Financial Viability Of Non-Residential Electric Vehicle Charging Stations

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About the Report

The electric vehicle (EV) market is experiencing a resurgence with traditional automakers recognizing the need to move into this market. As a result, we are in a moment of exciting transition in which consumers now have a number of EV options to consider. While EVs such as the Chevrolet Volt, the Nissan Leaf, and Tesla are leading the charge, adoption by consumers will largely be a function of the electric vehicle charging options available. Studies show that most EV charging currently takes place in the home (Carr 2010). Even so, in order for EVs to gain widespread consumer adoption, it is critical for an infrastructure of electric vehicle supply equipment (EVSEs) to exist outside the home.

The purpose of this report is to assess the financial viability of non-residential EV charging stations in the Los Angeles metro area. The report will look at important cost and revenue drivers that impact cost recovery specifically for commercial site owners. Taking the site owner's perspective, our report will account for the key variables informing the decision making process. Ultimately, the goal is to provide site owners with a Discounted Cash Flow (DCF) model that highlights the conditions that must be met in order for an EVSE investment and installation to be profitable.

Disclaimer

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About the UCLA Luskin Center for Innovation

The Luskin Center for Innovation, founded with a generous gift from Meyer and Renee Luskin, unites the intellectual capital of UCLA with forward-looking civic leaders to address pressing issues and translate world class research and expertise into real-world policy solutions. Research initiatives are supported by teams of faculty and staff from a variety of academic disciplines. The Luskin Center supports these initiatives by funding original research, scholars, conferences, technical internships and solution-oriented speaker series.

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UCLA Anderson School of Management is perennially ranked among the top-tier business schools in the world. Award-winning faculty renowned for their research and teaching, highly selective admissions, successful alumni, and world-class facilities combine to provide an extraordinary learning environment. Established in 1935, UCLA Anderson provides management education to more than 1,500 students enrolled in full-time, part-time and executive M.B.A. programs; doctoral programs; and executive education and management development programs.

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1. Executive Summary

The electric vehicle (EV) market is experiencing a resurgence with traditional automakers recognizing the need to move into this market. As a result, we are in a moment of exciting transition in which consumers now have a number of EV options to consider. While EVs such as the Chevrolet Volt, the Nissan Leaf, and Tesla are leading the charge, adoption by consumers will largely be a function of the electric vehicle charging options available. Studies show that most EV charging currently takes place in the home (Carr 2010). Even so, in order for EVs to gain widespread consumer adoption, it is critical for an infrastructure of electric vehicle supply equipment (EVSEs) to exist outside the home.

1.1 Purpose

The purpose of this report is to assess the financial viability of non-residential EV charging stations in the Los Angeles metro area. The report will look at important cost and revenue drivers that impact cost recovery specifically for commercial site owners. Taking the site owner's perspective, our report will account for the key variables informing the decision making process. Ultimately, the goal is to provide site owners with a Discounted Cash Flow (DCF) model that highlights the conditions that must be met in order for an EVSE investment and installation to be profitable.

1.2 Importance

The UCLA Luskin Center is a thought leader in California and aims to address issues surrounding environmental sustainability in Los Angeles and Southern California. Since electric vehicles and electric vehicle charging stations represent the next wave of green technology, it is critical for the Luskin Center to thoroughly understand this industry. The EV market is still young, but signs point to major potential growth (Barney et al. 2011). Research has shown that "range anxiety", the term used to describe consumers' fear that their electric car battery will run out mid-route, poses a major barrier to EV adoption. Thus, building EVSE infrastructure outside the home, in non-residential, public areas, is essential for EV adoption to take place. That said, without many EVs on the road, it is difficult to make a case for installing EVSEs. The Luskin Center seeks an understanding of the present and future conditions and business models that will make non-residential EVSE installation financially viable.

1.3 Methods

The primary deliverable is a Discounted Cash Flow Analysis for three different types of scenarios that aim to reflect the typical duration of parking at different non-residential locations. These scenarios are as follows:

1) Scenario A: Grocery store with parking duration of 0-2 hours

2) Scenario B: Mall with parking duration of 2-4 hours

3) Scenario C: Workplace with parking duration of 4-8 hours

A Discounted Cash Flow Analysis is a commonly used method in finance to value a project, company, or asset. Incoming and outgoing cash flows are estimated and then a discount rate is applied to those cash flows to arrive at a present value. The sum of those present values is the Net Present Value or NPV. The DCF model is especially valuable because it takes into account the time value of money, which is the idea that money in the present is more valuable than the same amount of money in the future due to the ability of money to earn interest. The Internal Rate of Return or IRR, which is the rate of return that makes the NPV zero, will also be used to assess each charging scenario.

To facilitate the formation of the DCF model, our research and analysis aimed to identify reasonable ranges for all DCF line items on both the revenue and cost side. On the revenue side, research focused on identifying pricing strategies and business models in which charging units currently operate. On the cost side, research identified equipment and installation costs, electricity costs, opportunity cost of parking, government subsidies, and cost of equity as the main items impacting the financial model.

In researching revenue drivers, primary research yielded the most reliable revenue information. As the EVSE market is still very young, much of this information was not available in secondary literature. Primary research included in-depth interviews with key players in the EVSE industry including: 350 Green, Clean Fuel Connection, Ecotality, and EVGo. Information was also gathered from site owners who have installed EV charging stations such as the Burbank Airport, the City of Santa Monica, the Santa Monica Airport, The Getty Center, a leading national retailer, and UCLA.

1.4 Scope

The scope of this report entails determining the financial viability of three non-residential EV charging scenarios in the Los Angeles metro area. The DCF model is our primary deliverable to the Luskin Center and allows for dynamic inputs across important revenue and cost driver variables. Our DCF model allows a site owner to quickly assess the financial viability of an EVSE investment and installation according to the specifics of their site location.

1.5 Findings

To build the DCF model, research was conducted surrounding the revenue and cost drivers of an EV charging station. After consulting multiple primary and secondary sources, the following ranges were determined.

- Equipment Costs: Costs of Level I and Level II chargers to site owners range from $400-$800 and $800-$3,000, respectively.
- Installation Costs: Installation costs can vary widely depending on location and the electrical system already in place. This cost typically falls between $2,000 and $10,000.
- Maintenance Costs: Maintenance costs of the machine fall on the low side, around $300 per annum. Based on our research, this cost does not include any administrative fees (i.e. billing and processing fees). Network operators are typically responsible for administrative costs.
- Marginal Electricity Costs: Marginal electricity costs range from $0.09 to $0.56 per kW•h depending on utilization and time of use.
- Depreciation: The actual lifespan of the machines is uncertain at this point, but the model assumes 10 years. For tax purposes, the machine is depreciated straight line over a useful life of 7 years.
- Subsidies/Tax Credits: In December 2011, tax credits for EV installation expired. It is unclear if these

credits will be reinstated in the future. For now, the model reflects cost recovery without tax credits.

- Cost of Equity: Cash flows are discounted based on cost of equity because of the assumption that there will be no debt financing. Stemming from comparable analysis, the cost of equity is determined to be 12.2%.
- Revenue Sharing Models: There is no dominant model right now among site owners. Research indicates that the current models are either free or charging a combination of fixed and variable fee per use. This revenue is shared with the EVSE network operator.

Our report also explores other variables including opportunity cost of parking, future subsidies, demand charging, utilization, turnover rate, and markup on electricity costs. Beyond the aforementioned variables, three important findings are as follows:

1) Key determinants to profitability are utilization, willingness to pay, and parking turnover. After building our DCF model around the important factors outlined above, sensitivity analysis was performed to determine a range of scenarios likely to be faced by site owners. Utilization, willingness to pay, and parking turnover emerged as the three variables with the greatest impact on financial viability of EVSE installation.

2) Tax credits and revenue sharing could be potential determinants of profitability. In reviewing the variables, equipment costs, installation costs, and electricity costs are more certain. Because of this, assumptions made regarding equipment and installation costs are on the optimistic side. However, variables such as future tax credits and revenue sharing terms, which potentially provide more upside to site owner profitability, are more uncertain at this point. Additional sensitivity analysis captures their significance to the profitability of the charging station.

3) Workplaces with Level I chargers potentially exhibit positive NPV. All modeled scenarios reflecting attributes of a grocery store, shopping mall, and workplace generate negative NPV. The workplace scenario with Level 1 chargers assuming 8 hours of charger utilization and zero fixed-fee generates the least negative NPV. In this scenario, the breakeven mark-up electricity charge is $0.07/kW•h on top of the marginal electricity cost of $0.14/kW•h. This translates into a price of $0.37/hour or $0.20/kW•h, which is below the gasoline equivalent of $0.40/kW•h. To the extent that consumers are willing to pay above this price, investments in EVSE station will be profitable. Although Level I chargers show a lower breakeven electricity sale markup, which may point to a higher potential of profitability, Level I chargers may also solicit a lower willing to pay due to the slow rate of charge.

1.6 Recommendations

Since the current state of the EVSE market does not allow site owners to benefit financially, we have the following four recommendations for both site owners and policy makers to improve cost recovery.

1.6.1 For Site Owners

- Enhance purchasing power. National retailers are placing large volume orders which undoubtedly allow them to negotiate a lower per unit cost, thereby decreasing the cost recovery time horizon. While this may be a great solution for large chains, most site owners, without the geographic coverage and the need for mass quantities of EVSE, will be unable to leverage large volume discounts. If site owners can band together to purchase EVSEs, as small companies do for health insurance policies, they may be able to better recover costs for equipment.

- Secure long-term contracts to guarantee utilization. Since utilization is a major driver of an EV charger's profitability, site owners should attempt to secure long-term contracts with the users of its charger before making the decision to install an EVSE. For example, the owner of a workplace can attempt to negotiate long-term contracts with the employees of the site that guarantees either steady utilization of the charger or at the least, monthly revenues should the employee decide not to charge. This will improve the top-line generated from the charger, improving its profitability.
- Leverage EVSE for "Green PR". While EVSEs may not be a profit-generating enterprise in the near term, there are other benefits to installation such as promoting sustainability through "green PR".

1.6.2 For Policy Makers

- Continue subsidies for site owners to encourage EVSE adoption. From a financial perspective, the expiration of federal tax credits increases the cost of EVSEs significantly. There was a 50% tax credit in 2010 that was gradually phased out (30% in 2011 and no tax credits in 2012). Many of the federal and state subsidies have rewarded manufacturers and network operators but have failed to address the continued need for incentives at the site-owner level.

1.6.3 Recommendations for further research

- Evaluate true willingness to pay and demand of consumers. Revenue is key determinant to profitability for EVSEs but both the willingness to pay and the demand of the consumers seems to be an unknown at this point. Most current locations either have a set fee or do not require users to pay for charging. To determine actual profitability, it is necessary find to what the demand will be at different potential prices. The big question is, how price sensitive will EV drivers be when they are charging outside of their homes? Further research on the consumers' willingness to pay is essential to determine the possible profitability of a charging unit.
- Measure the impact of public EVSE installation and EV adoption. Currently, public EVSE installation is viewed as a means to resolve "range anxiety" among consumers and encourage EV adoption. As more and more EV chargers are installed at commercial sites, it will be important to research and evaluate the actual impact that the penetration of public chargers has on EV adoption.
- Measure ancillary revenues from EVSE installation. Although EVSE may not be a profit-generating enterprise in the near term, there may be indirect revenues and value-add opportunities that arise from EVSE installation. For example, a retailer with an EVSE may attract more shoppers than another retailer without an EVSE. Further research on how much additional revenue EVSE installation can bring from attracting a higher number of visitors to a site will be useful in better capturing the profitability of an EV charger.

2. Introduction

Following a period of dormancy, the electric vehicle market has re-emerged in recent years. With rising fuel prices and public and private sector interest in developing green technologies, the consumer incentive to purchase an EV has grown significantly. Yet even with the arrival of the Chevrolet Volt, the Nissan Leaf, and other EVs, the rate of adoption will largely depend on the electric vehicle supply equipment (EVSE) available to consumers. Given this backdrop, it is important to understand how EVSE infrastructure will evolve and develop in order support the new electric vehicles on the market.

The purpose of this report is to present the analysis of cost and revenue drivers behind non-residential EV charging stations in the Los Angeles metro area. Analysis will focus on the site owner's perspective, taking into account the different factors informing their decision making process. The goal is to give site owners a concise framework, in the form of a Discounted Cash Flow model, outlining the important variables driving the financial viability of EVSE investment and installation. In addition, certain qualitative issues that factor into the site owner's decision will be considered.

