EVS26
GRANDES MENTES PENSAM ELETRICAMENTE
LAS MENTES BRILLANTES TIENEN IDEAS ELÉCTRICAS
GREAT MINDS THINK ELECTRIC
LES GRANDS ESPRITS S'ILLUMINENT
AGAR BUDDHIMAN HO BIJLI YAAD KARO
GROTE GEESTEN ZIJN VERLICHT KLUGE KöPFE DENKEN ELETRISCH
26th International Electric Vehicle Symposium

Mitigation of Vehicle Fast Charge Grid Impacts with Renewables and Energy Storage

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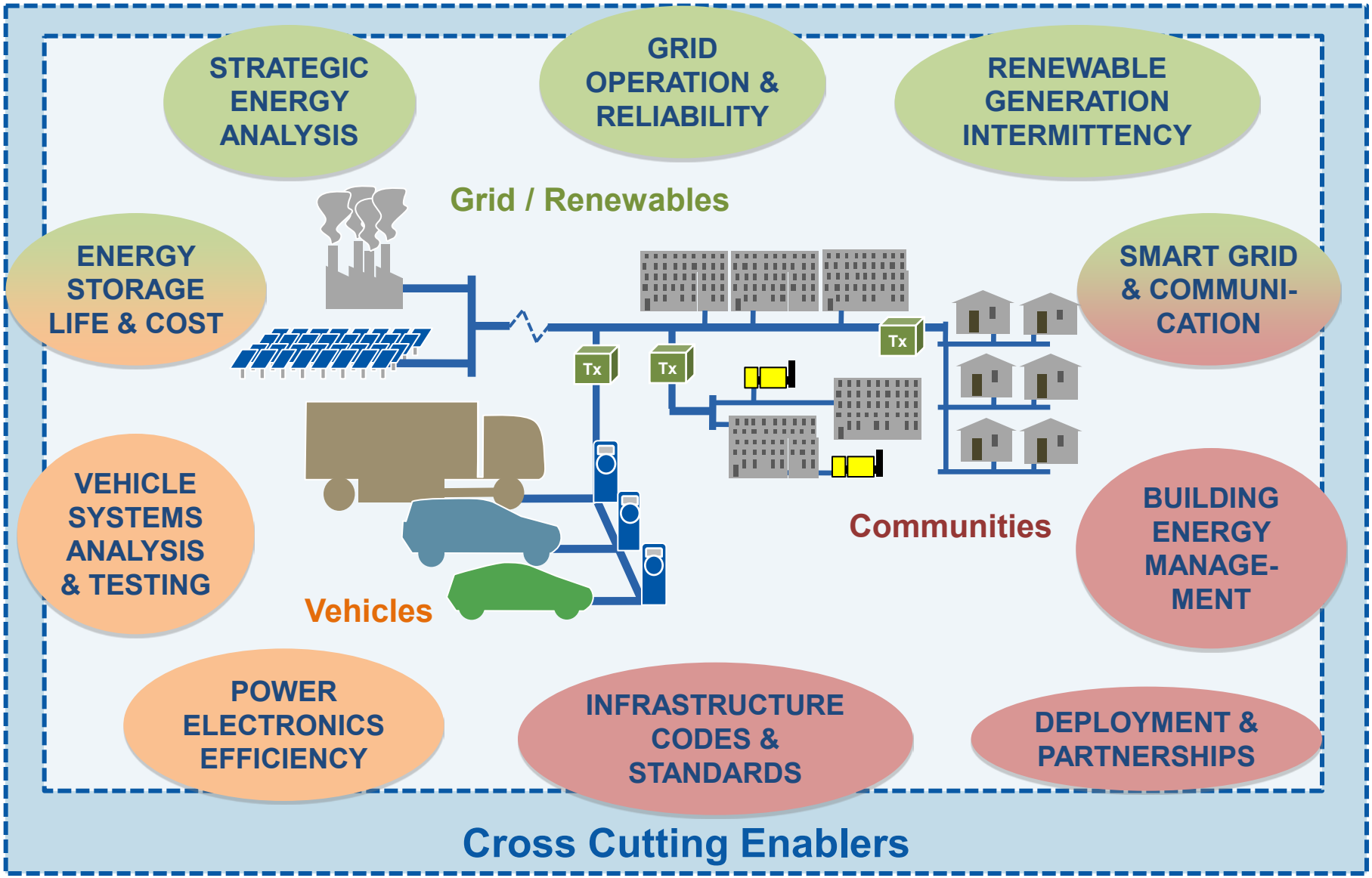
ORGANIZED BY THE WORLD ELECTRIC VEHICLE ASSOCIATION, WEVA HOSTED BY ELECTRIC DRIVE TRANSPORTATION ASSOCIATION, EDTA IN COLLABORATION WITH
WEVA World Electric Vehicle Association
EDTA Electric Drive Transportation Association
AVERE
EVAAP Electric Vehicle Association of Asia Pacific

