Version	Date of Issue	Author	Brief Description of Change(s)
1.0	5/30/2012	Dr. Jeffrey Wishart	Initial Issue
1.1	6/20/2012		Revised document title, title to the tables and minor formatting issues
1.2	7/2/2012		Revised document title.

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List of Acronyms

AC	Alternating Current
APS	Arizona Public Service
ARRA	American Recovery and Reinvestment Act
CAFE	Corporate Average Fuel Economy
CO_2	Carbon Dioxide
CH_4	Methane
DC	Direct Current
DCFC	DC Fast Charger
DOE	U.S. Department of Energy
EPA	Environmental Protection Agency
EV	Electric Vehicle
EVSE	Electric Vehicle Supply Equipment
GCV	Grid-Connected Vehicle
GHG	Greenhouse Gas
GWP	Global Warming Potential
HEV	Hybrid Electric Vehicle
ICEV	Internal Combustion Engine Vehicle
kW	Kilowatt
kWh	Kilowatt-hour
MSRP	Manufacturer's Suggested Retail Price
MPG	Miles per Gallon
N_2O	Nitrous Oxide
NHTSA	National Highway Traffic Safety Administration
OEM	Original Equipment Manufacturer
PEV	Plug-In Electric Vehicle
PHEV	Plug-in Hybrid Electric Vehicle
TCO	Total Cost of Ownership
TOU	Time-of-Use
TTW	Tank-to-Wheel
UCS	Union of Concerned Scientists
U.S.	United States
WTW	Well-to-wheel

1 Company Profile

ECOtality, Inc. (NASDAQ: ECTY), headquartered in San Francisco, California, is a leader in clean electric transportation and storage technologies. Its subsidiary, Electric Transportation Engineering Corporation (eTec) dba ECOtality North America (ECOtality), is the leading installer and provider of charging infrastructure for electric vehicles (EVs). ECOtality has been involved in every major EV or plug-in electric vehicle (PEV) initiative to date in North America and is currently working with major automotive manufacturers, utilities, the United States (U.S.) Department of Energy (DOE), state and municipal governments, and international research institutes to implement and expand the presence of this technology for a greener future.

ECOtality designed and currently manages the world's largest EV infrastructure demonstration - The EV Project. With a budget of over $230 million, The EV Project will deploy and study Level 2 alternating current (AC) electric vehicle supply equipment (EVSE) stations for residential use, Level 2 AC EVSE stations for commercial and direct current (DC) fast charge (DCFC) stations. This represents thousands of field assets, utilized in concert with the deployment of Nissan LEAF™ vehicles and Chevrolet Volt® vehicles.

The EV Project is a public and private partnership administered by the DOE through a federal stimulus grant, made possible by the American Recovery and Reinvestment Act (ARRA) and by the private investment of ECOtality and its partners.

The EV Project is an infrastructure study. The EV Project will deliver to ECOtality, the Government and the general public a wealth of directly-applicable technical and professional experience for jumpstarting regional EV adoption and replicating business models that lead to sustainable, market-based charge infrastructures.

One purpose of The EV Project is to identify potential barriers to the widespread adoption of EVs and the deployment of EVSE to support them. This process identifies topics of national interest in the early deployment of EV charging stations in order to facilitate discussion and resolution. This paper documents the issues associated with and The EV Project's approach to greenhouse gas (GHG) avoidance and reducing the cost for the owner.

2 Statement of Need

The EV Project involves the installation of, and usage data collection from, nearly 14,000 residential and publicly accessible grid-connected vehicle (GCV) charging infrastructure units. These units will support the deployment of vehicles by Nissan North American and General Motors in their partnership with ECOtality. Nissan North America will deploy up to 5,700 Nissan LEAF EVs and General Motors will deploy up to 2,600 Chevrolet Volt plug-in hybrid electric vehicles (PHEVs). The objective of The EV Project is to collect usage data from the deployed EVSEs to elucidate the charging behavior and habits of users, as well as the motivations and hindrances to EVSE and GCV ownership. To this end, it is important to consider the various factors that a prospective GCV owner will weigh when deciding to purchase a vehicle.

The benefits of EVs (and PHEVs, when in all-electric mode) include zero tailpipe emissions and reduction in costs for refueling. However, there are pervasive myths surrounding EVs that suggest the avoided tailpipe emissions are simply transferred to the power plant, and that the reduced fuel costs are balanced by the cost of electricity to charge the batteries.

A recent report by the Union of Concerned Scientists (UCS) examined this issue in detail[1]. The report compared the various grids throughout the U.S and calculated how the GHG emissions of an EV would compare with internal combustion engine vehicles (ICEVs) in the regions. The comparisons gave rise to three categories for how EVs fared: “Good”, “Better” and “Best”. These categories correspond to vehicles with the following fuel economies, respectively: 31-40 miles per gallon (mpg); 41-50 mpg; and greater than 50 mpg. The report states that 45% of the U.S. population lives in the “Best” regions, and in some of the cleanest regions, the GHG emissions avoided by driving an EV were equivalent to an ICEV that achieves over 70 mpg. Then, 37% live in the “Better” regions and 18% live in the “Good” regions. The report also looked at fuel-cost savings for the 50 largest cities in the U.S. for EVs versus ICEVs over the lifetime of vehicle ownership. For regions with the lowest-cost electricity rates, the yearly savings ranged from $750 to $1,200 (when compared against an ICEV with a 27 mpg fuel economy). In 44 out of the 50 cities, the standard electricity plan results in fuel-cost savings for EVs over even ICEVs that achieve 50 mpg. The only exceptions were in California, where time-of-use (TOU) rates were required to be used to meet the same GHG emissions avoided. The report is a very useful contribution in the effort to understand the various benefits of EV ownership.

[1] Union of Concerned Scientists (2012). “State of Charge: Electric Vehicles’ Global Warming Emissions and Fuel-Cost Savings across the United States”.

The purpose of this document is to further demonstrate that the myths surrounding EVs are false: EVs are both more environmentally friendly and cheaper to operate than conventional vehicles. There are several rationales for publishing this paper in light of the UCS study. First, the UCS study uses a well-to-wheel (WTW) analysis while this paper will use the more simplistic tank-to-wheel (TTW) technique. WTW analysis is still in its infancy, and as the boundary of the analysis grows, the confidence in the results decrease. The results of a TTW analysis may be more reliable. The UCS study examined regional grids while the current study is more granular and looks at individual states and ranks each in terms of the GHG-intensity of the electrical grid, that is, what quantity of GHGs are emitted for a given unit of electrical energy. This study also looks at per capita GHG emissions for the individual states and presents the per capita GHG emissions that would be avoided for EV ownership. The UCS study took an average gasoline cost while this study has attempted to use more contemporary numbers for the individual states to illustrate more starkly the differences across the regions. The total cost of ownership (TCO) is also included in this study, and not just fuel cost reductions. Finally, science progresses by replication or refutation of the results of other research groups, and this study was deemed to be another valuable contribution. A comparison of a representative EV with a representative ICEV with respect to GHG emissions and fuel costs is conducted below.

3 GHG Emissions Avoidance

In order to demonstrate that owning an EV will result in real GHG reductions (and that the tailpipe emissions are not transferred in their entirety to the power plant), the objective is to calculate the amount of GHGs avoided by charging (and driving) an EV as opposed to the emissions released when driving an ICEV (note that the ICEV can be either a conventional ICEV or a hybrid electric vehicle (HEV) since gasoline provides both with all of the off-board energy). As mentioned above, a full WTW analysis is possible, but considering the range of emission levels from the myriad sources, methods of extraction, and delivery of fossil fuels, it was decided that only direct combustion of the fossil fuels is to be considered in order to minimize the assumptions. The kilowatts per hour (kWh) of electricity consumed by the EV during the charge process—energy consumed from the grid—as well as the gasoline transferred to the ICEV will be considered. The following emissions associated with fossil fuel usage are omitted:

- Extraction of the fossil fuels
- Delivery of the fossil fuels
- Refinement of the fossil fuels
- Losses in transmission of the electricity

In order to minimize the controversy over this calculation, some of the assumptions are fairly conservative. Attempts have been made to use figures and conversions provided by U.S. government agencies with the expectation that these have been well vetted.

For the ICEV, the Corporate Average Fuel Economy (CAFE) value used for mid-size vehicles is 28.6 MPG, based on 2004 figures from the National Highway Traffic Safety Administration (NHTSA)[2]. This assumption masks the true average fuel economy of U.S. light-duty vehicles, which is much lower (according to the NHTSA, the average fuel economy for all light-duty vehicles was 24.6 in 2004).

The mid-sized Nissan LEAF will represent the EV. The emissions for the LEAF are those emitted in producing the electricity for the vehicle. The energy consumption for the LEAF according to the Environmental Protection Agency (EPA) tests is 340 kWh/mile (AC electricity)[3]. Thus, traveling 100 miles would require 34.0 kWh AC.

In the following sections, the GHG emissions avoided by using an EV rather than an ICEV are considered. It should be noted that the U.S. grid is introducing clean energy sources at a rapid rate. For example, wind power accounted for 39% of new power plant capacity installed in the U.S. in 2009[4]. Coal plant electricity production peaked in 2007 and has dropped by 3.2% per

[2] http://www.nhtsa.gov/cars/rules/CAFE/NewPassengerCarFleet.htm (Last accessed May 1, 2012)
[3] http://www.fueleconomy.gov (Last accessed May 1, 2012)
[4] http://www.greentechmedia.com/articles/read/whats-next-for-wind/ (Last accessed May 1, 2012)

year since[5]. If no emissions are released during the electricity production stage, the EV can be considered to be a zero-emission vehicle (if the embedded energy due to the production of vehicle and power plant are ignored). Thus, the avoided emissions calculated in this document represent only a snapshot in time, and the avoided emissions will grow quickly as clean energy sources continue to be introduced and more emission-intensive sources such as coal power are retired.

3.1 ICEV GHG Emissions

The GHGs associated with the ICEV will be considered first. The initial step is to determine the amount of GHGs that will be produced by the ICEV. Combusting one gallon of gasoline (perfectly) yields 19.60 lb-carbon dioxide (CO_2). However, CO_2 although the most significant, is not the only GHG released during the combustion of gasoline. The two other important GHGs released during combustion of gasoline are methane (CH_4) and nitrous oxide (N_2O). The unit pounds-of-CO_2-equivalent, or *lb-CO_2e*, is introduced to incorporate the effects of these other gases released when combusting gasoline. According to the EPA, the ratio of *CO_2* emissions to total emissions (including CO_2, CH_4, and N_2O, all expressed as *CO_2e*) for combustion of gasoline is 0.977[6]. Therefore, the rate of GHG emissions for the ICEV increases to 20.1 lb-CO_2e/gallons.