2.1 The problem/strategic question

The EV charging station predicament is a classic chicken and egg problem. EVSE infrastructure is essential for EV adoption to take place, but at the same time EVSE installation does not make sense in the absence of electric vehicles on the road. This is a difficult scenario to reconcile. Studies show that the rate of EV adoption remains quite unclear. A report by the Boston Consulting Group found that, assuming a steady growth rate, by 2020, 18% of cars in city regions will be EVs (Book et al. 2009). However, given the conventional belief that most charging will likely take place at the home, it is important to first build an understanding of EV owner behavior outside the home.

Our analysis will consider the risks associated with this behavior, and those findings will factor into our financial model. Early indicators point towards the need for subsidies in the near term, without which cost recovery for site owners will be a real challenge.

2.2 Relevant and succinct history of the situation

A study conducted in 2011 by a group of UCLA Anderson School of Management students found that charging for electric vehicles takes place predominantly at the homes of EV drivers. At present, few public charging stations are available to EV drivers in non-residential areas, creating "range anxiety." This is the term that encapsulates the fear that an EV driver may end up stuck, away from home, with no charge left in their car (Nilsson 2010). Range anxiety has been highlighted as a major psychological barrier preventing widespread EV adoption.

As long as EV drivers are concerned that they may run out of power when driving longer distances and there are limited public charging options, EV adoption will be hindered. As such, implementing public EV charging stations is of critical concern, from both a practical and psychological standpoint. One recent case study from 2009 worth noting is the Tokyo Electric Power Company (TEPCO). TEPCO deployed a fleet of electric vehicles with charging available at the home base for the fleet. Concerned about range anxiety, TEPCO drivers would bring their electric cars back with 50% of the charge still remaining. In order to relieve this range anxiety, TEPCO installed chargers throughout Tokyo, and as a result, drivers became much more confident, returning to the fleet base with much less charge remaining (Kearney 2011). The Tokyo example underscores the salient role of charging station infrastructure in encouraging EV adoption.

However, there is encouraging data that points towards the viability of electric vehicles for typical American consumers. A report by Kearney found that the average US driver drives 33 miles per day. Electric vehicle ranges more than satisfy the average driver's needs with the Volt getting 40 miles per charge and the Leaf getting 100 miles per charge. Although the potential ranges exceed the typical driver's needs, it is essential to assure consumers that the infrastructure is there to protect them from running out of a charge, building confidence in EVs.

According to the 2010 census, Los Angeles County has a population of just under 10 million (Greninger 2011). As of 2007, there were more than 6.6 million registered automobiles, trucks and motorcycles registered in Los Angeles County (LADOT 2009). These vehicles traverse thousands of miles of roadway, including 527 miles of dedicated freeway (LADOT 2009).These factors, combined with demand side preferences where a higher number of residents are concerned about the environment and are willing to pay to be "green", points to Los Angeles as a prime market for EV adoption.

2.3 Scope

The focus of this report is on non-residential EV charging stations in the Los Angeles metro area. According to a 2011 report by a team of MBA students from the UCLA Anderson School of Management, by the end of 2015, Los Angeles will have 80,000 plug-in vehicles. In order to meet the charging demand of these vehicles, it is imperative to build a charging infrastructure that reaches beyond the home. Non-residential charging options are also essential to assuage "range anxiety."

In order for there to be wide implementation of charging stations, they have to profitable. Determining the financial viability of different non-residential site locations is driven by a number of factors. Our report will consider different EVSE pricing, ownership, and leasing models through the eyes of a site owner. The report will look at the different locations, assessing the variables that impact their viability for charging station equipment.

2.4 Importance of the study to the organization

The Luskin Center has a rich history as a thought leader in Los Angeles and Southern California, examining present and future market developments and how they will inform public policy. The EV market has major policy implications, and the Luskin Center wants to have a solid understanding of the EV market, the value chain, and how it will likely transform Los Angeles in the years to come. In addition, it is important to understand how policy will impact the private sector.

2.5 Plan of presentation

Our report will begin with our research methodology. From there, we will present our findings as a result of the research and evidence we collected. Finally we take those findings and make recommendations in regards to site owners, public policy, and future research.

Over the course of our work on the report, our team has been in contact with primary and second sources that have knowledge of the EV market at large and the important variables that are shaping the EVSE market in Los Angeles. With this backdrop established, we will then present the Discounted Cash Flow model we have created for site owners. Focusing on three site locations, we will demonstrate their financial prospects according to important variables and educated assumptions. This model is a function of our research efforts, and it is created in dynamic fashion so that it will remain relevant and useful even as the EVSE landscape undergoes change.

3. Methodology

To gain a big picture understanding of the EV and EVSE industries, both primary and secondary sources were consulted. However, the EV industry is a nascent one and the commercial EVSE market is even younger. Information on prices EV drivers pay to charge at commercial sites and utilization of EVSE is very limited in secondary literature. Primary sources, including stakeholders of private companies and site owners that have installed EVSE, are still considering different type of pricing methods and business models and are continually changing them based on actual utilization and other factors. Stakeholders of private companies are also concerned with revealing proprietary information and revenue numbers. Because there is not yet a critical mass of EV drivers, it is especially difficult to assess consumers' willingness to pay at this point. Due to these limitations, assumptions, especially for utilization, pricing and revenue share with network operators, are made in our DCF model.

As previously stated, the purpose of this report is to analyze the profitability of non-residential EV charging stations from the site owner's perspective. As such, research and analysis behind this report is mainly focused on determining and quantifying the revenue and cost drivers behind charging stations. To evaluate profitability, a Net Present Value (NPV) and Internal Rate of Return (IRR) analysis is conducted using a discounted cash flow (DCF) model.

3.1 Research and Analysis

To facilitate the building of the DCF model, our research and analysis mainly focused on the revenue and cost drivers of the charging station infrastructure.

Research on revenue drivers included:

- Existing pricing strategies and business models in which charging units currently operate

Research on cost drivers included:

- Equipment and installation costs
- Electricity costs
- Opportunity cost of parking
- Government subsidies
- Cost of equity

In researching revenue drivers, primary research was heavily relied upon to explore existing business models and cost recovery methods. Primary research included in-depth interviews with key players in the EVSE industry such as: 350 Green, Clean Fuel Connection, Ecotality, and EVGo. Other primary sources consulted also include site owners who have installed EV charging stations such as the Burbank Airport, the City of Santa Monica, the Santa Monica Airport, The Getty Center, a leading national retailer, and UCLA. Interview questions along with a detailed log of interviews conducted during the research phase can be found in Appendix I and Appendix II, respectively.

Information on cost drivers was obtained from a combination of primary and secondary research. Secondary sources, such as industry reports, were used to quantify each cost item. Primary research also helped confirm whether numbers extracted from secondary research were consistent in practice.

To gain a perspective of the current EVSE penetration in Los Angeles, locations with existing public chargers were analyzed. A taxonomy of current EV charging sites in the Los Angeles area was performed to assess the main categories of charging sites and to analyze any location-specific advantages or constraints.

Primary and secondary research also added color to the bigger picture of the EVSE industry including the value chain and any trends that may impact revenue and cost items going forward. Secondary sources consulted can be found in Appendix III.

3.2 Profitability Analysis (NPV and IRR)

Typical capital budgeting methods to evaluate investment into any project include:

- Net present value (NPV)
- Adjusted present value (APV)
- Internal rate of return (IRR)
- Modified internal rate of return (MIRR)
- Payback period

For the purpose of this report, NPV and IRR analysis are used to measure the profitability of installing a public charger. These two methods are arguably the most common metrics used to measure project profitability and are the two most appropriate measures in this case. The APV is a variation of the NPV that allows for changing debt structures throughout the life of the project. Similarly, the MIRR is also a variation of the IRR that addresses the inability of the IRR to account for cash flows switching between positive and negative during the project life. Since the DCF model assumes no debt financing and projects positive cash flows subsequent to the initial cash outlay for the equipment, the NPV and IRR methods are most fitting. Moreover, the payback period method is inappropriate for the purpose of this report. Since the payback period method simply calculates the time required to recoup the investment of a project, it ignores any project cash flows generated beyond the payback period and neglects the time value of money.

To conduct an NPV analysis, a DCF model was built. Sample DCF inputs and outputs can be found in Appendix III and Appendix IV. First, future cash flows generated by the charger were estimated. These cash flows were then discounted using a discount rate that is representative of the time value of money and risks of the project to bring them into present values. In other words, future cash is worth less than present cash and uncertain cash flows are also worth less than cash flows that are more certain. The discount rate is, in essence, the return investors require and thus, their cost of capital. In the DCF model, the cost of capital (or cost of equity since it assumes no debt financing) is calculated using comparable analysis and the Capital Asset Pricing Model (details on this in Findings section). Summing the present values of future cash flows and subtracting from it any initial cash outlay required for this investment, the NPV of the investment is produced. A project with a positive NPV indicates a profitable investment because a positive NPV indicates that investors are sufficiently compensated for the time value of money and the risks they are taking on for investing in the project.

An internal rate of return of the project or IRR can also be found by setting the NPV factor to zero and calculating the now unknown discount value. A company or site owner should invest in projects with an IRR higher than the company's hurdle rate, or target rate of return.

The NPV and IRR analysis was applied to charging stations operating in three different scenarios aimed to reflect parking characteristics of different commercial sites: a grocery store, a shopping mall, and a workplace. The three scenarios were chosen to capture different types of utilization patterns where utilization is a function of the number of charge events per day and duration of potential charge events, which are based on how long visits to these locations are.

For each of the three scenarios, we also conducted sensitivity analysis to identify the key determinants to the profitability of a charging unit. Further sensitivity analysis and break even scenarios are provided for lesser known variables such as utilization and pricing.

4. Findings

As mentioned before, the EVSE market is nascent, and as a result, there is limited data available from secondary sources. Furthermore, different players in the value chain are reticent to share their business model for fear of losing their competitive advantage. These facts made it necessary to work with existing information to form educated projections of financial scenarios that may face site owners. Other motivations also play a role in the site owner's decision making process for EVSE installation. Sources confirmed that there is a public relations consideration to charging station installation, as an EVSE investment is a means to establish a green, environmentally friendly brand. The findings in this report encompass both sides of the coin, the quantitative and the qualitative.

4.1 Qualitative Findings

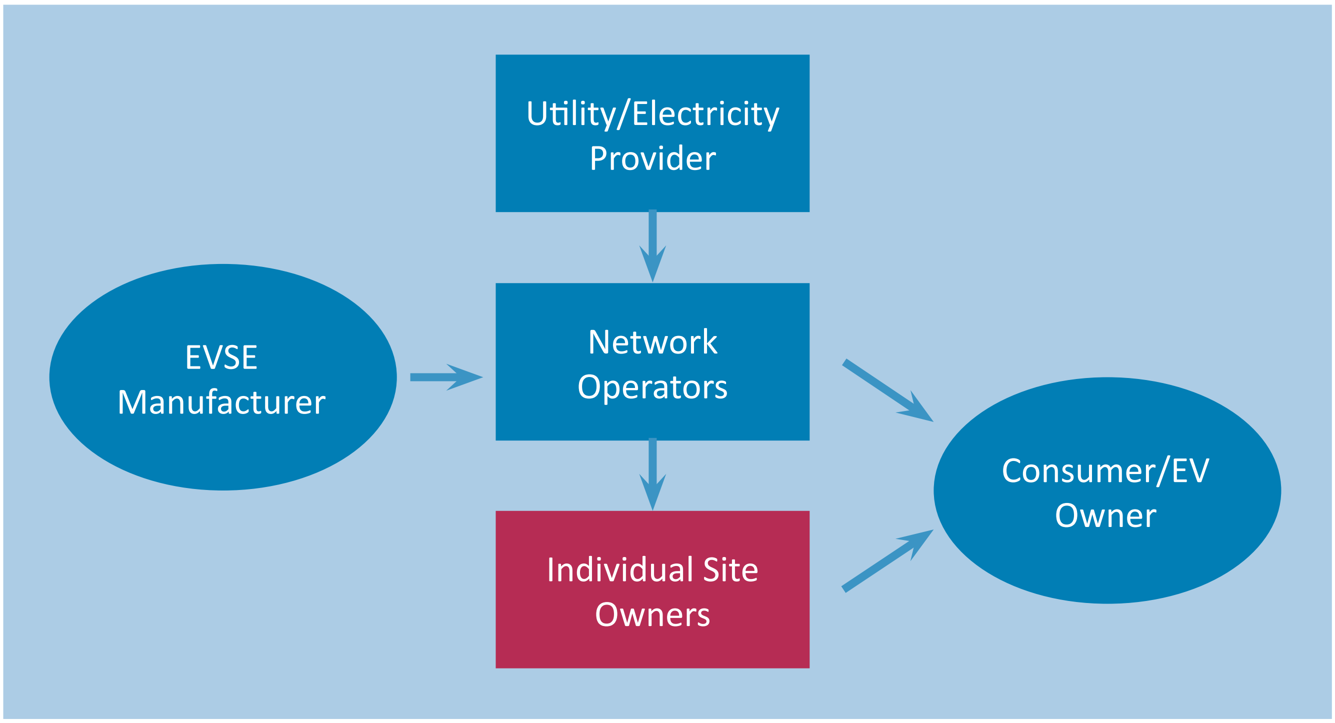
4.1.1 Overview of Value Chain and Charging Equipment

Before delving into the financial details of our DCF model, it is important to first understand the value chain of the current EVSE environment. The current value chain has a significant impact on the financial evaluation a site owner performs for its EVSE investment since players in the value chain currently dictate the cost of equipment and the cost of sharing revenue with network operators. These costs represent a significant portion of the initial cost as well as the ongoing cost of operating the EVSE.

