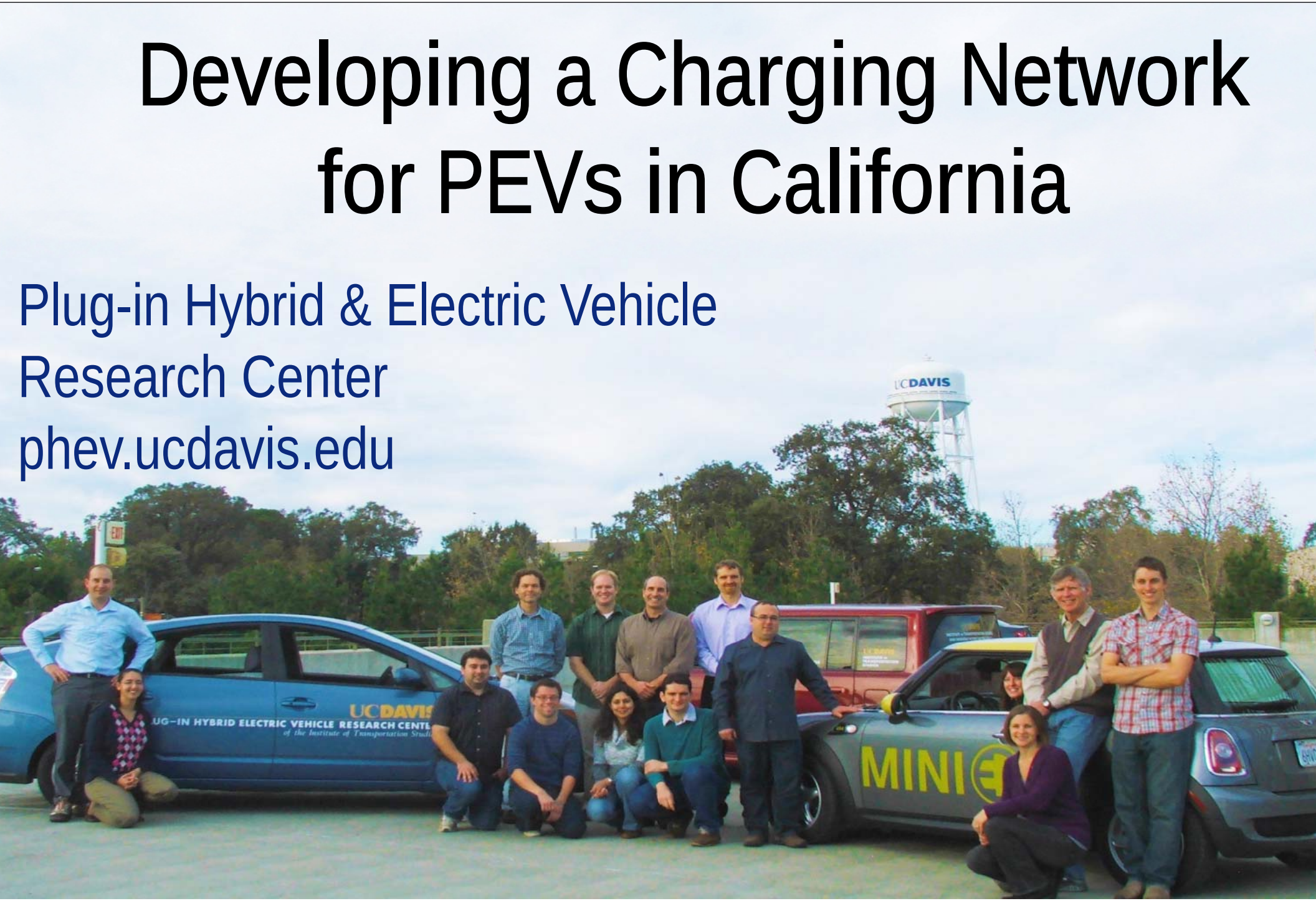
Developing a Charging Network for PEVs in California

Plug-in Hybrid & Electric Vehicle Research Center

phev.ucdavis.edu



There are no examples in the world of a PEV charging network…

- What is the right ratio of home, workplace and public?
- How much public charging network is needed for market success?
- Where exactly to put workplace or public chargers?
- Do we encourage “free” charging and dedicated “PEV” parking spots?
- Do we need fast chargers? How many?
- What is the right mixture of Level 1, Level 2, and “fast” chargers (50KWh….)?
- Do we need to provide chargers on long distance corridors?

