MANAGED EV CHARGING

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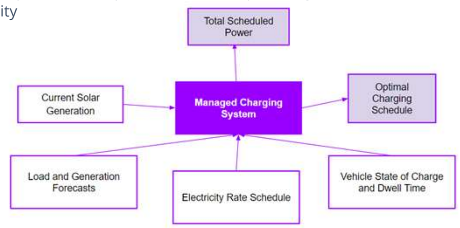
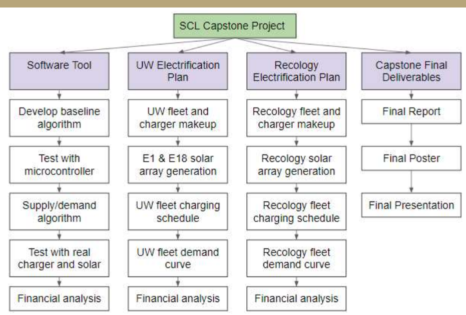
Seattle City Light

Project Objectives and Requirements

- Write a transportation electrification plan including solar generation for UW Transportation and for Recology
- Develop a software tool to schedule and allocate charging for an EV fleet that meets operational requirements while optimizing the demand for solar grid capacity

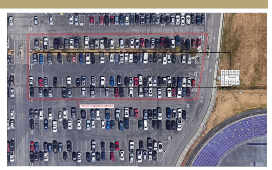


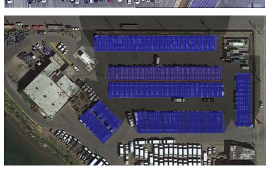
Key Milestones



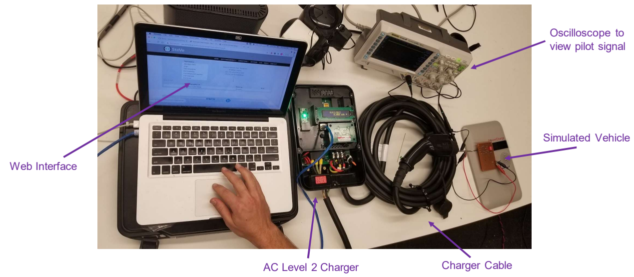
Project Procedure

1. Research the fleet's composition and operational requirements
2. Identify EVs with similar capabilities
3. Calculate the vehicles' energy requirements based on current usage
4. Determine the number and type of EV chargers needed to meet these energy requirements during the time the vehicles are parked
5. Create a charging schedule
6. Determine the charging infrastructure needed for each fleet and incorporate solar generation in the electrical design [1]



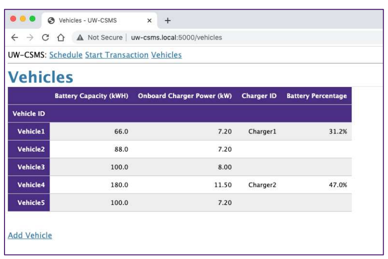


Software and Hardware Implementation

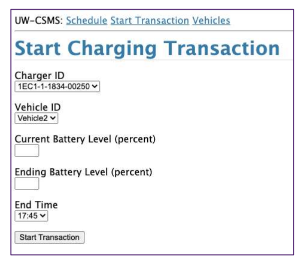


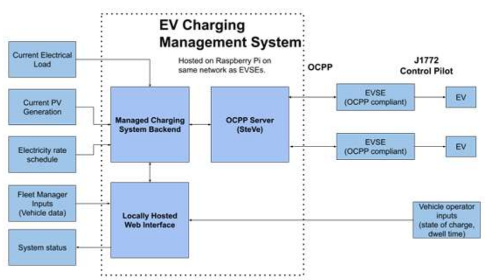
Software Tool Features

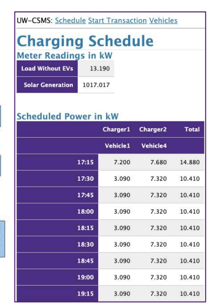
- Algorithm to minimize the overall cost of charging by scheduling charging operations when electricity is less expensive and utilizing solar generation when it is available
- Controlled using a Raspberry Pi
- Local wi-fi communication of software tool and SteVe server with EV chargers [2] [3]
- Stored database for fleet vehicles
- Web interface where users can view the system status and initiate a new charging transaction
- Automatic calculation for optimal charging schedule for each vehicle. The schedule is recalculated every 15 minutes, and whenever a charging transaction begins or ends.



