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The Economics of Non-Residential Level 2 EVSE Charging Infrastructure

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Abstract

The paradigm for residential EV charging via a Level 2 EVSE is well established, and is a low-cost, highly convenient way for the EV driver to recharge for those with a dedicated parking space (e.g., garage). Residential charging has other potential benefits relative to electric utility demand response and emergency home power. For residences without such EVSE ready availability (e.g., multi-unit dwellings, street parking), other charge options may be necessary.

Non-residential Level 2 charging is a still-evolving business case. The non-residential EV charging model is complicated by a number of issues, including: the need for credit card systems at many venues, the question of roaming, communications and control with utilities, data reporting, the need to accommodate subscription networks, and site host requirements. This paper discusses the economic considerations and potential trade-offs for both the EV driver and the charge station site host for the following non-residential Level 2 charging venues:

- Workplace (offices, manufacturing, fleets)
- Parking structures/lots
- Publicly-accessible venues (courts, train stations, malls, museums, restaurants, grocery stores, etc.)

Keywords: Level 2 EVSE, public EV charging, demand response

1 Introduction

Residential Charging. Residential Electric Vehicle (EV) charging via Level 2 Society of Automotive Engineers (SAE) J-1772 Electric Vehicle Supply Equipment (EVSE) is a low-cost, highly convenient way for the EV driver to recharge. Residential charging has other potential benefits relative to electric utility demand response and emergency home power. Given proper coordination with the electricity provider (utility), the EV driver can reduce electricity costs during charging via Time-of-Use rates, especially during early morning hours, and further reduce the rate via grid services. For this low-cost operation, the residential owner buys the EVSE and pays for installation, a total cost of $1,500 to $2,000.

However, not all EV drivers have ready access (e.g., multi-dwelling units or MDUs, street parking) to parking suitable for EVSE access.

If residential EV charging is the baseline for cost and convenience, what are the economics and other issues associated with non-residential Level 2 EV charging?

2 Analysis Methodology

Non-residential Level 2 charging can be divided into two classes: (1) commercial and (2) public. While the lines can blur when making generalized distinctions, these two classes can further be split into:

Commercial:

- Workplace charging (Section 3)
- Fleet charging (Section 4)

Public:

- Parking venues – structures and lots (Section 5)
- Publicly-accessible private venues (train stations, courts, malls, museums, restaurants, grocery stores, etc.) (Section 6)

Before discussing business cases and economics for each of these Level 2 non-residential charging types, a discussion about charger power levels and dwell time is appropriate to set the context.

2.1 Charger Power Levels

EV manufacturers typically rate their on-board chargers at 3.3kW and 6.6kW. For example, the Nissan LEAF™ and Chevy Volt on-board chargers are rated at 3.3kW, while 2012 Ford Focus will be rated at 6.6kW.

Currently, EV charge station manufacturers rate their Level 2 equipment at 16A and 30A for 208/240VAC service. While 240VAC is common service for residential Level 2, 208VAC is common for non-residential applications. This analysis assumes the more conservative 208VAC service, or 3.3kW for 16A. For 30A, the power 208V power level would be 6.2kW, but 6.6kW is consistent with vehicle manufacturer ratings and takes into account a mix of 240 and 208V. 240VAC service would provide proportionally higher power (3.8kW and 7.2kW) if available. A 32A Level 2 charger would provide higher power, but at time of writing the Level 2 connectors and cables near this power level are rated and UL-listed at 30A.

DC fast charging systems, on the other hand, are designed to provide a fast charge by by-passing the on-board charger altogether, effectively minimizing dwell times and supplying an efficient charging solution for venues with short dwell times. At the other end of the spectrum, Level 1 charging is defined as 120VAC, which provides only approximately 1.4kW, and is the slowest type of charging.

2.2 Dwell Time: Likely Locations for Level 2 Venues

The extent to which a host venue lends itself to long dwell times determines whether it is a suitable revenue-generating charging location. For example, dwell times at a rest stop or gas station last only ~3-5 minutes, while dwell times at venues such as a workplace or large retail location could last anywhere from 1-8 hours. This is further complicated when very long dwell time venues are considered. For example, an EV that stays at the airport for a week will fully charge to 100% capacity in a day (or less), and thus, for many revenue models, sacrifices the charger revenue generating capacity for the subsequent six days. Perhaps Level 1 charging provided at little or no cost would be the best solution for these very long dwell time venues.