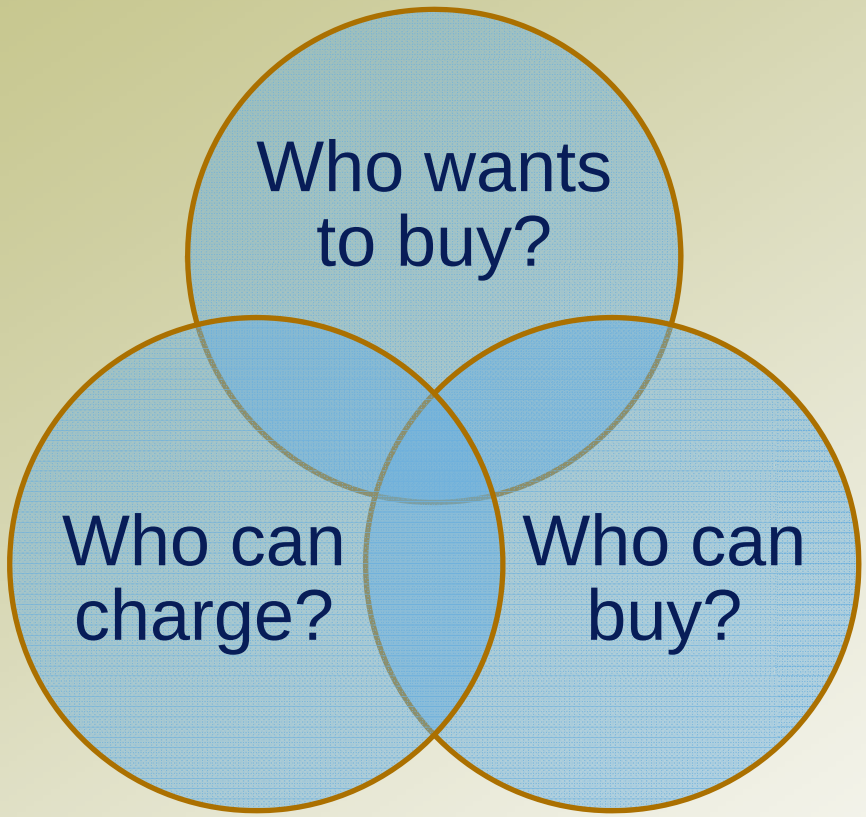
There are several opinions about how a PEV charging network should be developed…

- **Develop a ubiquitous network:** “build it they will buy”
- **Let the private sector fund development:** “let private sector take risk and direct rollout of chargers”
- **Focus on regional “ecosystem:”** Develop network around concentrated, adjacent urban markets, ignore rural, low market areas.
- **Be data driven:** Plan network scale, design and pace of rollout based on usage patterns. Monitor use carefully.

PH&EV Center is exploring a data driven, regional design

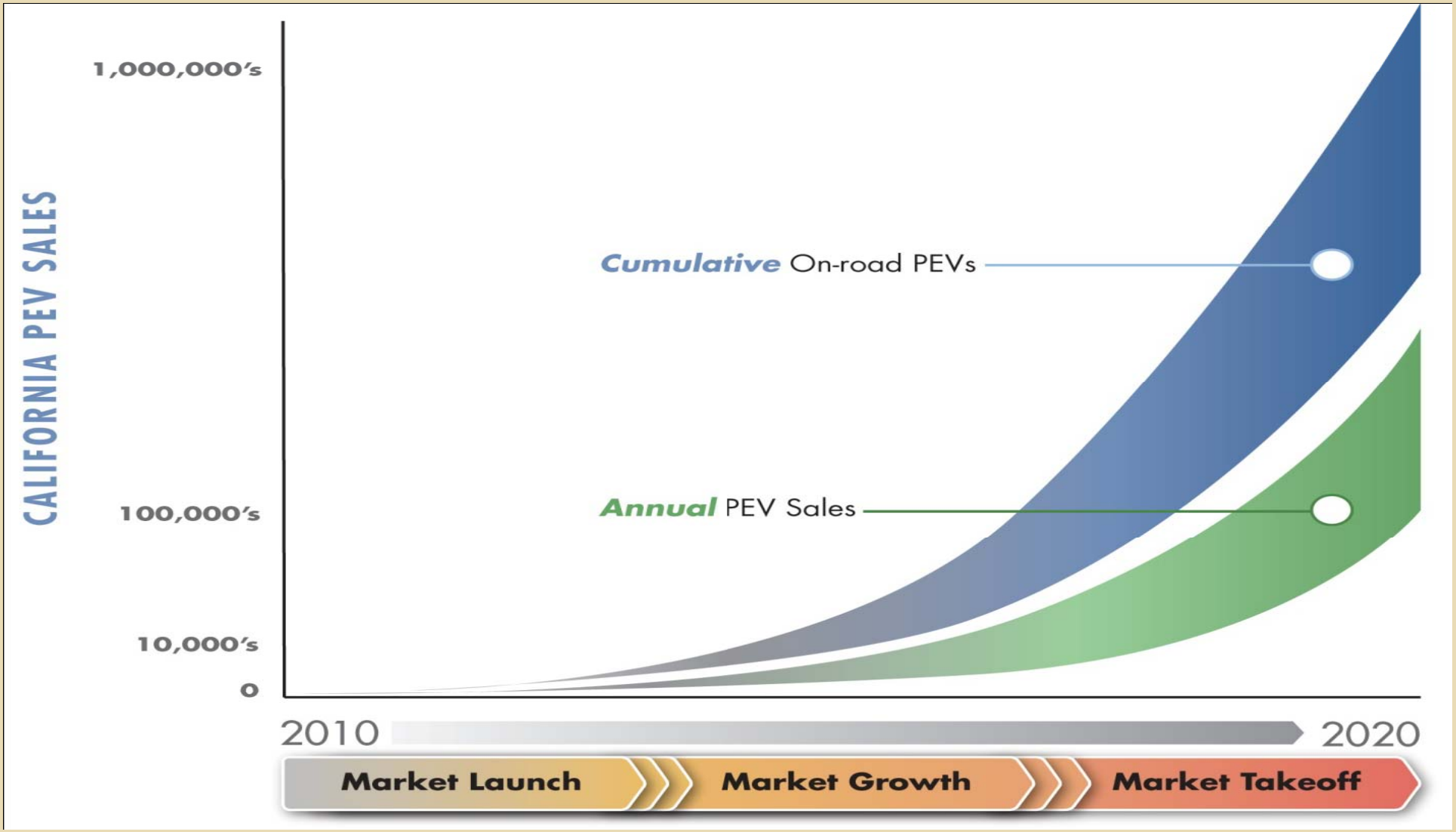
- "Home base" as core of network
  - Nighttime, home base as 80% or more of demand
- Emergency locations next priority
  - Hospitals, transit centers, government services, schools
- Workplace next
  - Need program to assist businesses to assess opportunities
- Public locations to "expand" driving opportunities
  - Recreation locations
  - Regional shopping
- Fast chargers to access adjacent (50 miles) cities within region (this is still research, not certain)
- Rigorous monitoring of network use to indicate where, when and how much capacity needed at each stage of market.

