

Report of the Electric Vehicle Charging Task Force

October 9, 2018

Executive Summary

As requested by the Office of the Provost, the Electric Vehicle (EV) Charging Task Force completed a survey of campus EV users and reviewed existing infrastructure and pricing rates. The survey found 42 EV owners in the campus area. EV purchases are anticipated to climb steadily in the next few years, and provision of appropriate charging infrastructure for commuters who own EVs supports the Illinois Climate Action Plan goals.

The recommendations are based on EV charging station types: Level 1 (wall-outlets), Level 2 (240 volt charging), and Level 3 (fast chargers).

- Level 1 Charging: Immediately expand the availability of Level 1 permit spaces in parking decks B4, F29, and the E-14 lot, using the existing signage in storage at the Parking Department. This work should be funded by the Campus, as there is no realistic business model that could possibly recover the cost of installing the infrastructure.

We also recommend expanding the availability of Level 1 permit spaces in parking decks C7 and C10 in conjunction with the refurbishment. There should be at least 8 permit spaces for Level 1 EV charging in each of these decks upon reopening.

- Level 2 Charging: Immediately institute a Level 2 fee structure of \$0.20/kWh, switching to \$1.00/hour once the car has stopped charging, with a minimum cost of \$1.00. This can easily be done through a revision of the ChargePoint programming.
- Parking Deck Refurbishment: Whenever a parking deck is refurbished or built, the design should incorporate at least one Level 2 charging station, multiple Level 1 spaces, and the ability to expand Level 1 spaces in the future. Specifically, the planned refurbishing of C7 and C10 should incorporate the addition of at least one Level 2 charging station (the two ChargePoint chargers in storage at the Parking Department are available to use.).
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- Moving Forward: Initiate a long-term study after the charging infrastructure recommended in this report is in place, or in two years, whichever comes first. This study would seek to further understand short- and long-term demand elasticity and to better determine future infrastructure expansion and pricing. It could be conducted in collaboration with the Transportation Sustainability Working Advisory Team (SWATeam).

Introduction

The mission of the University of Illinois at Urbana-Champaign is to enhance the lives of citizens in Illinois, across the nation, and around the world through our leadership in learning, discovery, innovation, engagement, and economic development. The Illinois Climate Action Plan (iCAP) is the strategic plan for improving campus sustainability and meeting the Climate Leadership Commitments. The iCAP objectives for transportation range from offsetting air-travel emissions to implementing the Campus Bicycle Plan, with the goal to eliminate transportation-related emissions. One potential strategy in the iCAP is to support public-use electric vehicle (EV) charging.

Task Force Overview

On February 2, 2018, Provost Andreas Cangellaris formed the Electric Vehicle Charging Task Force “to make recommendations on what steps should be taken by the university, both now and in the future, to make EV charging available to commuters.”

The specific tasks were as follows:

1. Survey the campus EV community to help determine what EV charging infrastructure would be the most useful and cost effective.
2. Review the existing EV charging infrastructure and rate structure and recommend changes that should be made immediately, near the beginning of FY 2019.
3. Make recommendations on what investments the University should make to support EV charging over the next five years.
4. Estimate costs and develop a funding model for those investments.
5. Develop a plan to allow ongoing monitoring of the use of the EV charging infrastructure.

Task Force Members:

- Scott Willenbrock, Chair
- Michelle Wahl, Director of Parking
- Morgan White, Associate Director, Sustainability, F&S
- Paul Foote, Utilities & Energy Services, F&S
- Peter Varney, Director of Transportation and Automotive Services, F&S
- Rob Fritz, Director of Facilities, Beckman Institute
- Ben McCall, Professor, Chemistry
- Yanfeng Ouyang, Professor, Civil and Environmental Engineering
- Philip Krein, Professor Emeritus, Electrical and Computer Engineering
- Scott Greene, student

The Task Force met ten times during Spring 2018. This report summarizes their findings.

Overview of EV Benefits

Electric vehicles are desirable to campus in several respects. They emit no local pollution and are much quieter than conventional cars, so their use enhances the campus environment. They emit less carbon dioxide per mile driven than their conventional gasoline-powered counterparts, 30 – 40% less in our electrical grid region. This advantage will become even greater as our regional electric grid continues to become cleaner. Eventually, most

light-duty vehicles will need to be electric if the world is to drastically cut its carbon emissions.ⁱ For these reasons campus should encourage the use of electric vehicles.

There are two major classes of EVs that require charging infrastructure: pure electric and plug-in hybrid electric vehicles.ⁱⁱ Both types of EV's are already present on campus. Pure EV's typically have a range greater than 100 miles. The electric range of a plug-in hybrid is typically 50 miles or less, but it has a conventional engine to extend its range. The full distance for EVs before needing to recharge currently ranges from 25 miles (Prius plug-in) to 335 miles (Tesla Model S) on a full charge.