In order to assess the current value chain in the EVSE industry, we have considered a classic business strategy framework: Porter's Five Forces. The five forces are: the threat of substitutes, buyer power, supplier power, barriers to entry, and the intensity of rivalry. As it relates to EVSEs, substitutes can be defined as traditional gas stations, and we will discuss prices for gasoline as a comparable to EV charging pricing in our quantitative findings. Buyer power refers to the EVSE site owners, and supplier power refers to the network operators. Barriers to entry describe the characteristics of the industry that prevent any profit-seeking firm from entering the industry, protecting existing firms and inhibiting new rivals. Lastly, the intensity of rivalry is highly determined by the previous four forces and is affected by the number of firms, the industry's growth rate, product costs, and switching costs.

In the context of this report, we focus primarily on the relationship between the site owner buyers, who lack power because they are numerous and varied, and the network operator suppliers, who have amassed a strong degree of power through government subsidized funding and the creation of network effects through subscriptidels.

The following is a representation of the current value chain:



In order to understand the EVSE value chain, it is important to understand the financial structure and incentives of each player. Many of the individuals we interviewed were reluctant to provide financial insight into their business models as the companies are still in process of determining a viable financial and cost recovery model. However, there are several publicly traded EVSE players such as Aerovironment (Nasdaq: AVAV) and Ecotality (Nasdaq: ECTY). Studying their annual reports allowed us to gain additional insight into the market. Both Aerovironment and Ecotality rely heavily on government subsidies with Ecotality indicating that it expects over $100 million in government grants to build out EV infrastructure.

Before proceeding further, we would like to provide a brief overview of the charging stations made by EVSE manufacturers like Aerovironment and currently available for site owners. For site owners interested in installing EV chargers, three charger options are available: Level 1, Level 2, and Level 3 (also known as the DC fast charger).

A Level 1 charger consists of simply a special cord that plugs an EV to a traditional 110-volt (AC) plug with a dedicated 15-amp circuit. The capacity of these chargers are 1.9 kW (Balon2011). A vehicle with a 24-kW•h battery, such as a Nissan Leaf, can attain a full charge in 8 to 14 hours (Kearney 2011).

A Level 2 charger is a standalone box that can be mounted to a wall and wired directly to an electrical panel. It carries a charge of 220-volt (AC) with a dedicated 80-amp circuit and. The maximum rate of a Level 2 charger is 6.6kW•h. A Nissan Leaf, plugged to a level 2 charger can be fully charged in 3 to 5 hours.

Level 3 chargers carry a charge of 480- volt (DC) using a 60-amp dedicated breaker with special grounding equipment. Charging time for Nissan Leaf charging on a Level 3 is around 40 minutes to a little under an hour (Balon 2011).

While Level 1 chargers are mostly found in homes due to the longer time it takes to charge a car, it is more common to find Level 2 chargers in commercial places. Level 3 DC chargers are rare due to its high cost. Concerns have also been raised on the negative effects its high-voltage will have on EV battery life.

Aerovironment, based in Southern California, is a manufacturer of both residential and non-residential charging equipment. Their main non-residential product is a Level II charger (EVSE-CS) and charging docks (Aerovironment 2011). Based on the publicly issued financial statements for Aerovironment, there are several highlights worth noting. First, gross margins for the company have fluctuated widely over the past several quarters, ranging from 25% in the most recent quarter (Q3 2011) to 43% in the same quarter in the last fiscal year (Q3 2010). The company attributes this swing to newer products that required additional development costs. Second, revenues increased in 2011 as a result of number of EVSEs delivered (Aerovironment 2011). This is not surprising given the expiration of federal subsidies which drove purchases of EVSE at the end of 2011.

Unlike Aerovironment, Ecotality does not manufacturer its chargers and outsources manufacturing to its strategic partner, Roush Manufacturing (Ecotality 2010). In addition, Ecotality is highly concentrated in EVSEs, whereas EVSE represents a small percentage of total revenues and total profitability for Aerovironment. Therefore, Ecotality’s business model is heavily dependent on additional revenue, including the development of a network of subscribers. Ecotality is relying on widespread adoption of their Blink Network, a network of charging stations throughout the United States, and has announced partnerships with gas stations like ARCO and BP as well as retailers like Best Buy and Kroger. The costs of developing this network have led to several quarters of continuous losses and thinner margins (when compared to Aerovironment), but for the quarter ending September 30, 2011, Ecotality increased gross margins to 30% from 3.5% in the same quarter of the prior year (Ecotality 2011).

There are three primary revenue models for network operators which are described by the following themes: Prepaid, Club Membership, and the Cell Phone. The Prepaid model allows EV owners to prepay a fixed amount for unlimited access to EVSE within the network. Austin Energy currently offers a $25 prepaid plan for unlimited charging over a 5 month period. The Club Membership model where EV owners pay a small monthly fee plus the electricity cost per charge. Coloumb Technology offers their Chargepoint Network which operates under this model. The third is a Cell Phone model which derives similarity from wireless carrier plans. This model offers EV drivers a combined home and public charging plan. eVgo, offered by energy and utility company NRG, offers EV drivers with a public/private solution. EV owners can choose among 3 plans that offer a combination of home charging and public charging, plus the electricity cost.

Table 1: Network Operator Revenue Models

Model	Description	Example
Prepaid	Access to in-network charging stations with prepaid fee	Austin Energy ($25 for six-month unlimited access)
Club membership	Small monthly fee + Electricity Cost	Chargepoint by Coloumb Technology
Cell phone	Offer residential + public charging plan +High monthly fee + electricity cost	eVgo (eVgo 2011) (3 year service agreements) Home: $49 + electricity cost Mobile: $79 + electricity cost Complete: $89 (includes electricity cost during non-peak hours) Mobile and complete come with unlimited charging in network

Some site owners are currently in the process of evaluating and experimenting with their own revenue structures. Many of the site owners that we interviewed indicated that there is no revenue model as the non-financial benefits (including being a good corporate citizen and green public relations) outweigh the financial costs of installing EVSEs. However, the site owners operating under this "green model" have also indicated that they are wary of having their charging stations become the primary source of charging for EV owners. To prevent this, site owners have implemented time restrictions to ensure that there are no electricity or parking space hogs. There is also a slow migration of many of these "green model" operators towards a "gas station" model, where EV owners who are not in a network, would be charged a per session fee. One site owner we interviewed is currently charging $2.00 per hour for a Level II charge.

Table 2: Site Owner Revenue Models

Model	Description	Example
Green	Free	Walgreens, Kohl's
Gas station	Fee-for-service, per session fee	UCLA parking, if EV owner is not part of Coulomb network

Many individual site owners have partnered with network operators including Ecotality and Coulomb Technologies. As demonstrated in Table 1: Network Operator Revenue Models above, Coulomb Technologies becomes a one stop shop for servicing and payment processing. This results in additional costs for site owners. For example, one site owner we interviewed indicated that the network operator would charge a fixed fee per charge of $0.50 plus a percentage of the total fee charged (variable fee) of 7.5%. This model is similar to a credit card payment processor, in which the payment processor charges the vendor a fixed fee plus a percentage of every dollar charged. There is also a hybrid model that entails a partnership between network operators and site owners. In this case, network operators would lease parking space from the site owner, take on the costs of operating the EVSE, but also retain the revenue collected, similar to a vending machine operator.

Site owners and network operators each hold their own responsibilities within the value chain. These responsibilities are summarized in the table below:

Table 3: EVSE Responsibilities

Installation	Site owner
Station maintenance	Site owner (electrical problem) and/or network operator (equipment related)
Advertising and promotion	Site owner and/or network operator
Payment processing	Network operator

4.1.2 EVSEs in Los Angeles

According to data from the U.S. Department of Energy, there are currently 75 sites in Los Angeles County with Level 2 chargers. Many of these sites have multiple chargers bringing the total amount of chargers in Los Angeles County to 173. A summary of the taxonomy findings can be found on the next page.

The largest portion of chargers is located in the retail/commercial category with the majority of retail/commercial sites belonging to car dealerships, namely, Nissan and Toyota. Other prevalent sites include university parking lots (13.3%) as well as public parking garages (13.3%).

Table 4: Los Angeles County EVSE Taxonomy

Category	Number of Sites	% to Total
Education	19	25.3%
Adult School	1	1.3%
High School	8	10.7%
University	10	13.3%
Public	20	26.7%
Airport	2	2.7%
Attraction	5	6.7%
Government	1	1.3%
Metro Station	1	1.3%
Parking Garage	10	13.3%
Street	1	1.3%
Retail /Commercial	27	36.0%
Car Dealership	23	30.7%
Mall	2	2.7%
Shopping Center	2	2.7%
Workplace	9	12.0%
Utility	4	5.3%
Workplace	5	6.7%
Grand Total	75	100.0%

4.1.3 Case Studies

As seen in the taxonomy above, there are chargers located in public parking facilities throughout municipalities in Los Angeles County. A lot of the public parking facilities are located next to museums and other local attractions. For example, the parking facility at the Long Beach Aquarium is owned and operated by the city of Long Beach, and the parking facility for the Los Angeles Music Center and the Los Angeles Arboretum are owned by Los Angeles County with operations contracted out to a third party at the music center. As a result, the local municipality or county is responsible for installing EVSEs in the parking facilities adjacent to the local attractions.

City of Santa Monica

Interviews with the City of Santa Monica were conducted because they have the highest concentration of publically available chargers in Los Angeles County with 47 EVSEs at various locations throughout the City including the Santa Monica Airport, Pier, Civic Center, 4th Street Parking Facility and an on-street charger on Montana Avenue. Through a grant from the California Energy Commission (CEC), Santa Monica installed 24 new Level II chargers to upgrade locations with old paddle type chargers. They are planning on the installation of 12 more chargers this coming year. The City's goals with the chargers are to meet the targeted sustainability objectives in order to become a carbon neutral city. With a long standing reputation as an environmental leader, Santa Monica feels the obligation to be on the forefront of EVSE technology.

While the goal of the chargers is to promote sustainability, the City is currently not charging a fee for EVSE charging. However, Santa Monica does not plan on permanently paying for charging at these sites. As one of the Energy Efficiency Engineers stated in an interview, the public service to the community is to provide chargers in publically accessible locations not to provide free electricity especially as electric vehicles become more widely adopted. He feels that it is likely that they will charge start charging a flat rate per hour in the near future. This flat rate is to encourage drivers to come back and move their car once adequately charged instead of drivers use the charging location as a parking opportunity (since a lot of the chargers are located in lots where parking is a premium).

In keeping with the City's reputation as "the People's Republic of Santa Monica", the City is reticent of any subscription type model with their fee structure because they want the EVSE to remain accessible to all, not just members of a particular network. The City is optimistic and feels that once they begin charging they will be able to break even on the operations, maintenance and electricity costs required. An interview with the fleet manager determined that the costs of both maintenance and operations were minimal at this point. He estimated the maintenance costs at all 47 locations to be around $1,000/year. Currently, the City pays between $50 and $85 per month for the electricity used at the publicly-accessible EV chargers that it maintains (Kubani 2011). They do not have any installation costs or equipment costs since their chargers were upgrades to existing locations and funded by CEC grants.

Leading National Retailer (they asked that their name not be disclosed)

This retailer recently installed 33 Level 2 EV charging stations around the country including 7 locations in California on a trial basis. We were fortunate to speak with their Senior Manager of Sustainability who was responsible for the project. Their decision to install the EV charging stations was motivated by greater company initiatives rather than for green PR purposes. As part of an environmental sustainability program, the company has taken on numerous green initiatives including: building all new stores according to LEED certified specifications, installing solar panels on 121 stores, and using recycled content in its boxes, cartons, and bags whenever possible. Although the stations were just installed, customer feedback has been fantastic with numerous messages received through the company's website inbox.

Another primary motivation for installing the 33 EV stations was to be a participant in the Department of Energy's EV project. The company was identified as a prime retail candidate and was actually approached by the Department of Energy to partner with Ecotality's EV Project and Coulomb's ChargePoint America. As a participant in these programs, this retailer has access to valuable data on utilization for other sites.

