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Electric Vehicle Characteristics:

- Instant and smooth acceleration
- Quiet (inside and out)
- Minimal maintenance
- Efficient energy usage
- Zero tail-pipe emissions

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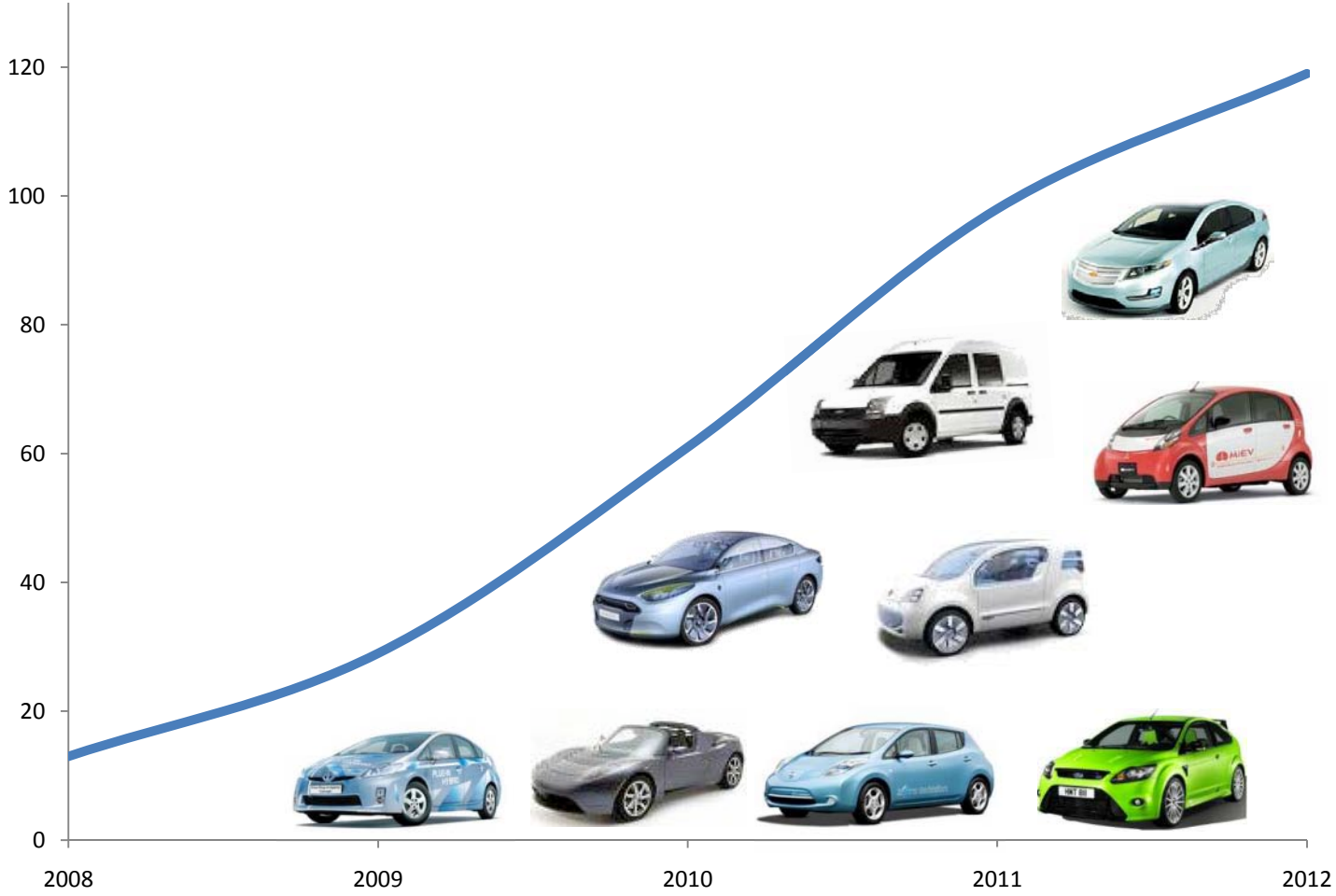
Electric Vehicle Models



Electric Vehicles: Battery Electric (BEV) vs. Plug-in Hybrid (PHEV)