Nationally, EV purchases are increasing, and the rate of growth is anticipated to climb steadily in the next few years. Although currently less than 1% of all car sales in the US are EVs, a recent survey by AAAⁱⁱⁱ expects that number to increase to 20% within the next five years. Supporting the AAA survey, Green Car Reports^{iv} found that 19% of their respondents agree with the AAA survey, 37% anticipated EV purchases more likely to be only 10% of all cars, and the least optimistic respondents coming in at 2% of US vehicle sales. This suggests EV sales in the US will, at a minimum, more than double in the next five years.

The EV industry is still in its infancy, and it is changing rapidly. Innovations in battery and vehicle technologies, charging requirements, accessibility, and consumer interest continue, but one thing is certain: EVs are here to stay. Even oil giant BP is investing in technology that will enable charging to full capacity with a 5 minute fill time. BP's recent Energy Outlook, as quoted by GreenTEchMedia's^v article shows the 2040 worldwide EV demand reaching 320 million or approximately 16% of total vehicle demand.

EV Charging Station Levels

The main types of EV charging options are typically categorized into three classes, dubbed Levels 1, 2, and 3. The following section provides a brief explanation of the three levels, and the recommendations of this committee are categorized into groups based on these different levels.

- Level 1 charging involves plugging into an ordinary 110 V outlet, just like a wall outlet in a home. Level 1 chargers typically yields just 4 miles of range per hour of charging; thus, a typical EV could acquire as much as 32 miles of range in an 8-hour work day. For a plug-in hybrid of limited EV range, this could make the difference between driving home in electric mode rather than gasoline mode.
- Level 2 charging involves special infrastructure with a higher voltage system and charger cables. These stations usually include the option to connect two vehicles at a time, with two charger cables available for use. Level 2 chargers can deliver up to 20 miles of range per hour of charging.
- Level 3 charging is direct current (DC) fast charging and can fully charge an EV in about an hour. Level 3 charging is useful for road trips, so the chargers are best located along major highways. Level 3 is useful for quick turnaround charging and would be best located near business/entertainment centers that provide activities for EV occupants.

Existing EV Infrastructure and Rates for Commuters

Within the University District, the first EV charging station was installed at Enterprise Works in 2012.^{vi} This station is primarily for the use of Research Park employees, and it requires checking in at the EnterpriseWorks desk to access the charging station. In 2014 the Parking Department installed public-access EV charging stations in several locations on campus, including both Level 1 and Level 2 options.

Level 1 EV charging is available in some parking areas, as listed in the following table. There is currently no fee for the use of these chargers, other than the normal cost of parking.

Parking Lot/Deck	Level 1 # of permit spaces	Level 1 # of metered spaces
B4	1	2
F29	4	0
C7	0	2
C10	1	0
D5	1	2

Level 2 EV charging stations, each with two charging ports, are located at the North Campus Parking Deck (B4), Alice Campbell Alumni Center (D22), and State Farm Center (E14), as summarized in the following table. The fee for charging at a Level 2 charger on campus is \$2.00/hour for the first four hours and \$8.00/hour for each additional hour. Of this fee, \$1.00/hour covers the normal cost of parking for a metered space.

Parking Lot/Deck	Level 2 # of metered spaces
B4	2
D22	2
E14	2

There are also Level 2 EV charging stations for university-owned car pool vehicles at the Garage and Car Pool and for visitors to the Institute for Sustainability, Energy, and Environment at the National Soybean Research Center, but these are not public-access charging stations. Similarly, there is a Level 2 EV charging station proposed for the Illini Union hotel visitors, which will not be public-access.

Task Force Findings

A survey of present and future EV owners was distributed via Eweek, and the results helped inform the discussions of the Task Force. A second, student-focused, survey was also distributed, from which we learned that there are very few EVs owned by students at this time. Additionally, EV Task Force members visually audited the existing EV charging locations and reviewed the utilization records of the Level 2 charging stations managed by the Parking Department.

The Eweek survey had 75 respondents, almost entirely faculty and staff. Of these, 39 are EV owners, and 36 are considering EV ownership. The student survey had 19 student respondents, with 3 EV owners and relatively short commutes. These findings, along with the anecdotal evidence gathered by visiting various campus parking decks and lots, indicate that while there has been significant growth in EVs on campus since 2014, there are still a relatively small number of vehicles. Some expansion of the EV charging infrastructure is warranted, but it is too soon for a major expansion.