Over the course of 100 miles, the CO_2e emitted by the ICEV would be:

$$\begin{aligned} CO_2e\ emitted_{ICEV} &= \frac{100\ miles}{28.6\ mpg} \cdot 20.1 \frac{lb - CO_2e}{gallon} \\ &= 70.3\ lb - CO_2e \end{aligned} \quad (1)$$

3.2 EV GHG Emissions

The emissions are estimated for the U.S. grids as well as the individual are stated below.

3.2.1 U.S. Grid Average

The GHG emissions associated with the Nissan LEAF will now be considered. Generating one kWh AC of electricity on the U.S. grid generates, on average, 1.52 lb-CO_2 (non-base load values are used in this calculation since electricity usage reductions generally lower this type of generation and not base load generation)[7]. Again, the emissions must be converted to *lb-CO_2e* to account for the other GHGs that are emitted in the electricity production process, although the calculation will be done differently than for the ICEV above. Here, the 'global warming potential'

5 http://www.eia.gov/energyexplained/index.cfm?page=electricity_in_the_united_states (Last accessed May 1, 2012)
6 http://www.epa.gov/cleanenergy/energy-resources/refs.html (Last accessed May 1, 2012)

7 http://www.epa.gov/ttn/chief/conference/ei18/session5/rothschild.pdf (Last accessed May 1, 2012)

(GWP), which is a measure of the relative strength of a GHG (where CO_2, has a GWP of 1), of CH_4 is defined as 23 and that of N_2O as 296[8]. The rates of CH_4 and N_2O emissions for the U.S. grid are, on average, 32.23 lb-CH_4/GWh and 18.41 lb-N_2O/GWh, respectively. Accounting for the contribution of the non-CO_2 GHGs increases the rate to 1.53 lb-CO_2e per kWh of electricity produced. The amount of CO_2 e emitted to produce the amount of electricity required to travel 100 miles would be:

$$\begin{aligned} CO_2e\ emitted_{EV} &= 34.0\ kWh \cdot 1.53\ \frac{lb-CO_2e}{kWh} \\ &= 52.0\ lb-CO_2e \end{aligned} \qquad (2)$$

The CO_2e avoided by charging an EV rather than using gasoline in an ICEV can now be calculated:

$$\begin{aligned} CO_2e\ avoided &= CO_2e\ emitted_{ICEV} - CO_2e\ emitted_{EV} \\ &= 70.3\ lb-CO_2e - 52.0\ lb-CO_2e \\ &= 18.3\ lb-CO_2e \end{aligned} \qquad (3)$$

The generic equation for the amount of CO_2e avoided by driving an EV rather than an ICEV, as it relates to the amount of AC electricity used by the EV is then:

$$\boldsymbol{CO_2e\ avoided = X\ kWh \times 0.54\ \frac{lb\text{-}CO_2e}{kWh}} \qquad (4)$$

The 0.54 lb-CO_2e/kWh is called the 'multiplication factor' and is used to determine the GHG emissions avoided by an EV by simply multiplying by the amount of AC electricity that is used. As long as the multiplication factor is positive, the EV will emit fewer GHG emissions than an ICEV that achieves a fuel economy of 28.6 mpg.

The total of U.S. emissions in 2005 was 5.8 billion metric tons of CO_2 (CO_2e numbers were not available), and the population in that year was estimated to be 280,852,543, for a per capita emission value of 20.6 tons. If the Nissan LEAF were to be driven 12,000 miles per year, then this would mean that the total amount of energy used by the vehicle battery would be 4080 kWh (AC). Therefore, the amount of avoided CO_2 in a full year would be 1.0 metric tons, or 5% of the total per capita emissions of the average U.S. resident driving the CAFE-averaged mid-size vehicle.

[8] IPCC AR4 Working Group 1 report, http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html#table-2-14 (Last accessed May 1, 2012)

In order for an ICEV to achieve the same level of GHG emissions as the Nissan LEAF (with the U.S. average grid), Equation (1) can be used to determine that the fuel economy required would be 38.7 mpg. A generic equation can be derived so that both the fuel economy (Y, in mpg) of the ICEV and the electricity consumption (Z, in Wh/mile) of the EV can be input with the U.S. average grid numbers to obtain the CO_2e avoided:

$$CO_2e\ avoided = \frac{2010}{Y\ mpg} - Z\ {}^{Wh}/_{mi} \times 0.153 \qquad (5)$$

Equation 4 will be used throughout the rest of the document, meaning that the fuel economy of the ICEV is fixed at 28.6 mpg.

3.2.2 State Grid Averages

The real advantages of the Nissan LEAF become clearer when individual states are considered. Generating one kWh AC of electricity in each state generates the CO_2, CH_4, and N_2O values contained in Table 3-1 (2005 data) [9]. A total value in units of *lb-CO_2e* per kWh AC is presented as well, in the right-most column for each state. The states are listed from the least carbon intensive (in terms of electricity production) to the most carbon intensive. To skip the details of the calculations, the results for the avoided emissions for residents of each state is presented in Table 3-1.

Table 3-1 State and National Electricity Production Emission Rates

State	Electricity Production Emission Rates (non-base load)			
	CO_2 (lb/MWh)	CH_4 (lb/GWh)	N_2O (lb/GWh)	CO_{2e} (lb/kWh)
Vermont	173.96	1,016.50	136.04	0.24
Idaho	653.57	72.11	13.81	0.66
Oregon	999.75	42.47	11.1	1.00
Rhode Island	1,053.31	21.14	2.2	1.05
California	1,061.13	39.98	4.9	1.06
Texas	1,138.47	20.71	5.83	1.14
Arizona	1,175.38	20.04	9.39	1.18
Washington	1,240.81	71.56	21.36	1.25
Nevada	1,254.35	22.07	7.26	1.26
Maine	1,261.17	264	37.23	1.28
Oklahoma	1,293.63	21.57	10.08	1.30
Louisiana	1,294.94	27.53	10.02	1.30
Massachusetts	1,295.66	44.94	12.48	1.30
New Hampshire	1,362.59	63.24	15.84	1.37

[9] http://www.eredux.com/states/index.php (Last accessed May 1, 2012)

Table 3-1 State and National Electricity Production Emission Rates (Continued)

State	Electricity Production Emission Rates (non-base load)			
	CO_2 (lb/MWh)	CH_4 (lb/GWh)	N_2O (lb/GWh)	CO_{2e} (lb/kWh)
Florida	1,382.92	47.46	14.04	1.39
New Jersey	1,464.80	35.42	17.03	1.47
Alaska	1,470.56	40.63	8.87	1.47
Mississippi	1,473.67	29.27	16.86	1.48
New Mexico	1,480.82	24.85	10.41	1.48
Connecticut	1,478.77	77.68	17.37	1.49
New York	1,517.76	51.98	13.83	1.52
Arkansas	1,572.16	45.7	24.18	1.58
Colorado	1,606.13	22.1	20.35	1.61
Virginia	1,612.42	55.13	24.39	1.62
Georgia	1,654.63	33.18	24.93	1.66
Michigan	1,698.29	29.59	26.93	1.71
Alabama	1,723.00	41.29	28.23	1.73
South Carolina	1,760.87	28.36	25.34	1.77
Wisconsin	1,789.46	36.34	25.23	1.80
Hawaii	1,800.75	185.69	29.99	1.81
Utah	1,838.57	24.47	24.85	1.85
Pennsylvania	1,845.16	34.63	25.71	1.85
Delaware	1,947.85	39.23	23.37	1.96
North Carolina	1,952.11	29.8	31.41	1.96
Maryland	1,964.52	50.19	31.08	1.98
West Virginia	1,965.62	22.52	33.1	1.98
Ohio	1,988.51	24.17	32.48	2.00
Missouri	2,031.97	25.04	31.25	2.04
Tennessee	2,050.63	26.41	34.99	2.06
Illinois	2,097.08	25.51	32.78	2.11
Minnesota	2,102.88	72.75	36.74	2.12
Kentucky	2,113.67	25.68	35.31	2.12
Indiana	2,120.76	25.55	33.93	2.13

Table 3-1 State and National Electricity Production Emission Rates (Continued)

State	Electricity Production Emission Rates (non-base load)			
	CO_2 (lb/MWh)	CH_4 (lb/GWh)	N_2O (lb/GWh)	CO_{2e} (lb/kWh)
Wyoming	2,141.24	25.98	33.46	2.15
Nebraska	2,172.49	29.03	29.49	2.18
South Dakota	2,224.28	29.49	29.9	2.23
Iowa	2,240.01	27.16	36.15	2.25
Kansas	2,351.42	37.22	34.58	2.36
Washington D.C.	2,432.30	104.97	21	2.44
North Dakota	2,508.90	41	41.71	2.52
Montana	2,760.93	75.25	50.35	2.78
U.S	**1,520.11**	**32.23**	**18.41**	**1.53**

Using Equation (2) for each of the lb-CO_2e/kWh values in Table 3-1, the amount of CO_2e emitted in producing the amount of electricity required to travel 100 miles in the Nissan LEAF for all of the states can be calculated. The results are presented below in Table 3-2, again in the order from the least GHG-intensive states to the most.

Table 3-2 Emissions for 100 Miles of Travel in Nissan LEAF for Each State and the Nation

State	Emissions for 100 Miles of Nissan LEAF Travel (lb-CO_2e)	State	Emissions for 100 Miles of Nissan LEAF Travel (lb-CO_2e)
Vermont	8.2	Alabama	58.9
Idaho	22.4	South Carolina	60.2
Oregon	34.1	Wisconsin	61.1
Rhode Island	35.9	Hawaii	61.7
California	36.2	Utah	62.8
Texas	38.8	Pennsylvania	63.0
Arizona	40.1	Delaware	66.5
Washington	42.5	North Carolina	66.7
Nevada	42.7	Maryland	67.2
Maine	43.5	West Virginia	67.2
Oklahoma	44.1	Ohio	68.0
Louisiana	44.2	Missouri	69.4
Massachusetts	44.2	Tennessee	70.1

Table 3-2 Emissions for 100 Miles of Travel in Nissan LEAF for Each State and the Nation (Continued)

State	Emissions for 100 Miles of Nissan LEAF Travel (lb-CO2e)	State	Emissions for 100 Miles of Nissan LEAF Travel (lb-CO2e)
New Hampshire	46.5	Illinois	71.7
Florida	47.2	Minnesota	71.9
New Jersey	50.0	Kentucky	72.2
Alaska	50.1	Indiana	72.5
Mississippi	50.3	Wyoming	73.2
New Mexico	50.5	Nebraska	74.2
Connecticut	50.5	South Dakota	76.0
New York	51.8	Iowa	76.5
Arkansas	53.7	Kansas	80.3
Colorado	54.8	Washington D.C.	83.0
Virginia	55.1	North Dakota	85.8
Georgia	56.5	Montana	94.4
Michigan	58.0	**U.S**	**52.0**

Using Equation (3), the CO_2e avoided by charging an EV rather than using gasoline in an ICEV can now be calculated for all of the states, and the results are presented below in Table 3-3, from least to most GHG-intensive. From the table, it is apparent that the EV GHG emissions are lower for most states, but there are states where the average ICEV mid-size vehicle emits fewer GHGs (i.e. the avoided emissions is a negative number). These regions account for a total of 13.1% of the total U.S. population, meaning that for the vast majority of U.S. residents, an EV will emit fewer GHG emissions than will an ICEV. Furthermore, the average vehicle driven in these states may not be comparable to the representative ICEV used in these calculations.