If you follow a data driven approach, you need to assess market growth, and then driver needs and wants…



- Where do they have to charge at night?
- Do they need to charge at work?
- Where else?
- Which chargers get used, how much, when…

The number of chargers will follow the growth of the market..

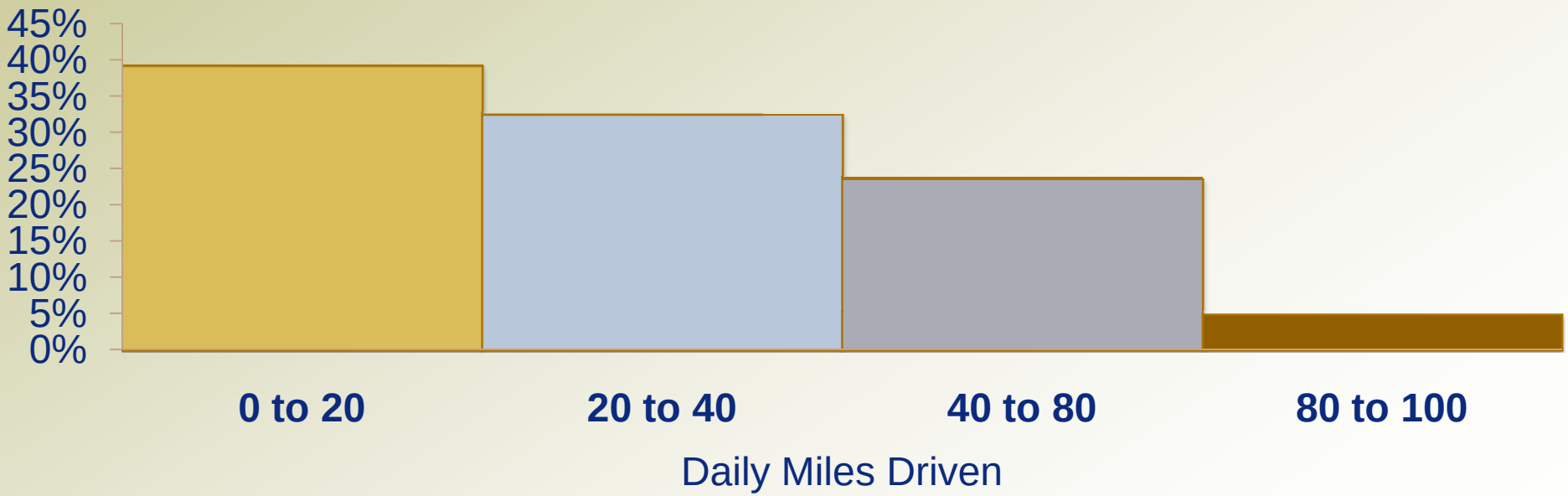


We expect most electricity will come from home based, nighttime charging…

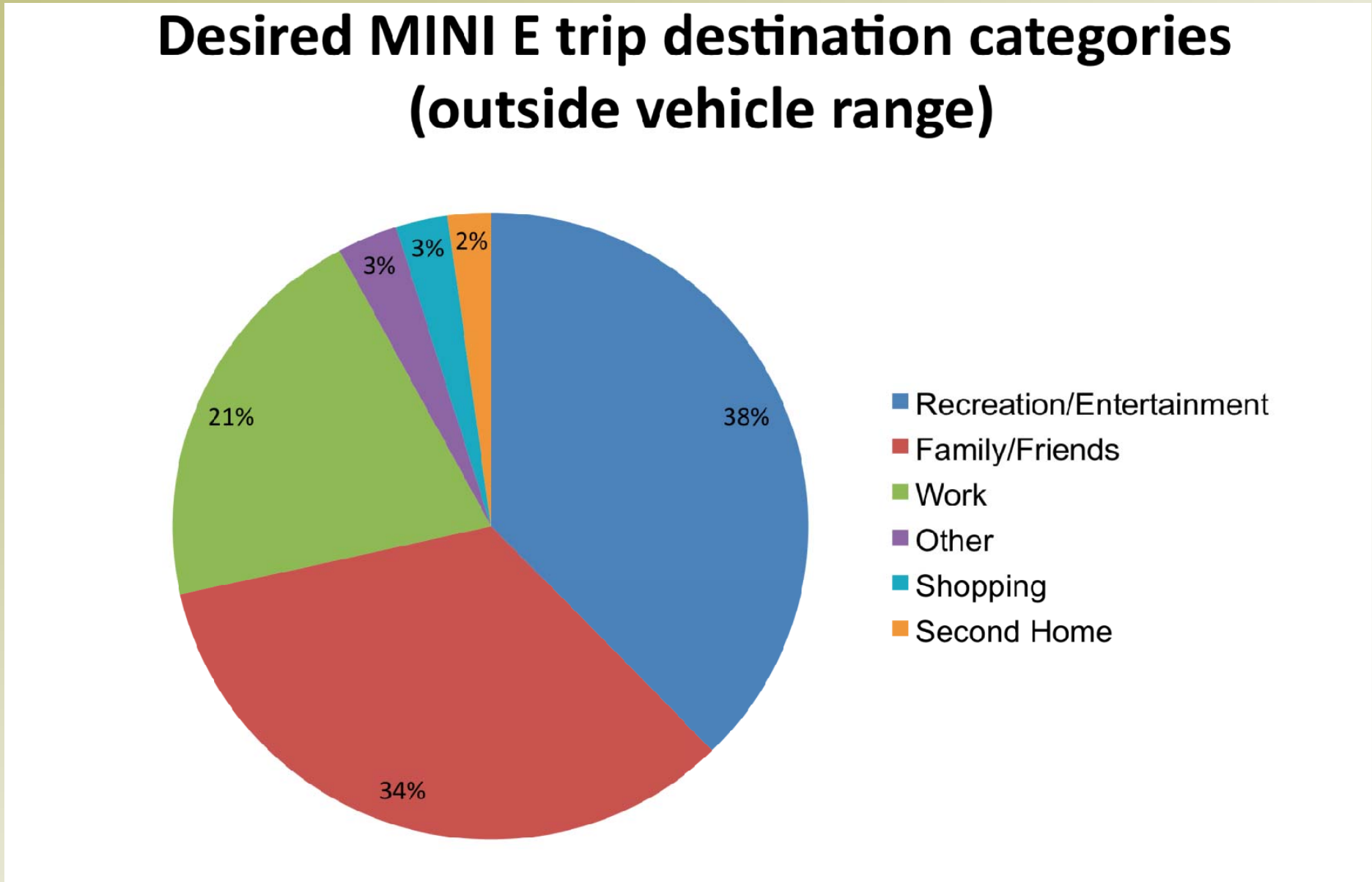
- We expect 80-90% of charging needs to be covered by “home, nighttime” based charging.
- In some cities, like San Francisco, Berlin there are serious barriers to this “nighttime” home base model

BMW drivers say they accomplished most driving tasks with only home charging and 90-100 miles of range

On average, about how many miles did you drive the MINI E each day?
(n = 102)



