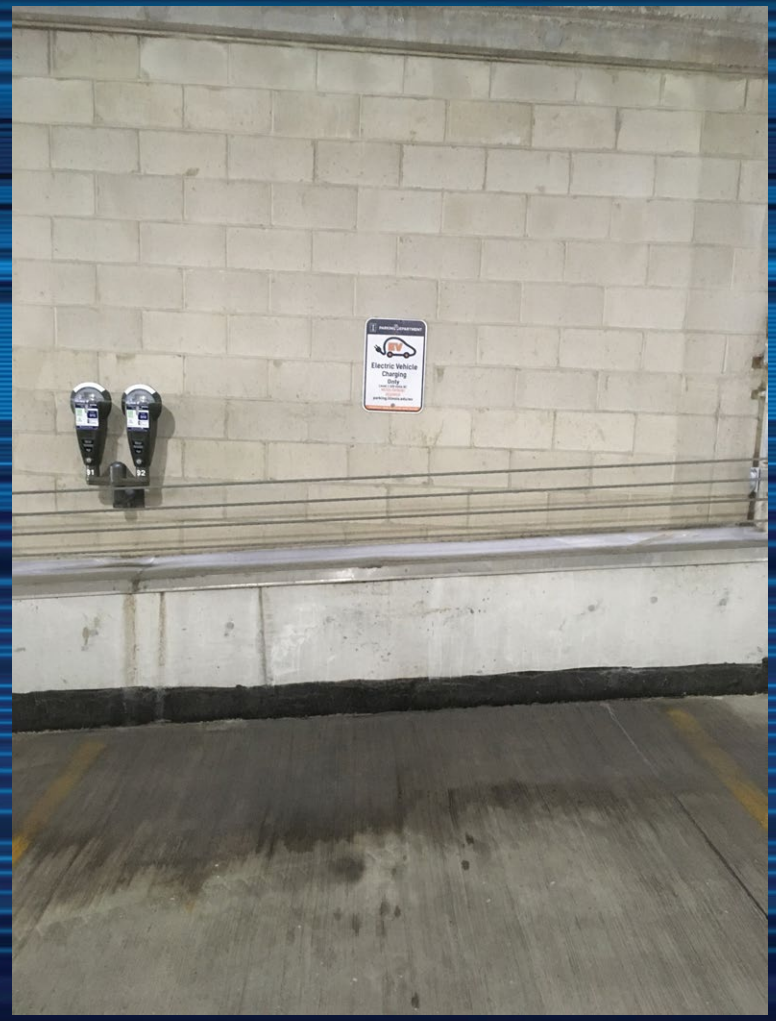
Analysis of some electric vehicle charging scenarios



Parking structure B4 has two spaces for visitors to charge at Level 1.

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Commute analysis based on parking lot B4, North Campus Parking Structure, 1201 W University, Urbana

- Level 2 charging is defined to work at 208 V, 32 A (6.66 kW), penalized by 10% loss, so 6.00 kW to the vehicle battery.
- Level 1 is defined to work at 120 V, 12 A (1.44 kW), penalized by 10% loss, so 1.30 kW to the vehicle battery.
- Level 2 cost: The UIUC Parking Office advertises $1.25/h for each of the first four hours. The table assumes the car is moved after it is full.
- Level 1 cost: $0.10/kWh based on 1.44 kW usage, essentially the campus retail (not wholesale) electricity rate.

Commuting examples. Energy based on EPA estimates of modest sedan.

Typical area commute	Urbana Carle Park	Urbana Stone Creek	Champaign Clark Park	Champaign Southwood	Champaign Ironwood (average)	Mahomet	Rantoul	Monticello
One-way drive distance	1.6 mi	3.8 mi	2.9 mi	5.4 mi	6.94 mi	12.9 mi	15.6 mi	22.7 mi
Estimated one-way energy from battery, summer	0.40 kWh	0.95 kWh	0.73 kWh	1.35 kWh	1.74 kWh	4.54 kWh	4.70 kWh	7.76 kWh
Estimated one-way energy from battery, winter	0.56 kWh	1.33 kWh	1.02 kWh	1.90 kWh	2.43 kWh	6.35 kWh	6.58 kWh	10.9 kWh
Time to recover energy, Level 2, summer	4 min	10 min	8 min	14 min	17 min	46 min	47 min	78 min
Time to recover energy, Level 2, winter	6 min	14 min	11 min	19 min	24 min	64 min	66 min	109 min
Cost, level 2, summer/winter	$1.25	$1.25	$1.25	$1.25	$1.25	$1.25/$2.50	$1.25/$2.50	$2.50
Time to recover energy, Level 1, summer	19 min	44 min	34 min	63 min	80 min	3 h 30 min	3 h 37 min	5 h 58 min
Time to recover energy, Level 1, winter	26 min	62 min	47 min	88 min	112 min	4 h 53 min	5 h 4 min	8 h 23 min
Cost, Level 1, summer/winter	$0.046/$0.062	$0.11/$0.15	$0.082/$0.11	$0.15/$0.21	$0.19/$0.27	$0.50/$0.70	$0.52/$0.73	$0.86/$1.21