Table 3-3 Avoided Emissions for 100 Miles of Nissan LEAF Driving for Each State and the Nation

State	**Avoided Emissions (lb-CO_2e)**	**State**	**Avoided Emissions (lb-CO_2e)**
Vermont	62.1	Alabama	11.4
Idaho	47.9	South Carolina	10.1
Oregon	36.2	Wisconsin	9.2
Rhode Island	34.4	Hawaii	8.6

Table 3-3 Avoided Emissions for 100 Miles of Nissan LEAF Driving for Each State and the Nation (Continued)

State	Avoided Emissions (lb-CO2e)	State	Avoided Emissions (lb-CO2e)
California	34.1	Utah	7.5
Texas	31.5	Pennsylvania	7.3
Arizona	30.2	Delaware	3.8
Washington	27.8	North Carolina	3.6
Nevada	27.6	Maryland	3.1
Maine	26.8	West Virginia	3.1
Oklahoma	26.2	Ohio	2.3
Louisiana	26.1	Missouri	0.9
Massachusetts	26.1	Tennessee	0.2
New Hampshire	23.8	Illinois	-1.4
Florida	23.1	Minnesota	-1.6
New Jersey	20.3	Kentucky	-1.9
Alaska	20.2	Indiana	-2.2
Mississippi	20.0	Wyoming	-2.9
New Mexico	19.8	Nebraska	-3.9
Connecticut	19.8	South Dakota	-5.7
New York	18.5	Iowa	-6.2
Arkansas	16.6	Kansas	-10.0
Colorado	15.5	Washington D.C.	-12.7
Virginia	15.2	North Dakota	-15.5
Georgia	13.8	Montana	-24.1
Michigan	12.3	**U.S**	**18.3**

The multiplication factor for the amount of CO_2e avoided per unit of AC electricity used in the form of Equation (4) is then calculated, and is presented in for each state below in Table 3-4. The values for the states (from Illinois to Montana in the right-hand columns), where the EV will emit more GHG emissions than an ICEV, are given as a negative avoidance multiplication factor in Table 3-4.

Table 3-4 Multiplication Factor for Avoided Emissions for Each State and the Nation

State	Multiplication Factor (lb-CO_2e/kWh)	State	Multiplication Factor (lb-CO_2e/kWh)
Vermont	1.83	Alabama	0.34
Idaho	1.41	South Carolina	0.30
Oregon	1.06	Wisconsin	0.27
Rhode Island	1.01	Hawaii	0.25
California	1.00	Utah	0.22
Texas	0.93	Pennsylvania	0.21
Arizona	0.89	Delaware	0.11
Washington	0.82	North Carolina	0.11
Nevada	0.81	Maryland	0.09
Maine	0.79	West Virginia	0.09
Oklahoma	0.77	Ohio	0.07
Louisiana	0.77	Missouri	0.03
Massachusetts	0.77	Tennessee	0.01
New Hampshire	0.70	Illinois	-0.04
Florida	0.68	Minnesota	-0.05
New Jersey	0.60	Kentucky	-0.06
Alaska	0.59	Indiana	-0.06
Mississippi	0.59	Wyoming	-0.09
New Mexico	0.58	Nebraska	-0.11
Connecticut	0.58	South Dakota	-0.17
New York	0.54	Iowa	-0.18
Arkansas	0.49	Kansas	-0.29
Colorado	0.46	Washington D.C.	-0.37
Virginia	0.45	North Dakota	-0.46
Georgia	0.41	Montana	-0.71
Michigan	0.36	**U.S**	**0.54**

The total and per capita emissions for all states are presented in Table 3-5, from the least to the most GHG intensive (again, CO_2e values are not available)[9]. Using the same amount of energy of 4080 AC kWh to power the Nissan LEAF for one year (for 12,000 miles of driving), the percentage of emissions that the use of the EV would reduce for the average resident of each state can be calculated. The amount of avoided CO_2e in a full year (by driving an EV) and the percentage of the total emissions for the residents of each state are also provided below in Table 3-5. The state where the Nissan LEAF will make the biggest difference in terms of CO_2e avoidance is Vermont, where the avoided emissions are 31.9% of the average Vermont resident yearly per capita emissions. The avoided emissions are highest because this state has the lowest carbon intensity and a low total emissions value. Conversely, Montana has the highest carbon intensity and an EV owner would see an increase of 3.6% in yearly per capita GHG emissions.

Table 3-5 Total and Per Capita Emissions Avoided for Residents of Each State and the Nation

State	Total CO_2 Emissions (million metric tons/year)	Per Capita CO_2 Emissions (million metric tons/year)	Yearly Avoided Emissions (tons-CO_2e)	Percentage Reduction of Yearly Per Capita GHG Emissions
Vermont	6.5	10.6	3.4	31.9%
Idaho	14.2	11.0	2.6	23.8%
Oregon	40.4	11.8	2.0	16.7%
Rhode Island	11.4	10.8	1.9	17.4%
California	389.0	11.5	1.9	16.2%
Texas	670.2	32.1	1.7	5.3%
Arizona	88.8	17.3	1.6	9.5%
Washington	78.7	13.3	1.5	11.4%
Nevada	43.3	21.7	1.5	6.9%
Maine	23.3	18.3	1.5	8.0%
Oklahoma	103.3	29.9	1.4	4.8%
Louisiana	179.1	40.1	1.4	3.6%
Massachusetts	87.0	13.7	1.4	10.4%
New Hampshire	20.5	16.6	1.3	7.8%
Florida	243.9	15.3	1.3	8.3%
New Jersey	123.7	14.7	1.1	7.5%
Alaska	44.8	71.4	1.1	1.5%
Mississippi	62.1	21.8	1.1	5.0%
New Mexico	57.6	31.7	1.1	3.4%
Connecticut	42.4	12.4	1.1	8.7%
New York	214.3	11.3	1.0	8.9%
Arkansas	62.4	23.3	0.9	3.9%

Table 3-5 Total and Per Capita Emissions Avoided for Residents of Each State and the Nation (Continued)

State	Total CO2 Emissions (million metric tons/year)	Per Capita CO2 Emissions (million metric tons/year)	Yearly Avoided Emissions (tons-CO2e)	Percentage Reduction of Yearly Per Capita GHG Emissions
Colorado	89.7	20.9	0.8	4.0%
Virginia	122.6	17.3	0.8	4.8%
Georgia	168.0	20.5	0.8	3.7%
Michigan	184.9	18.6	0.7	3.6%
Alabama	136.0	30.6	0.6	2.0%
South Carolina	79.2	19.7	0.6	2.8%
Wisconsin	104.8	19.5	0.5	2.6%
Hawaii	21.5	17.8	0.5	2.6%
Utah	62.4	27.9	0.4	1.5%
Pennsylvania	271.4	22.1	0.4	1.8%
Delaware	17.2	21.9	0.2	0.9%
North Carolina	146.2	18.2	0.2	1.1%
Maryland	78.8	14.9	0.2	1.2%
West Virginia	114.4	63.3	0.2	0.3%
Ohio	265.5	23.4	0.1	0.5%
Missouri	137.2	24.5	0.0	0.2%
Tennessee	120.1	21.1	0.0	0.1%
Illinois	230.0	18.5	-0.1	-0.4%
Minnesota	102.4	20.8	-0.1	-0.4%
Kentucky	143.0	35.4	-0.1	-0.3%
Indiana	235.1	38.7	-0.1	-0.3%
Wyoming	62.9	127.3	-0.2	-0.1%
Nebraska	43.2	25.2	-0.2	-0.8%
South Dakota	13.7	18.1	-0.3	-1.7%
Iowa	78.9	27.0	-0.3	-1.3%
Kansas	79.9	29.7	-0.5	-1.8%
Washington D.C.	N/A	25.1[10]	-0.7[10*]	-2.7%[10*]
North Dakota	50.7	79.0	-0.8	-1.1%

10 http://www.e3network.org/papers/Why_do_state_emissions_differ_so_widely.pdf (Last accessed May 1, 2012)

Table 3-5 Total and Per Capita Emissions Avoided for Residents of Each State and the Nation (Continued)

State	Total CO2 Emissions (million metric tons/year)	Per Capita CO2 Emissions (million metric tons/year)	Yearly Avoided Emissions (tons-CO2e)	Percentage Reduction of Yearly Per Capita GHG Emissions
Montana	32.7	36.2	-1.3	-3.6%
U.S	**5800**	**20.6**	**1.0**	**4.8%**

4 Fuel and Ownership Cost Reduction

In addition to emissions reduction, an analysis of the fuel costs and TCO of an EV versus those of a conventional ICEV is important since these costs will be a major factor in the adoption of EVs into the transportation fleet.

4.1 Fuel Costs

The average price for gasoline (on May 1, 2012) is provided for each state and for the nation below in Table 4-1. Using the fleet average of ICEVs and hybrid electric vehicles (HEVs) (28.6 mpg), the annual cost to travel 12,000 miles is estimated and presented in the table for the state and national averages. On May 1, 2012, the average U.S. cost per gallon for regular gasoline ($3.809)[11] results in an annual cost of $1598.18. Using the calculated AC consumption per mile for the Nissan LEAF EV (340 Wh/mile) over 12,000 miles and the average U.S. electricity cost per kWh in 2010 ($0.0983)[12] results in an annual cost of $401.06. Therefore, the "fuel" costs of the Nissan LEAF are 75% less than those for the fleet average vehicle and the yearly savings would be $1,197.12. The largest savings across the country would be experienced by a resident of the state of Washington, where an owner of a mid-sized vehicle would enjoy $1,437.22 in savings. The smallest savings across the country would be experienced by a resident of Hawaii, with an annual savings of $895.94. Even though the cost of gasoline in Hawaii is the highest in the country, the electricity costs are also the highest by an even larger margin. The cost of gasoline in May has historically been higher than the yearly average, but it is felt that gasoline costs are likely to remain elevated and will not return to the sub-$3.00/gallon costs of the past.