Also important to consider when discussing dwell time variability is the effect of different power levels. The on-board charger or the Level 2 EVSE limits the AC power to whichever is lower. A vehicle with a 3.3kW on-board charger will obviously take longer to charge than a vehicle with a more powerful 6.6kW charger.

Figure 1 depicts dwell times necessary to recharge for increments of 25 miles at different power levels. For calculation purposes, 1kWh provides a range of approximately 3.3 miles (~300Wh/mi). Actual range varies per vehicle and driver. Thus, a battery pack with a usable 20kWh capacity should provide a range of approximately 70 miles. Therefore, 25 miles of range would require about 7.6kWh. This is an hour and ten minutes charge at 6.6kW, or 2.3 hrs at 3.3kW.

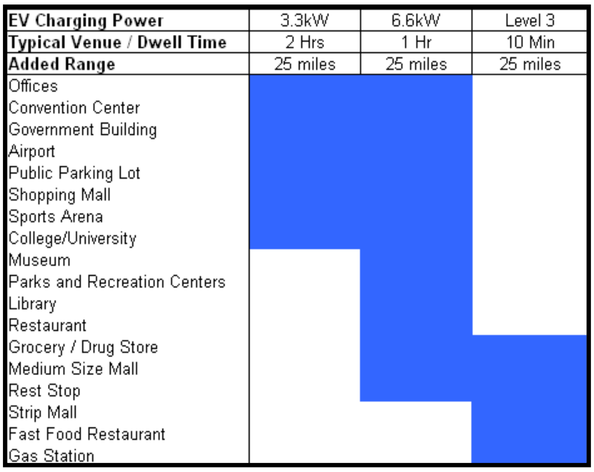

Figure 1: Dwell Times for Public Venues Versus Charger Power Level

2.3 Economic Analysis Methodology

This analysis uses primarily a top-level approach, more for sensitivity analysis than detailed purposes. The variability for capital and installation costs is such that the general case can provide only top-level analysis. The individual case will always yield more location-specific detail with which to drill down to more accurate costs and revenue.

For each of the non-residential charging classes, the economic analysis comprises estimates of:

Costs*

- Capital and installation costs
- Operating and maintenance costs
- Transaction costs

- Taxes, other costs

Revenue*

- User revenue, capacity factor issues
- Subsidies
- Secondary potential revenue streams – e.g., advertising, demand response/grid services, market pull

Summary

**All cost and revenue amounts are presented in $USD.*

Initial capital and installation costs are annualized assuming a ten-year life and 4% cost of money. This factor is 0.123 [1]. Thus, for a $1,000 initial capital equipment cost, the equivalent annualized cost would be $123. This analysis does not assume a salvage value at the end of ten years. After this period, the equipment and installation may very well still have value. In which case, the next ten year analysis would show a benefit.

2.4 Costs

Capital Cost – EVSE

EVSE are available in many styles to accommodate the different types of installations. For example, residential installations use wall-mount EVSE almost exclusively. Non-residential installations typically use pole-mounted units (also called bollard-style), though wall-mounted units are still used. Bollard-style units can have two or more EVSE (also called ports), which significantly lowers the effective installation cost per port. This analysis assumes a per port cost using a dual-port bollard-style EVSE unit because of this cost efficiency (i.e., total dual-port capital cost divided by two.)

The per port capital cost for a dual-port bollard-style EVSE is in the range of $1,500 to 5,000 USD based on published prices listed on the Government Services Administration website [2]. The price range reflects whether the EVSE has only basic EV charging functionality or full networking communications using cellular or Wi-Fi connectivity or additional optional features such as RFID Authentication.

Incentives such as government tax credits and volume discounts may contribute to lowering the capital cost, however, duration of these incentives are limited and discounts are never guaranteed so they should not be considered a permanent cost cutting solution.

Assuming a ten-year life and 4% cost of money, the annualized per port capital cost ranges from $185 to $615.