In deciding where to install chargers, the retailer considered a few factors. First, they obtained data from the Ecotality's EV Project identifying locations and regions where the new EVs, Nissan Leafs and Chevy Volts, would be available for sale. Then, they filtered those locations by owned versus leased stores, choosing owned stores. Finally, they evaluated electric conduit locations as well as the corresponding installation costs to make their final site selections. Our contact could not provide exact numbers but said that installation costs varied by location. Our source also mentioned that permitting and the approval process with city governments was highly variable with some cities already having robust approval processes in place while others had none due to the nascent nature of the EVSE industry.

Right now, like many retailers with EVSEs, this retailer is offering free charging as they want it to be a service for customers and employees instead of a money-making venture. Since EVSEs were just launched the program a few months ago, there is no clear utilization data; however, our source did say that most charges right now are under one hour and that their most utilized location is seeing 8 to 10 hours of usage per day. As for the ongoing costs of ownership including maintenance and repair, the retailer shares the cost with Ecotality or Coulomb depending on the issue. If the problem is equipment related, then the EVSE network provider will take care of it, but if is an electrical problem (ex: bad connection), the retailer will take care of it. When asked about exit strategies in the event that EV adoption does not take off, our contact was not especially concerned saying the stations can always be uninstalled or could be left as non-functioning.

Airport Commercial Parking Site

Unlike city parking or shopping center parking, airport parking falls on the long-term end of the spectrum. A reputable airport parking company with operations in Los Angeles and other major US cities is in the process of installing two EV charging stations at its LAX location. The variables surrounding an airport parking structure are vastly different from most other non-residential locations. Two important characteristics to consider are that there are around 2,000 parking spots at each location and that vehicles stay on average for three days.

An executive at the company noted that their decision to install EVSEs at their LAX location was driven by a combination of factors. In recent months, customers using their facility expressed a desire for the company to install EV charging stations for their electric vehicles. Thus, this is a case where consumer demand is playing a direct role in the site owner decision. Second, the executive noted that installing EV charging stations is a great way to differentiate from the competition. Situated front and center, the EV charging stations provide a great image for the company and shine a light on its efforts to support green technology. Unlike other site locations, a typical airport parking site does not have great electricity needs beyond lights and a small office. A company source estimated that utilization rate would be 50%, but even at this rate, there is no concern that there will be a major impact on electricity costs at the location.

The important takeaways from this airport parking location are twofold. One, it seems that consumer demand is starting to crest for certain sites, and site owners will need to determine at what point it makes sense to respond to this demand. Two, installation may make sense from a public relations perspective, and how it can really strengthen the brand equity of a company and drive ancillary revenue streams.

4.1.4 Subsidies/Public Policy

There are currently a number of Federal and State programs providing subsidies for the EVSE industry that impact the equipment and installation costs going into the model. The most common subsidy is from the US Department of Energy (DOE). The DOE received funding through the American Recovery and Reinvestment Act and is using a portion of those funds to subsidize EVSE infrastructure through programs such as Ecotaility's EV Project and Coulomb Technologies' Chargepoint America.

A federal tax credit was also available until just recently but expired on December 31, 2011. The tax credit for an EV charge station was 30% up to $1,000 for consumers and 30% up to $30,000 for businesses in 2011 (Department of Energy 2011). For the two previous years, the program offered tax credits of 50% up to $2,000 and 50% up to $50,000, for consumers and businesses respectively. Advocates are working to reinstate this program.

There are also a number of state programs that provide grants for advanced technology and emissions reductions programs including the Motor Vehicle Registration Fee program and grants from the California Energy Commission. EVSE meets the requirements of both of these programs and is eligible for grants and loans; however, amounts may vary, subject to availability and are typically based on a project priority list.

AB2766, or the Motor Vehicle Registration Fee Program, enables local air districts to assess motor vehicle registration fees "to reduce air pollution from motor vehicles and for related planning, monitoring, enforcement, and technical studies necessary for the implementation of the California Clean Air Act of 1988." (Health & Safety Code (HSC) section 44220(b), CA Air resources Board 2012). The funding is administered by local air districts, and alternative fueling infrastructure is considered an eligible use of funds. The City of Santa Monica was able to secure $100,000 through this program for EVSEs (Kubani 2011).

AB118, or the Alternative and Renewable Fuel and Vehicle Technology Program, is run by the California Energy Commission and provides an annual program budget of approximately $100 million to support projects which expand fueling infrastructure for alternative fuel vehicles as well as several other vehicle related advanced technology programs. The AB118 statute allows the Energy Commission to use grants, loans, loan guarantees, revolving loans, and other appropriate measures. Eligible recipients include: public agencies, private businesses, public-private partnerships, vehicle and technology consortia, workforce training partnerships and collaboratives, fleet owners, consumers, recreational boaters, and academic institutions (The California Energy Commission 2011). The City of Santa Monica has received substantial funding through the CEC to upgrade old paddle type chargers.

The South Coast Air Quality Management District administers the Clean Fuels Program which provides funding for various types of projects that are expected to help accelerate the commercialization of advanced low emission transportation technologies. EVSE infrastructure is included in this eligible project list. Projects are selected via specific requests for proposals on an as-needed basis or through unsolicited proposals. Approximately $10 million in funding is available annually with expected cost-share from other project partners and stakeholders (Department of Energy 2011).

While not specifically designated for the EVSE industry, several other programs exist which may provide possible grant funding for players in the EVSE value chain including the California Alternative Energy and Advanced

Transportation Financing Authority or in office locations, the Employer Invested Emissions Reduction Funding through the South Coast Air Quality Management District. In short, the state government has a number of programs that while not specifically designated for EVSEs could potentially provide opportunities for grant funding depending on the circumstances and application of the EVSE.

In summary, there are many subsidy, loan and rebate programs in variable amounts that are available to both private enterprise and municipalities. The funds received from these programs could drastically change the capital outlay required for a city or business to install an EV charger and impact the time to breakeven on installing EVSEs, changing the dynamics of the financial model.

4.2 Quantitative Findings

4.2.1 EVSE Equipment Costs

The U.S. Department of Energy summarizes equipment costs for EVSEs in a research report entitled Plug-In Hybrid Charging Infrastructure Review, which was published in 2008. This report outlines two scenarios: 1) one Level 1 charger is installed in an apartment complex and 2) ten Level 2 chargers are bought and installed at a commercial site. We can see from their findings that charging equipment for a Level 1 and Level 2 charger cost about $250 and $850, respectively.

Table 5: Infrastructure costs for Level 1 residential charging

Level 1 Residential	Labor	Material	Permits	Total
EVSE (charge cord)	$0	$250	$0	$250
Residential circuit installation (20A branch circuit, 120 VAC/1-Phase	$300	$131	$85	$516
Administration costs	$60	$43	$9	$112
Total Level 1 Cost	$360	$424	$94	$878

(Source: Francfort et al. 2008)

The numbers in Table 6 are based on the following assumptions: 1) Electrician rates of $75/hour 2) EVSE is located within 40 feet of breaker panel, 3) City permit fee of $85, 4) Administration costs to support infrastructure installation at 20% of total installation cost, and 5) Installation of protective bollards that are required for public charging.

Table 6: Infrastructure costs for Level 2 commercial charging

Level 2 Commercial	Labor	Material	Permits	Signage	Total
EVSE (1032A wall boxes)	$0	$6,500	$0	$0	$6,500
EVSE (10 charge cords)	$0	$2,000	$0	$0	$2,000
Circuit installation (10, 40A branch circuit, 240 VAC/1-Phase	$3,400	$3,899	$700	$350	$8,349
Administration costs	$680	$780	$140	$70	$1,670
Total Level 2 Cost	$4,080	$13,179	$840	$420	$18,519
Total per Charger Cost	$408	$1,318	$84	$42	$1,852

(Source: Francfort et al. 2008)

4.2.2 EVSE Equipment Mark-Up for Site Owners

From a site owner's perspective where chargers are purchased individually rather than in bulk, charger costs are two to four times more than what a network operator would have to pay for them. The prices of Level 1 chargers that are readily available for purchase range from $400 to $800. As for Level 2 chargers, most models range from $800 to $3,000 (Plug in America 2012). Finally, prices for Level 3 chargers are much higher at a minimum of $20,000.

4.2.3 Trends in Equipment Costs

As electric vehicles become more widely adopted, more EV chargers are produced, and subsidies continue to trend downwards, it is reasonable to expect equipment costs to decrease over time. Our interviews have shown that this is already happening. However, some secondary literature argues that since the charging station uses low technology electronics and standard commodities like stainless steel, the cost of the devices is insensitive to scale, and scale cost reduction will not play a major part for individual charging stations in the long run (Philip and Wiederer 2010).

4.2.4 Installation Costs to Site Owners

In addition to the cost of equipment acquisition, site owners also have to bear the costs of installation and maintenance. In the Plug-In Hybrid Charging Infrastructure Review, installation costs are quoted at around $600 for a Level 1 charger and $1,000 for a Level 2 charger. Realistically, installation costs can be much higher than these projections as chargers in commercial sites are often placed more than 40 feet away from the breaker panel. Commercial providers may choose to install a charge-point further away from a breaker panel for a few reasons. First, the breaker panel may not be in a vehicle accessible location. Second, the charge-point needs to be installed in a highly visible or highly utilized parking spot that is far away from the breaker panel. In these cases, significant structural work may be necessary to add electrical lines to a desired EVSE location. Since installation costs are highly dependent on each locations, they can vary widely. Estimates from McKinsey and the Boston Consulting Group show that installation costs range from $2,000 to $8,000. However, our interviews have shown that some installations can go beyond these estimates and cost as much as $10,000.

Table 7: Installation Cost Estimates

	Level 2: Commercial Garage/Public Street	Level 3
Plan NYC/McKInsey	$2,000-$7,500 dependent on location	More than $40,000
BCG, Element Energy and Other Studies	$3,000-$8,000 dependent on location	More than $40,000

(Source: Philip and Wiederer 2010)

Secondary literature estimates maintenance costs to be about $300 a year or 10% of the total installation cost (Kearney 2011). Since installation costs vary widely and can be unusually high, a maintenance cost dependent on installation costs may be unreasonable. As such, our DCF model assumes a maintenance cost of 10% of equipment costs. The prior assumption is supported by our primary research, where we have learned that maintenance costs can be written off to nearly nothing. Administrative costs such as billing and payment fees (i.e. credit card processing fees) are typically covered by network operators.

4.2.5 Cost of Electricity

The cost of electricity varies from site to site depending on the existing energy demand, time of use profile, and whether there is a separate meter. Several electricity rate schedules are offered by Southern California Edison (SCE) for commercial sites with an energy demand of between 20 kW to 500 kW (SCE 2012). For a site owner considering installing EV charging stations, the options are either to separately meter the charging stations or to tag the additional electricity demand on the existing meter. Level II chargers with 6.6 kW demand each can increase a site's daily energy consumption considerably.

The three main line items on a commercial electricity bill are:

1) Energy charge ($/kW•h/Meter/Month)
2) Customer charge ($/Meter/Month)
3) Demand charge ($/kW/Meter/Month), which is comprised of Facility-Related Demand and Time-Related Demand

Energy charge applies to the total amount of electricity that is consumed within a month. Depending on the type of rate schedule and the time of use, the billing rate differs. The electricity rate is higher during the day, or on-peak hours, because utilities need to operate additional electricity generators to meet higher demand.

Customer charge pertains to the metering service provided by the utilities; this is the fixed charge per meter regardless of usage amount.

Demand charge is tied to the peak electricity demand during on-peak hours within a month. Facility-related demand is a demand charge that applies year round while the time-related demand is an additional demand charge during the summer months.

The DCF model we developed in this report employs an average marginal cost of electricity based on a predetermined pattern of charging time. The average marginal cost is determined by comparing the various rate schedules, choosing the one that gives the lowest total electricity bill cost (inclusive of energy charge, customer charge, and demand charge), and dividing the cost by the total usage time. Because an average marginal cost is used, a constant price markup on top of the marginal cost means the profit margin on electricity varies throughout the day and across seasons as the underlying rate varies. Appendix VI has a more detailed discussion of the cost of electricity calculation.

4.2.6 Depreciation/Tax

The federal government enacted several incentives as part of the American Recovery and Reinvestment Act. The most favorable incentive was a tax credit allowing qualified alternative fuel vehicle refueling properties a 50% tax credit, up to $50,000 per location for commercial properties in 2009 (Section 1123) (IRS 2011). The provision was renewed and extended for 2010, albeit with a reduction to a 30% tax credit, but recently expired on December 31, 2011.