Table 4-1 State and National Annual EV Fuel Savings (May 1, 2012)

State	Average Gasoline Price[11]	Average Annual ICEV Fuel Costs	Average Retail Price, Residential Electricity[12] (cents/kWh)	Average Annual EV Electricity Costs	Annual EV Savings
Alabama	$3.66	$1,536.92	8.89	$362.71	$1,174.21
Alaska	$4.36	$1,829.37	14.76	$602.21	$1,227.16
Arizona	$3.83	$1,606.15	9.69	$395.35	$1,210.80
Arkansas	$3.61	$1,515.94	7.28	$297.02	$1,218.92
California	$4.16	$1,746.29	13.01	$530.81	$1,215.49
Colorado	$3.87	$1,622.94	9.15	$373.32	$1,249.62
Connecticut	$4.10	$1,719.44	17.39	$709.51	$1,009.93
Delaware	$3.77	$1,579.72	11.97	$488.38	$1,091.34
Florida	$3.79	$1,588.53	10.58	$431.66	$1,156.87

11 http://www.fuelgaugereport.com/ (Last accessed May 1, 2012)

12 http://www.eia.gov/cneaf/electricity/st_profiles/e_profiles_sum.html (Last accessed May 1, 2012)

Table 4-1 State and National Annual EV Fuel Savings (May 1, 2012) (Continued)

State	Average Gasoline Price[11]	Average Annual ICEV Fuel Costs	Average Retail Price, Residential Electricity[12] (cents/kWh)	Average Annual EV Electricity Costs	Annual EV Savings
Georgia	$3.68	$1,541.96	8.87	$361.90	$1,180.06
Hawaii	$4.58	$1,920.84	25.12	$1,024.90	$895.94
Idaho	$3.77	$1,582.24	6.54	$266.83	$1,315.41
Illinois	$4.00	$1,679.58	9.13	$372.50	$1,307.08
Indiana	$3.84	$1,612.87	7.67	$312.94	$1,299.93
Iowa	$3.61	$1,515.52	7.66	$312.53	$1,203.00
Kansas	$3.58	$1,502.10	8.35	$340.68	$1,161.42
Kentucky	$3.73	$1,565.03	6.73	$274.58	$1,290.45
Louisiana	$3.69	$1,546.57	7.8	$318.24	$1,228.33
Maine	$3.90	$1,637.62	12.84	$523.87	$1,113.75
Maryland	$3.82	$1,601.12	12.7	$518.16	$1,082.96
Massachusetts	$3.87	$1,622.10	14.26	$581.81	$1,040.29
Michigan	$3.82	$1,602.38	9.88	$403.10	$1,199.27
Minnesota	$3.70	$1,553.29	8.41	$343.13	$1,210.16
Mississippi	$3.67	$1,539.86	8.59	$350.47	$1,189.39
Missouri	$3.54	$1,483.22	7.78	$317.42	$1,165.79
Montana	$3.77	$1,581.82	7.88	$321.50	$1,260.31
Nebraska	$3.69	$1,546.99	7.52	$306.82	$1,240.18
Nevada	$3.92	$1,643.50	9.73	$396.98	$1,246.51
New Hampshire	$3.82	$1,603.64	14.84	$605.47	$998.16
New Jersey	$3.75	$1,571.33	14.68	$598.94	$972.38
New Mexico	$3.74	$1,567.13	8.4	$342.72	$1,224.41
New York	$4.10	$1,719.44	16.41	$669.53	$1,049.91
North Carolina	$3.78	$1,586.85	8.67	$353.74	$1,233.12
North Dakota	$3.79	$1,588.53	7.11	$290.09	$1,298.44
Ohio	$3.73	$1,565.87	9.14	$372.91	$1,192.96
Oklahoma	$3.55	$1,489.09	7.59	$309.67	$1,179.42
Oregon	$4.02	$1,685.45	7.56	$308.45	$1,377.01
Pennsylvania	$3.86	$1,617.90	10.31	$420.65	$1,197.25
Rhode Island	$3.93	$1,646.85	14.08	$574.46	$1,072.39

Table 4-1 State and National Annual EV Fuel Savings (May 1, 2012) (Continued)

State	Average Gasoline Price[11]	Average Annual ICEV Fuel Costs	Average Retail Price, Residential Electricity[12] (cents/kWh)	Average Annual EV Electricity Costs	Annual EV Savings
South Carolina	$3.59	$1,505.03	8.49	$346.39	$1,158.64
South Dakota	$3.72	$1,561.26	7.82	$319.06	$1,242.20
Tennessee	$3.64	$1,526.85	8.61	$351.29	$1,175.57
Texas	$3.70	$1,552.45	9.34	$381.07	$1,171.38
Utah	$3.70	$1,552.45	6.94	$283.15	$1,269.30
Vermont	$3.95	$1,657.34	13.24	$540.19	$1,117.15
Virginia	$3.74	$1,568.39	8.69	$354.55	$1,213.84
Washington	$4.07	$1,708.95	6.66	$271.73	$1,437.22
Washington D.C.	$4.03	$1,689.23	13.35	$544.68	$1,144.55
West Virginia	$3.86	$1,617.90	7.45	$303.96	$1,313.94
Wisconsin	$3.82	$1,604.48	9.78	$399.02	$1,205.45
Wyoming	$3.64	$1,526.85	6.2	$252.96	$1,273.89
U.S.	**$3.81**	**$1,598.18**	**9.83**	**$401.06**	**$1,197.12**

4.2 Ownership Costs

It is important to look not only at fuel costs, but also upfront costs so that prospective EV owners can compare financing implications. The Nissan LEAF manufacturer's suggested retail price (MSRP) is $35,200[13]; however, with the $7,500 federal tax credit for which LEAF purchases are eligible reduces the price to $27,700. The LEAF is classified as a midsize vehicle. The average midsize MSRP for major original equipment manufacturer (OEM) 2012 models is $35,674[14]. The surprising implication is that the LEAF is actually nearly $8,000 less expensive than the average vehicle in the same class. Even the higher-trim version of the LEAF (SL, at $37,250) is nearly $6,000 less than the average vehicle in the same class. Furthermore, some states like California, Tennessee, and Colorado have state incentives that bring down the cost even more.

The fuel costs and upfront costs can be combined in a TCO analysis that allows for prospective EV owners to clearly understand the financial implications of an EV purchase. The popular site, Kelley Blue Book, provides an estimate of five-year TCOs for new vehicles. The five-year cost for the 2012 Nissan LEAF is $38,559 (with an assumption of 15,000 miles per year). The TCO

13 http://www.nissanusa.com/leaf-electric-car/feature/pricing_information#/leaf-electric-car/feature/pricing_information (Last accessed May 1, 2012)

14 http://www.automobilemag.com/midsize/car_costs/t3_67_5/ (Last accessed May 1, 2012)

for the most popular midsize vehicle, the 2012 Toyota Camry, is listed as $34,966[15]. However, this value does not include the $7,500 federal tax credit (or the various state credits), and so the Nissan LEAFs TCO is reduced to $31,059. Therefore, the Nissan LEAF is approximately 11% less expensive to own over five years than the most popular vehicle in its class (provided the EV owner is eligible for the full tax credit).

15 http://www.kbb.com (Last accessed May 1, 2012)

5 Conclusion

The purpose of this white paper is to demonstrate the differences in GHG emissions and fuel costs with EV ownership for residents of the U.S. While the general case of an ICEV and EV comparison has been presented, it is hoped that the methodology presented here has sufficient details to allow for individuals to calculate their particular emissions and fuel costs based on the fuel economy of their vehicle and the electricity generation details of their state. Using the study assumptions, the average U.S. resident would see a percentage reduction in yearly per capita GHG emissions of 4.8%. Residents of Vermont would see the greatest percentage reduction in yearly per capita GHG emissions, at nearly 32%.

It is apparent from the data and calculations provided that for a large majority of U.S. residents (approximately 87%), driving an EV as opposed to a comparable ICEV will result in reductions in emissions, while all U.S. residents will enjoy a reduction in fuel and ownership costs. A small minority will see their GHG emissions rise, depending on the state in which they reside. However, as the push to adopt cleaner electricity sources across the country continues, the emissions reduction numbers will continue to become more and more favorable. The grid transition may raise the price of electricity, but the volatility of oil prices and the specter of constrained oil supplies mean that the price of gasoline is also likely to rise, affirming the fuel cost benefit for the foreseeable future. The results generally confirm the conclusions of the UCS report, and there can thus be confidence in the results of this white paper.

Appendix –A: Utility Rates

Utility Rates for Seattle, Washington

Utility	Seattle City Light		
Base Rate	**(Up To 50 kW Max Demand) Schedule SMD: Small General Service Network**: Minimum Charge: $0.27 per meter per day, **Schedule SMC: Small General Service City:** Minimum Charge: $0.27 per meter per day	**(50 kW - 1,000 kW Max Demand) Schedule MDD: Medium General Network Service:** Minimum Charge: $0.71 per meter per day, **Schedule MDC: Medium General Service City:** Minimum Charge: $0.71 per meter per day	**Schedule LGD: Large Network General Service: (max demand is greater than or equal to 1,000 kW)** $33.15 per meter per day. **Schedule LGC: Large Standard General Service: City: (max demand is greater than 1,000 kW, but less than 10,000 kW)**: $33.15 per meter per day
Energy Charge	**SMD:** $0.0669 per kWh, **SMC:** $0.0669 per kWh	**MDD:** $0.0669 per kWh, **MDC:** $0.0569 per kWh	**LGD: Peak**: $0.0720 per kWh, **Off-Peak**: $0.0485 per kWh; **LGC: Peak**: $0.0648 per kWh, **Off-Peak:** $0.0438 per kWh
Demand Charge?	No	Yes	Yes
Utility Definition of Demand Charge		Classification of new customers will be based on the Department's estimate of maximum demand in the current year.	
When Does It Take Effect?		All kW of maximum demand is charged a specific rate per kW	
Cost of Demand Charge		**MDD:** All kW of maximum demand at $1.89 per kW, **MDC**: All kW of maximum demand at$1.22 per kW	**LGD: Peak**: $1.99 per kW, **Off-Peak**: $0.25 per kW; **LGC: Peak**: $0.95 per kW, **Off-Peak**: $0.25 per kW
Contact Info	(206)-684-3000 (Customer Service)		