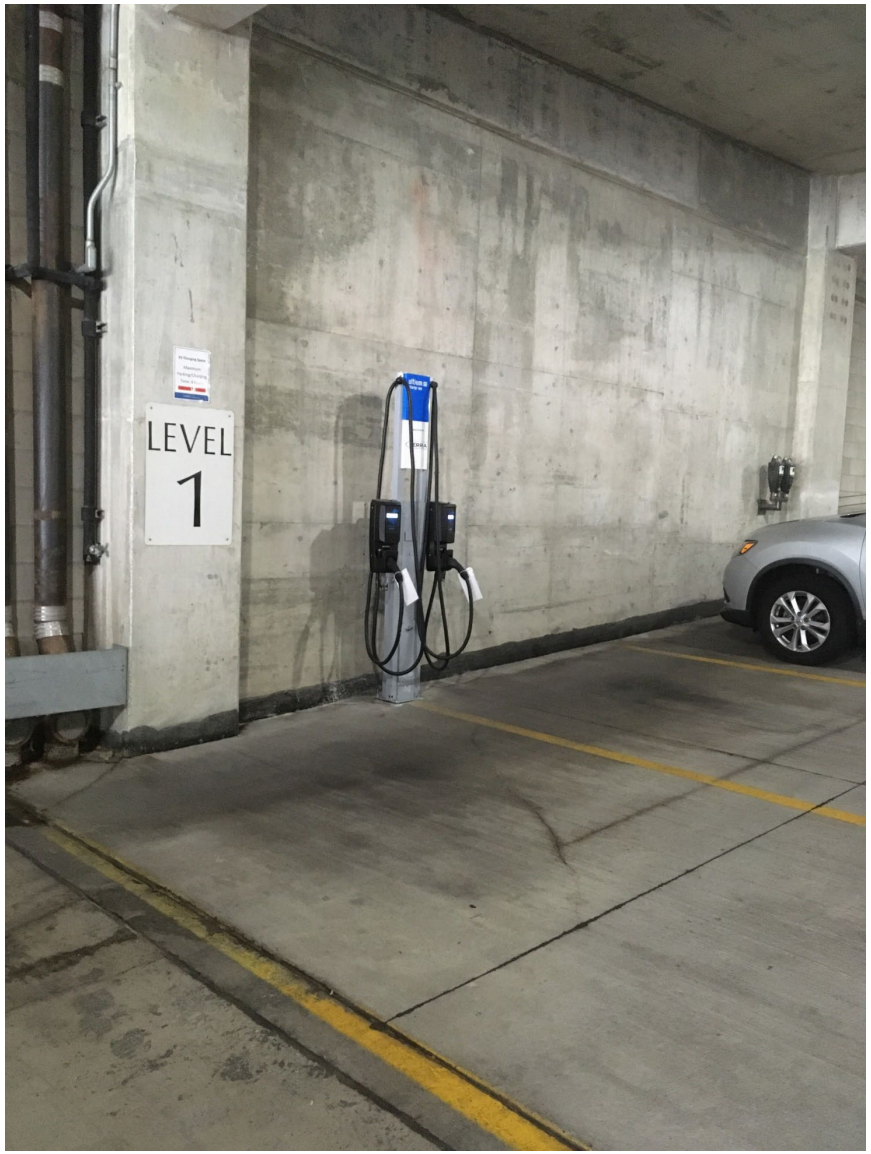
Comments

- Survey information reports average UIUC commute as 6.94 miles each way. See the “Ironwood” column in the preceding table.
- Level 2 charging is expensive, especially for commuters within Champaign-Urbana. Best-case scenarios for distant commuters: about a 2:1 premium price. Typical in-town scenarios impose a premium that often exceeds 10:1.
- In all cases, Level 2 chargers require drivers to move vehicles within one hour or two. The result pushes behavior to charge infrequently or to avoid Level 2 units.
- The “lost time” cost of moving a vehicle is substantial.
- All but the longest winter commutes can be supported with outlet-based charging (simpler than Level 1 chargers since there are no cables or extra equipment).
- Level 1 scenarios presume that vehicles will *not* be moved, but it is plausible to share one outlet across two adjacent spaces.

