CENTER FOR
POWER OPTIMIZATION OF
ELECTRO-THERMAL SYSTEMS

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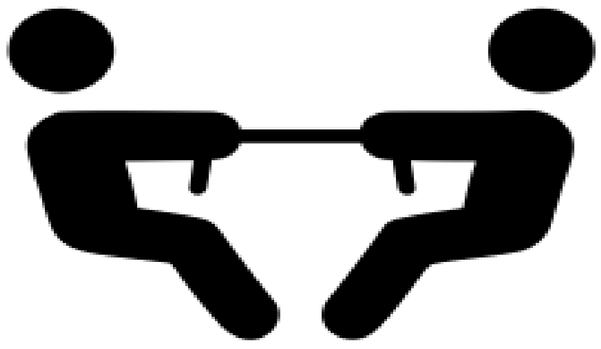
The solution to 95% of EV charging daily needs

Raya Mahony and Philip T. Krein (UIUC).

Affordability is fundamentally at odds with fast charging

Affordable energy *(maximizing charger usage)*



No wait time *(consistent availability)*

Nissan Leaf vs Nissan Versa

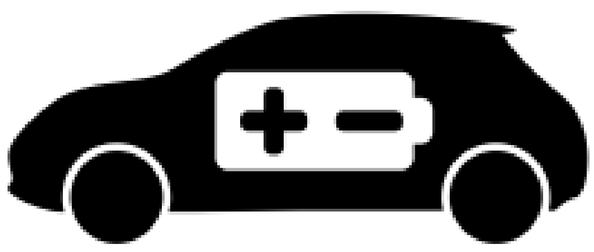
- **Level 1 charging imposes less battery wear**
- **Slow charging enables grid stability/flexibility**
- **Numbers here based on "combined cycle" tests**

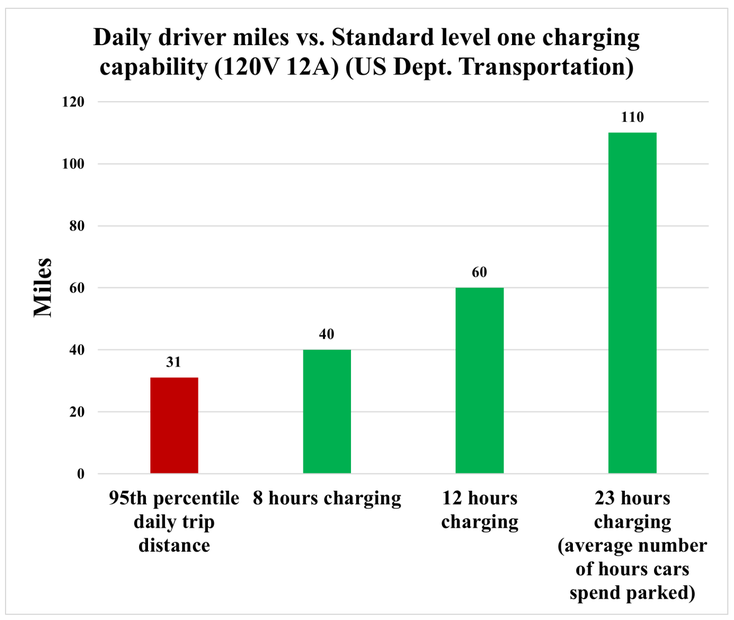
Current gas combustion engine ~ ***9.8¢/mile***
Retail EV level 1 (Slow) charging cost ~ ***4.5¢/mile***
*Current EV DC level 3 (fast) charging ~****14.6¢/mile***

Even if DC fast chargers impose 3X the retail energy cost, they may never break even.

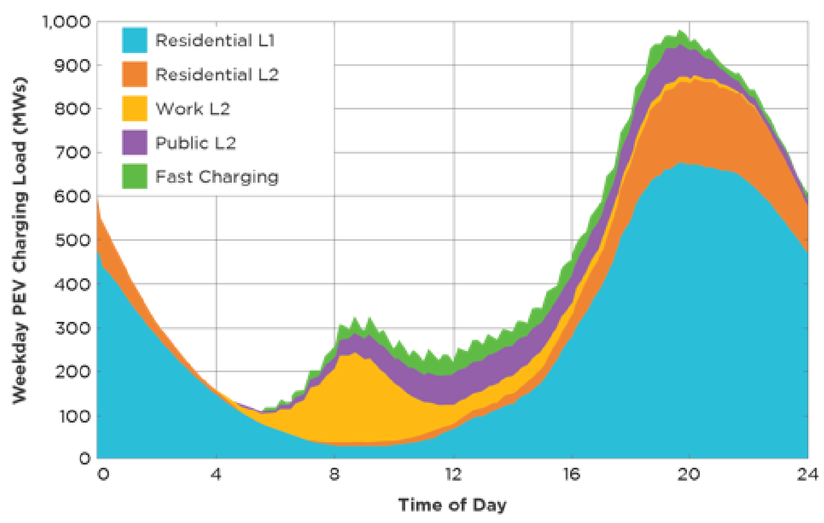
How many miles do passenger EVs need to be charged each day?