Utility Rates for California

Utility	Burbank Water and Power	Glendale Water and Power	
Base Rate	**Schedule D: Medium General Service (20 - 250 kW)**: **1-Phase:** $10.67 per meter; **3-Phase:** $15.99 per meter	**Small/Medium Business Standard Service Rate LD-2A**:$3.60 per meter per day	Large Business Standard Service Rate PC-1-A: (less than 500 kW of demand): Customer Charge: $30.00 per meter per day
Energy Charge	All kWh/mo. $0.0081	**July through October per kWh**: $0.07; **November through June per kWh**: $0.065	July - October: $0.0600 per kWh, Nov. - June: $0.0500 per kWh
Demand Rate?	Yes	Yes	Yes
Utility Definition of Demand Charge	**Billing Demand:** kW of measured max demand, but not less than 70% of the highest demand established in billings for the preceding months of July, August, September, and October, with meters read on and after July 1. **Special Demand:** applies to devices and equipment that produce highly intermittent demands of short duration.	see below	
When does it take affect?	Billing demand shall be defined as the kilowatts of measured maximum demand, but not less than 70% of the highest demand established in billings for the preceding months of July, August, September, and October, beginning with meters read on and after July 1.	Maximum kW reading for last 12 months	
Cost of Demand Charge	Min: $87.96 per month; All kW of Billing Demand: $9.86 per kW;	**Small/Medium Business:** **July through October** Max kW reading for last 12 months: $0.32; **November through June** Max kW reading for last 12 months: $0.22	July - October: $0.3200 per kWh; November - June: $0.2200 per kWh
Additional Monthly Charges	Special Demand Charge: $11.18 per kW. Special Demand Charge applies to devices and equipment that produce highly intermittent demands of short duration.		Fuel Adjustment Charge: $0.0448 per kWh
Contact Info		Linda Umeda (PEV) **Tel:**818-551-3043 **Email:** lumeda@ci.glendale.ca.us	

Utility	Los Angeles Department of Water and Power		Southern California Edison	
Base Rate	**Small General Service A1:** Service Charge $6.50	**Primary Service Schedule A2a:** Service charge $25.00 per month; **Schedule A2b: TOU Rate Schedule**: $28.00 Service Charge per month (Rate plan B required if max demand (over 30 kW) is reached 3 out of 12 months, or 2 times during high season billing months	**Schedule GS-1: Demand Should Not Exceed 20kW:** **Customer Charge**: $0.733 per meter per day, **3-Phase**: $0.032 per day	**Schedule GS-2: (Demand) 20kW-200kW**: Customer Charge: $134.17 per meter per month
Energy Charge	**High Season, June - September**: $0.06558 kWh; **Low Season, October - May**: $0.04268 kWh	**Schedule A2a: High Season, June-September:** $0.03645 per kWh; **Low Season, October - May:** $0.02995 per kWh; **Schedule A2b TOU Rate: June-September: High Peak**: $0.04679, **Low Peak:** $0.03952, **Base**: $0.01879; **Oct. - May: High Peak**: $0.04045, **Low Peak**: $0.04045, **Base:** $0.02252	$0.06353 per kWh per meter per day for both Summer and Winter months	$0.02216 per kWh per meter per month for both Summer and Winter months
Demand Rate?	No	Yes	No	Yes
Utility Definition of Demand Charge		**Demand:** based on max demand recorded at any time during billing month. **Facilities Charge**: based on highest demand recorded in last 12 months, but not less than 30 kW.		**Time Related Demand:** a per kW charge applied to greatest amount of registered demand during summer season. **Facilities Related Demand:** a per kW charge applied to greatest amount of registered demand during the year.
When does it take affect?	Plan is based on a less than 30 kW monthly load	Based on the Maximum Demand recorded at any time during billing month. Plan is intended for loads greater than 30 kW.	Plan is based on a less than 20 kW monthly load	Only during Summer, it is the max demand for each billing period
Cost of Demand Charge		**Rate A: High Season, June- September:** $9.00 per kW; **Low Season, October - May:** $5.50 per kW **Rate B:, June- Sept. High Peak**: $9.00 per kW, **Low Peak**: $3.25 per kW; **Oct. - May High Peak**: $4.00 per kW		**Facilities Related Demand Charge: $12.15 per kW.** Facilities related demand charge shall be for the kW of Maximum Demand recorded during the monthly billing period, year round.

Utility	Los Angeles Department of Water and Power		Southern California Edison	
Additional Monthly Charges	**Facilities Charge: $5.00 per kW :** Facilities Charge is based on highest demand recorded in last 12 months, but not less than 4 kW.	**Facilities Charge: $5.00 per kW:** Facilities Charge is based on highest demand recorded in last 12 months, but not less than 30 kW.		
Contact Info	**Aviva Raskin** (Rates)aviva.raskin@ladwp.com **John Romero** (Major Accounts) john.romero@ladwp.com		**Chris Vournakis** (PEV or Rates Group) 626-302-7319 christopher.vournakis@sce.com	**Kelly Garcia** (Major Accounts Group) 714-895-0335 kelly.garcia@sce.com

Utility	Pacific Gas and Electric		City of Palo Alto Utilities	
Base Rate	**Schedule A-1: 1-Phase**: $0.29569 per meter per day **Poly-Phase**: $0.44353 per meter per day **(Includes both Summer and Winter)**	**Schedule A-10**: $3.94251 per meter per day	**E-2: Small Business Electric Service (no demand),** less than or equal to 6,000 kWh a month	**E-4: Medium Commercial Electric Service:** max demand is less than 1,000 kW per month. **TOU Rate Schedule:**
Energy Charge	**Summer:** $0.19712 per kWh, **Winter**: $0.14747 per kWh	**Secondary Voltage:** **Summer:** $0.13666 per kWh, **Winter**: $0.10643 per kWh **Primary Voltage:** **Summer:** $0.13007 per kWh, **Winter:** $0.10142 per kWh; **Transmission Voltage:** **Summer:** $0.11470 per kWh, **Winter**: $0.09101 per kWh	**Summer Period per kWh**: $0.14045, **Winter Period per kWh:** $0.12661	**Summer Period per kWh**: $0.08171, **Winter Period per kWh**: $0.07318; **TOU Rate Schedule: Summer: Peak**: $0.14526, **Mid**: $0.07561, **Off**: $0.05837, **Winter: Peak**: $0.09620, **Off**: $0.05722
Demand Rate?	No	Yes	No	Yes
Utility Definition of Demand Charge		Max load expressed in kW placed on PG&E's system by the customer's equipment as recorded over a specific interval of time, normally 15 minutes.		**Max Demand:** average power in kW taken during any 15 min interval, City may use a 5 min interval in cases of violent fluctuations; **Billing Demand**: actual max demand in kW for the month

Utility	Pacific Gas and Electric		City of Palo Alto Utilities	
When does it take affect?		Based on highest level of kW required by a customer during a billing period		All kW over 1,000 kW per month; max demand in any month will be the max average power in kW taken during any 15 minute interval in the month
Cost of Demand Charge		**Secondary Voltage:** **Summer**: \$11.05 per kW, **Winter**: \$7.02 per kW **Primary Voltage:** **Summer**: \$10.39 per kW, **Winter:** \$6.49 per kW; **Transmission Voltage:** **Summer:** \$7.96 per kW, **Winter:** \$4.58 per kW		**Summer Period**: \$20.54 per kW, **Winter Period:** \$13.84 per kW; **TOU Rate: Summer: Peak**: \$12.08, **Mid:** \$7.64, **Off:** \$4.39; **Winter: Peak:** \$7.87, **Off**: \$4.43
Additional Monthly Charges		**Optional Meter Data Access Charge:** \$0.98563 per meter per day		
Contact Info	Reiko Takemasa (PEV);**Tel**: 415-973-5742; **Email:** r1t6@pge.com		Shiva Swaminathan; **Tel**: 650-329-2465; **Email**: shiva.swaminathan@cityofpaloalto.org	

Utility	San Diego Gas and Electric		
Base Rate	**Schedule A**- **General Service (less than 20 kW per month)**:\$9.56 per month	**Schedule AL-TOU: (loads greater than 20 kW automatically placed on this plan): (0-500 kW)**: **Secondary:** \$58.22 per month,	**Schedule A6-TOU (max demand is greater than or equal to 500 kW):** **Basic Fee: Primary:** \$232.87, **Primary Substation:** \$16,630.12, **Transmission**: \$1,270.44
Energy Charge	**Summer: Secondary**: \$0.09804 per kWh, **Primary:** \$0.09170 per kWh; **Winter**: **Secondary:** \$0.08516, **Primary:** \$0.08010	**Summer: On-Peak:** Secondary: \$0.01312 per kWh, **Semi**: Secondary: \$0.01046 per kWh, **Off-Peak**: Secondary: \$0.00970 per kWh; **Winter: On-Peak:** Secondary: \$0.01209 per kWh, **Semi:** Secondary**:** \$0.01046 per kWh, **Off-Peak**: Secondary: \$0.00970 per kWh,	**Summer: On-Peak: Primary:** \$0.00936, **Primary Substation& Transmission:** \$0.00930, **Semi-Peak: Primary:** \$0.0083, **Primary Substation/Transmission:** \$0.00825, **Off-Peak: Primary:** \$0.00796, **Substation/Transmission**: \$0.00795; **Winter: On-Peak: Primary:** \$0.00897, **Substation/Transmission**: \$0.00885, **Semi Peak: Primary:** \$0.0083, **Substation/Transmission**: \$0.00825, **Off-Peak: All**: \$0.00796 (all per kWh)

Utility	San Diego Gas and Electric		
Demand Rate?	No	Yes	Yes
Utility Definition of Demand Charge	Monthly demand is the 15 min interval in which average electricity consumption is greater than any other 15 min interval for the month		Non-Coincident Demand: The Non-Coincident Demand Charge shall be based on the higher of the Maximum Monthly Demand or 50% of the Maximum Annual Demand.
When does it take affect?	Less than 20 kW per month	**Non Coincident Demand Charge** is based on the higher of the Maximum Monthly Demand, or 50% of the Maximum Annual Demand. **On-Peak Demand Charge** is based on the Max On-Peak Period Demand.	Maximum Demand at the Time of System Peak. The Maximum Demand at the Time of System Peak will be based on the kW of Maximum Demand measured at the time of system peak occurring during each billing period during the on-peak period.
Cost of Demand Charge		<u>**Non Coincident:**</u> Secondary: $14.03 per kW, Primary: $13.71 per kW, Transmission: $4.99 per kW; <u>**Max On-Peak:**</u> **Summer:** Secondary: $7.35 per kW, Primary: $8.03 per kW, Transmission: $1.50 per kW; **Winter:** Secondary: $5.22 per kW, Primary: $5.34 per kW, Transmission: $0.32 per kW	**Non-Coincident Demand: Primary:** $14.85, **Primary Substation**: $6.18, **Transmission**: $6.12; **Max Demand at Time of System Peak: Summer: Primary:** $9.31, **Primary Substation:** $2.07, **Transmission**: $2.10; **Winter: Primary**: $6.10, **Primary Substation** $0.40, **Transmission** $:0.39 (all per kW)
Additional Monthly Charges			
Contact Info	**Phone:** 800-411-SDGE		

