U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

Department of Energy's Vehicle Technologies Office Perspective

Michael Berube, Director

Vehicle Technologies Office

Refueling Infrastructure: Needs for the Future

Infrastructure in a Changing Mobility Landscape

SMART Mobility Lab Consortium

High-Performance Computing / Big Data Analytics

Advanced R&D Projects

EEMS Living Labs

Sneak Peak at VTO's Recent Infrastructure Analysis

DOE's Energy Efficient Mobility Systems – Generating New Insights

U.S. DEPARTMENT OF ENERGY
SMARTMOBILITY
Systems and Modeling for Accelerated Research in Transportation

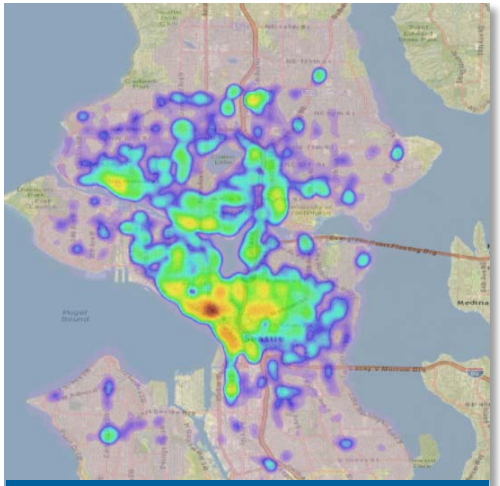
Argonne NATIONAL LABORATORY · INL Idaho National Laboratory · BERKELEY LAB · OAK RIDGE National Laboratory · NREL NATIONAL RENEWABLE ENERGY LABORATORY

Multi-Lab Consortium creating new knowledge and understanding about the energy implications and opportunities from future mobility.

- Connected & Automated Vehicles
- Mobility Decision Science
- Multi-modal Transport
- Advanced Fueling Infrastructure
- Urban Science

What infrastructure is required to support future mobility systems?

How will changes in individual vs. group ownership of vehicles impact refueling?

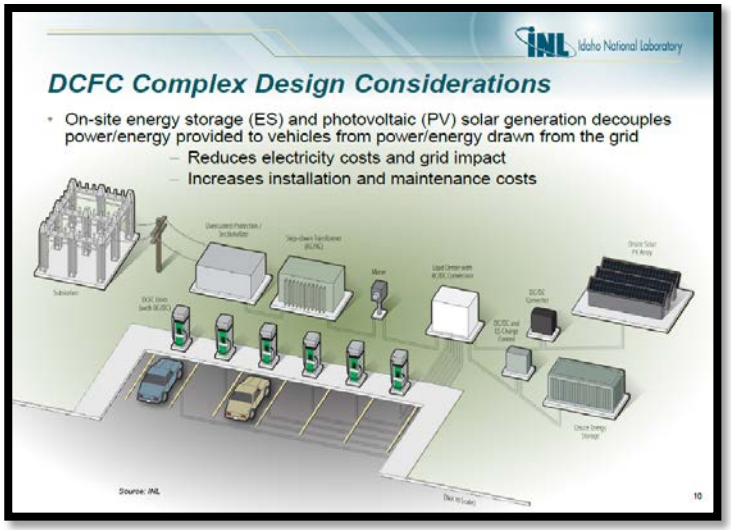


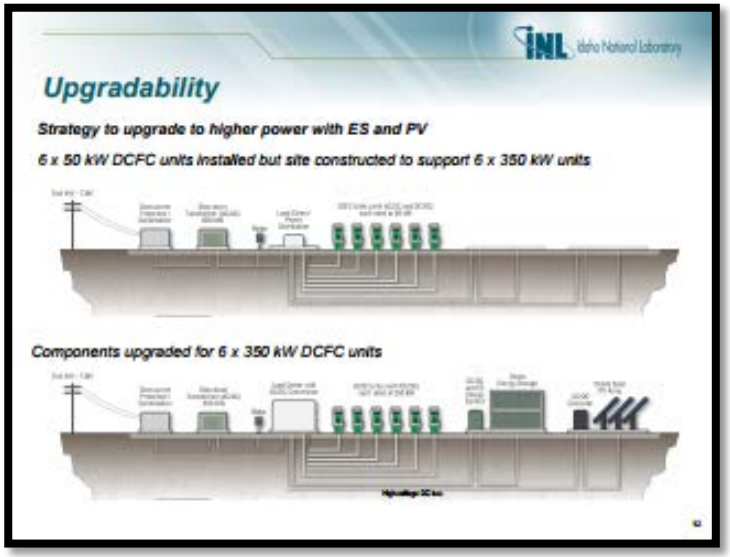
ReachNow free-floating car-sharing vehicle parking density in Seattle, WA May 2016 to Feb 2017

Modeling charging requirements for electrified shared mobility service fleets using spatially-resolved vehicle activity patterns (INL/NREL).