Example: Nissan LEAF

- All Electric Range: 60 - 200 Miles, depending on battery size
- Level 1 (120 v), Level 2 (240 v) and optional Fast-Charging (480v)
- Target markets:
  - Urban Commuters
  - Second Car in Every Home
  - Eventually: all-purpose

Example: Chevy Volt

- Battery Electric plus ICE range extender
- 10-40 mi all-electric, 200-300 mi gas
- Level 1 (120v) and Level 2 (240v) Charging
- Target Market: all automotive applications

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Nissan LEAF Range and Vehicle Efficiency

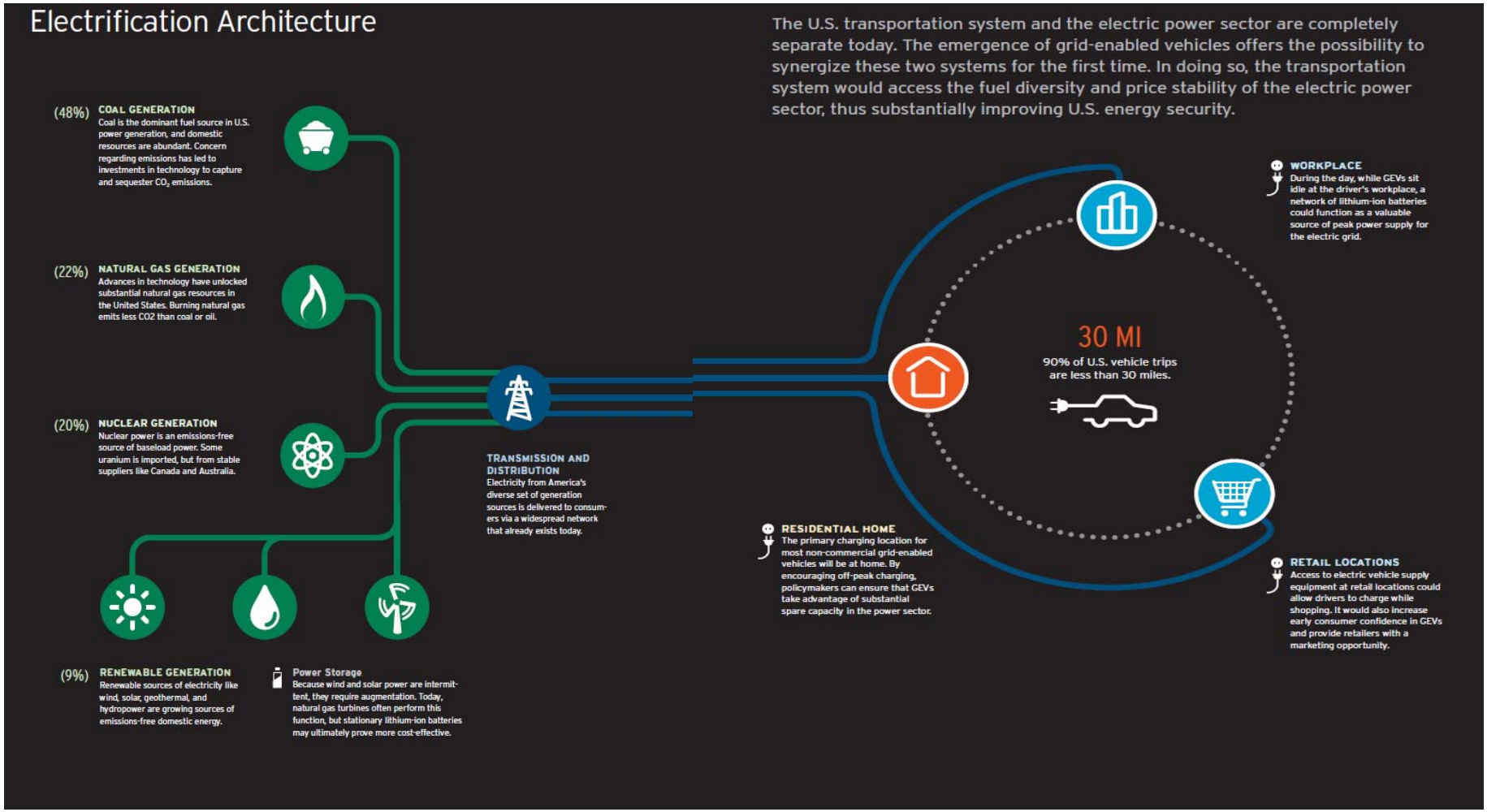
Speed and Driving Conditions	Outside Temp (F)	Accessories	Estimated Range (mi)	Vehicle Efficiency (mi/kWh)*
Cruising 38 mph	68°	None	138	5.75
Fairly steady 24 mph City traffic	77°	None	105	4.38
Steady 55 mph Highway	95°	A/C on	70	2.91
Crawling 15 mph Stop-and-go	14°	Heater on	62	2.60
Average 6 mph Heavy stop-and-go	86°	A/C on	47	1.96