Installation Cost

Typical installation costs range from $3,000 to $10,000 for single port bollard-style units. The range is approximately twenty percent higher for dual-port bollard units, resulting in a per port cost ranging from $1,800 to $6,000. Installation costs depend on the number of ports installed, difficulty of electrical panel upgrade, length and type of conduit run, permitting authority, and a host of lesser factors. High variability also results from differences in electrical contractors, geographical location, and local permitting and regulations. For example, a joint report by the Business Council on Climate Change and Bay Area Council [3] states, “Panel and supply upgrading, trenching, and permitting can range from $1000 to possibly $25,000+ depending on existing infrastructure deficiencies and trenching needs.”

Assuming a ten-year life and 4% cost of money, the annualized per port installation cost ranges from $221 to $738.

Operation and Maintenance Costs

Operation and maintenance costs are dependant largely on charger utilization. To reach 100% utilization, an EV with a 6.6kW on-board charger would have to be plugged in and charging 24 hours/day. Utilization, here, is defined as actual time charging (as opposed to time plugged in.) With the EV market (number of vehicles on the road) still in its infancy, 100% charger utilization is unlikely.

Realistically, a twenty to twenty-five percent capacity factor might be more appropriate when considering the Chevy Volt, Nissan LEAF™ and Mitubishi iMiEV all currently have 3.3kW on-board chargers. Over a 24-hour period, the total possible energy dispensed is 158kWh for a 6.6kW EVSE. At $0.10/kWh (the average electrical rate in U.S.) the daily electricity cost would be $4.00 for 40kWh (~25% capacity factor.) This rate varies regionally and by commercial customer.

Another source of variability in electricity costs are Time-of-Use (TOU) rates, applied by electric utilities to account for the value of the electricity they generate at different times of the day. For example, during peak usage on a summer afternoon, the TOU rate could be many times the TOU rate at 3am. Thus, in the above example, the operating cost could be much higher than the national average of $0.10/kWh, and even upwards of $0.40/kWh.

Electric utilities often impose a fee called a "demand charge" based on kW usage. For a large industrial facility that uses multi-MW for processes, the demand charge for an incremental 50kW (roughly eight 6.6kW EVSE charging simultaneously) could be managed by prioritizing loads. However, for a facility with little electrical usage, a parking structure for example, the demand charge for this same 50kW could be $500/month (depending on season and the utility), and it would have minimal load management capability.

If the EVSE is network-enabled, the operating cost for wireless communications plus data/back office fees ranges from $10 to $25 per month, or $120 to $300 annually [2].

Maintenance costs for workplace EVSE would be relatively low given the limited access to these chargers compared with the full access for public chargers. For example, a majority of these charger installations would be within gated locations, making vandalism a lesser problem than full access public locations. A semi-annual preventive maintenance program would be on the order of $100/yr per port for a facility with multiple ports, while a public EVSE could require double that cost.

<u>Transaction Costs</u>
Transaction costs from the charger's point-of-sale mechanism (RFID, contactless credit card, magnetic swipe. etc.) are typically proportional to the fee for the total charge event to account for credit card transaction costs and overhead. Depending on the network operator this can range from 5% to 7.5% of the transaction. A workplace system of EVSE might use RFID for authentication, but not have any transaction costs, while a public charger that uses a credit card would likely be in this 5-7.5% range.

<u>Taxes and Other Costs</u>
All venues which gather revenue from EV drivers could be subject to income tax. The corporate tax is currently 35% for large corporations. For workplace charging, an employer or real estate investment trust may not treat the EVSE system as a profit center and may have no net revenue. They would likely still have to account for this revenue as taxable, but it may ultimately net out. For a parking venue, the EVSE system would likely be expected to carry its weight in profitability, which could mean taxable revenue would play a large role in the price set for the EV driver.

The property owner may seek to recover cost of the property and property taxes via incremental revenue from the EVSE system. This all depends on the property owner's situation and application for the EVSE.

2.5 Revenue

<u>Revenue from the EV Driver</u>
An EVSE site owner/operator will likely expect the primary source of revenue to come from the EV driver. However, unlike the workplace EVSE owner who may only have an expectation to recover electricity and operating costs, the public venue EVSE owner may require recovery of all costs plus a profit. The profit aspect will be especially important for parking venue and third-party owner/operators.