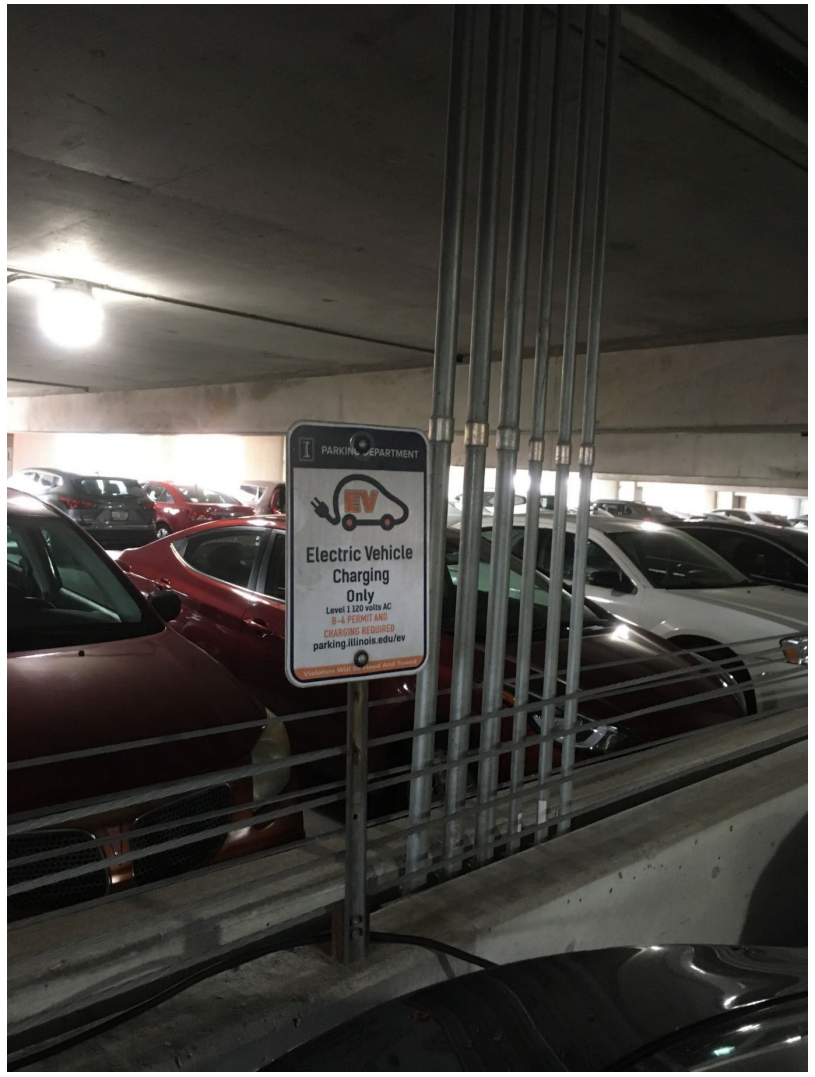
Cost estimate – Level 1

- For Level 1 charging, what is the cost of providing this service?
  - Use the average commute of 6.94 mi one way as a reference.
  - Set up the case in which the vehicle is driven to campus daily for working days, less twelve days for vacation/floating holidays. Campus has about 246 work days per year, so use 234 driving days.
  - The average battery recovery energy for this commute is about 2.1 kWh (averaging summer and winter).
  - With 10% loss, this requires 2.33 kWh from the outlet each day, 545 kWh over the entire year.
  - At the retail cost of $0.10/kWh, total annual price is less than $55.
  - At the campus wholesale cost of $0.085/kWh, total annual cost is about $46.
  - Notice that if a “Level 1” output is used 8 hours every day at 100% capacity, the draw will be 11.5 kWh per day – less than $1 burden on the campus energy grid.