Utility	Alameda Municipal Power			Hercules Municipal Utility		
Base Rate	A-1 General Service (kW is less than 500 kW a month for any 6 out of 12 months) Customer Charge: $10.00	A-2 General Service - Demand Metered: (equals or exceeds 8,000 kWh, demand is less than 500 kW for 6 of 12 months): Customer Charge: $90.00	A-3 Medium General Service - Demand Metered (demand is equal to or exceeds 500 kW for any 6 out of 12 months): Customer Charge: $290.00	E-5: Small Commercial Electrical Service (demand is less than 50 kW for 3 consecutive months, or use less than 100,000 kWh per year) Customer Charge: $16.93 per month	E-10 Medium Commercial Electrical Service (demand is between 50 kW and 399 kW, but has not exceeded 399 kW for 3 consecutive months) Customer Charge: $93.75 per month	E-19: Industrial Electrical Service (billing demand has exceeded 399 kW for at least 3 consecutive months): Customer Charge: $2.85 per meter per day

Utility	Alameda Municipal Power			Hercules Municipal Utility		
Energy Charge	$0.14612 per kWh	$0.10898 per kWh	$0.10316 per kWh	$0.2253 per kWh	$0.1526 per kWh	$0.1240 per kWh
Demand Rate?	No	Yes	Yes	No	Yes	Yes
Utility Definition of Demand Charge						
When does it take affect?		The Metered Demand is the maximum average power taken per meter during any 15-minute interval in the month			The demand charge is based on the highest 30-minute average usage measured in kW during the monthly billing period	Demand will be averaged over 30-minute intervals for customers whose maximum demand exceeds 399 kW. “Maximum demand” will be the highest of all the 30-minute averages for the billing month. The customer’s maximum-peak-period demand will be the highest of all the 30-minute averages for the peak period during the billing month
Cost of Demand Charge		$9.00 per kW of Metered Demand	$9.00 per kW of Metered Demand		Summer: $7.54 per kW of max demand per month, Winter: $1.86 per kW of max demand per month	Summer: $5.75, Winter: $3.25 per kW of max demand per month
Additional Monthly Charges						Install Charge: $443.00, one time charge per meter
Contact Info						

Utility	San Diego Gas and Electric		Silicon Valley Power		
Base Rate	**Schedule AL-TOU: (loads greater than 20 kW automatically placed on this plan): (0-500 kW)**: **Secondary:** $58.22 per month,	**Schedule A6-TOU (max demand is greater than or equal to 500 kW): Basic Fee: Primary:** $232.87, **Primary Substation:** $16,630.12, **Transmission**: $1,270.44	**Schedule C-1: General Service (less than 8,000 kWh per month): Customer Charge**: $3.14 per meter per month **(same for TOU Rate Option)**	**Schedule CB-1 (energy exceeds 8,000 kWh, demand is less than 4,000 kW)** Customer Charge: $57.12 per meter per month **(same for TOU Option)**	**Schedule CB-3: Large General Service Demand Metered (Billing Demand exceeds 4,000 kW):** Customer Charge: $57.12 per meter per month **(same rate for TOU Option)**
Energy Charge	**Summer: On-Peak:** Secondary: $0.01312 per kWh, **Semi**: Secondary: $0.01046 per kWh, **Off-Peak**: Secondary: $0.00970 per kWh; **Winter: On-Peak:** Secondary: $0.01209 per kWh, **Semi:** Secondary**:** $0.01046 per kWh, **Off-Peak**: Secondary: $0.00970 per kWh,	**Summer: On-Peak: Primary:** $0.00936, **Primary Substation& Transmission:** $0.00930, **Semi-Peak: Primary:** $0.0083, **Primary Substation/Transmission:** $0.00825, **Off-Peak: Primary:** $0.00796, **Substation/Transmission**: $0.00795; **Winter: On-Peak: Primary:** $0.00897, **Substation/Transmission**: $0.00885, **Semi Peak: Primary:** $0.0083, **Substation/Transmission**: $0.00825, **Off-Peak: All**: $0.00796 (all per kWh)	**First 800 kWh:** $0.15136 per kWh, **Over 800 kWh:** $0.13742 per kWh; **TOU Peak: First 800 kWh:** $0.016473, **Over 800 kWh**: $0.015078, **Off-Peak: First 800 kWh:** $0.14044, **Over 800 kWh**: $0.12648 per kWh.	**All kWh:** $0.09176 per kWh; **TOU Rate: Peak**: $0.10513, **Off Peak**: $0.08084 per kWh	$0.08451 per kWh; **TOU Rate: Peak**: $0.09786, **Off-Peak:** $0.07357 per kWh
Demand Rate?	Yes	Yes	No	Yes	Yes
Utility Definition of Demand Charge	Monthly demand is the 15 min interval in which average electricity consumption is greater than any other 15 min interval for the month	Non-Coincident Demand: The Non-Coincident Demand Charge shall be based on the higher of the Maximum Monthly Demand or 50% of the Maximum Annual Demand.			

Utility	San Diego Gas and Electric		Silicon Valley Power		
When does it take affect?	**Non Coincident Demand Charge** is based on the higher of the Maximum Monthly Demand, or 50% of the Maximum Annual Demand. **On-Peak Demand Charge** is based on the Max On-Peak Period Demand.	Maximum Demand at the Time of System Peak. The Maximum Demand at the Time of System Peak will be based on the kW of Maximum Demand measured at the time of system peak occurring during each billing period during the on-peak period.		All kW of Billing Demand	All kW of Billing Demand
Cost of Demand Charge	**Non Coincident:** Secondary: $14.03 per kW, Primary: $13.71 per kW, Transmission: $4.99 per kW; **Max On-Peak: Summer:** Secondary: $7.35 per kW, Primary: $8.03 per kW, Transmission: $1.50 per kW; **Winter:** Secondary: $5.22 per kW, Primary: $5.34 per kW, Transmission: $0.32 per kW	**Non-Coincident Demand: Primary:** $14.85, **Primary Substation**: $6.18, **Transmission**: $6.12; **Max Demand at Time of System Peak: Summer: Primary:** $9.31, **Primary Substation:** $2.07, **Transmission**: $2.10; **Winter: Primary**: $6.10, **Primary Substation** $0.40, **Transmission** $:0.39 (all per kW)		$6.91 per kW; **TOU Rate: Pea**k: $6.91, **Off-Peak:** $0.00	$9.21 per kW; **TOU Rate: Peak:** $9.21 per kW, **Off-Peak:** $0.00 per kW
Additional Monthly Charges					
Contact Info	**Phone:** 800-411-SDGE				

Utility Rates for Arizona

Utility	SRP	Tucson Electric Power		
Base Rate	<u>E-36:</u> **General Service Price Plan: Total Monthly Service Charge:** $14.61	**<u>Schedule GS-10:</u> General Service: Single Phase Service (min)**: $8.00 per month, **Three Phase Service (min)**: $14.00 per month	**Schedule LGS-13: Large General Service: (Min demand is 200 kW)** Customer Charge: $371.88 per month	**Schedule LGS-85N Large General Service "Powershift" TOU Program (min demand is 200 kW): Customer Charge**: $371.88 per month
Energy Charge	**<u>First 350 kWh:</u> Summer:** $0.0911 per kWh, **Summer Peak:** $0.1098 per kWh**,** **Winter:** $0.0790 per kWh; **<u>Next 180 kWh:</u> Summer:** $0.0908 per kWh, **Summer Peak:** $0.1095, **Winter:** $0.0787 per kWh	**<u>Base Power Supply Charge:</u>** **Summer:** $0.031550 per kWh; **Winter:** $0.024222 per kWh	**Base Power Supply Charge:** **Summer:** $0.032554 per kWh; **Winter**: $0.025054 per kWh	**Base Power Supply Charge:** **Summer: Peak:** $0.059253 per kWh, **Shoulder Peak**: $0.033588 per kWh, **Off-Peak**: $0.025299 per kWh; **Winter: Peak**: $0.036088 per kWh**,** **Shoulder Peak**: N/A, **Off-Peak**: $0.027799 per kWh
Demand Charge?	Yes	No	Yes	Yes
Utility Definition of Demand Charge	Billing demand is the max 15 minute integrated kW demand occurring during the billing cycle			
When does it take affect?	Over 5 kW	Monthly load must be less than 200 kW	The maximum 15 minute measured demand in the month, but not less than 50% of the maximum demand used for billing	
Cost of Demand Charge	**Summer**: $4.21 per kW, **Summer Peak**: $4.21 per kW, **Winter**: $2.46 per kW		$10.362 per kW	**Summer: Peak**: $11.869 per kW, **Off-Peak**: $8.239 per kW; **Winter: Peak**: $8.908 per kW, **Off-Peak:** $6.418 per kW
Additional Monthly Charges		**<u>Delivery Charge</u>**: **First 500 kWh:** **Summer**: $0.056236 per kWh, **Winter:** $0.051252 per kWh; **<u>Remaining kWh:</u> Summer:** $0.085145 per kWh, **Winter:** $0.080145 per kWh	**Delivery Charge:** **Summer**: $0.025656 per kWh; **Winter:** $0.023910 per kWh	**Delivery Charge: Summer: Peak:** $0.059253 per kWh, **Shoulder-Peak**: $0.033588 per kWh, **Off-Peak**: $0.025299 per kWh; **Winter: Peak**: $0.036088 per kWh, **Shoulder-Peak**: N/A, **Off Peak:** $0.027799 per kWh
Contact Info	**(602)236-8833 (Customer Service)**	**(520)623-7711 (Customer Service)**		

Utility	TRICO Electric Cooperative		
Base Rate	**GS2: General Service Plan (10 kW to 200kW)** **Single Phase Service:** $18.00 per month, **Three Phase Service:** $26.00 per month	**GS3: General Service less than 12,000 kW):** **Single phase:** $18.00, **Three-phase**: $26.00	**GS-TOU:** **Single-phase:** $24.00, **Three-phase:** $32.00
Energy Charge	$0.1380 per kWh	$0.0830 per kWh	$0.06375 per kWh
Demand Charge?	Yes	Yes	
Utility Definition of Demand Charge	**Demand:** the rate at which power is delivered during any specified (15 minutes) period of time. **Coincident Demand Charge:** applied to the customer's monthly measured demand as recorded by a suitable metering device at the time of the AEPCO peak		
When does it take affect?	First 10 kW: no charge; Each kW over 10 kW	$16.65 per kW	$5.95 Coincident Demand Charge: $29.50
Cost of Demand Charge	$4.50 per kW over 10 kW		**This utility's service rules are very vague (see TOU): http://www.trico.coop/index.php?option=com_content&view=article&id=113&Itemid=114**
Additional Monthly Charges			
Contact Info	Customer Service: (520)744-2944		