Electric Vehicle Grid Integration



Vehicle Test Facilities at NREL

Photo by Dennis Schroeder, NREL/PIX 19757

Photo by Dennis Schroeder, NREL/PIX 20045

Photo by Dennis Schroeder, NREL/PIX 19699

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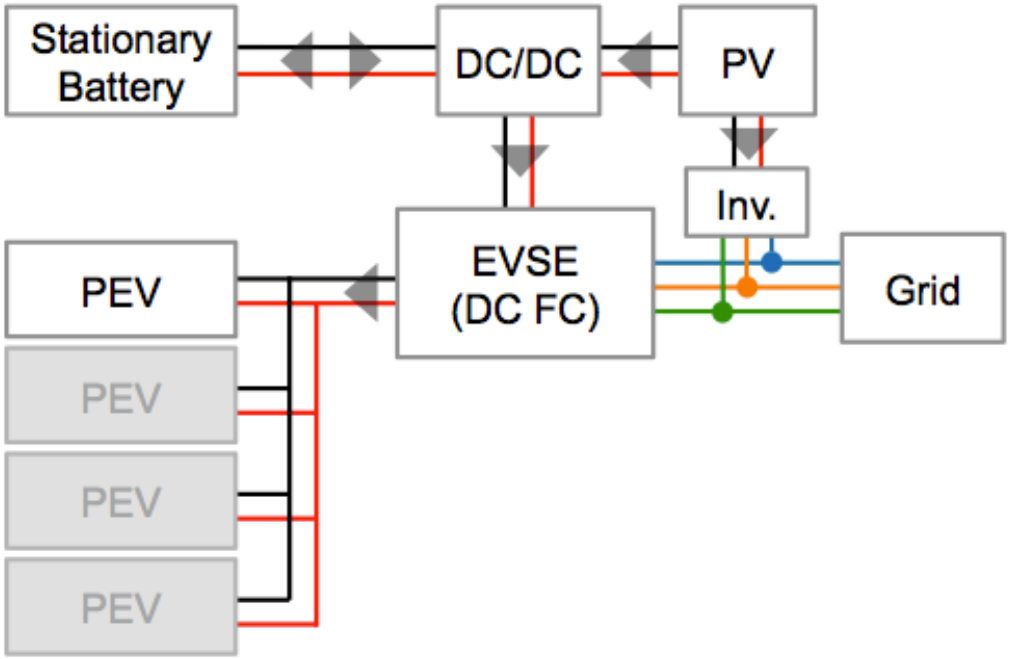
How Will Fast Chargers Impact the Grid?

- How will drivers use fast chargers?
- What does the time-dependent demand look like?
- How does the aggregate fast charge demand correlate with grid peaks?
- How can photovoltaics (PV) and energy storage reduce the impact and thus the cost of fast charging?