The table below summarizes the history of EV infrastructure tax incentives. Stakeholders are currently working with Congress to extend these benefits. For tax purposes, electrical vehicle infrastructure should be depreciated over a useful life of 7 years.

Table 8: History of non-residential EV infrastructure tax incentives

1/1/2009 – 12/31/2010	1/1/2011-12/31/2011	1/1/2012 and beyond
Up to 50% cost of the equipment and installation not to exceed $50,000	Up to 30% cost of the equipment and installation not to exceed $30,000	No infrastructure tax credits available

(Source: California Center for Sustainable Energy 2010)

4.2.7 Cost of Equity

The cost of equity that is used in our discounted cash flow model was determined using the betas of comparable companies (listed in Table 9 below). As EVSE industry is nascent, the availability of comparable companies is limited. The only publicly-listed EVSE company was network operator Ecotality, which has been public for less than two years. Other companies such as A123, ZAP, and UQM are EVSE manufacturers and are engaged in the development, the manufacturing, and the selling of EVs or EV components, and are deemed the best comparables apart from Ecotality, as these companies' performance will be highly dependent on the success of the EV industry.

Table 9: Calculation of Asset Beta Based on Comparables.

Companies	Business Summary	Market Capitalization (million)	Debt (million)	Levered Beta	Asset Beta
A123	Develops, produces, and sells EV batteries and battery systems	$255.31	$203.55	2.41	1.62
Ecotality	Provides EVSE products and solutions	$29.88	$0.32	2.74	2.72
ZAP	Designs, manufactures, and sells EV and EV power systems	$50.02	$22.00	2.01	1.59
UQM	Develops and produces electric motors, generators, and power electronic controllers	$59.55	$0	2.24	2.24

The average asset beta based on this set of comparables is 2.04. The beta data on the comparables was obtained from Yahoo! Finance (Yahoo Finance 2012). Assuming a risk-free 10-year rate of 1.98% and a market risk premium of 5%, the unlevered cost of equity for an EVSE investment according to the Capital Asset Pricing Model or CAPM is determined to be 12.2%.

The CAPM is another commonly used tool in finance to determine the appropriate discount rate for a project. It encompasses two parts: 1) compensation to the investor for non-diversifiable risk (the risk free rate) plus 2) compensation to the investor for taking on additional risk.

Cost of Equity = Risk free rate + Beta x (Market Risk Premium)

This report uses this 12.2% as the baseline discount rate for our DCF valuation of all-equity EVSE investments. A sensitivity analysis around this discount rate is shown in Appendix VII. One consideration from the site owner's perspective is if there is an illiquidity premium applicable to the investments. This depends on whether the claims on the EVSEs can be traded in a liquid fashion. For example, a 12.2% cost of equity is appropriate for Walgreens which is a publicly-traded company. However, site owners such as a university or a government entity who do not have liquid claims on EVSE assets should have an additional illiquidity discount applied to the NPV calculation. We do not address the illiquidity premium in this report.

Another consideration for site owners is the capital structure employed to finance the EVSE investments. To the extent that the site owner takes on debt, the discount rate should be the levered cost of equity taking into account the debt capacity of the owner. In order to simplify the NPV analysis, this report assumes that the DCF model will be discounted at the unlevered cost of equity and ignores debt financing. This is a reasonable assumption give that EV charging stations have little collateral value.

4.2.8 Opportunity Cost of Parking

The opportunity cost of parking space should be considered from a site owner's perspective. The opportunity cost of parking, to be exact, is the marginal revenue loss due to the installation of an EV charger. If a parking garage or lot has many empty spots under normal use, the marginal cost would be zero because there is no forgone revenue opportunity. On the other hand, an opportunity cost definitely exists if the EV charging spot is the only parking spot being considered by a marginal vehicle driver looking for parking. This exact opportunity cost is difficult to determine and is highly site-specific. However, it can be approximated as the average revenue under normal operation multiplied by the underutilization of the parking spot upon EV charger installation:

Opportunity cost of parking = Average revenue per spot x Underutilization upon EV charger installation

If the utilization of the parking spot remains the same, it is reasonable to assume that the site owners will obtain the same amount of parking revenue from parking receipts.

The revenue per spot at different sites in Los Angeles is shown in Table and was determined by using the national average revenue data from the National Parking Association. This national data was adjusted by the ratio of average Los Angeles parking rates to the national average rates as reported in the Colliers International

Parking Rate Survey (National Parking Association 2010, Moore 2011).

Table 10: Opportunity cost of parking at different sites in Los Angeles

Annual Parking Revenue per Spot		
	National Average	Los Angeles*
Hotel	$3,098	$4,181*
Airport	$2,369	$3,197*
Central Business District	$1,510	$2,038*
Hospital	$1,331	$1,796*
Municipal	$1,249	$1,686*
College/University	$635	$857*
***1.35% of national average revenue**		

4.3 Key Findings from Discounted Cash Flow Analysis

4.3.1 Basic Assumptions

In performing our 10-year DCF analysis, we make the following base assumptions:

Table 11: DCF Base Case Assumptions

Assumptions	
Revenue-sharing with EVSE - fixed fee	50%
Charger type	Level 2, 6.6k•W Level 1, 1.8k•W
Charger cost	$2,000 $400
Installation cost	$2,000 $400
Depreciation	Straight-line, 7 years
Subsidies	None
Tax rate	35%
Cost of Equity	12.20%

4.3.2 Scenario-Specific NPVs

Our assumptions leave out items including 1) Duration of charge event, 2) Time of charge, 3) Number of charge events per day, 4) Fixed fee charges, and 5) Mark-up charge for electricity. We tweak these inputs of the DCF model to capture and leverage the different characteristics of each of the three locations (grocery store, shopping mall, and workplace).

One characteristic that characterizes different charging sites is parking turnover. For instance, a parking spot at a grocery store exhibits considerably higher turnover since the average parking duration there is likely 30 minutes to 2 hours at most. A site that exhibits intermediate parking turnover would be a shopping mall parking garage. The average parking duration is estimated at 2 to 4 hours. And, on the other side of the spectrum, a workplace parking space is expected to accommodate only 1-2 cars or 1-2 turnovers per day with parking duration expected to be between 4 to 8 hours.

In our 10-year DCF analysis, we model higher per charge fixed fees for chargers installed in locations that experience shorter parking durations, as this will likely lead to shorter charge events and a higher turnover for each charger. Vice versa, we assume a higher mark-up charge on the cost of electricity for chargers installed in locations with longer parking durations and fewer turnovers, such as workplaces. In addition, for locations with longer parking duration likes workplaces, we hypothesized that Level 1 chargers should be sufficient. We incorporate this Level 1 workplace charging scenario as part of our calculations. All assumptions made for each location can be found in table 12 on the next page.

Table 12: NPVs Under Different Scenarios

	Scenario A	Scenario B	Scenario C1	Scenario C2
Approximations of location characteristics of:	Grocery Store	Shopping Mall	Workplace (Level 2)	Workplace (Level 1)
Duration of charge event (hours)	1	2	4	8
Time of charge	2pm-7pm	2pm-8pm	8am-12pm 1pm-5pm	8am-4pm
# of charge events per day (turnover)	5	3	2	1
Utilization (hours)	5	6	8	8
Per charge fixed fee	$1.00	$$0.75	$0	$0
Mark-up on electricity cost	0	$0.02/kW•h	$0.06	$0.06
Marginal cost of electricity	$0.18/kW•h	$0.16/kW•h	$0.14/kW•h	$0.14/kW•h
Revenue share (fixed:variable)	50% : 0%	50% : 5%		
Average price to customer (per hour)	$2.18	$1.57	$1.31	$0.35
Average price to customer ($/kW•h)	$0.33	$0.24	$0.20	$0.20
Average profit to EVSE network operators (4/hour)	$0.50	$0.25	$0.20	$0.05
Average gross profit to site owners ($/hour) - net of revenue share and marginal cost of electricity	$0.50	$0.26	$0.20	$0.05
Charger type	Level 2, 6.6kW•h	Level 2, 6.6kW•h	Level 2, 6.6kW•h	Level 1, 1.8kW•h
Charger cost	$2,000	$2,000	$2,000	$400
Installation cost	$2,000	$2000	$2,000	$400
Maintenance cost (10% of installation)	$200	$200	$200	$40

Based on the assumptions above, the NPV of the EV chargers installed in each location is as follows:

	Scenario A	Scenario B	Scenario C1	Scenario C2
NPV	($197)	($1,583)	($1,494)	($130)
IRR	10.9%	0.8%	1.6%	8.0%

Based on our assumptions, NPV is negative under all four scenarios. Scenario C2 generates the least negative NPV of -$130. The breakeven electricity sale markup for the chargers is $0.07/kW•h on top of the marginal electricity cost of $0.14/kW•h. This translates into a price of $0.37/hour or $0.20/kW•h, which is below the gasoline equivalent of $0.40/kW•h. To the extent that consumers are willing to pay at these prices or above these prices, investments in EVSE station will be profitable.

While the industry has moved beyond Level 1 chargers at this point in time, we found that their low equipment and installation cost make Level 1 chargers potentially viable options at locations where parking duration is long such as workplace. Based on our assumptions of 8 hours of charger utilization and zero fixed-fee, Level I chargers show a lower breakeven electricity sale markup which may point to a higher potential of profitability. However, Level I chargers may also solicit a lower willingness to pay due to their slower rate of charge.

Please note that the initial charge state of the EV batteries has not been taken into account. For example, in the scenario with Level I charger, there may not be a need to charge for 8 hours if the battery is half-full. This is also true for Level II chargers. Another consideration is that it may be difficult to achieve the two charging events per day assumed in Scenario C with drivers needing to move their cars during their lunch hours.

4.3.3 Key Determinants of Profitability

To determine the key determinants of an EV charger's profitability, we performed sensitivity analysis on key inputs such as utilization, number of charge events per day, per charge fixed fee, mark-up fee on electricity cost, charger cost and installation cost. For inputs unitized in hours, we increased the number by one hour. For inputs in dollar units, we increased the dollar amount by 20%. The following two tables show the changes in NPVs resulting from these variations, keeping all else constant.

Table 13: Sensitivity Analysis of NPV

	Scenario A	Scenario B	Scenario C1	Scenario C2
Time of Charge	1pm-7pm	1pm-8pm	8am-5pm	8am-5pm
# of charge events per day	5 ➔ 6	3 ➔ 4	2 ➔ 3	1 ➔ 2
change in NPV	$741	$557	$0	$0
Utilization	5 hours ➔ 6 hours	6 hours ➔ 7 hours	8 hours ➔ 9 hours	8 hours ➔ 9 hours
change in NPV	$0	$150	$391	$106
Per charge fixed fee	$1.00 ➔ $1.20	$0.75➔ $0.90	$0	$0
change in NPV	$741	$334	N/A	N/A
Mark-up ($/kW•h)	$0	$0.02➔ $0.022	$0.06➔ $0.072	$0.06➔ $0.072
change in NPV	N/A	$113	$807	$218
Charger Cost	$2000➔ $1800	$2000➔ $1800	$2000➔ $1800	$400➔ $320
change in NPV	$154	$236	$236	$95
Installation Cost	$2000➔ $1800	$2000➔ $1800	$2000➔ $1800	$400➔ $320
change in NPV	$154	$236	$236	$95
Original NPVs	($197)	($1,583)	($1,494)	($130)

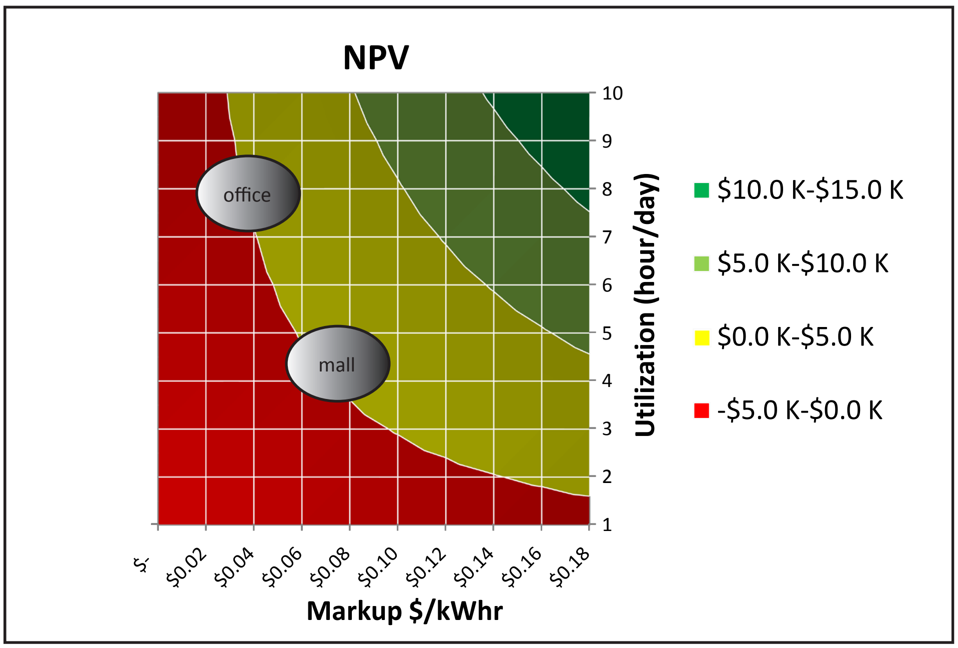
From our sensitivity analysis, we see that for grocery stores and shopping malls higher fixed fees, the number of charge events, and the level of fixed fee are the factors that impact NPV the most. For the workplace location which assumes fewer turnovers, the mark-up on electricity cost is the most influential on NPV value. In summary, the two key determinants of the profitability of an EV charger are 1) Utilization, a function of turnover and parking duration, and 2) Price consumers are charged, which is dependent on willingness to pay.