<u>Subsidies</u>
Many states and municipalities provide subsidies and tax credits for purchasing and installing EV infrastructure [4], which serve to offset high capital and installation costs. However, as the duration of these incentive programs are limited, they should not be considered a permanent solution. For example, the U.S. Federal government allowed the 30% Investment Tax Credit to lapse at the end of 2011, without any immediate plans for supplying additional financial support.

<u>Depreciation</u>
Corporations commonly depreciate capital equipment, often using an accelerated depreciation schedule. They use depreciation to offset income. This may be an important offset for parking venue and third-party owner/operators.

<u>Secondary Revenue Streams</u>
Utility demand response and other grid ancillary services promise a potential revenue stream. While many use cases have been identified, actual contracts are likely years away relative to EVSE-related services. The Federal Energy Regulatory Commission (FERC) provides rules and guidelines for energy market services [5]. A US Department of Energy Report [6] indicates a minimum of 100kW may be required to qualify for entry in some markets. This would be equivalent to a group of 15 or more EVSE. Viridity and Axion Power announced in November 2011 participation in Pennsylvania/Jersey/Maryland Power Pool (PJM) regulation market, stating a projected value ranging from $180,000 to 240,000 per MW of

delivered generation [7]. For a 100kW source this would be $18,000 to 24,000/yr. Translation of this value to EVSE would be misleading because of the typically low EVSE capacity factor.

Advertising is also a potential revenue stream still in the nascent stages for EVSE installations.

3 Workplace Charging

Workplace charging is considered the next most important leg in the EV charging infrastructure ecosystem. For those EV drivers with long commutes of greater than forty miles each way, workplace charging provides a way for them to use their EVs as commuter vehicles. For those EV drivers without easy access to residential charging, workplace charging could be their primary charging method.

Before going into the workplace charging cost and revenue analysis, a brief discussion of Multi-Dwelling Units (MDU) is called for. The economics for MDU (e.g., apartment buildings, condominiums) charging infrastructure are in many ways more similar to that of workplace, rather than residential charging. For example, both employers and business owners are likely to own the EV chargers as opposed to the employees or MDU residents, and payment systems for frequent users and guests would also be similar. Therefore, rather than conducting a separate analysis for MDU charging infrastructure economics, this section will assume MDUs are contained within the workplace category and only note major differences when they occur.

3.1 Workplace EV Charger Costs

Capital Cost

If data or complex financial transaction are not required, workplace and MDU EVSE can be non-networked, which would place the EVSE cost at the low end of the spectrum. Networked workplace and MDU EVSE are likely to be less expensive versions of the public EVSE. The annualized capital cost would then be $185 to $369.

Many employers can gain credit for installing EV charging stations as a mitigation measure for air pollution in ozone non-attainment areas [8], credit towards LEEDS certification, or credit towards greenhouse gas reduction. Thus, capital and installation cost in many cases may be fully accounted for. For MDUs, only LEEDS certification credit may pertain.

Installation Cost

The installation cost for workplace and MDU EVSE is typically lower than public locations because of lower permitting-related costs. A typical range of installation costs are $1,800 to $5,000 per port. Assuming a ten-year life, the annualized installation cost is then $221 to $554.

Operating and Maintenance Costs

Typical of both workplace and MDU parking, only one vehicle parks in a space each day. Thus, an EV that requires 40 miles worth of charge would use approximately 12kWh. At $0.10/kWh, the daily electricity cost would be $1.20, or $300 per port annually for an average workplace. The annual cost for an MDU would be $438.

Workplace charging would incur a utility demand fee, but may be able to mitigate this based on load management. An MDU would likely not be subject to a demand charge.

If the EVSE is networked, the cost for cellular and data/back office fees ranges from $10 to $25 per month, or $120 to $300 annually.

A semi-annual preventive maintenance program for workplace and MDU EVSE would be on the order of $100/yr per port for a facility with multiple ports. Vandalism and theft costs would be minimal if the workplace EVSE are installed in gated facilities. For MDUs, however, this could introduce significant maintenance costs.

Taxes and Other Costs

Taxes may play a minimal part in the pricing strategy for the EV driver.

Workplace Cost Summary

Cost	$USD/yr/port
Capital	185 to 369
Installation	221 to 554
O&M – not networked	400 to 538
O&M – networked	520 to 838
Taxes	N/A
Other	N/A
Total (networked)	926 to 1,761

3.2 Workplace EV Charger Revenue

Revenue from the EV Driver

Assuming the employer or property owner funds the EVSE capital and installation costs, then the O&M and transaction fees remain for the EV driver to pay. According to the above cost table this range would be $520 to $838 annually.

