Energy Storage Optimizations for Plug-In Electric Vehicle Charging Stations

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Introduction:

Electric vehicles offer an important step forward in sustainable modes of transportation, but are limited in viability for many people due to the high upfront cost. While reduction of this upfront cost is mostly only possible by the electric vehicle manufacturer, this research aims to make some improvement on the electricity usage costs when charging the vehicle, by focusing on a storage element.

The Goal:

Create a device (product) which can serve as a proof-of-concept for ideas which will reduce electricity usage costs by any amount, which can be applied to a full-scale implementation.

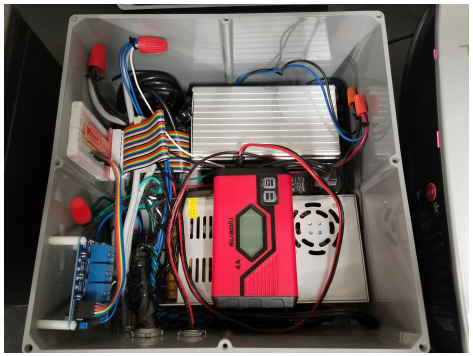
Features:

- Utilizing TOU rates from electricity providers to reduce charging costs
- Accepting either 110 V or 220 V as input (increased accessibility/availability)
- Consistent charging rate regardless of input characteristics
- Variable output characteristics (potentially higher than what is available in residential wiring)
- Modular design (can be applied to any existing charging station installation)

Product Picture:

Major Components:

- Tesla Wall Connector
- SLA Battery Charger
- 12V SLA Battery
- 12V Power Supply
- 220V Power Inverter
- Microcontroller
- Relays



Results:

The resulting product fulfilled all of the proposed goals and features. Baseline tests were run with the following results:
Using CT TOU Eversource rates on 6/8/18:

- On-peak: $0.11711/kWh
- Off-peak: $0.074488/kWh

SAVINGS:

  - 50kWh battery: $3.75 / $5.86 -> $2.11/charge
  - 75kWh battery: $5.59 / $8.79 -> $3.20/charge
    - MAX yearly savings: $700 / $1100 per year

Future Work:

As this product is primarily a proof-of-concept work, it only shows an example of the technology at work to save money and implement the proposed ideas. Future work will include components with upgraded power ratings to handle the full load of PEV charging characteristics.