4.3.4 Utilization and Willingness to Pay

As seen in previous sections of this report, the profitability of an investment in EV charger will depend on many DCF line items. However, the two key determinants and the biggest unknowns among the inputs are those that relate to consumer behaviors and adoption: cumulative utilization of the charger within a day and the willingness to pay of EV drivers.

Although we make assumptions for the purpose of calculating a NPV, it is speculative to project what the cumulative utilization of the charger within a day and the willingness to pay of EV drivers will be. As such, we performed another sensitivity analysis around these two variables in Figure 1 to illustrate circumstances under which the NPV becomes positive.

Figure 1: Sensitivity of NPV on Utilization (hours/day) and Electricity Sale Markup ($/kW•h), which is correlated to consumers' willingness to pay



Assumptions

- No subsidy
- No loan
- No opportunity cost of parking
- Installation cost of $2000
- Charger cost of $2000
- Electricity cost of $0.16/kWhr
- 3 turnovers per day
- Per-charge fee of $0.75
- 50% fixed revenue and 7.5% variable revenue share

Figure 1 above shows that NPV is highest at charging sites with high utilization and high markup of electricity cost, as expected. However, it is likely that actual sites will exhibit a trade-off of these two characteristics. Therefore, it is essential to understand consumer behaviors along these dimensions.

A potential comparable for the total out-of-pocket cost consumers are willing to pay is the $/kW•h-equivalent of gasoline. For example, a Chevy Volt owner has the option to plug-in to recharge the battery or fill up the gas tank. Assuming that the depreciation cost of the EV battery is not under consideration, the potential cost ceiling was derived as follows:

- An EV with 24 kW•h battery is assumed to cover 85 miles per full charge
- Assuming gasoline prices of $4/gallon and gas mileage of 35 mpg, the equivalent fuel cost to cover 85 miles is $9.71
- The kW•h-equivalent of this gasoline cost is $9.71/24 kW•h = $0.40/kW•h

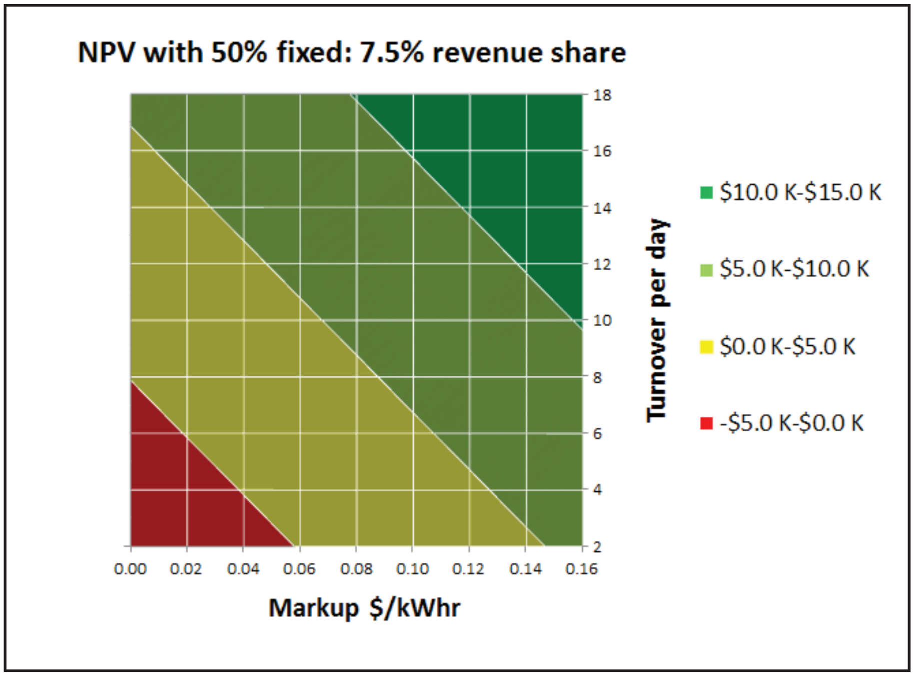
This calculation shows that there is potentially room to charge consumer a higher markup at public charging stations if at-home charging is not possible.

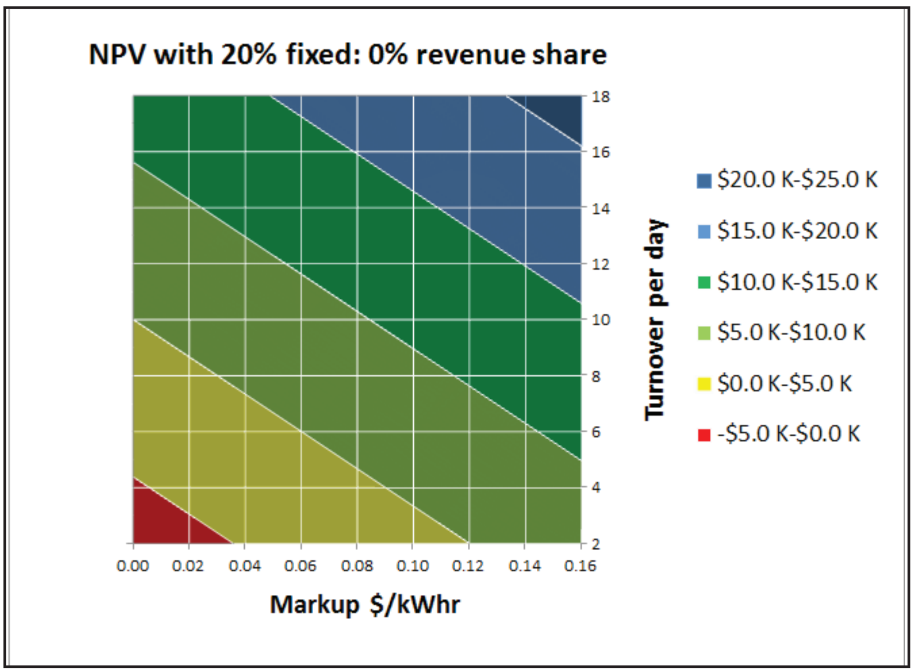
4.3.5 Revenue-Sharing with EVSE

One input we held constant was the revenue-sharing of the fixed fee with network operators. However, this input deserves considerable attention, especially if turnover is high at the particular location. Turnover affects the NPV of investment in the form of per-charge fee. Higher turnovers at EV charging stations would automatically translate to a higher revenue stream if there is a fixed-fee scheme and site owners were able to capture this revenue stream. A case in point is Coulomb's current revenue share arrangement. Coulomb keeps 100% of the fixed fee while site owners only get paid the variable fee. If an arrangement could be made such that site owners also partake in the fixed fee revenue, then a fee structure that weighs towards a fixed fee would be preferable at sites with high turnovers.

Figure 2 on the next page shows the sensitivity of the NPV as a function of electricity cost markup and parking turnover. As the percentage share of the fixed fee decreases from 100% to 0%, the NPV becomes positive at a lower markup given a constant parking turnover.

Figure 2: Sensitivity of NPV on Turnover (/day) and Electricity Sale Markup ($/kW•h) as Revenue Share Decreases from 50% fixed: 7.5% variable to 20% fixed: 0% variable





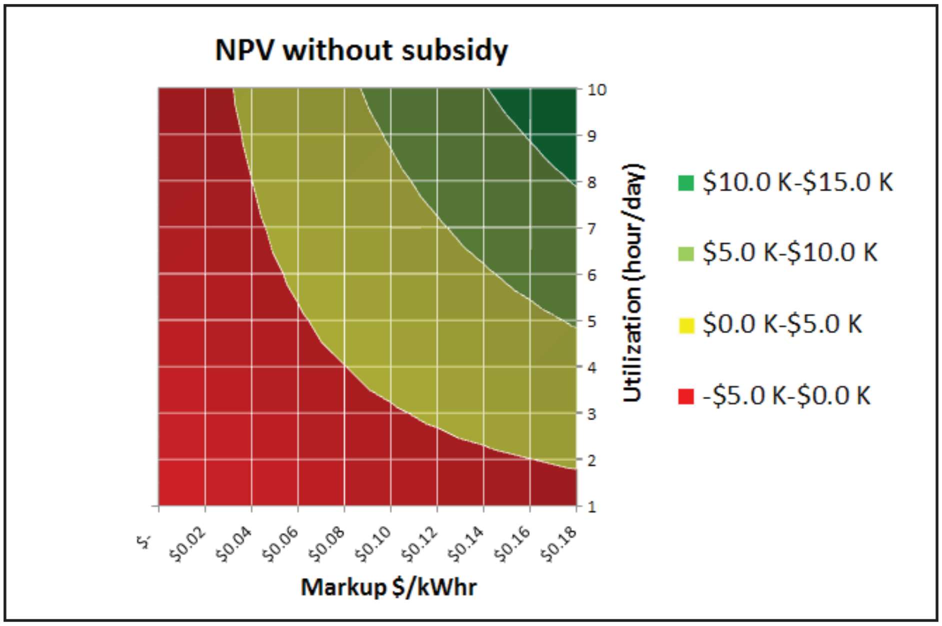
Assumptions

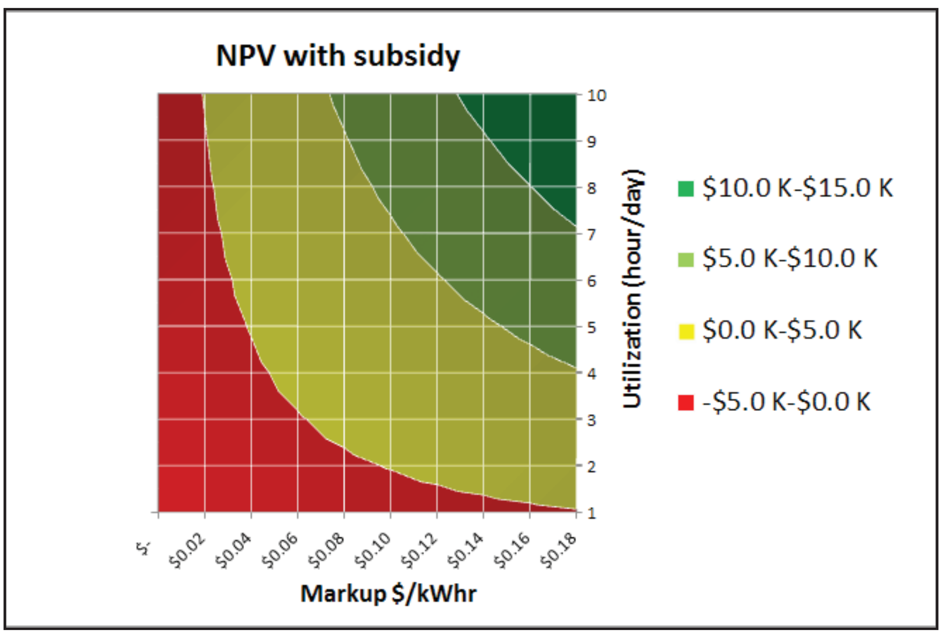
- No subsidy
- No loan
- No opportunity cost of parking
- Installation cost of $2000
- Charger cost of $2000
- Electricity cost of $0.16/kWhr
- 6 hours of utilization per day from 2pm to 8 pm
- Per-charge fee of $0.75

4.3.6 Tax Credits

Finally, we previously assumed tax credits to be zero as the 30% tax credit expired at the end of 2011. However, we believe public policy to be a considerable force in the growing EVSE market. To understand the impact of tax credits, Figure 3 shows the break even circumstances under a scenario with a 30% tax credit and one without. We can see that a tax credit reduces the markup by up to $0.06/ kW•h at low utilization.

Figure 3: Sensitivity of NPV on Utilization (hours/day) and Electricity Sale Markup ($/kW•h) without and with a 30% tax credit.