MINI E drivers want chargers at visiting & recreation spots

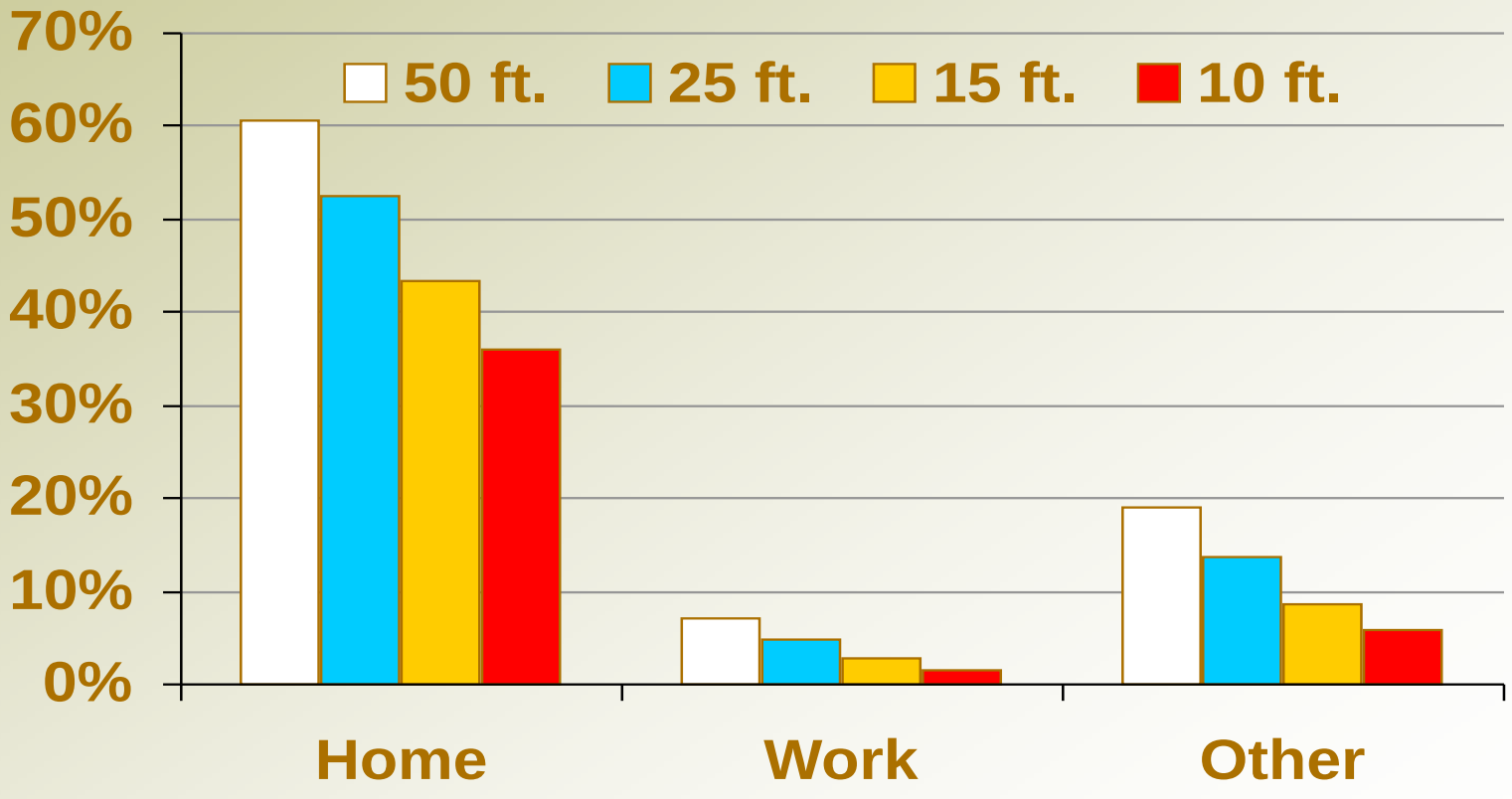


We are defining the PEV and charger market by ease of charger installation..

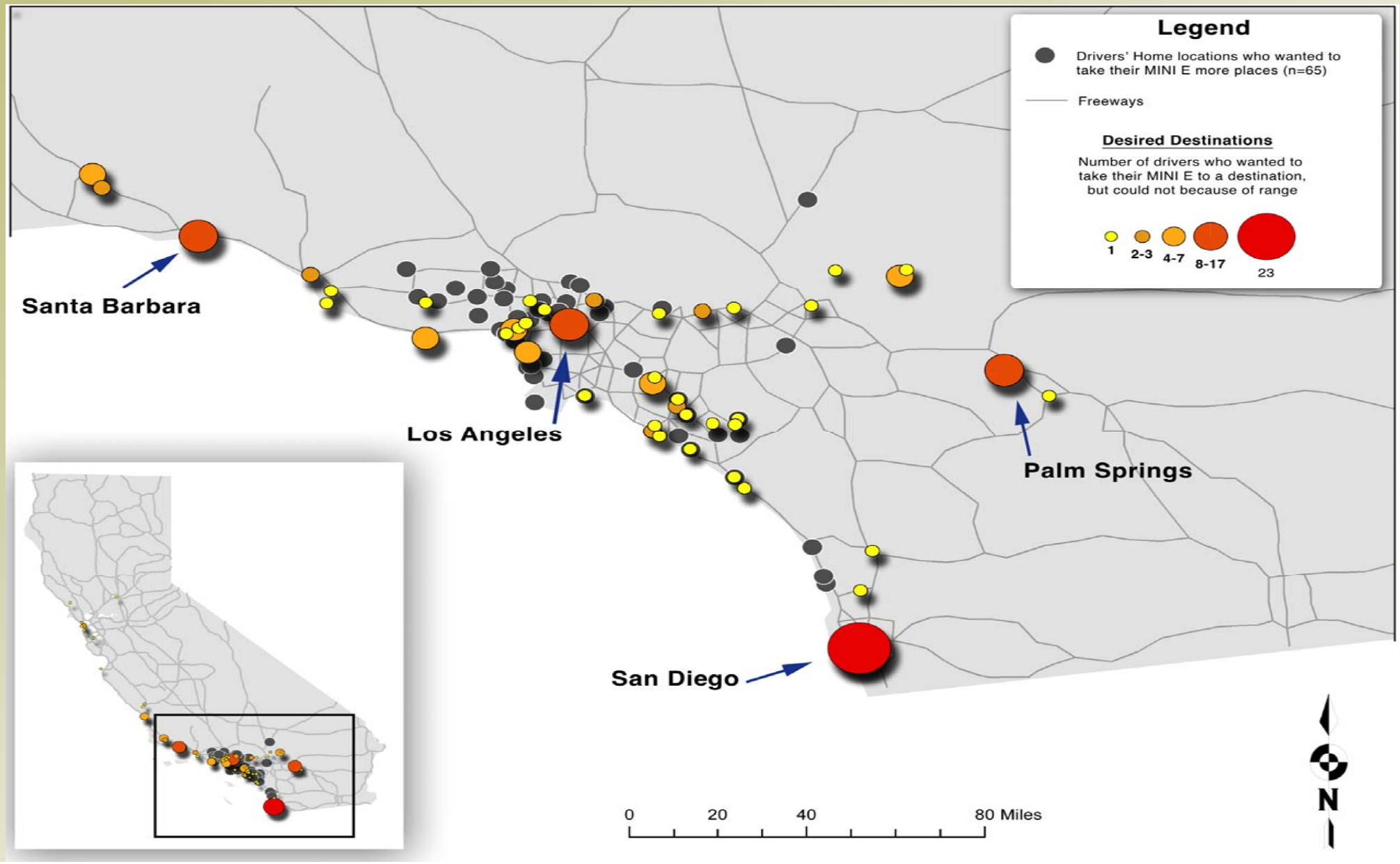
- **Primary market**:
  - Lowest cost installations, no upgrades, nighttime fixed parking with low cost panel access
- **Secondary markets**:
  - Nighttime fixed parking, costly upgrades (panels, trenching, etc…)
- **Tertiary markets:**
  - No fixed parking at night, no easy access to electrical system

Our survey data has indicated that the primary and secondary markets in US are sizable..

- Most of USA, California (about 50% of new car buyers) a place 25 feet from electricity each night
- But some dense cities it will be difficult: Berlin 7%, San Francisco 20% have a garage



PEV drivers will use a regional network (PEV ecosystems)



Workplace is next priority after night parking spots..