Secondary Revenue Streams
At this point in the workplace and MDU EVSE business model, it is unknown what impact advertising and grid services will have.

Workplace Revenue Summary

Revenue	$USD/yr/port
EV Driver Fees	520 to 838
Secondary Revenue	Unknown

3.3 Workplace Summary

From an EV driver perspective, the workplace EVSE serves an important function if access to residential EVSE is not available or if the commute is farther than 40 miles each way. To avoid excessive TOU rates, the employer could encourage or enforce morning charging or incentivize off-peak charging.

One other note relevant to workplace charging is the average dwell time. Employees can be parked for eight or more hours, which can provide ample time to charge using Level 1 (120V) outlets, which are much less expensive assuming no networking or billing. Thus, a mix of Level 1 and Level 2 EVSE may be an optimal solution for workplace charging.

4 Fleet Charging

The economics for fleet charging, is similar to residential charging, except the home base has many, often larger, vehicles. Higher power EVSE (greater amperage) may be required for these larger vehicles. Other differences are that the electricity rates could be lower depending on the utility, and the EVSE would likely be networked.

4.1 Fleet EV Charger Costs

Capital Cost
Fleet EVSE are likely to be networked to capture vehicle charging costs, energy usage, and other data. However, wall mounted, non-networked EVSE would be a lower cost system, if applicable. The annualized per port capital cost for dual port networked chargers is $369 to $430.

Installation Cost
The installation cost for fleet EVSE is typically lower than public locations because of lower permitting-related costs. A typical range of installation costs are $1,800 to $5,000 per port. Assuming a ten-year life, the annualized installation cost is then $221 to $554.

Operating and Maintenance Costs
Typical of fleet parking, one EV might be assigned a parking location and charge overnight. During the day, the EV would run its route and potentially come in for a mid-day refueling. Thus, a fleet EV could require up to 100 miles worth of charge daily and would use approximately 30kWh. At $0.10/kWh, the daily operating cost would be $3.00, or $750 per port annually for an average workplace. This could be significantly higher depending on the demand charge from the utility and the electricity rate applicable for a mid-day recharge. The demand charge might be mitigated using individual EVSE metering.

If the EVSE is networked, the cost for cellular and administrative fees ranges from $10 to $25 per month, or $120 to $300 annually.

A semi-annual preventive maintenance program for fleet EVSE would be on the order of $100/yr per port for a facility with multiple ports. Vandalism and theft costs would be minimal if the fleet EVSE are installed in gated facilities.

Taxes and Other Costs
Taxes would likely play a minimal role for fleet decisions because of low or no revenue expectations.

Fleet Cost Summary

Cost	$USD/yr/port
Capital	369 to 430
Installation	221 to 554
O&M	970 to 1,150
Taxes	N/A
Other	N/A
Total	1,560 to 2,134

4.2 Fleet EV Charger Revenue

Revenue from the EV Driver
The fleet owner would likely not require the EV driver to pay for vehicle charging.

Secondary Revenue Streams
Grid services may provide a revenue stream. However, other secondary streams such as advertising would likely be negligible due to the nature of fleet operations.

Fleet Revenue Summary

Revenue	$USD/yr/port
EV Driver Fees	N/A
Secondary Revenue	Unknown

4.3 Fleet Summary

For the fleet owner/operator, the costs associated with installing and operating EVSE are part of the overall value proposition for operating an EV fleet. For example, the cost of electricity may be likened to the cost of gasoline for an IC engine fleet.

5 Parking Venues

Ideally, EVSE charging should be cast as providing incremental revenue to the parking venue owner operator, or potentially a third party EVSE owner/operator. The difference between this and workplace, MDU or fleet charging is that the parking venue owner/operator will likely expect to recover all EVSE-related costs and also make a profit. The primary burden of these fees will be placed on the EV driver.

5.1 Parking Venue Charger Costs

Capital Cost

Parking venue EVSE typically require a tie in to the venue's payment system. This can take the form of a magnetic stripe reader or contactless card reader that enables authentication. Networking is not required, but may prove a valuable option for the venue owner/operator. Assuming a ten-year life, the annualized non-networked capital cost is $307 to $430.