Level 1 EV Charging

The number of survey respondents who said they would use Level 1 charging was 61, and their average one-way commute was 11 miles. The cost of electricity to support the average one-way commute is about \$6/month. We considered the option of implementing a fee for Level 1 charging. After much discussion, we decided it is not worth the administrative effort at this time, as there are relatively few cars using Level 1 charging. We

concluded that it would be best to modestly expand the number of Level 1 outlets and continue to account for this cost as part of the standard parking fee. This can be revisited if and when the number of EVs on campus grows further. By continuing to provide Level 1 charging within the existing parking rates, we maintain the flexibility to impose a fee if the campus undertakes a significant expansion of Level 1 charging in the future.

EVs are still expensive compared with their conventional counterparts. By providing Level 1 charging, campus is incentivizing EV ownership, but not to the extent that the cost of EV ownership is less than that of a comparable conventional car.

Based on the survey, the parking decks/lots and the number of EVs currently using them are listed below. There were also some respondents that do not park in a specific deck/lot. Also listed are the number of Level 1 charging locations available in permit spaces and metered spaces.

Parking Lot/Deck	# of EVs using them, survey data	Level 1 # of permit spaces	Level 1 # of metered spaces
B4	4	1	2
F29	5	4	
C7	4		2
C10	3	1	
D5	5	1	2
E14	4		
E15	4		
B21	4		
B2	3		
B1	2		

The first four listed above are parking decks, and all of the Level 1 charging permit spaces in those decks are used daily. These decks have a significant number of additional Level 1 outlets potentially available. However, some outlets are on the same circuit, and only one outlet on a circuit can be used before overloading the circuit.

The parking deck D5 (Krannert Center for the Performing Arts) has one Level 1 charging space available to permit holders, and it is unused, despite there being several EVs parking in that deck. There are no additional outlets available, so expanding the number of available outlets would require significant investment. Given these facts, it is not warranted to increase the number of Level 1 charging spaces in D5 at this time.

The lot E14 has two banks of Level 1 plugs at the north end already available and energized. These have been used for tailgating and could be repurposed for Level 1 charging. We considered the number of spaces that should be added in this lot, and we believe campus should start with two permit spaces in the northwest corner.

The remaining lots listed do not have easy access to Level 1 outlets, and installing them would be a significant expense that is not warranted at this time.

There are also several Level 1 charging spots with parking meters available for visitors (B4: 2; C7: 2; D5: 2). These are rarely used, so it is not warranted to expand their number at this time.

In addition, signage will be needed to indicate EV parking. The Parking Department has 13 signs in storage.

Level 2 EV Charging

The Parking Department installed three Level 2 EV charging stations in 2014. These charging spaces are available to permit holders and visitors alike. The charging stations were purchased from ChargePoint, who charges a fee ranging from \$170.00 to \$285.00/year per charging station to administer them. This allows the Parking Department to set the fee structure of charging stations, collect revenues, and access data to monitor their use.

Of the 75 survey respondents, 48 said they would use Level 2 charging, but the ChargePoint charging stations have been only lightly used. In the past year each port has averaged about 8 hours of use per month. As stated earlier, the fee for charging is \$2.00/hour for the first four hours and \$8.00/hour for each additional hour.

In the second half of April 2018 the Parking Department offered free Level 2 charging to recognize Earth Month, and this was announced on Eweek. This resulted in a significant increase in use, up by a factor of more than three from the same period a year earlier. This suggests that the fee structure may be suppressing demand for Level 2 charging. Several comments from survey respondents support this viewpoint.

The ideal fee structure would maximize use of the charging stations while recovering the cost of the electricity and the ChargePoint administrative fee. The capital cost of installing the charging stations, borne by the Parking Department in 2014, runs in the tens of thousands of dollars, and there is no way to recover that cost from fees. The Parking Department has two additional ChargePoint stations in storage, but there is no significant demand for them at this time.

EVs charge at different rates depending on manufacturer and model, and a fee based on energy rather than time will attract more users. An EV owner pays about \$0.10/kWh for electricity at home. Implementing a fee structure of \$0.20/kWh would attract more users than the current \$2.00/hour fee and potentially generate enough income to cover the expense of electricity and the annual administration fee. Once the car is done charging, the fee could switch to a per hour fee of \$1.00/hour. There could also be a minimum fee of \$1.00. Most users are also permit holders so the hourly fee will encourage them to move their cars once they are done charging. There is not a lot of demand for Level 2 charging, so a larger fee (meant to encourage non-permit holders to move once fully charged) is not warranted at this time. Visitors may require many hours of charging, and once they are done charging the \$1.00/hour fee is the same as they would pay at a parking meter.

Level 3 EV Charging

The only Level 3 charging in Urbana-Champaign are the Tesla superchargers at the Meijer on North Prospect, and these are proprietary. As more EVs from other carmakers appear on the road, demand for Level 3 charging will increase. If EV ownership increases among students, campus could consider installing a Level 3 charger for students who do not have access to charging at their place of residence. At this time, however, no action on Level 3 charging is warranted on campus property.