Assumptions

- No loan
- No opportunity cost of parking
- Installation cost of $2000
- Charger cost of $2000
- Electricity cost of $0.16/ kW•h
- 3 turnovers per day
- Per-charge fee of $0.75
- 50% fixed revenue and 7.5% variable revenue share

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4.3.7 Other relevant considerations

As mentioned before, the EVSE industry is a young market dependent on many changing variables. From a site owner's perspective, there are a few other important issues to consider when deciding to install an EV charger including: 1) the outlook of public policy, 2) the mileage of EV batteries, and 3) the cost of Level 3 chargers.

As we have recently witnessed, public policy geared towards EV chargers is changing from year to year. Site owners should be aware of newly implemented public policy and the implications they have on costs and taxes. As mentioned before, although tax subsidies have been eliminated for this year, a reinstatement may be possible in the future. In addition, as grants allocated to public charging stations diminish, it is important for site owners to see whether costs of equipment will decrease as a result.

Another trend to consider is that with improving battery technology, EVs will eventually achieve a 200 mile or greater range, decreasing the need for public chargers. Site owners will need to consider the timing of EVSE installation as public chargers may end up being obsolete assets.

Finally, costs of EVSE equipment may decrease as a function of diminishing subsidies and economies of scale. Although prices of Level 3 chargers are currently in the tens out thousands of dollars, Level 3 chargers may become more and more affordable going forward. If Level 3 chargers become the preferred chargers in the market, Level 1 and 2 chargers may, again, become obsolete.

5. Recommendations

Our report looks at the profitability of EV charging stations from the site owner's perspective. Based on our financial analysis, site owners have little control over revenues and costs with respect to EVSEs, and unfortunately, site owners do not benefit financially from the current value chain.

From a revenue perspective, site owners are reliant on consumers for high turnover, high utilization, and a willingness to pay a premium, or markup for the electricity used. Given that electric vehicles are so new and such a large proportion of owners tend to charge predominately in their own homes, a lot of the revenue related variables are currently quite low, and growth is somewhat uncertain since many public locations currently offer free charging.

From a cost perspective, site owners are beholden to local regulations as well as electricians, often resulting in high installation costs. And, while Level 2 charging equipment is relatively inexpensive, issues with the electrical panel, meter and conduits can also drastically increase installation costs. Demand charges may also increase the overall price the business pays for electricity if the charging location is not metered separately. In addition, site owners are dependent on a handful of network operators who not only serve as distributors but also as revenue share partners in billing and payment processing. Despite these barriers, interest in non-residential charging has been increasing as more drivers adopt electric vehicles. In order to meet electric vehicle charging demand, we have several key recommendations.

5.1 For Site Owners

5.1.1 Enhance purchasing power

National retailers are placing large volume orders which undoubtedly allow them to negotiate a lower per unit cost, thereby decreasing the cost recovery time horizon. While this may be a great solution for chains with a large number of locations, most site owners, without the geographic coverage and the need for mass quantities of EVSE, will be unable to leverage volume discounts. If site owners can band together to purchase EVSEs, as small companies do for health insurance policies, they may be able to increase buyer power and recover substantial costs for equipment.

5.1.2 Secure long-term contracts to guarantee utilization

Since utilization is a major driver of an EV charger's profitability, site owners should attempt to secure long-term contracts with the users of its charger before making the decision to install an EV charger. For example, the owner of a workplace can attempt to negotiate long-term contracts with employees of the site for an EV parking spot. This would guarantee steady utilization of the charger or at the very least monthly revenues even if the employee does not charge. This will improve the top-line generated from the charger, improving profitability.

5.1.3 Leverage EVSE for "Green PR"

While EVSEs may not be a profit-generating enterprise in the near term, there are other benefits to installation such as promoting sustainability as a public relations tool.

5.2 For Policy Makers

5.2.1 Continue subsidies for site owners to encourage EVSE adoption

From a financial perspective, the expiration of federal tax credits increases the cost of EVSEs significantly. There was a 50% tax credit in 2010 that was gradually phased out, dropping to 30% in 2011 and 0% or none in 2012. Many of the federal and state subsidies have rewarded manufacturers and network operators but have failed to address the continued need for incentives at the site-owner level.

5.3 Further Research

After evaluating our findings, a number of topics have arisen as key issues that require further research.

5.3.1 Evaluate the true willingness to pay and demand of consumers

Revenue is key determinant to profitability for EVSEs but both the willingness to pay and the demand of the consumers seems to be an unknown at this point. Most current locations either have a set fee or do not require users to pay for charging. To determine actual profitability, it is necessary find to what the demand will be at a range of potential prices. The big question is, how price sensitive will EV drivers be when they are charging outside of their homes? Further research on the consumers' willingness to pay is essential to determine the possible profitability of a charging unit.

5.3.2 Measure the impact of public EVSE installation and EV adoption

Currently, public EVSE installation is viewed as a solution for solving "range anxiety" and subsequently, encouraging EV adoption. As more and more EV chargers are installed at commercial sites, it will be important to research and evaluate the actual impact the penetration of public chargers has on EV adoption.

5.3.3 Measure ancillary revenues from EVSE installation

Although EVSEs may not be a profit-generating enterprise in the near term, there may be indirect revenues and value-add opportunities that arise from EVSE installation. For example, EVSE installation may increase the number of shoppers that visit the site and the amount of dollars spent. Further research on how much additional revenue EVSE installation can bring from attracting a higher number of visitors to the site will be helpful in capturing the full profit potential of an EV charging station.

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Appendix I: Primary Research Instruments

The two sets of questions below summarize the interview questions used for EVSE providers and site owners (current and potential EVSE sites).

A. EV Providers

- o Who are your upstream (manufacturers) and downstream (buyers)?
- o Where do you see opportunities in the LA market and how is your company pursuing these opportunities?
- o How are you pursuing clients for EVSE? What is your client selection and business development process to get buy-in from a site?
- o What do you foresee as the main barriers to these particular types of sites?
- o What types of sites are more receptive?
- o What kind of contract do you have with the different sites? Is it the same across the board?
- o Does the contract vary?
- o Site owns completely outright
- o EV provider leases
- o Who does service and maintenance?
- o We spoke with UCLA Parking about EV chargers on campus and understand that Coulomb is taking a fixed fee + a percentage of revenue on each charge.
- o Is this standard?
- o What if the service is free for drivers?
- o What types of rebates are you receiving at the city, state, and federal level?
- o How does that affect your pricing?
- o What do you see happening in the next few years?
- o Are there network effects? It's difficult to cross networks? Will this become like gas stations?
- o Installation costs?
- o Retrofitting?
- o Level 3 ($20k - $60k in installation costs)
- o Level 2 or Level 3?
- o Do you have warranties on these machines?
- o How are you handling maintenance?
- o What is the cost of maintaining these units?
- o Do people lease equipment from you?
- o Contract terms

- Different financial models?
- What's your view on the hydrogen technology?
- What is the useful life, as you know right now?
- How do you market your product?
- What is your business model?
- What is your pricing strategy?
- Who are the key players?
- What's your competitive advantage?
- What is your business model?

Manufacturing

- In your view, how are your costs going to be in the future?
- How do you see this network effect/cross-charging?
- What is your business model?

B. Site Owners

- Who is the project manager?
- What is the motivation behind installing the EV chargers? (profitability, subsidies/tax credits, "green" transportation)
- If PR/Sustainability, what other PR initiatives did you think about?
- Were you contacted by an EV installation company or vice versa?
- How did you decide which locations you would install the chargers in?
- What is your business model? Revenue share? Contract terms with EV providers?
- How often is your space being used/What is the current demand or utilization?
- How did you determine the pricing strategy?
- Can you give me an idea of the ongoing cost of ownership? (installation, maintenance, operations)?
- Is there significant cost involved in upgrading your site's electrical meters to support EV Charging? How do you price this upgrade in charging rate?
- What do you do when your equipment breaks down? How often does this happen? Who pays for the repair?
- How has the feedback been?
- In the event EV demand doesn't grow, do you have an exit strategy?

Appendix II: Interview Research Log

This research log summarizes all the contacts made with electric vehicle service equipment providers, local retail and office locations, and local public parking facilities.

Company/Organization	Role in Value Chain	Contact Name/Title	Date of Interview	Synopsis of Interview
EVGo	EVSE Service Provider	Terry O'Day, Director California Business Development	11/16/2011	EVGo uses a different model than a lot of the other providers. They own, operate and maintain the equipment and use a subscription model to push the cost of the fuel back onto the driver. Terry feels that this is the only way to make EVSE profitable.
City of Santa Monica—Fleet Management	Public Parking Management	Rick Sikes, City Fleet Manager	2/3/2012	Rick talked about the maintenance and operations costs for all existing chargers in Santa Monica. For EVSE installations overall, he said that they were unsure of how many chargers the city would need and there was a concern that they may become obsolete if a less costly Level III charger came to market.
City of Santa Monica—Office of Sustainability and Environment	Public Parking—EVSE decision maker	Matt Henigan, Electric Efficiency Engineer	2/1/2012	The City has received funding from the CEC to replace older generation chargers with new Level II charging. While the stations currently do not require payment, the City plans to change that soon. They will charge enough to cover electricity and maintenance of the EVSE but do not plan to make a profit. Installing EVSE is in line with the sustainability goals of the city and the city feels a responsibility to provide accessible EVSE to the public.
Santa Monica Airport	Public EVSE Site	Deena Meecham, Facilities Director	1/18/2012	The airport is City run and the chargers were installed by the City. According to Deena, the publically accessible chargers are not used often and one of the biggest problems they have had is cars running into the chargers.

Company/Organization	Role in Value Chain	Contact Name/Title	Date of Interview	Synopsis of Interview
The Getty Center	Private EVSE Site	Joel Burden, Electrical Supervisor	1/30/2012	Currently there are two older generation chargers that are rarely used. As a result of the 405 widening, the Getty parking structure is being renovated and the decision regarding new chargers is still pending. With the change to the structure they will likely lose quite a few spaces and concerns have been voiced about dedicating spaces to chargers that will likely go empty.
Burbank Airport	Public EVSE site	Victor Gill, Airport Public Relations Director	1/18/2012	The chargers at Bob Hope have been removed but Victor could not remember the time frame. When the chargers were there they were most often used by the state legislators who had EVs.
Clean Fuel Connection	EVSE distributor for Coulomb in California	Joseph Shinn, EV Department Manager	11/2/2011	Joseph outlined the EVSE value chain and answered some questions regarding ownership models, revenue streams, and the future of government subsidies.
Large National Retailer	Site Owner	Name omitted, Sr. Manager of Sustainability	2/3/2011	Our contact shared information regarding the retailer's motivations for installing EVSEs, the decision process on where to locate the chargers, and very preliminary usage numbers.
UCLA	Site Owner	Matt Hissom, Sr. Transportation Planner	10/26/2011	Matt shared valuable information with us on installation costs, utilization, and pricing per hour. Pricing arrangement is Coulomb gets $0.50 fixed fee per charge plus 7.5% of variable fee. Utilization in Parking Structure 9 was less than 20 hours total since installation. Installation cost is $20,000 per charger.
Ecotality	EVSE Service Provider	Adrene Briones, Utility Integration	11/09/2011	Adrene shared insights about the opportunities in EV charging and Ecotality's strategies. Discussions also included EV charger warranty for 2 years and charger lifetime of 10,000 cycles. She touched on the business model of advertising on EV charger with touch screen.

Company/Organization	Role in Value Chain	Contact Name/Title	Date of Interview	Synopsis of Interview
350 Green	EVSE Provider	Timothy Mason, CEO/Founder	2/14/2012	Shared company's views on the market and the opportunity they want to capture – to own a network of chargers predominantly installed in retail locations with shorter duration of parking and higher turnover rates. Lifetime of the equipment is expected to be 10+ years but is depreciated on a 7 year basis.
Airport Commercial Parking Location	Site Owner	Name Omitted, Vice President of Operations	1/31/12	The contact discussed the rationale behind the company installing EV charging stations at their LAX location. Company driven by consumer demand, need to stay ahead of competition, and good PR that can come from it. Company believes utilization will be high.
Parking In Motion	Parking technology company	Sam Friedman, CEO/Founder	12/1/11	Discussed with Sam the issues he faces with parking site owners and implementing his company's technology. Went over the different variables that differentiate parking locations.

Appendix III: Secondary Research Log

This research log summarizes all the secondary research conducted and a synopsis of the findings that are relevant to our study.