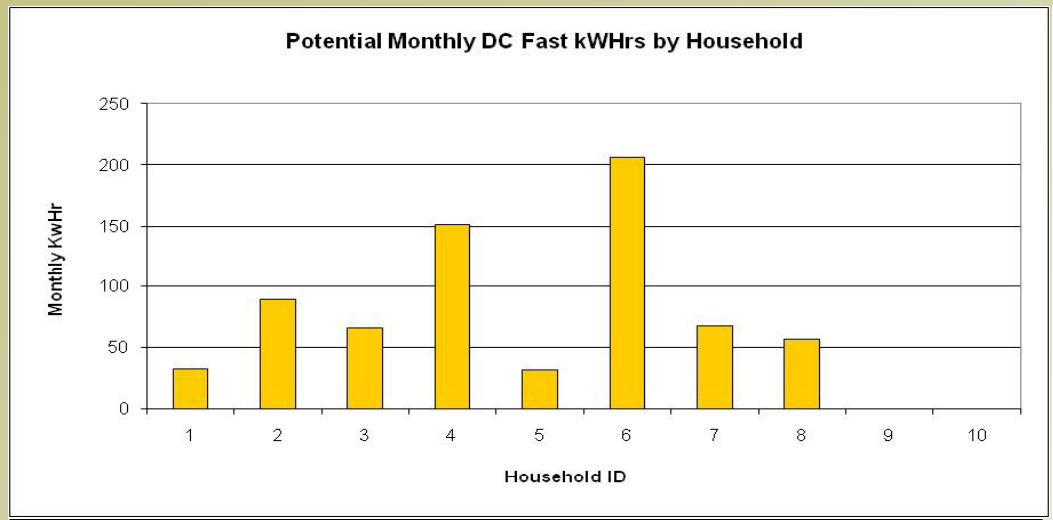
- Workplace charging can have significant benefits for PEV drivers
  - Can double utility factor for PHEVs.
  - Can extend range of BEVs
- Workplace charging can be used by fleet vehicles, employees, clients.
- Data driven approach.
  - Provide analytical tools to access market potential in firm's fleet and employees,
  - Coordinate charger placement with PEV incentives

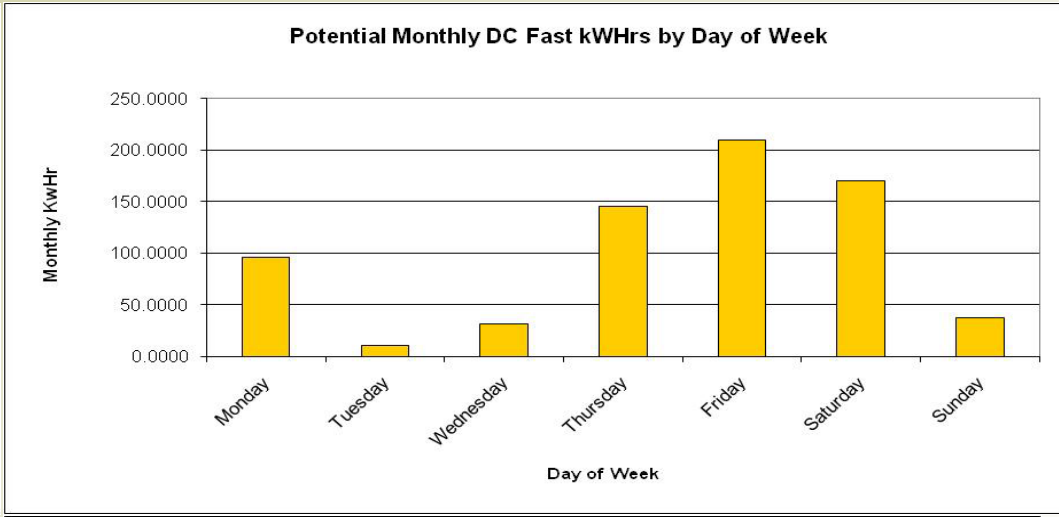
Priorities for “Regional” Public Network

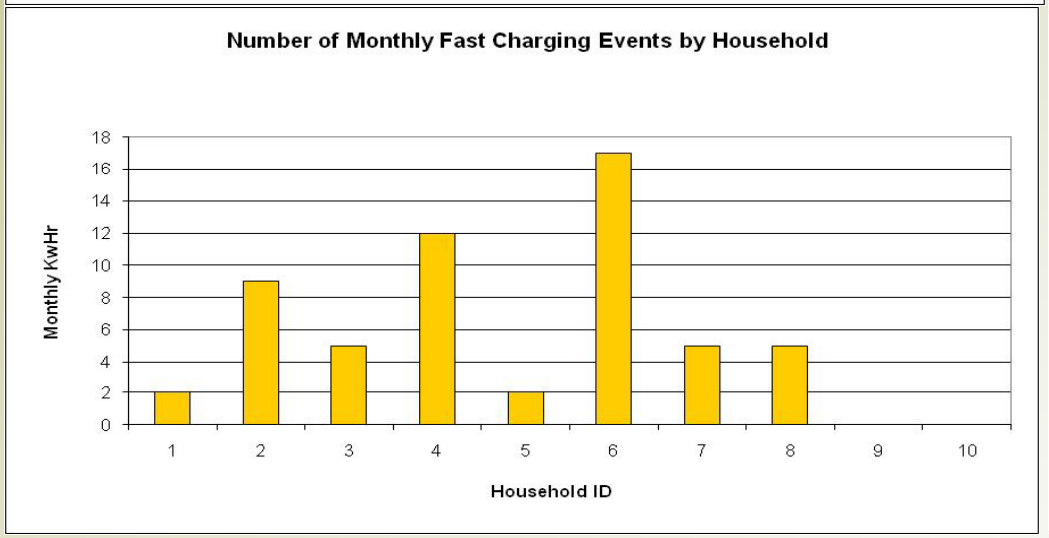
- First: Develop regional safety net
  - Hospitals, government zones, schools
- Second: Expand activity space of drivers
  - Create access to adjacent areas, highways that connect major populations.
  - Create access to regional recreation,
  - Regional shopping, dining
- Third: provide “fast” charge to improve access to adjacent cities and regions.