Nissan LEAF has a 24 kWh battery

Source: "Nissan Agrees - EV Mileage Will Vary; Leaf Tests Show 91-Mile Variation." Green Car Advisor – edmunds.com. June 15, 2010.

Fuel Source: Electric Power Grid

Grid-Enabled Vehicle System Architecture



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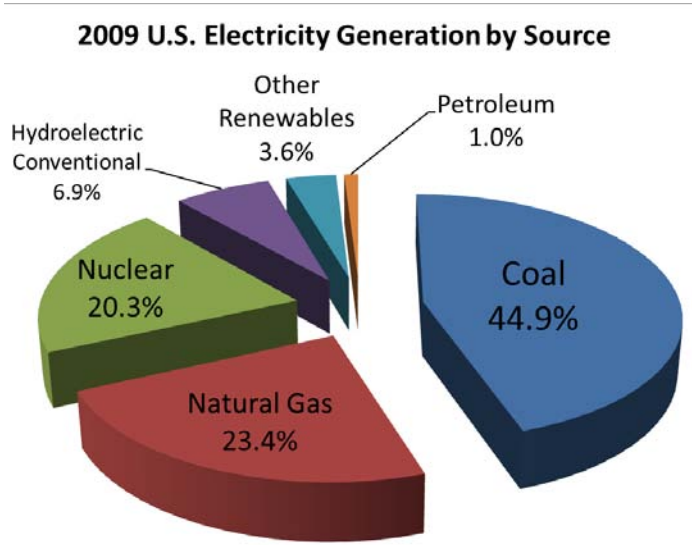
Fuel Source: Electric Power Grid

Advantages:

- Diverse and domestic
- Prices are stable
- Substantial spare capacity



- Network infrastructure already in place
- Electric miles cheaper than gas
- Electric miles are cleaner than gas
- 65 percent of present U.S. light-duty vehicles could be powered by existing off-peak generating capacity

Fuel Source: Electric Power Grid

Managed Charging Reduces Costs and Risks to Utilities

Projected grid Impacts of 2 million electric vehicles				
Israel Electric Co. (2008)	**Additional Generation**	**Additional Transmission**	**Additional Distribution**	**Total Cost**
Unmanaged Charging	2,345 MW	1 switching station 10 substations 18 transformers	2,158 km cables	$4,586M
Off-Peak Incentives	1,770 MW	1 switching station 7 substations 13 transformers	1,581 km cables	$3,414M
Managed Charging	***None***	***None***	***287 km cables***	***$471M***

Charging Infrastructure

- Level 2 charging (SAE 1772) will be the majority of charging both at home and in public and will be used by all OEMs for both electric and plug-in vehicles.
- DC Fast-charge (Level 3) is more expensive, but delivers higher performance.

Level	Input Voltage	Typical Charging Time	Breaker Size (A)	Electrical Loads (kW)	Typical Locations
I	120 V	8 – 12 hours	15-20	2	Standard 120 volt plug; NEV/Motorcycle charging, Emergency charging
II	240 V	2 – 4 hours	40 amp Typical	3-6	Residential garages, parking lots, public garages, transit centers
DC Quick Charge	480 V 3 phase	20 – 40 minutes	various	30-60	Rapid charging facility near high traffic volume arterials

Charging Infrastructure

- Level 2 chargers (SAE 1772)

DC Fast-charge (Level 3)