Utility	APS					
Base Rate	<u>**E-32S: Small General Service (21 kW- 100 kW):**</u> **Self Contained Meters:** $0.672 per day, **Instrument-Rated Meters:** $1.324 per day, **Primary Voltage:** $3.415 per day	**E- 32S-TOU: Self Contained Meters**: $0.672 per day, **Instrument-Rated Meters:** $1.324 per day, **Primary Voltage:** $3.415 per day	**E-32M: Medium General Service (101 - 400 kW) Self-Contained Meters**: $0.672 per day, **Instrument-Rated Meters:** $1.324 per day, **Primary Voltage:** $3.415 per day, **Transmission Voltage**: $26.163 per day	**E-32M-TOU: Self Contained Meters**: $0.672 per day, **Instrument-Rated Meters:** $1.324 per day, **Primary Voltage**: $3.415 per day, **Transmission Voltage:** $26.163 per day	**E-32L: Large General Service (over 400 kW): Self Contained Meters**: $1.068 per day, **Instrument-Rated Meters:** $1.627 per day, **Primary Voltage**: $3.419 per day, **Transmission Voltage:** $22.915 per day	**E-32I-TOU**: **Self Contained Meters**: $0.710 per day, **Instrument-Rated Meters:** $1.324 per day, **Primary Voltage**: $3.415 per day, **Transmission Voltage**: $26.163 per day
Energy Charge	**Summer**: $0.10403 per kWh for first 200 kWh, plus $0.06083 per kWh for all additional kWh; **Winter**: $0.08689 per kWh for first 200 kWh, plus $0.04369 for all additional kWh	**May-Oct.: Peak**: $0.07291 per kWh, **Off-Peak:** $0.05794 per kWh; **Nov. - April: Peak:** $0.05586 per kWh, **Off-Peak**: $0.04089 per kWh	**May- Oct.: 1st 200 kWh:** $0.10320 per kWh, **additional kWh**: $0.06034 per kWh, **Nov. - April: 1st 200 kWh:** $0.08619 per kWh, **additional kWh:** %0.04334 per kWh	**May - Oct: Peak**: $0.07233 per kWh, **Off-Peak**: $0.05748 per kWh; **Nov. - April: Peak:** $0.05542 per kWh, **Off-Peak:** $0.04057 per kWh	**May - Oct: First 200 kWh:** $0.10093 per kWh, **Additional**: $0.05902 per kWh; **Nov. - April: First 200 kWh:** $0.0843 per kWh, **Additional:** $0.04239 per kWh	**May- Oct**.: **Peak**: $0.07076 per kWh, **Off-Peak**: $0.05623 per kWh; **Nov. - April**: **Peak:** $0.05421 per kWh, **Off-Peak**: $0.03968 per kWh
Demand Charge?	Yes	Yes	Yes	Yes	Yes	Yes
Utility Definition of Demand Charge	Average kW used during the 60 min period of max use during the on-peak hours of the billing month.					
When does it take affect?	Separate costs between first 100 kW and any additional kW used					

Utility	APS					
Cost of Demand Charge	**Primary**: $8.976 per kW for first 100 kW, plus $4.448 per kW for all additional kW; **Secondary**: $9.675 per kW for first 100 kW, plus $5.146 per kW for all additional kW	**Secondary: Peak:** $14.322 per kW for the first 100 on-peak kW, plus $9.725 per kW for all additional on-peak kW, **Off-Peak**: $5.492 per kWh for the first 100 off-peak kW, plus $3.059 per kW for all additional off-peak kW; **Primary: Peak**: $13.863 per kW for the first 100 on-peak kW, plus $9.657 per kW for all additional on-peak kW, **Off-Peak**:$4.916 per kW for the first 100 off-peak kW, plus $2.979 per kW for all additional off-peak kW	**Secondary: 1st 100 kW:** $9.597 per kW, **Additional**: $5.105 per kW, **Primary: 1st 100 kW**: $8.905, **Additional:** $4.412 per kW; **Transmission: 1st 100 kW:** $6.942 per kW, **Additional:** $2.45 per kW	**Secondary:** $14.209 per kW for the first 100 on-peak kW, plus $9.649 per kW for all additional on-peak kW, $ 5.449 per kWh for the first 100 off-peak kW, plus $3.034 per kW for all additional off-peak kW; **Primary:**$13.753 per kW for the first 100 on-peak kW, plus $9.581 per kW for all additional on-peak kW, $4.877 per kW for the firs 100 off-peak kW, plus $2.955 per kW for all additional off-peak kW; **Transmission**: $12.938 per kW for the first 100 on-peak kW, plus $9.300 per kW for all additional on-peak kW, $4.232 per kW for the first 100 off-peak kW, plus $2.849 per kW for all additional off-peak kW	**Secondary: 1st 100 kW:** $9.384 per kW, **Additional**: $4.993 per kW; **Primary: 1st 100 kW**: $8.703 per kW, **Additional:** $4.315 per kW; **Transmission: 1st 100 kW:** $6.788 per kW, **Additional:** $2.396 per kW	**Secondary:** $13.901 per kW for the first 100 on-peak kW, plus $9.439 per kW for all additional on-peak kW, $ 5.331 per kWh for the first 100 off-peak kW, plus $2.969 per kW for all additional off-peak kW; **Primary**: $13.455 per kW for the first 100 on-peak kW, plus $9.373 per kW for all additional on-peak kW, $4.771 per kW for the firs 100 off-peak kW, plus $2.891 per kW for all additional off-peak kW; **Transmission:** $12.658 per kW for the first 100 on-peak kW, plus $9.098 per kW for all additional on-peak kW, $4.140 per kW for the first 100 off-peak kW, plus $2.787 per kW for all additional off-peak kW
Additional Monthly Charges						
Contact Info						

Utility Rates for Oregon

Utility	Pacificorp	
Base Rate	**<u>Schedule 28: General Service, Large Non-Residential (31 kW - 200 kW) Primary:</u>** **(Less than 50 kW per month):** $17.00, **(52 kW - 100 kW per month):** $29.00,	**<u>Schedule 28: General Service, Large Non-Residential (31 kW - 200 kW) Secondary</u>**: **(Less than 50 kW per month):** $15.00, **(51 kW - 100 kW per month):** $28.00,
Energy Charge	$0.0325 per kWh	$0.619 per kWh
Demand Rate?	Yes	Yes
When Does It Take Effect?	15 minute period of greatest use during month, but not less than 15 kW.	
Utility Definition of Demand Charge	**Special Demand:** In the event of loads with large short-period fluctuations, Pacificorp reserves the right to employ special demand determinations	
Cost Of Demand Charge	$4.16 per kW	$4.39 per kW
Additional Monthly Costs	**<u>Load Size Charge:</u> Loads less than 50 kW**: $0.95 per kW, **Loads 51 - 100 kW:** $0.80per kW	**<u>Load Size Charge:</u> Loads less than 50 kW**: $0.95, **Loads 51- 100 kW:** $0.75
Contact Info		

Utility	Portland General Electric		
Base Rate	**Schedule 32: Small Non-Residential (up to 30 kW):** **Single-Phase:** $12.00 per month, **Three-Phase:** $16.00 per month	**Schedule 38: Medium and Large Non-Residential (up to 200 kW):** **Single-Phase:** $20.00, **Three-Phase:** $25.00	**Schedule 83: Large Non-Residential Standard Service (31 kW - 200 kW):** **Single-Phase:** $20.00, **Three-Phase**: $30.00
Energy Charge	**Total**: $0.10186 per kWh for first 5,000 kWh, then $0.07674 per kWh over 5,000 kWh	**Total On Peak:** $0.11912 per kWh, **Total Off Peak:** $0.10662 per kWh	$0.06993 per kWh
Demand Rate?	No	No	Yes
When Does It Take Effect?	Greater than 30 kW twice will result in removal from schedule		Separate Charges for first 30 kW of demand, and all kW over 30 kW
Utility Definition of Demand Charge			Demand: Measure the highest average usage over a 30 minute period.
Cost Of Demand Charge			**Facilities Charge:** **First 30 kW**: $2.38 per kW, **Over 30 kW:** $2.08 per kW,
Additional Monthly Costs			**Transmission and Related Services Charge:** $0.82 per kW of monthly demand; **Distribution Charge:** $1.76 per kW
Contact Info	1-800-743-5000 (Customer Service)		

Utility Rates for Tennessee

Utility	Middle Tennessee Electric (MTEMC)		Duck River Electric Membership Corporation	
Base Rate	**Schedule GSA1-40 (Less than 50 kW, Less than 15,000 kWh)**: $16.60 per month	**Schedule GSA2-50 (51- 1,000 kW, Greater than 15,000 kWh)**: $45.33 per month	**General Service Rate: GSA-1 (loads less than 50 kW)**:$20.00 per month	**GSA-2 (50 kW- 1,000kW):** $175.00 per month
Energy Charge	$0.09226 per kWh	**First 15,000 kWh**: $0.09593 per kWh; **Additional kWh:** $0.05545 per kWh	$0.10349 per kWh	**Summer:** **First 15,000 kWh**: $0.10159 per kWh, **Additional kWh**: $0.06281; **Winter:** **First 15,000 kWh:** $0.10147 per kWh, **Additional kWh**: $0.06281 per kWh; **Transition:** **First 15,000 kWh**: $0.10083 per kWh, **Additional kWh:** $0.06281 per kWh
Demand Charge?	No	Yes	No	Yes
Utility Definition of Demand Charge		Demand is determined by the higher of the following calculations: metered demand at 100%, kVa at 85%, contract demand at 30%, or 12 month high demand at 30%		
When Does It Take Effect		Over 50 kW		Anything over 50 kW results in a demand charge
Cost of Demand Charge		**First 50 kW**: $0.00; **Excess over 50 kW:** $12.07		**Summer:** $13.79 per kW, **Winter:** $26.00 per kW, **Transition:** $13.00 per kW
Additional Monthly Costs]	**TVA Fuel Cost Adjustment:** $0.00864 per kWh per month	**TVA Fuel Cost Adjustment:** **First 15,000 kWh**: $0.00864 per kWh per month, **Additional kWh**: $0.00855 per kWh per month		
Contact Info	Russell Lane **Email:** rlane@mtemc.com **Phone:** (615)453-3078		Steve Lyne **Email:** slyne@dremc.com **Phone:** (931)728-7547 x.5402	