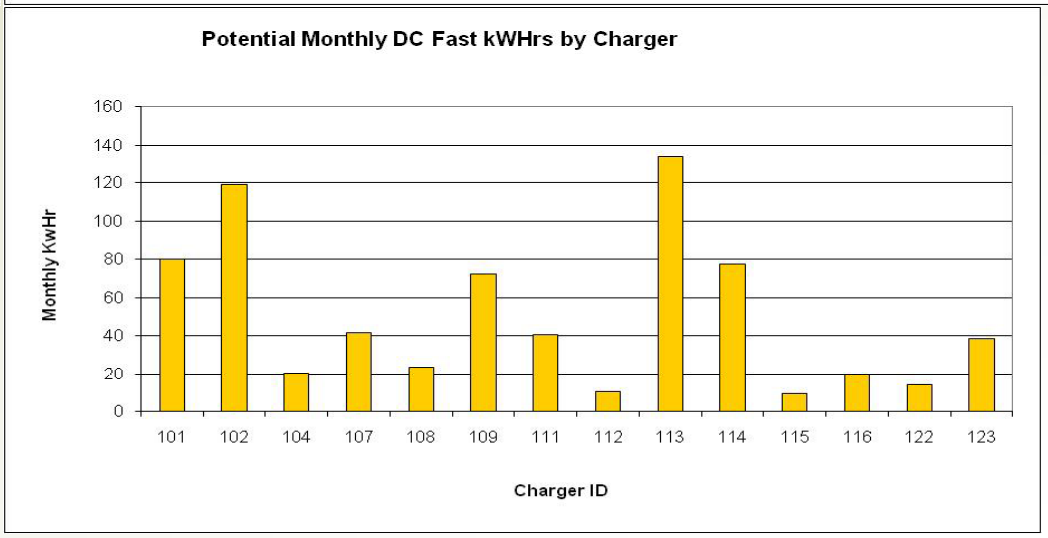
Data driven approach can reveal optimal locations for chargers (details of 10 households)

Fast charging demand is not even across households, fast charge locations and time (simulation of 10 households based on GPS travel data)