Vehicle ID	Battery Capacity (kWH)	Onboard Charger Power (kW)	Charger ID	Battery Percentage
Vehicle1	66.0	7.20	Charger1	31.2%
Vehicle2	88.0	7.20		
Vehicle3	100.0	8.00		
Vehicle4	180.0	11.50	Charger2	47.0%
Vehicle5	100.0	7.20		







Load Without EVs	13.190
Solar Generation	1017.017

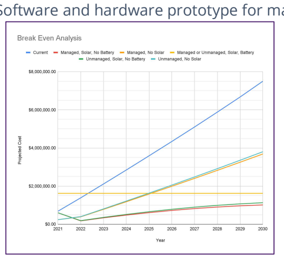
Scheduled Power in kW

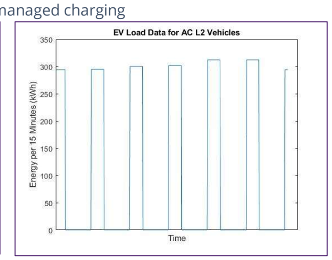
	Charger1	Charger2	Total
	Vehicle1	Vehicle4	
17:15	7.200	7.680	14.880
17:30	3.090	7.320	10.410
17:45	3.090	7.320	10.410
18:00	3.090	7.320	10.410
18:15	3.090	7.320	10.410
18:30	3.090	7.320	10.410
18:45	3.090	7.320	10.410
19:00	3.090	7.320	10.410
19:15	3.090	7.320	10.410

Discussion of Results

Project Outputs

- Energy requirements for an electrified fleet
- Solar generation estimate
- Financial estimate [4]
- Managed and unmanaged charging schedules
- Infrastructure preliminary design
- Software and hardware prototype for managed charging





Conclusion and Future Work

- The software tool and transportation electrification designs will help UW transportation achieve its goal of reducing the University's carbon footprint to 45% in 2030 and help Recology to electrify its fleet efficiently in the near future.

UW Transportation Electrification Plan

Proved the feasibility 100% fleet electrification

Recology Electrification Plan

Developed a solution given grid feeder and space constraints

Managed Charging Software and Hardware

Demonstrated the use of the SteVe server to implement a managed charging schedule

UW Transportation Electrification Plan
- Scaled-down implementation of system
- Transportation Electrification Plan document from UW Solar

Recology Electrification Plan
- Propose solution options to Recology

Managed Charging System
- Modify assumptions and constraints in charge scheduling
- Test algorithm with more chargers

Acknowledgements and References

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We really appreciate everyone's support and advising for this project and hope to continue managed charging efforts at UW and in the Seattle area!

References

[1] Advanced Solar Design Software. HelioScope. (n.d.). https://www.helioscope.com/.

[2] J1772: SAE Electric Vehicle and Plug in Hybrid Electric Vehicle Conductive Charge Coupler - SAE International, 2017. [Online]. Available: https://www.sae.org/standards/content/j1772_201710/. [Accessed: 01-May-2021].

[3] "Open Charge Point Protocol 1.6 ," Open Charge Alliance, 2017. [Online]. Available: https://www.openchargealliance.org/protocols/ocpp-16/. [Accessed: 01-May-2021].

[4] Business Rates. Seattle City Light. (n.d.). https://www.seattle.gov/city-light/business-solutions/business-billing-and-account-information/business-rates#seattlebusinesses.

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