DC Fast Charging Complex System Design (INL)

What are the technical requirements to achieve recharging times under 15 minutes?





Insights from INL Study:

- Can reduce overall costs by:
  - Utilizing a phased upgrade strategy
  - Incorporating energy storage & onsite solar generation (given high-utilization)
- Profitability of DCFC complexes is difficult without additional revenue
- EV drivers may be willing/need to pay a premium for occasional DCFC use, given most charging conduced at home.

Extreme Fast Charge (400kW) Technical Gap Assessment (INL)

PRELIMINARY RESULTS

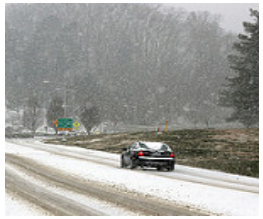
Sneak Peak of DCFC Corridor Analysis from NREL

What are the EVSE needs across the country to support up to 30% PEV penetration?

NREL Analyzed & Modeled

497 Cities

3,104 Towns



50 Corridors

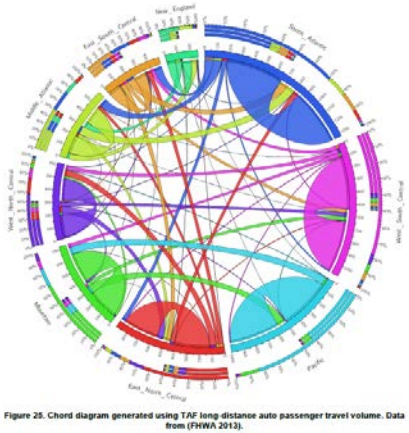
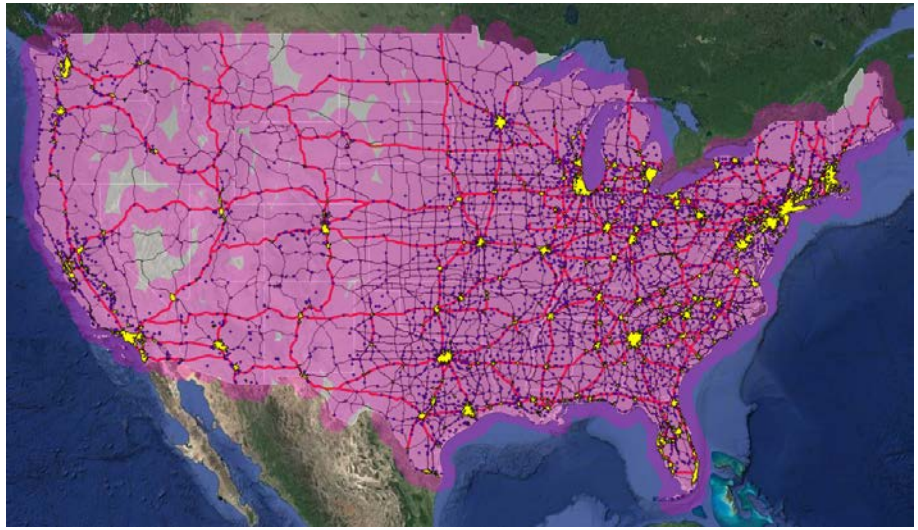


Figure 25. Chord diagram generated using TAF long-distance auto passenger travel volume. Data from (FHWA 2013).

FHWA Trips Over 100 Miles

Resulting Coverage Map



PRELIMINARY RESULTS

Sneak Peak of DCFC Corridor Analysis from NREL

By the Numbers:

- ~400 DCFC stations required on Corridors:
  - Tesla - 160 on corridors & Doubling them
  - Electrify America plans ~240 highway DCFC stations
- ~5,000 DCFC stations in Cities & Towns:
  - Just under 4,000 currently
  - driver never more than 3 miles from charger
- ~500,000 L2 Chargers:
  - 12,000 currently
  - Supports workplace, public locations with dwell time

Key Takeaways:

- ~90% of charging KwH will be done at home
- Well-placed, well-planned infrastructure is key but achievable
- "Long-distance travel" is not that long - under 400 miles
- "Urban network" supports long-distance intra-city travel, emergency charging & alleviates range anxiety
- L2 chargers may be biggest gap but more easily addressed
- Business model of who pays for electricity needs to mature – DCFC cost/KwH high
- DCFC and L2 mix is sensitive to range and PHEV e-miles support

Thank You

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