Utility	Harriman Utility Board		Athens Utilities Board	
Base Rate	**Small Commercial (less than 50 kW):** $27.60 per month ($16.60 if 300 kWh or less per month)	**Large Commercial (Greater than 15,000 kWh, 50 kW)**: $109.94 per month	**GSA Part 1 (less than 50 kW, 15,000 kWh):** $31.93 per month	**GSA Part 2 (50 kW - 1,000 kW, greater than 15,000 kWh):** $162.74 per month
Energy Charge	$0.10986 per kWh	$0.11012 per kWh (first 15,000 kWh); $0.06398 per kWh (over 15,000 kWh)	$0.07074 per kWh	**Summer:** **First 15,000 kWh:** $0.06960 per kWh **Over 15,000 kWh:** $0.03489 per kWh; **Winter:** **First 15,000 kWh:** $0.06686 per kWh, **Over 15,000 kWh**: $0.03227 per kWh; **Transition:** **First 15,000 kWh:** $0.06515 per kWh, **Over 15,000 kWh:** $0.03120 per kWh
Demand Charge?	No	Yes	No	Yes
Utility Definition of Demand Charge				
When Does It Take Effect		Anything over 50 kW results in demand charge		Anything over 50 kW results in demand charge
Cost of Demand Charge		$0.00 (first 50 kW), $15.36 (over 50 kW- 1,000 kW)		**First 50 kW**: $0.00, **51 kW - 1,000 kW:** **Winter:** $13.34 per kW, **Summer:** $12.53 per kW, **Transition:** $12.53 per kW
Additional Monthly Costs]				
Contact Info	Wayne Jenkins **Email:** gmelhorn@hub-tn.com **Phone:** (865)607-4058		Kent Wilson **Email:** kwilson@aub.org **Phone:** (423)745-4501	

Utility	Cookeville Electric Department		Cleveland Utilities	
Base Rate	**Schedule GSA Part 1 (0-50 kW, 0-15,000 kWh) Class 40:**$20.00 per month	**Schedule GSA Part 2 (51- 1,000 kW, greater than 15,000 kWh) Class 50:**$50.00 per month	**Schedule GSA-1 (up to 50 kW, and up to 15,000 kWh):**$15.41 per month	**Schedule GSA-2 (51 kW - 1,000 kW, or greater than 15,000 kWh):** $46.22 per month
Energy Charge	$0.10225 per kWh	**First 15,000 kWh:** $0.10287 per kWh, **Additional;** $0.06234 per kWh	$0.08372 per kWh per month	**First 15,000 kWh per month:** $0.08372 per kWh, **Additional:** $0.04299 per kWh
Demand Charge?	No	Yes	No	Yes
Utility Definition of Demand Charge				
When Does It Take Effect		Anything over 50 kW results in demand charge		Anything over 50 kW results in demand charge
Cost of Demand Charge		**0- 50kW:** $0.00, **51- 1,000 kW:** $11.85 per kW		**First 50 kW:** $0.00 per kW, **Excess over 50 kW per month:** $12.26 per kW
Additional Monthly Costs]				
Contact Info	Jeff Peek **Email:** jpeek@cookeville-tn.org **Phone:** (931)526-7411		David Tyner **Email:** dtyner@clevelandutilities.com **Phone:** (423)478-9323	

Utility	Nashville Electric Service		EPB Chattanooga	
Base Rate	**GSA-1 (0- 50kW, 0-15,000 kWh):** $25.38 per month	**GSA-2 (51 - 1,000 kW, Greater than 15,000 kWh)**: $156.87 per month	**GSA-1 (Less than 50 kW, less than 15,000 kWh)**: $9.90 per month per delivery point (account)	**GSA-2 (50 kW - 1,000 kW, greater than 15,000 kWh)**: $9.90 per month per delivery point (account)
Energy Charge	**Summer:** $0.10974 per kWh per month **Winter:** $0.10700 per kWh per month**,** **Transition:** $0.10529 per kWh per month	**Summer:** **First 15,000 kWh per month:** $0.10974 per kWh**,** **Additional**: $0.06564 kWh; **Winter**: **First 15,000 kWh per month:** $0.10700 per kWh, **Additional:** $0.06564; **Transition**: **First 15,000 kWh per month:** $0.10529 per kWh, **Additional**: $0.06564	$0.08072 per kWh	**First 15,000 kWh**: $0.08072 per kWh, **Additional kWh over 15,000 kWh**: $0.03355 per kWh
Demand Charge?	No	Yes	No	Yes
Utility Definition of Demand Charge				
When Does It Take Effect		Anything over 50 kW results in demand charge		Anything over 50 kW results in demand charge
Cost of Demand Charge		**<u>Summer:</u>** **Over 50 kW:** $12.22 per kW; **<u>Winter:</u>** **Over 50 kW:** $11.43 per kW; **<u>Transition:</u>** **Over 50 kW**: $11.43 per kW		**First 50 kW:** $0.00 per kW, **Over 50 kW**: $14.04 per kW
Additional Monthly Costs				
Contact Info	David McDannald **Email:** dmcdannald@nespower.com **Phone:** (615)747-3384		Melvin Baumgardner **Email:** Baumgardnermr@epb.net **Phone:** (423)648-3524	

Utility	Lenoir City Utility Board		Volunteer Electric Co-Op	
Base Rate	**GSA-1 (less than 50 kW, less than 15,000 kWh)**: $15.26 per month	**GSA-2 (51 kW - 1,000 kW, greater than 15,000 kWh):** $61.29	**GSA Part 1 (Does not exceed 50 kW/Does not exceed 15,000 kWh)**: $14.00 per month	**GSA Part 2 (Greater than 50 kW, but not to exceed 1,000 kW/Greater than 15,000 kWh):** $25.00 per month
Energy Charge	$0.09674 per kWh	**First 15,000 kWh:** $0.09618 per kWh, **Additional kWh over 15,000 kWh:** $0.05899 per kWh	**Summer:** $0.07889 per kWh, **Non-Summer:** $0.07849 per kWh	**Summer: First 15,000 kWh per month**: $0.07889 per kWh, **Additional kWh per month**: $0.03648 per kWh; **Non-Summer**: **First 15,000 kWh per month**: $0.07849 per kWh per month, **Additional kWh per month**: $0.01930 per kWh per month
Demand Charge?	No	Yes	No	Yes
Utility Definition of Demand Charge				
When Does It Take Effect		Anything over 50 kW results in demand charge		Anything over 50 kW results in demand charge
Cost of Demand Charge		**Between 51 - 1,000 kW:** $11.23 per kW		**Summer:** **First 50 kW**: $0.00 per kW, **Over 50 kW:** $13.10 per kW; **Non-Summer:** **First 50 kW:** $0.00 per kW, **Over 50 kW:** $12.50 per kW
Additional Monthly Costs				
Contact Info	Jay Hines **Email:** pcterry@lcub1.com **Phone:** (865)483-4730 x1730		Mark Evans **Email:** mevans@vec.org **Phone:** (931)484-3527 x7241	

Utility	Murfreesboro Electric		Sequatchee Valley Electric Cooperative	
Base Rate	**GSA-1 (0 - 50 kW):** $24.86 per month	**GSA-2 (51 -1,000 kW, or less than 15,000 kWh):** $49.00 per month	**GSA Part 1 (0 - 50 kW):** $20.56 per month	**GSA Part 2 (51 kW - 1,000 kW, or less than 15,000 kWh)**: $146.84 per month
Energy Charge	$0.07539 per kWh per month	**First 15,000 kWh per month:** $0.07648 per kWh per month, **Additional kWh per month:** $0.03679 per kWh per month	$0.07975 per kWh per month	**First 15,000 kWh per month**: $0.07858 per kWh, **Additional kWh:** $0.03936 per kWh
Demand Charge?	No	Yes	No	Yes
Utility Definition of Demand Charge				
When Does It Take Effect		Anything over 50 kW results in demand charge		Anything over 50 kW results in demand charge
Cost of Demand Charge		**Excess over 50 kW per month:** $11.71 per kW		**Excess over 50 kW:** $11.92 per kW
Additional Monthly Costs]		**FCA: First 15,000 kWh per month**: $0.02770, **Additional kWh per month**: $0.02742	**TVA Total Monthly Fuel Cost**: $0.02872 per kWh	
Contact Info	Mark Kimball **Email:** Mkimball@murfreesboroelectric.com **Phone:** (615)494-0424 or Chris Barns **Email:** cbarns@medtn.com **Phone:** (615)494-0428		Randy McClure **Email**: rmcclure@svalleyec.com **Phone:** (423)837-8605	

Utility	Knoxville Utility Board		Maryville		Fort Loudoun Electric Cooperative	
Base Rate	**GSA-1 Electric Rate (0-50 kW)**: $15.00 per delivery point per month	**GSA-2 Electric Rate (50 kW - 1,000 kW):** $50.00 per delivery point per month	**GSA-1 General Power Rate (0- 50 kW):** $16.06 per month	**GSA-2 General Power Rate (50 kW - 1,000 kW):** $53.50 per month	**GSA-1 (0 - 50 kW):** $27.75 per month	**GSA-2 (50- 1,000 kW)**: $135.00 per month
Energy Charge	**Summer Period**: $0.10097 per kWh per month; **Winter Period:** $0.10056 per kWh per month; **Transition Period:** $0.10056 per kWh per month	**Summer Period**: First 15,000 kWh per month at $0.10303 per kWh, Additional kWh per month at $0.06339 per kWh; **Winter Period**: First 15,000 kWh per month at $0.10262 per kWh, Additional kWh per month at $0.06339 per kWh; **Transition Period:** First 15,000 kWh per month at $0.10262 per kWh, Additional kWh per month at $0.06339 per kWh	**All kWh is at** $0.10001 per kWh	**First 15,000 kWh per month:** $0.10182 per kWh, **Additional kWh per month** : $0.06636 per kWh	**All kWh at:** $0.09871 per kWh	**First 15,000 kWh at** : $0.09763 per kWh, **Additional kWh at:** $0.06739 per kWh
Demand Charge?	No	Yes	No	Yes	No	Yes
Utility Definition of Demand Charge						
When Does It Take Effect		Any usage over 50 kW results in demand charge		Any usage over 50 kW results in demand charge		Any usage over 50 kW results in demand charge
Cost of Demand Charge		**Summer Period (over 50 kW per month):** $11.59 per kW; **Winter Period (over 50 kW per month):** $10.80 per kW; **Transition Period (over 50 kW per month):** $10.80 per kW		**First 50 kW:** No Charge **Over 50 kW:** $11.68 per kW		**First 50 kW**: No Charge **Over 50 kW:** $15.27 per kW
Additional Monthly Costs						
Contact Info			http://www.maryvillegov.com/uploads/8/2/6/7/8267180/electric.pdf			