US department of transportation reports that 95% of daily trips are 31 miles or fewer



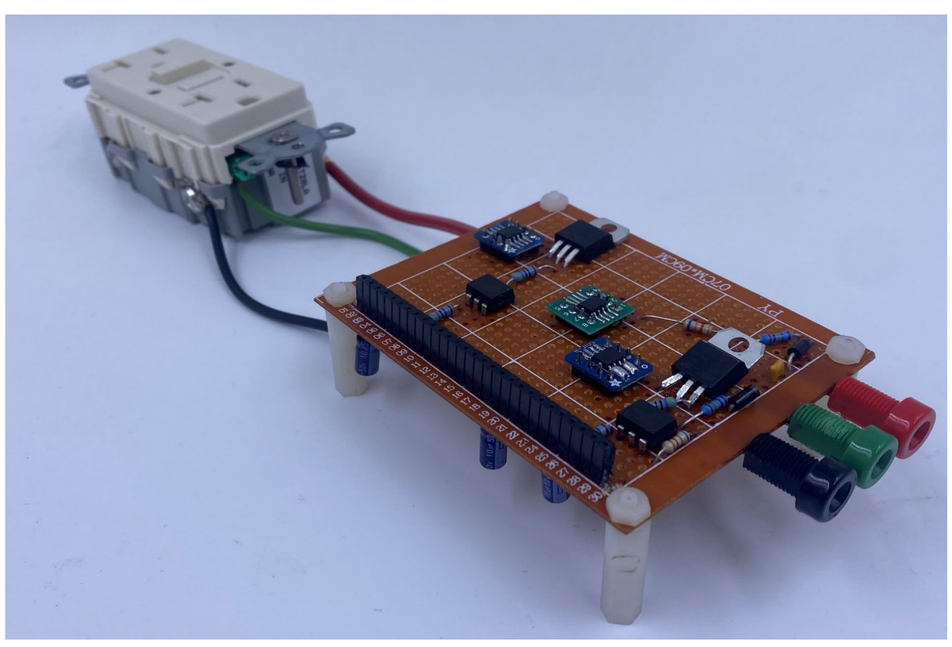


Uncontrolled charge type usage



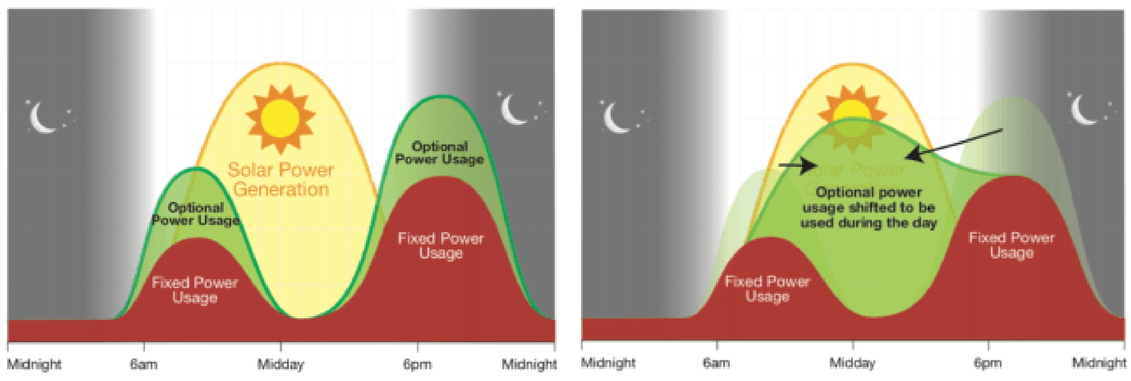
Standard US outlet, or Level 1 equivalent, is adequate to meet most daily needs.

Open engineering challenges (Public charging)



Controller and sensing prototype

- Addressing safety:
  - vandalism/tamper-proofing
- Effective vehicle/outlet handshake to initiate payment agreement
- Accurate charging data
  - Real time pricing
  - Power data
- Reliable communication with energy provider
- Security and data privacy
- EV chargers with high efficiencies across wide load range



[1] Federal Highway Administration. (2017). *2017 National Household Travel Survey*, U.S. Department of Transportation, Washington, DC. Available online: https://nhts.ornl.gov.

[2] Bedir, Abdulkadir, Noel Crisostomo, Jennifer Allen, Eric Wood, and Clément Rames. 2018. California Plug-In Electric Vehicle Infrastructure Projections: 2017-2025. California Energy Commission. Publication Number: CEC-600-2018-001.

[3] Nissan Lineup | Nissan USA. https://www.nissanusa.com/vehicles/new.html.

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