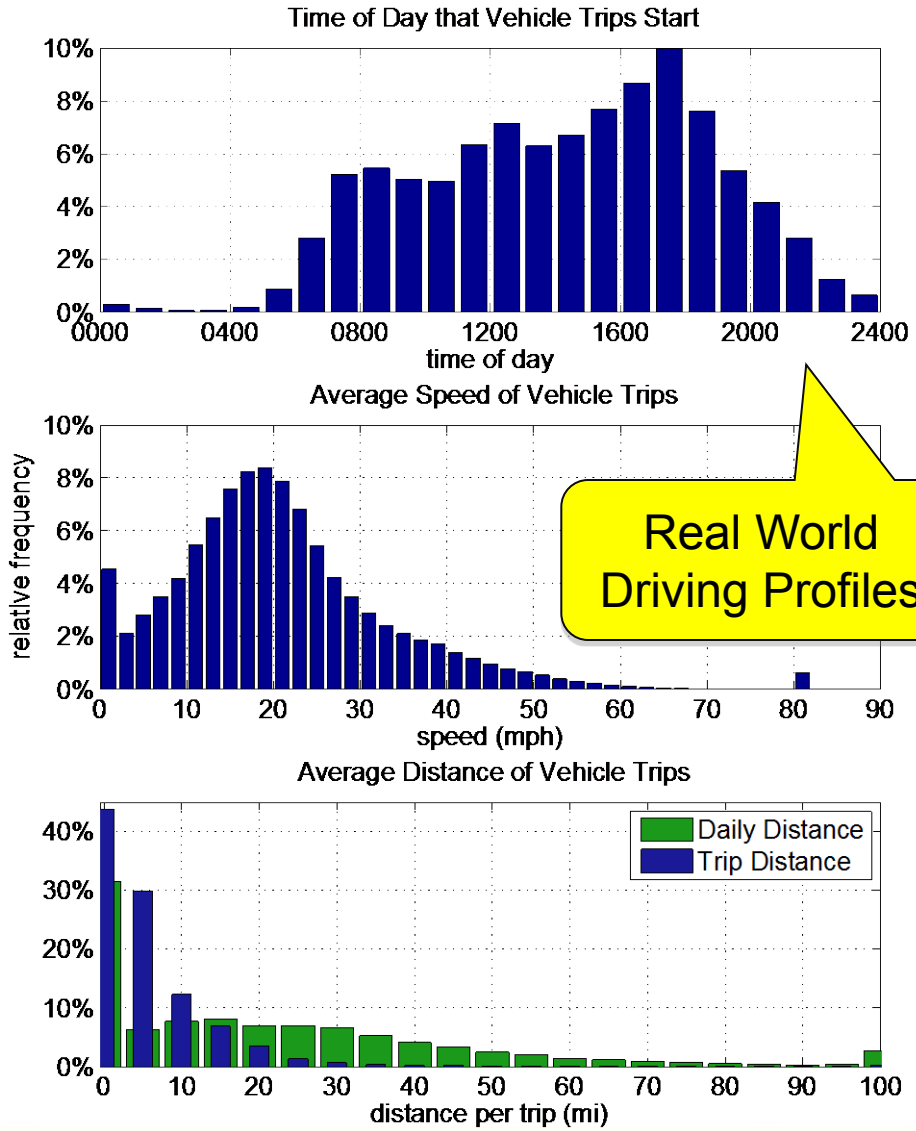
Fast Charge Grid Impact Mitigation

- Identify system benefits
  - Add efficient, electric transportation miles cost effectively
  - Enable competitive performance from all-electric vehicles
    - long-distance travel fueled with renewables
- Address fast charging concerns / barriers
  - Minimize power spikes on the local grid
  - Avoid exacerbating peak demand
  - Reduce system costs
  - Quantify battery utilization



Approach/Strategy

- Multiple fast charges of both CHAdeMO compliant vehicles
- Real-world traffic patterns [*Puget Sound Regional Council Traffic Choices Study*] and solar data incorporated
- Simulation assesses impacts of multiple vehicle adoption rates and station configurations
- PV and storage sizing conducted to mitigate impact