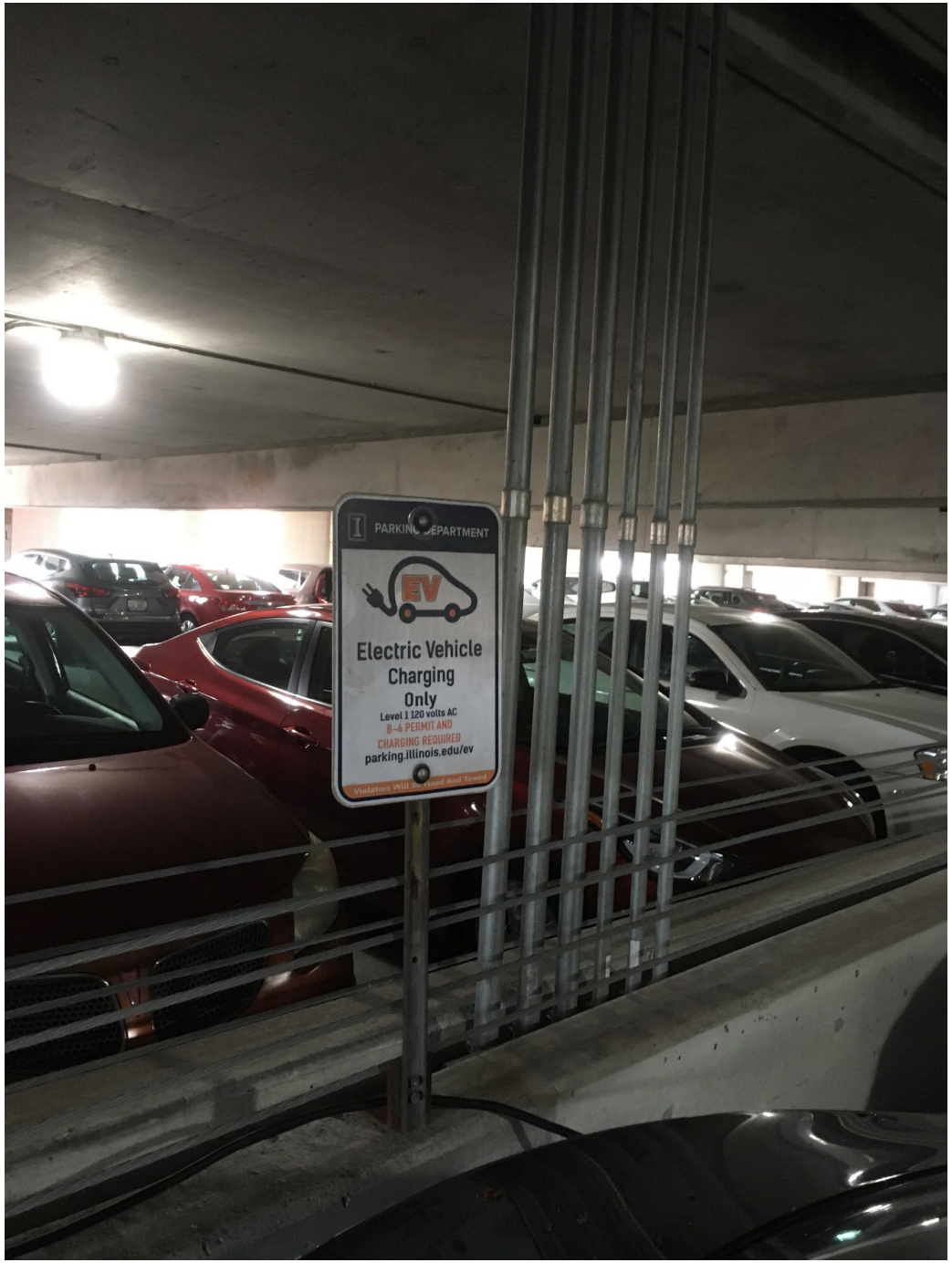
  - The analysis is likely to be pessimistic, since sometimes a different transportation mode might be used or days missed for other reasons.
  - Proposed approach: Allow vehicle permit holders to purchase an extra “EV charging endorsement” feature for their plug-in vehicles, at a price of $50 per year. They are allowed to park and obtain electricity from any permit-holder marked level 1 parking space in return.
  - This extra fee presumes that Level 1 spaces are readily available each day and can be used all day without moving a vehicle. If not, the fee should be lower in proportion. Example: $20/year if we think a driver will be able to charge only about twice a week, and so on.
  - The extra fee is hard to abuse, since an extreme recharge can only draw 11.5 kWh in an eight-hour day and since the fee only applies to level 1 spaces.



In lot B4, there are four Level 2 spaces. It is unusual to find more than one occupied.



In lot B4, there is exactly *one* Level 1 space for permit holders. It is almost always occupied during business hours.



Infrastructure is GFI-protected NEMA 5-20R receptacle

A typical 200 A three-phase service panel on campus can support about 40 of these receptacles.
Parking structure lighting updates to LED imply extra existing capacity.

Typical vehicle accessory cable for Level 1 charging.

A few outdoor outlets on ECEB.