We have 5 research teams based on our CEC research roadmap
phev.ucdavis.edu
We are comparing vehicle, infrastructure & program data from cities around the world – see www.WorldEVCities.org

- **Partnership:**
  - International Energy Agency, Clean Energy Ministerial Electric Vehicle Initiative,(16 Energy Ministries), Clinton 40, Rocky Mountain Institute, PH&EV Center

- **WECE Website**
  - 20 + cities, data sharing, project showcasing

- **WECE Cities**
  - Amsterdam, Shanghai, Stockholm, Barcelona, Lisbon, Tokyo, Hamburg, Victoria, Portland, San Diego, Los Angeles, etc.
There are a few theories about infrastructure

- Build it .. they will buy
- Ubiquitous infrastructure will rid society of range anxiety
- Build in response to market growth
- Build an optimal infrastructure for the early market, monitor needs & add accordingly.
The infrastructure must serve a wide range of plug-in capabilities & use patterns

<table>
<thead>
<tr>
<th></th>
<th>Plug-in Prius</th>
<th>Chevy Volt</th>
<th>Nissan LEAF</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Battery kWh:</strong></td>
<td>4 kWh</td>
<td>16 kWh</td>
<td>24 kWh</td>
</tr>
<tr>
<td><strong>Charge Time:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 1</td>
<td>3hrs/110v (15A)</td>
<td>10hrs/110v(15A)</td>
<td>20hrs/110v(20A), 8hrs/220v(40A)</td>
</tr>
<tr>
<td>Level 2</td>
<td>1.5hrs/220v(30A)</td>
<td>4hrs/220V(30A)</td>
<td>.5hrs/480v(80A)</td>
</tr>
<tr>
<td>Level 3</td>
<td></td>
<td></td>
<td>80% SOC</td>
</tr>
<tr>
<td><strong>All Electric Range:</strong></td>
<td>14 Miles</td>
<td>40 Miles</td>
<td>100 Miles</td>
</tr>
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<td>EPA 73</td>
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</tbody>
</table>
Each charge event will have its own optimal time & speed

- **Level 1**: 1.5 kW, 15 amps, 115 volt (typical wall plug power) normal to charge Prius Plugin, Volt over several hours
- **Level 2**: 30-40 amps, 220 volts normal for home charge of BEV, charge Volt in 2-3 hours, BEVs in 4-8 hours
- **DC fast**: quick charge, “Level 3” (industrial strength, can charge BEVs in 30 minutes to 80%
The theory is that bigger the battery, slower you need to charge, but charge more often….

- **Prius Plus PHEV**: 4 kWh, 14 miles electricity
- **Volt EREV**: 16 kWh, 40 miles electricity
- **Leaf BEV**: 24 kWh, 75 miles electricity
“Location, location, location”

- **PH&EV Center charger network planning toolbox:** A Geographic Information Systems (GIS) approach (multiple data sets)
- **Optimize density & locations:** Based on geography of driver lifestyle, vehicle mix & size of fleet.
- **Focus on regional systems:** Adjacent regions & local travel destinations.
- **Integrate multiple types of locations:** Homes, workplaces, public lots, freeway corridors.
- **Best charger type for location:** Level 1, 2 & DC fast
- **Maximize PEV VMT:** Meets goals of Calif. & drivers
Duvall’s charging pyramid
(expected % of demand)

Home charging

Workplace

Public

Lots of data is showing for the most part PEV drivers charge at home
MINI  E Driver charger behavior

Larger sample
– About 50% say they charge each time they park at home
– About 15% say 1 time per day
– About 15% say every 2 days
– About 7% say every 3 days
– About 7% say every time they have access to grid
– About 1% say less often than 3 days
How much does the lack of garage limit market?

- Berlin 7%, San Francisco 20% have a garage
- About 50% of USA, California new car buyers have a stable parking spot 25 feet from electricity each night
But time of day is important!

A million PEVs charging at night is only about 1% of the grid.
MINI E drivers want chargers at visiting & recreation spots

Desired MINI E trip destination categories
(inside vehicle range)

- Recreation/Entertainment: 38%
- Family/Friends: 34%
- Work: 21%
- Other: 3%
- Shopping: 3%
- Second Home: 2%