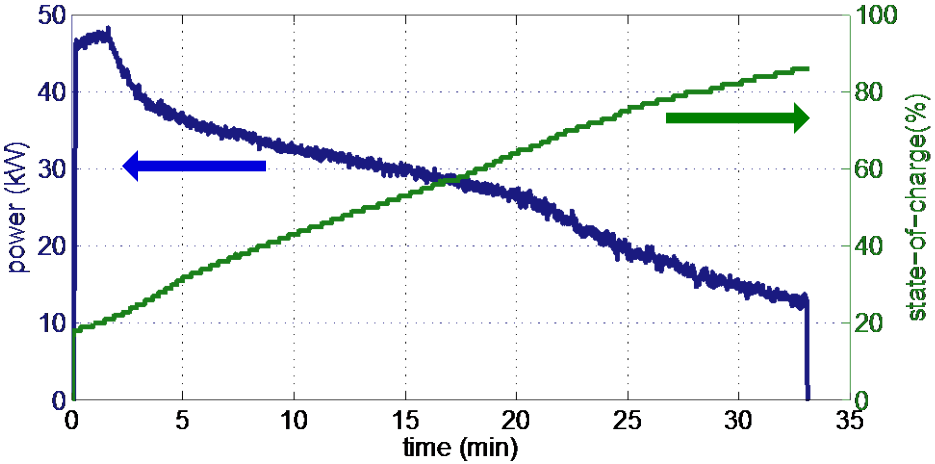


Real World Driving Profiles

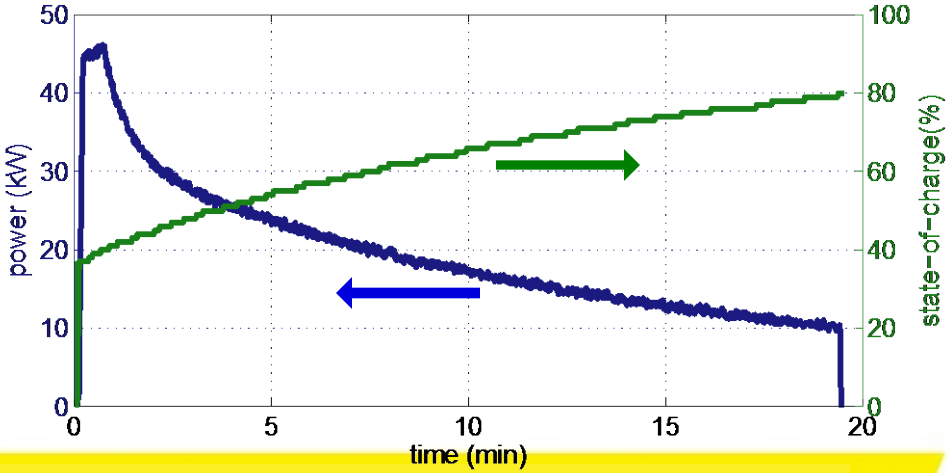
VTIF: Fast Charge Data Acquisition

NREL PIX #20144

Leaf Fast Charge Profile



i-MiEV Fast Charge Profile

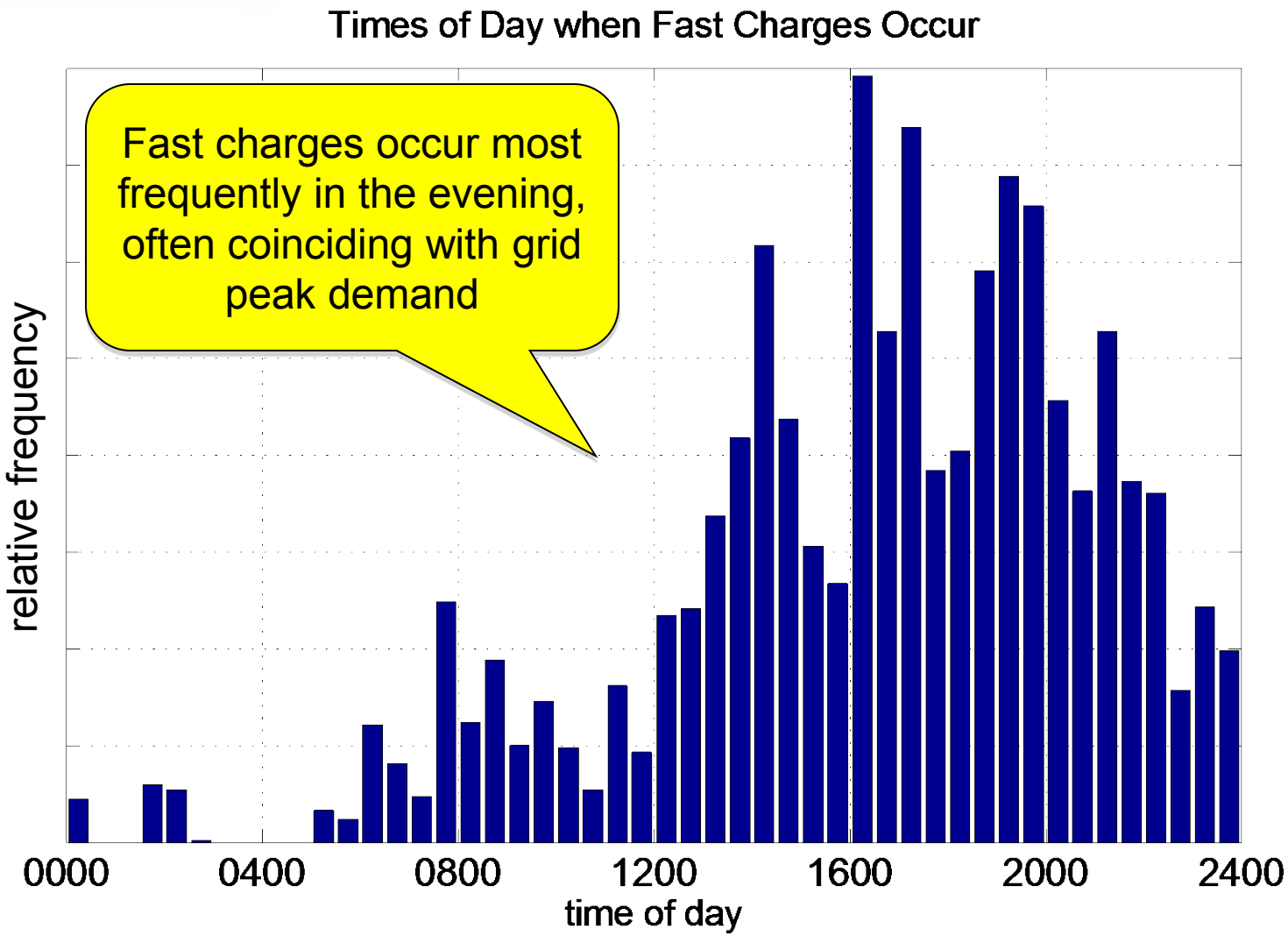


Model Assumptions

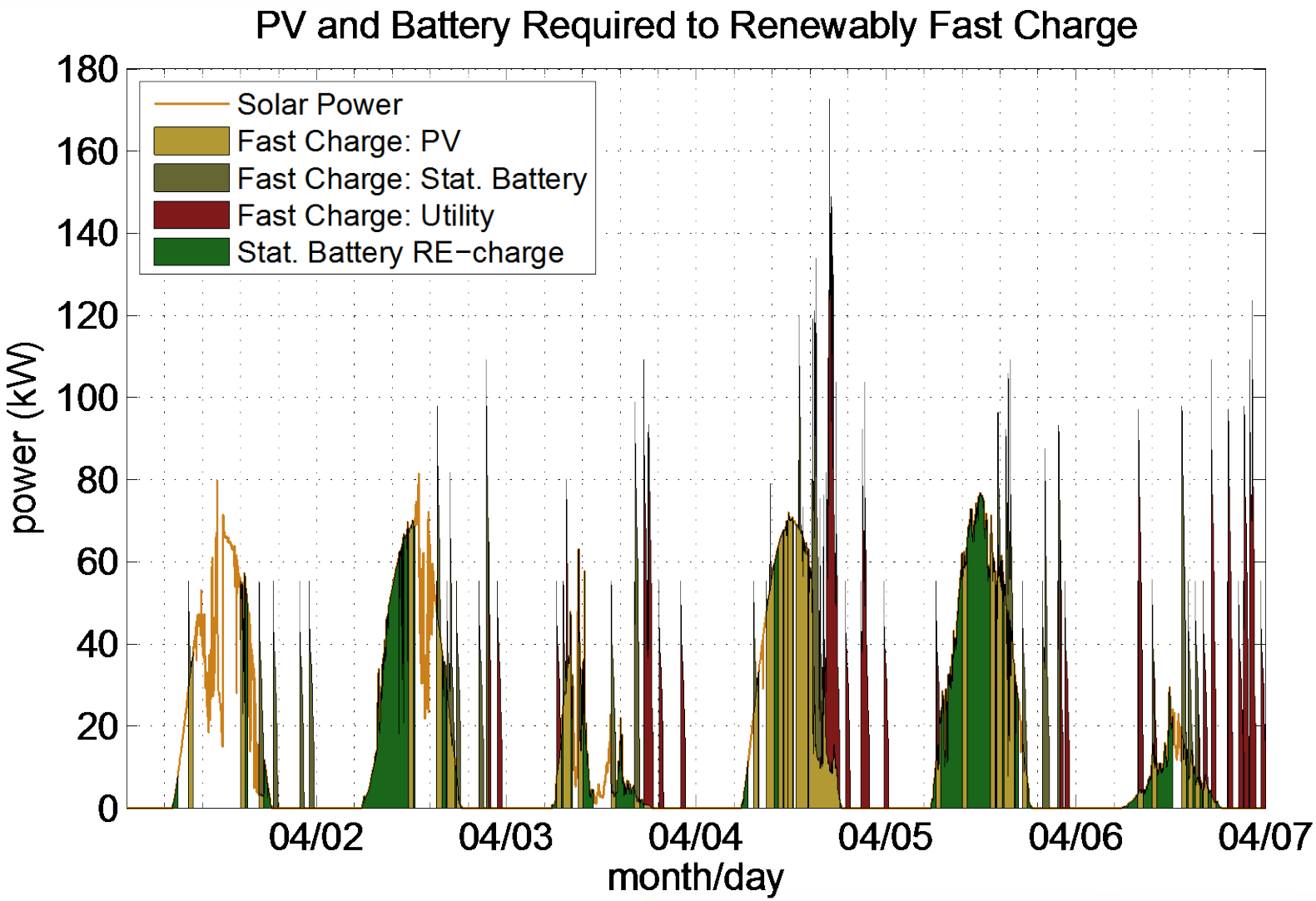
Assumption	Value	Units/Notes
Vehicle State-of-Charge Window	80%	*Min: 10%, Max: 90%*
Vehicle Energy Consumption Rate	300	Wh/mi
Forgetfulness Factor	10%	*User forgets to plug-in roughly 1 in every 10 days of driving*
Home Charge Power	3.3	kW
Fast Charger Efficiency	85%	*Source-to-Battery*
Fast Charger Power (max)	50	kW
Fast Charger Max SOC	80%	*Charger cuts off at 80% SOC*
Stationary Battery SOC Window	75%	*Min: 15%, Max: 90%*

- Home charging begins at midnight if the car is stationary and the driver doesn't forget
- Fast charges occur only secondary to home charging when, in the middle of a trip, the battery approaches minimum SOC