Concluding Recommendations

The EV Task Force recommends the following actions be taken:

- **Level 1 Charging:** Immediately expand the availability of Level 1 permit spaces in parking decks B4, F29, and the E-14 lot, using the existing signage in storage at the Parking Department. This work should be funded by the Campus, as there is no business model that could possibly recover the cost of installing the infrastructure.

We also recommend expanding the availability of Level 1 permit spaces in parking decks C7 and C10 in conjunction with the refurbishment. There should be at least 8 permit spaces for Level 1 EV charging in each of these decks upon reopening.

Parking Lot/Deck	# of EVs using them, survey data	Level 1 # of permit spaces	Level 1 # of metered spaces	Additional permit spaces Fall 2018	Additional permit spaces upon refurbishment
B4	4	1	2	7	
F29	5	4		5	
C7	4		2		8
C10	3	1			7
D5	5	1	2		
E14	4			2	
E15	4				
B21	4				
B2	3				
B1	2				

- Level 2 Charging: Immediately institute a Level 2 fee structure of \$0.20/kWh, switching to \$1.00/hour once the car has stopped charging, with a minimum cost of \$1.00. This can easily be done through a revision of the ChargePoint programming.
- Parking Deck Refurbishment: Whenever a parking deck is refurbished or built, the design should incorporate at least one Level 2 charging station, multiple Level 1 spaces, and the ability to expand Level 1 spaces in the future. Specifically, the planned refurbishing of C7 and C10 should incorporate the addition of at least one Level 2 charging station (the two ChargePoint chargers in storage at the Parking Department are available to use
- Moving Forward: Initiate a long-term study after the charging infrastructure recommended in this report is in place, or in two years, whichever comes first. This study would seek to further understand short- and long-term demand elasticity and to better determine future infrastructure expansion and pricing. It could be conducted in collaboration with the Transportation Sustainability Working Advisory Team (SWATeam).

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Appendix A: Carbon dioxide emission calculations

Chevy Volt

$1.4 \text{ lbs CO}_2/\text{kWh}/(106 \text{ mpg}_e/33.7 \text{ kWh/gallon}_e) = 0.44 \text{ lbs CO}_2/\text{mile}$

Comparable conventional car: Chevy Cruze

$18.9 \text{ lbs CO}_2/\text{gallon}/30 \text{ mpg} = 0.63 \text{ lbs CO}_2/\text{mile}$

The EV emits 30% less CO₂/mile.

Ford Focus Electric

$1.4 \text{ lbs CO}_2/\text{kWh}/(115 \text{ miles}/33.5 \text{ kWh}) = 0.41 \text{ lbs CO}_2/\text{mile}$

Comparable conventional car: Ford Focus

$18.9 \text{ lbs CO}_2/\text{gallon}/28 \text{ mpg} = 0.68 \text{ lbs CO}_2/\text{mile}$

The EV emits 40% less CO₂/mile

Nissan Leaf

$1.4 \text{ lbs CO}_2/\text{kWh}/(151 \text{ miles}/40 \text{ kWh}) = 0.37 \text{ lbs CO}_2/\text{mile}$

Comparable conventional car: Nissan Versa Note

$18.9 \text{ lbs CO}_2/\text{gallon}/35 \text{ mpg} = 0.54 \text{ lbs CO}_2/\text{mile}$

The EV emits 31% less CO₂/mile

Appendix B: Cost of Level 1 charging

In the Eweek survey, of the 48 survey respondents who said they would use Level 1 charging, the average one way commute was 10.75 miles. The typical charging rate is 4 miles of range per hour of charging, with a charging power of 110 V x 12 amps = 1.3 kW. The campus electricity rate (5 year average) is \$0.083/kWh. Thus the average annual cost (5 days a week x 50 weeks) of Level 1 charging is:

$(10.75 \text{ miles/day}) / (4 \text{ miles/hr}) \times 1.3 \text{ kW} \times \$0.083/\text{kWh} \times 250 \text{ days/yr} = \$72/\text{yr} = \$6/\text{month}.$

ⁱ Hydrogen fuel cell vehicles are another alternative.

ⁱⁱ A list of various available EVs is online at http://currentev.com/page/electric_vehicles_info.

ⁱⁱⁱ <https://newsroom.aaa.com/2018/05/1-in-5-us-drivers-want-electric-vehicle/>

^{iv} https://www.greencarreports.com/news/1116854_how-many-americans-will-buy-an-electric-car-in-the-next-5-years-twitter-poll-results

^v <https://www.greentechmedia.com/articles/read/bp-forecast-autonomous-electric-vehicles-peak-oil#gs.l=58o5A>

^{vi} <http://researchpark.illinois.edu/electricvehicle>