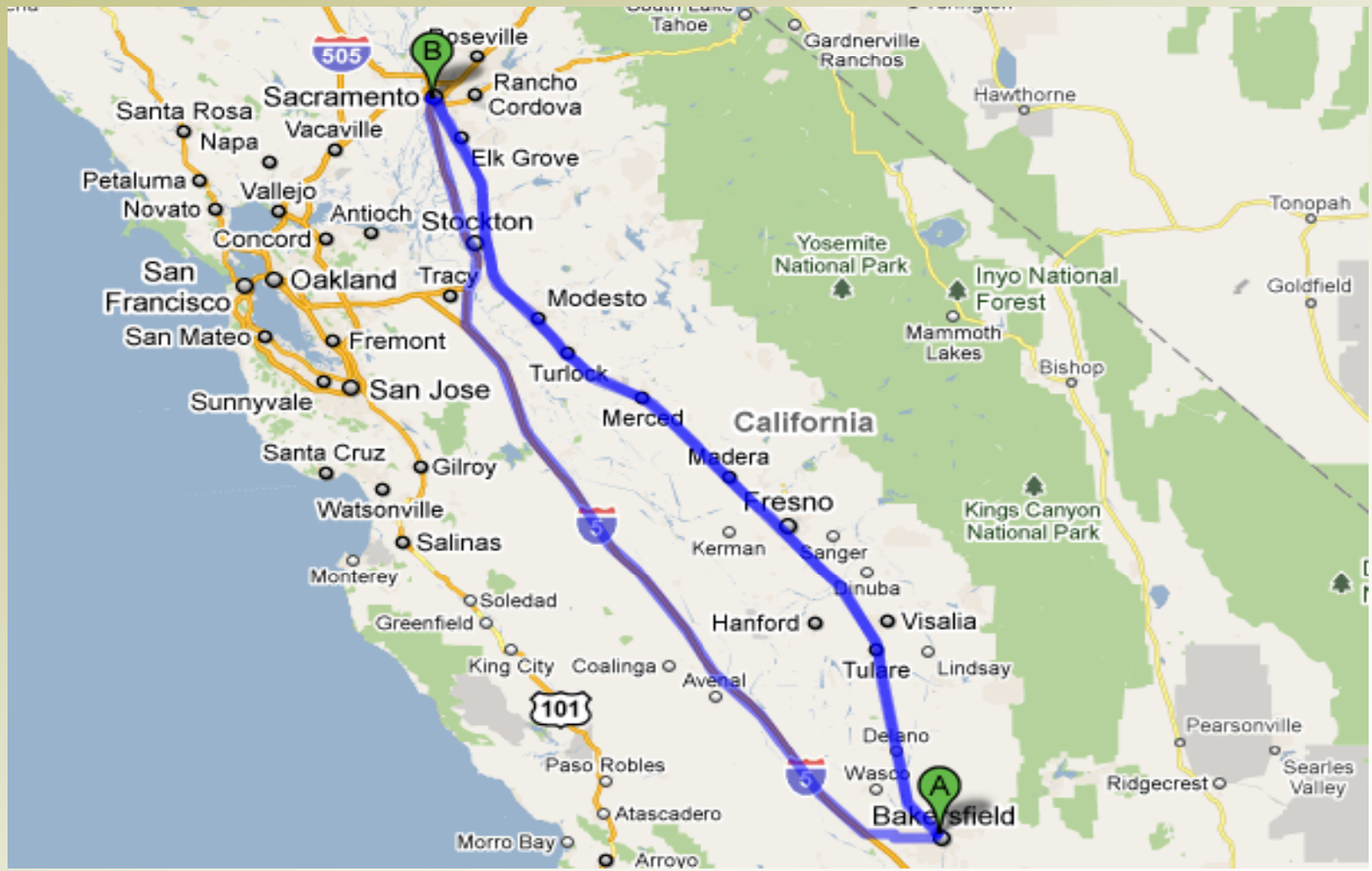




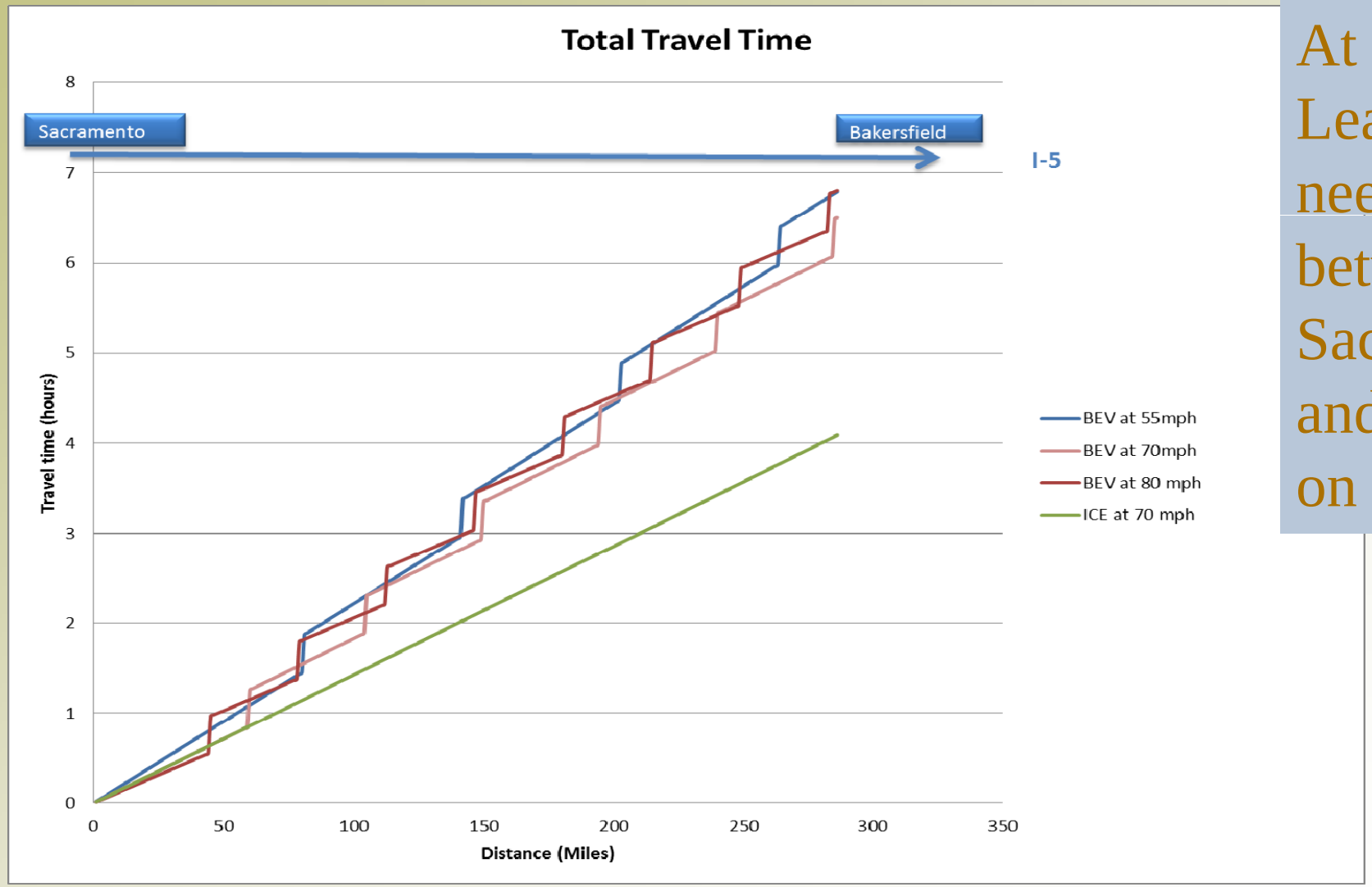




Sacramento to Bakersfield
I-5 or Hwy 99?



Charging for PEV drivers on a long corridor is not practical ...so should be a low priority



At 70 mph, a Leaf would need 6 charges between Sacramento and Bakersfield on I-5.