Simulations Indicate High Potential Utilization



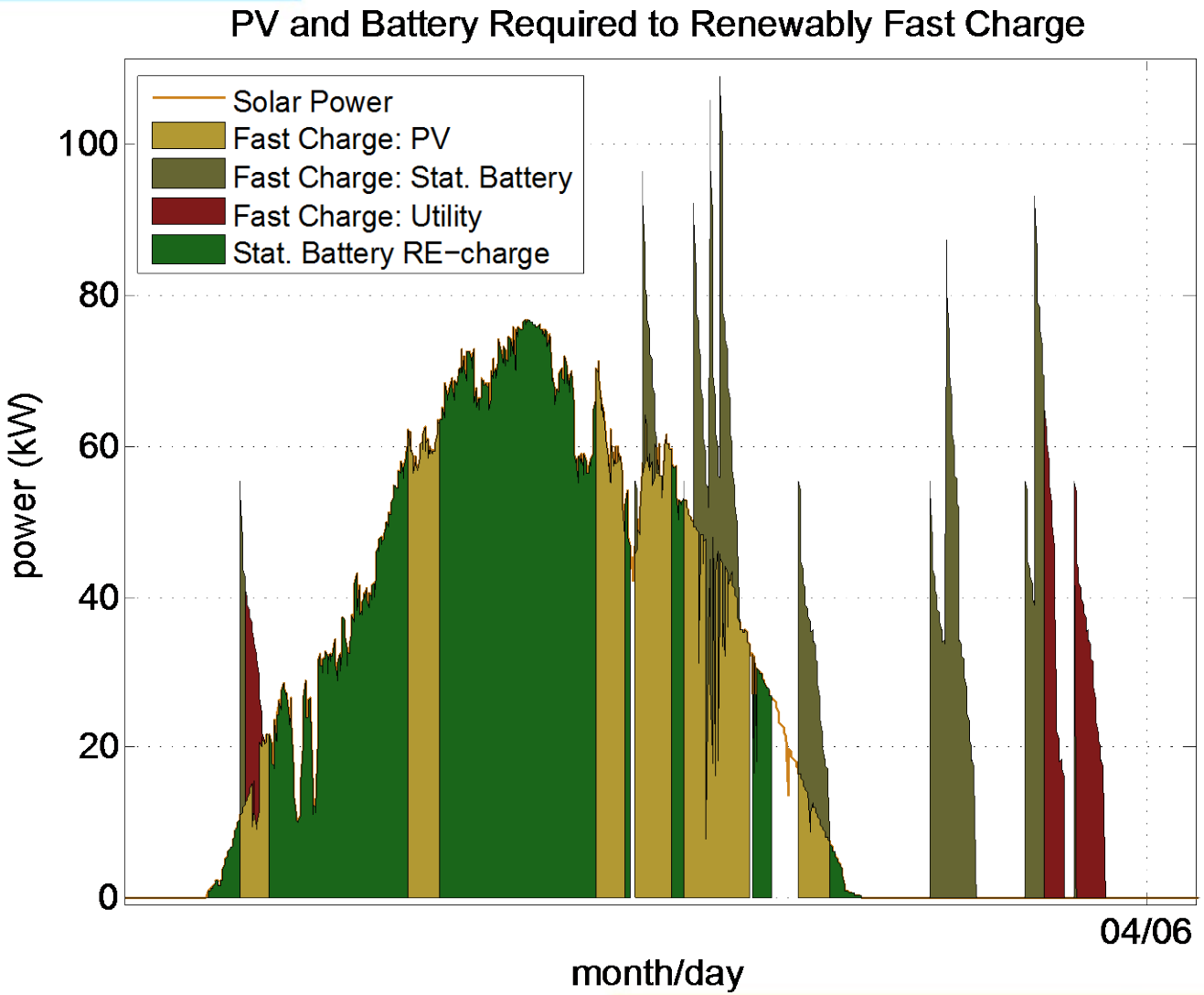
One Week's System Operation



Assuming 4 ports, 200 vehicles, 24 kWh per vehicle, 100-kW PV, 100-kW stationary battery