Title	Publisher	Key Findings of Study
Plug-in Hybrid Electric Vehicle Charging Infrastructure Review	US Department of Energy Vehicle Technology Program	This report analyzes the infrastructure requirements for PHEVs in both residential and commercial situations. It also provides cost estimates for infrastructure and seems to be the most often cited cost information in so some of the other reports that we have.
Market Models for the Roll-Out of Electric Vehicle Public Charging Infrastructure	Eurelectric	This paper looks at how to structure the future EVSE market in Europe. The document highlights four major market models describing the roles of possible market players in rolling out public electric vehicle charging infrastructure, but does not recommend any one model over another.
Electric Vehicle Infrastructure Manufacturing	SBI Energy	This report examines the global activities and market value of the EV infrastructure manufacturing industry and its projected future based on global economic conditions.
Bay Area Electrified Vehicle Charging Infrastructure: Options for Accelerating Consumer Access	Renewable & Appropriate Energy Laboratory, UC-Berkeley	While there are several barriers to large-scale EV deployment (e.g. upfront costs, near-term EV supply constraints, limited travel range, consumer education, and electric grid preparedness), local governments can play an important role in accelerating consumer access to EVSE throughout the Bay Area. This paper examines short term EVSE options for the Bay Area, in addition to the role the local government can take to accelerate deployment.
Electric Vehicle Charging Infrastructure Deployment: Policy Analysis Using a Dynamic Behavioral Spatial Model	Massachusetts Institute of Technology	This report contains a dynamic behavioral spatial model that demonstrate that importance of public sector infrastructure rollout and investment in innovation because there will be limited involvement from the private sector since it is difficult to earn a profit. As it stands now the costs greatly outweigh the revenues because the infrastructure has such a high cost when compared to the amount that could be charged to each user of the EVSE.
The EV Project and Beyond: Fueling Future Transportation	eTec: An Ecotality Company	This presentation gave an overview of the EV Project, including challenges to the deployment of EV infrastructure.
The EV Project: Quarterly Report: Quarter 2 2011	Ecotality	This quarterly fact sheet provides installation and usage information for the EV Project.
Parking in America: The Third Annual Review of Parking Rates in North America	The National Parking Association	This study provides the most comprehensive snapshot of state of the parking industry. The study looks at a wide range of parking operations from monthly, daily and hourly rates in Central Business Districts to specialty parking facilities at hotels, hospitals and educational institutions.

Title	Publisher	Key Findings of Study
The Future of E-Mobility and Commercial Electrification	Business Insights	The extensive report looks at: 1) drivers for EV adoption, which are predominantly government-backed initiatives, incentives, and policies in different countries, 2) infrastructure required to support EV adoption, 3) the costs and benefits of owning EVs, and, 4) major players in the EV market including EV manufacturers, EVSE providers, utilities, and commercial companies adopting EV fleet.
The Dollars – and Sense – of EV Smart Charging	Silver Spring Networks (Redwood City, CA based smart grid solution provider/ consultancy)	This paper places an emphasis on utility companies needing to understand EVSE options. Utilities that don't prepare to integrate EVSEs into their distribution networks are likely to incur unplanned costs and grid reliability problems, as well as be perceived as a bottleneck to EV adoption. The paper outlines three options: 1) Utility owns EVSE, 2) Customer owns EVSE with government subsidy, 3) EV treated as appliance.
Assessing the Viability of Level III Electric Vehicle Rapid-Charging Stations	Radu Gogoan, MIT	This paper focuses on a Level III charging dream world scenario where there is a rapid charging station in Connecticut between Boston and New York.
Vehicle Electrification	Dan Galves, Deutsche Bank	This presentation provides forecasts for EV and EV battery markets. It concludes that electric miles are still cheaper than petrol miles after accounting for battery depreciation. Therefore, EV provides compelling values to adopters.
Perspectives on Electric Vehicle and Charging Infrastructure	Tom Balon, M.J. Bradley & Associates	This report introduces four principles for EVs: 1) electricity must be less expensive than gasoline, 2)EV batteries will achieve a 200 mile range that may alleviate much of public charging infrastructure, 3) EVs will be used for commuting, not long distance travel, 4) EVSE must pay for itself and only socialized in rare conditions.

Title	Publisher	Key Findings of Study
Impact of Observed Travel and Recharging Behavior, Simulated Workplace Charging Infrastructure, and Vehicle Design on PHEV Utility Factors (UF), Total Charge Depleting (CD) Driving and Time of Day (TOD) Grid Demand: Scenarios Based on Consumers' Use of A Plug-in Hybrid Electric Vehicle (PHEV) Conversion	Jamie Davies, UC Davis	This paper focuses the implications plug-in hybrid EVs will have on electricity providers. This paper also explores consumers' recharging behavior to help interested parties better plan for PHEVs in the market place.
Fast and Furious: Dynamics of Range and Fast Charging Infrastructure	Michael Nicholas, Thomas Turrentine, Gil Tal, Justin Woodjack	The research behind this presentation tracks the traveling behavior of 48 households. Based on this data, the presentation shows where DC chargers would have to be installed in order to fulfill the charging needs of these households if they were driving EVs.

Appendix IV: Sample DCF Inputs

	Scenario A	Scenario B	Scenario C1	Scenario C2
Capital Expenditures				
Charging power (kW)	Level II	Level II	Level II	Level I
Charger cost	$2,000	$2,000	$2,000	$400
Installation cost	$2,000	$2,000	$2,000	$400
Depreciation - straight line (years)	7	7	7	7
Number of chargers on site	1	1	1	1
Revenue				
Per charge fee	$1.00	$0.80	$0.00	$0.00
Markup on variable electricity sale (kW•h)	$0.00	$0.02	$0.06	$0.06
Parking turnover/day	5	3	2	1
Utilization (hours/day)	5	6	8	8
Energy use (kW•h/day)	33.3	40.0	53.3	14.4
Parking duration	1	2	4	8
Average price to customer ($/hour)	$2.18	$1.57	$1.31	$0.35
Average price to customer ($/ kW•h)	$0.33	$0.24	$0.20	$0.20
Average profit to EVSE network operators ($/hour)	$0.50	$0.25	$0.20	$0.05
Average gross profit to site owners ($/hour) - net of revenue share and marginal cost of electricity	$0.05	$0.26	$0.20	$0.05
Operating Expenses				
Cost of parking space ($/space/year)	Free	Free	Free	Free
Revenue share (per charge fee)	50%	50%	0%	0%
Revenue share (variable fee)	0%	5%	15%	15%
Maintenance and operations ($/unit/year)	$200	$200	$200	$40
Marginal cost of electricity ($/ kW•h)	$0.18	$0.16	$0.14	$0.14
Financing				
Loan-to-value	0%	0%	0%	0%
Tax rate	35%	35%	35%	35%
Maximum subsidy/tax credit	$0	$0	$0	$0
COE	12.2%	12.2%	12.2%	12.2%

*** Inflation rate of 3%**

Appendix V: DCF Output (with Scenario A Inputs)

Year	0	1	2	3	4	5	6	7	8	9	10
Revenue											
Per Charge Revenue		$1,825.0	$1,879.8	$1,936.1	$1,994.2	$2,054.1	$2,115.7	$2,179.1	$2,244.5	$2,311.9	$2,381.2
Variable		$2,161	$2,226	$2,293	$2,362	$2,433	$2,505	$2,581	$2,658	$2,738	$2,820
Cost											
Electricity Cost		($2,161)	($2,226)	($2,293)	($2,362)	($2,433)	($2,505)	($2,581)	($2,658)	($2,738)	($2,820)
Maintenance and Operations		($200)	($206)	($212)	($219)	($225)	($232)	($239)	($246)	($253)	($261)
Parking Space Rent		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Depreciation		($571)	($571)	($571)	($571)	($571)	($571)	($571)	$0	$0	$0
Interest Payment		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Revenue Sharing with EVSE Providers		($913)	($940)	($968)	($997)	($1,027)	($1,058)	($1,090)	($1,122)	($1,156)	($1,191)
Operating Revenue		$141	$162	$184	$207	$230	$255	$279	$876	$903	$930
Tax		($49)	($57)	($65)	($72)	($81)	($89)	($98)	($307)	($316)	($325)
Income		$92	$106	$120	$135	$150	$165	$182	$570	$587	$604
Capita Expenditures											
Charger Cost	($2,000)										
Installation Cost	($2,000)										
Tax Credit/Subsidy	$0										
Financing											
Loan Amount	$0										
Free Cash Flow	($4,000)	$663	$677	$691	$706	$721	$737	$753	$570	$587	$604

IRR	10.9%
NPV	($197.34)

Appendix VI: Detailed Cost of Electricity Discussion

Two typical rate schedules for commercial sites are the GS-2 flat-rate schedule and the TOU-GS-3 Time-of-Use schedule. A flat-rate schedule has a fixed rate irrespective of time, while the time-of-use schedule offers lower rates during off-peak hours. A commercial site that predominantly consumes electricity during off-peak hours will have a lower electricity bill if the time-of-use schedule is adopted. In addition, SCE offers rate schedules of TOU-EV-3 and TOU-EV4 for separately metered EV charging stations. These EV-specific schedules benefit sites that will use EV charging predominantly during off-peak hours. However, commercial sites with the exception of hotels primarily consume electricity during the day, which likely makes TOU-EV schedules unsuitable for commercial site owners.

Table 14 compares the calculated monthly electricity bill according to different rate schedules assuming an EV charger is installed at a commercial site with a preexisting electricity demand of 20 kW to 500 kW. The hours of operation are assumed to be from 9 am to 6 pm. These costs reflect the marginal electricity costs for operating the EV charger. For example, even though there is a customer charge within the GS-2 and TOU-GS-3 schedule, the marginal customer charge for using the EV charger is actually zero because the charger is connected to an existing meter that would have been billed in the absence of EV charger use. This contrasts with TOU-EV-3 or TOU-EV-4 schedule, under which a customer charge applies because of the use of a separate meter.

Table 14: Comparison of a Monthly Electricity Bill Based on Different Rate Schedules for a level II EV Charger Operating from 9 am to 6 pm Daily

Electricity Bill Charges					
Demand	< 20 kW	20 kW - 500 kW			
Schedule	TOU-EV-3	GS-2	TOU-GS-3 (Option A)	TOU-GS-3 (Option B)	TOU-EV-4
Energy Charge (S/month)	306.2	131.6	196.5	134.8	248.9
Customer Charge ($/Meter/Month)	22.3	0.0	0.0	0.0	134.2
Facilities Related Demand ($/kW)	0.0	12.2	13.3	13.3	0.0
Time-Related Demand ($/kW/Meter/ Month)	0.0	17.1	0.0	7.0	17.1

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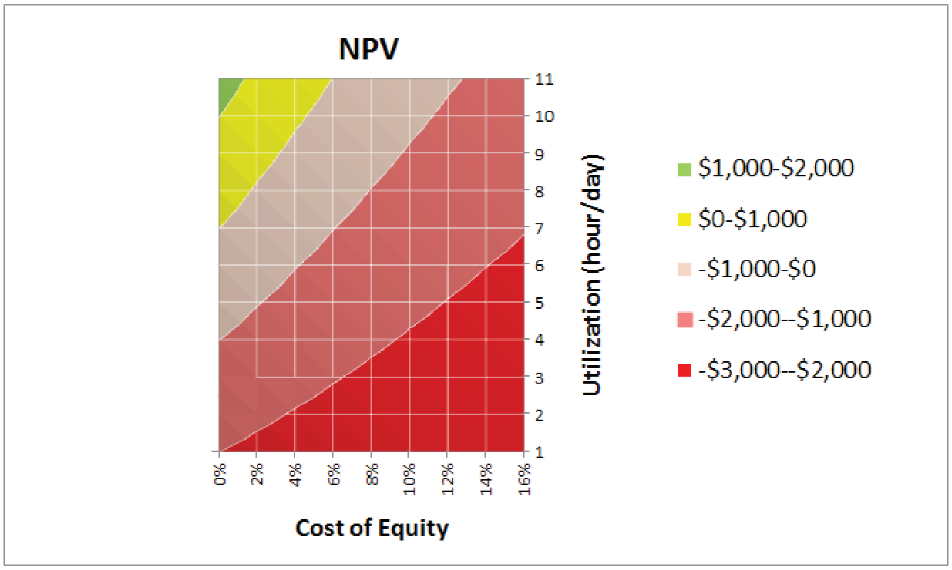
Appendix VII: Sensitivity Analysis around Cost of Equity

This report employs a cost of equity of 12.2% to discount future cash flows. The following sensitivity analysis around the cost of equity shows that an increase of 1% in the discount rate decreases the NPV by around $100 to $250 depending on the scenarios.



Assumptions

- No loan
- No opportunity cost of parking
- Installation cost of $2000
- Charger cost of $2000
- Electricity cost of $0.16/kWhr
- 3 turnovers per day
- Per-charge fee of $0.75
- Electricity sale markup of $0.02/kWhr
- 50% fixed revenue and 7.5% variable revenue share

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