Installation Cost

The installation cost for parking venue EVSE is typically lower than public venue locations because of lower permitting-related costs. A typical range of installation costs are $1,800 to $5,000 per port. Assuming a ten-year life, the annualized installation cost is then $221 to $615.

Operating and Maintenance Costs

The goal of the parking venue is to fill parking spaces, thus optimize profits. This goal is not necessarily in tune with the goal of optimizing EVSE revenue. For example, if an EV driver parks at 7 am, the EV could be fully charged before noon, and the rest of the day would be wasted from the EVSE revenue earning perspective. One possible solution to this could be installing EVSE in a valet section. If the EVSE is installed in the valet section, fully charged EVs could be moved to parking spaces without EVSE. Assuming a 25% capacity factor for 16 hours per day, the energy usage would be a little over 30kWh. At $0.10/kWh, the daily operating cost would be $3.00, or $1,095 per port annually if the parking venue operated 365 days per year.

Demand charges from the utility could add significantly to electricity costs, as could TOU rates (e.g., afternoon peak rate charging.)

A semi-annual preventive maintenance program for parking venue EVSE would be on the order of $100/yr per port for a facility with multiple ports. Vandalism and theft could be expected to add significantly to O&M costs.

Taxes and Other Costs

Tax required as result of EV driver revenue would be expected to play a significant role in pricing.

Parking Venue Cost Summary

Cost	$USD/yr/port
Capital	307 to 430
Installation	221 to 615
O&M	1,012
Subtotal	1,540 to 2,057
Overhead, Profit – subtotal	1,540 to 2,057
Taxes (+25% x revenue?)	1,078 to 1,440
Total	4,158 to 5,554

5.2 Parking Venue Charger Revenue

Revenue from the EV Driver

Assuming the parking venue owner/operator wishes to recover all costs from the EV driver (EVSE capital, installation, O&M, pay taxes) and make a profit, the EVSE fees for usage would be substantially higher than fleet, workplace or MDU charging. According to the above cost table this range would be $4,158 to $5,554 annually.

Secondary Revenue Streams

Advertising, if geared toward the parking venue destination (e.g., shopping mall), may provide a margin of incremental revenue.

Parking Venue Revenue Summary

Revenue	$USD/yr/port
EV Driver Fees	$4,158 to 5,554
Secondary Revenue	Unknown

5.3 Parking Venue Summary

Assuming two EV drivers use a given parking spot per day, the parking venue owner/operator would expect to recover the $4,158 to $5,554 annual amount from 730 drivers, or about $5-8 per charging event. For the EV driver, who may spend $10 to $30 for public parking, spending an additional $5 to charge their EV may not be objectionable if they don't have ready access to residential charging or if their shopping/business trip extends beyond the one way range of their EV. Additionally, the caveat for TOU rates remains. Parking often takes place during peak electricity usage. Thus, the parking venue operator may wish to recover these higher rates when the EV driver uses the charging infrastructure (e.g., $15 to charge from 2 to 6 pm), or average the higher TOU rates (e.g., a higher flat rate of $10 per four hour charge.)

6 Publicly-Accessible Venues

Venues for public charging would seem to overlap significantly with parking venue charging. For this paper, the distinction is that the public venue owner is also the EVSE owner/operator (grocery store, restaurants, train stations, etc.) In this case, the EVSE may serve as a market draw to the venue, which would provide incentive for the venue owner/operator to charge lower fees to the EV driver. However, the EVSE is also more expensive, because it is likely to be networked and require a point-of-sale (POS) device (e.g., credit card reader.) The EVSE economics should be similar to parking venue EVSE.

6.1 Public Venue Charger Costs

Capital Cost

With networking and POS, the EVSE will be at the high end of the cost range. Assuming a ten-year life, the annualized capital cost is then $430 to $615.

Installation Cost

The installation cost for public venue EVSE is typically expensive because of high permitting-related costs and long, difficult conduit runs. A typical range of installation costs are $3,600 to $6,000 per port. Assuming a ten-year life, the annualized installation cost is then $442 to $738.