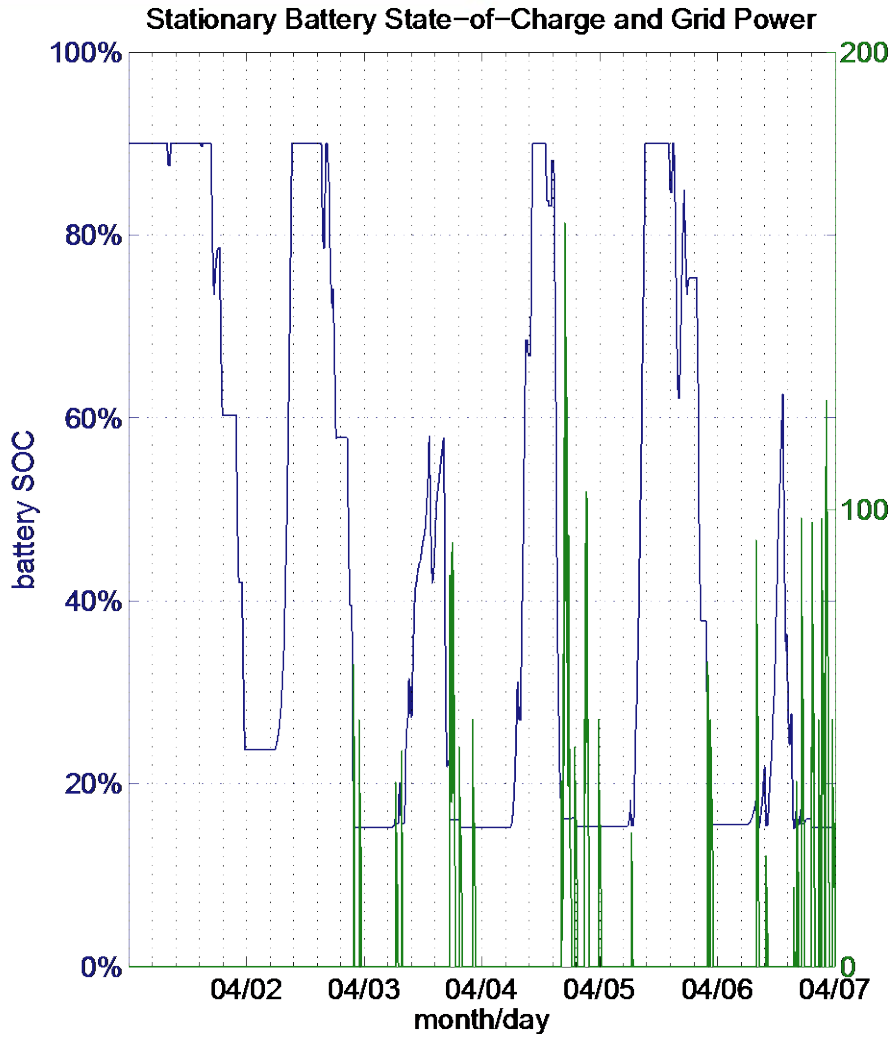
Single Day System Operation

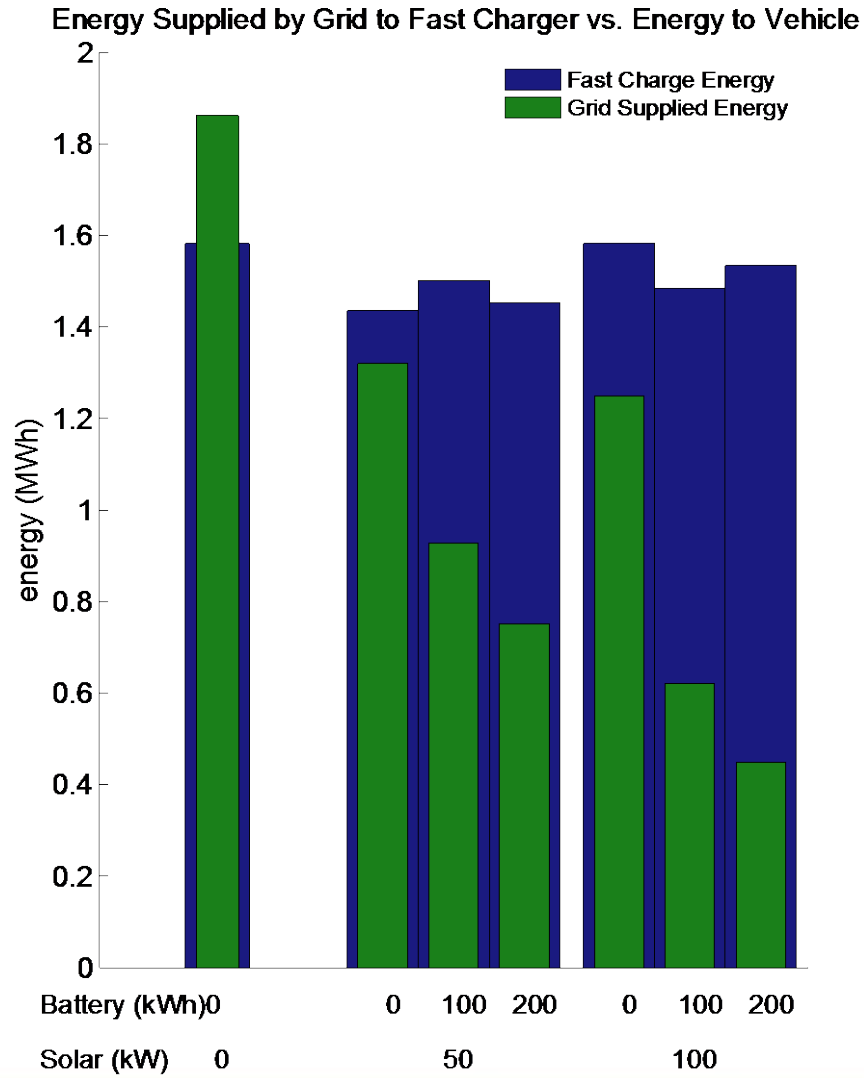
200 PEVs,100-kW PV, 100-kWh Battery



Assuming 4 ports, 200 vehicles, 24 kWh per vehicle, 100-kW PV, 100-kW stationary battery

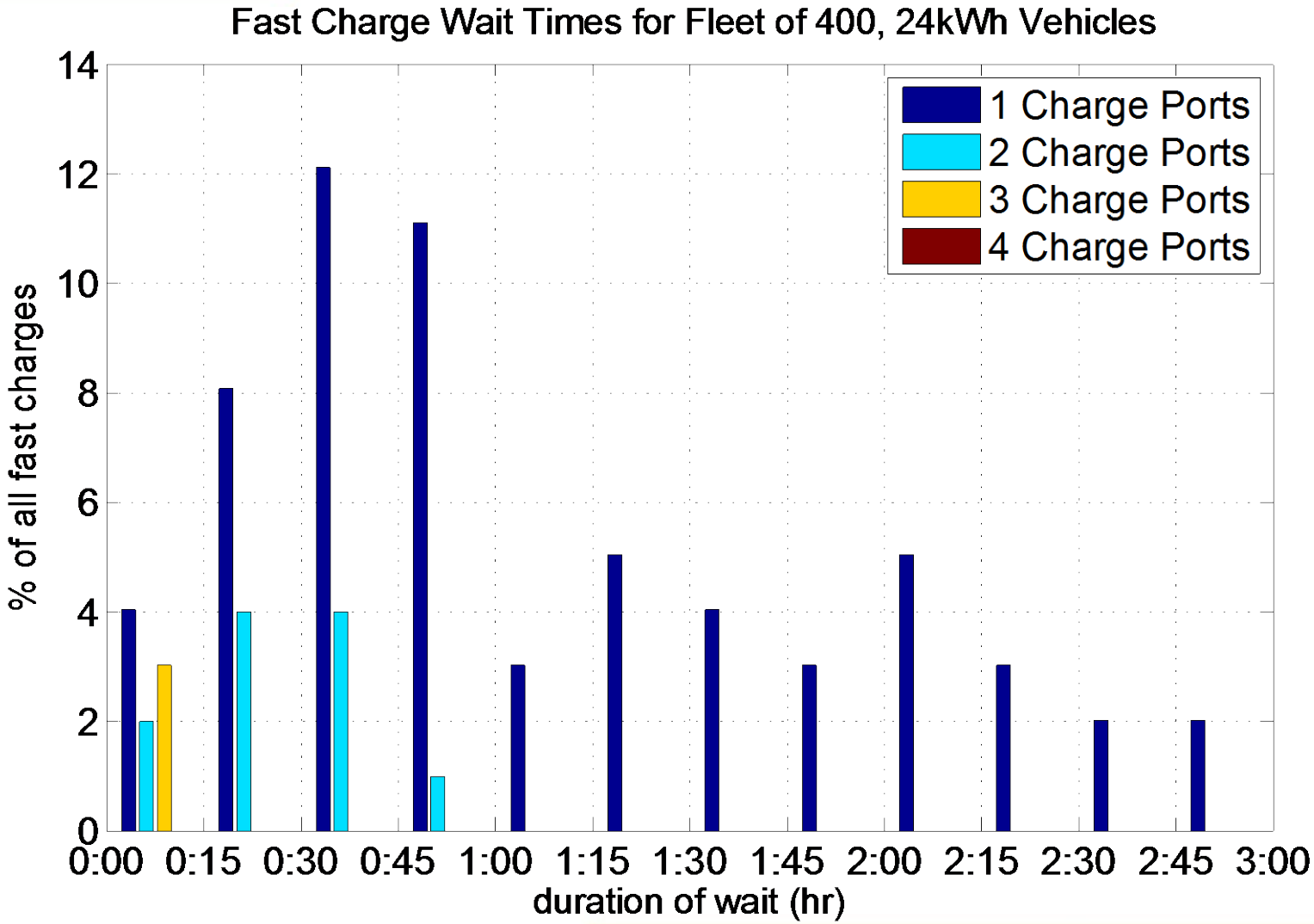
Avoiding expensive energy and demand charges on your bill…





Assuming 4 ports, 200 vehicles, 24 kWh per vehicle, 100-kW PV, 100-kW stationary battery

Reduced Wait Times with More Installed Ports



Conclusions

- Fast charge utilization simulation developed
- Grid impact options identified
- Next steps:
  - Include economics in design of experiments

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Questions?

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