Operating and Maintenance Costs

As with parking venue EVSE, many EV drivers could use public venue EVSE daily. Thus, assuming a 25% capacity factor for 16 hours per day, the energy usage would be a little over 30kWh. At $0.10/kWh, the daily operating cost would be $3.00, or $1,095 per port annually if the public venue operated 365 days per year.

Public venues provide unrestricted access and are more subject to vandalism than workplace, MDU, or fleet EVSE. Thus, in addition to a semi-annual preventive maintenance program ($100/yr per port), the venue owner can expect additional EVSE repair expense. For purposes of estimation, a $100/yr per port cost is assumed. This expense will also cover the additional cost required to repair the POS device.

Taxes and Other Costs

Revenue from the EV driver would likely be subject to taxation. It would be up to the venue owner/operator and the specific application as to the role taxes would play in pricing for charging events.

Public Venue Cost Summary

Cost	$USD/yr/port
Capital	430 to 615
Installation	442 to 738
O&M	1,295
Subtotal	2,167 to 2,648
Overhead – 0.5 x subtotal?	1,083 to 1,324
Taxes(+25% x revenue?)	1,137 to 1,390
Other	N/A
Total	4,387 to 5,352

6.2 Public Venue Charger Revenue

Revenue from the EV Driver

Assuming the public venue owner/operator wishes to recover capital, installation, and O&M costs from the EV driver, the EVSE fees are substantially higher than fleet, workplace or MDU charging. According to the above cost table this range would be $4,387 to $5,352 annually.

Secondary Revenue Streams

Advertising, if geared toward the public venue destination (e.g., restaurant or grocery store), may provide a margin of incremental revenue.

Public Venue Revenue Summary

Revenue	$USD/yr/port
EV Driver Fees	4,387 to 5,352
Secondary Revenue	Unknown

6.3 Public Venue Summary

The public venue owner/operator would likely expect to recover the $4,387 to $5,352 annual cost assuming 8 hours per day of use at 3.3kW (25% capacity factor, 16 hours per day), or about $2.50 per hour. If the public venue owner/operator mindset was to provide incentive to the EV driver they may not wish to apply significant overhead, and thus keep the cost at $2 per hour to the EV driver. For the EV driver who may spend $50 for groceries, spending $2 for the hour they are in the store, or $4 for a two-hour restaurant visit may be acceptable. As with parking venue charging TOU rates could significantly affect fees to the EV driver.

A variation on the public venue model is for a third party to supply the EVSE and installation free to the public venue owner/operator. This third party then owns and operates the EVSE. While attractive to the public venue owner/operator, the EV driver now pays $3-4 per hour to account for the third party cost of money, overhead and profit.

Another consideration with public venue EV charging is the dwell time. For those venues where the dwell time is fifteen minutes, the amount of electricity transferred is minimal. Even a one-hour dwell time may not be attractive for the EV driver to expend effort to determine whether a charging location is open, park, authenticate, and then pay for the charging event.

7 Conclusions

Non-residential charging includes a wide range of venues and applications. Some, like workplace, MDU and fleet charging appear to complement residential charging very smoothly from the perspective of both the EVSE owner/operator and the EV driver. Parking venues, public charging and third party financed systems, in contrast, may have economic challenges from a pricing standpoint to attract EV drivers. This conclusion is consistent with other analyses [9]. Indeed, TOU rates, vandalism/theft, and transaction costs could be significantly problematic with parking venue, third party, and public venue EV charging economics.

The potential revenue generation capabilities of grid services and advertising could provide the incremental tipping point to make a borderline venue economically viable.

The ultimate test for the viability of an EV charging infrastructure venue is whether the economics for EV charging are less expensive than operating a gasoline-powered vehicle, especially on a daily basis. As an example, with $4/gallon gasoline and a car that gets 20 miles per gallon, the cost is $0.20/mile ($0.10/mile for a 40 mpg car.) Assuming 3.3 miles/kWh and $0.10/kWh, the cost for powering an EV is $0.03/mile. Thus, residential charging in the early morning hours looks very attractive. However, a parking venue with an afternoon fee of $15 for four hours of charging (13.3 kWh at 3.3 kW), would be the equivalent of $0.34/mile, which is more expensive than the gasoline for a 20 mpg car. An EV driver may go for this upside-down condition on an occasional basis, but not day in and day out.

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