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Workplace Charging: Strategic Planning Metrics

SoCal PEVCC Meeting, 24 October 2012

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Framework: Strategic allocation of resources

Finite supportive resources: technical assistance, financial incentives, capacity to develop codes and streamline permitting, etc.

To aid governmental and corporate strategic planners, we are exploring what metrics are readily available to evaluate:

1. Individual workplaces
   - Consumers of charging infrastructure
   - Relatively neglected compared to PEV drivers
2. Jurisdictions (e.g., regions, cities)
   - Develop jurisdiction-wide polices, codes, streamline permitting, etc.
   - May in turn support individual consumers or consumer classes

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Scope: Overall workplace-charging potential

- A variety of complex factors influence implementation of workplace charging, particularly in near term.
- Further, workplaces, like vehicle consumers, are heterogeneous with respect to adoption, e.g., due to:
  - Presence or lack of an organizational PEV/workplace-charging champion
    - either at the visionary (CEO) or operational (facilities/fleet-manager) level
  - Willingness/ability to pay for infrastructure
  - Analytical capabilities (energy manager?)
  - Etc.

First taking a step back to evaluate underlying structure of workplace-charging potential (employee drivers and workplaces)

- This provides a foundation upon which to view longer-term adoption, and upon which to build subsequent and related analyses
  - E.g., of workplace market segmentation, grid impacts, etc.

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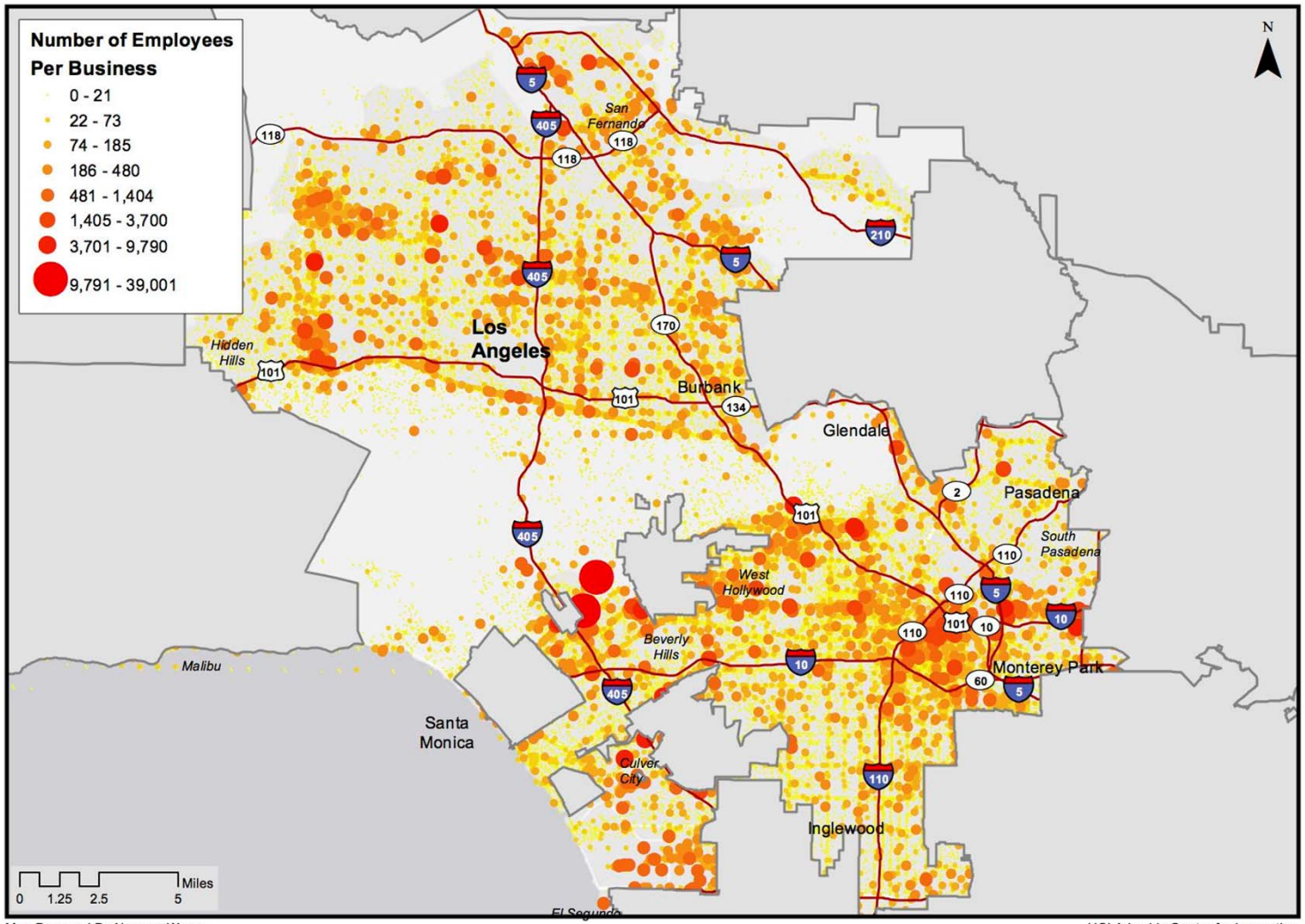
1. Individual workplace analysis

Los Angeles County Case Study[a]

[a] Aggregated and calculated from 2007 Infogroup employment data

Size and geographical distribution of employers[a]



Map Prepared By Norman Wong
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Workplaces: Los Angeles County[a]

Ranking	# of employees (thousands)	# of white-collar employees (thousands)	Annual location sales (thousand $)
1	UCLA (36)	UCLA (31)	Unihealth Found. (23,847)
2	USC (12)	USC (11)	Pacific Enterprise (6,372)
3	LA Police Dept. (9)	LA County Medical Ctr. (7)	BP Carson Refinery (2,784)
4	LA County Medical Ctr. (8)	JET Propulsion Lab. (6)	BP West Coast Products (2,784)
5	Pacific Enterprises (7)	Westcoast (5)	Gas Co (2,368)
6	JET Propulsion Lab. (6)	Kaiser Permanente (5)	Bargain Wholesale (2,154)
7	Westcoast (6)	Walt Disney Co (5)	Penske Truck Rental (1,843)
8	BP West Coast Products (6)	Kaiser Foundation Hospital (5)	Conoco Phillips (1,819)
9	BP Carson Refinery (6)	BP West Coast Products (4)	St Jude Medical (1,794)
10	Walt Disney Co (6)	BP Carson Refinery (4)	Boeing Co (1,680)
Sum	(101)	(82)	(47,926)
% of county	2.4%	3.3%	5.6%

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Non fossil-fuel firms[a]

Ranking	# of employees (thousands)	# of white-collar employees (thousands)	Annual location sales (thousand $)
1	UCLA (36)	UCLA (31)	Unihealth Found. (23,847)
2	USC (12)	USC (11)	Pacific Enterprise (6,372)
3	LA Police Dept. (9)	LA County Medical Ctr. (7)	Bargain Wholesale (2,154)
4	LA County Medical Ctr. (8)	JET Propulsion Lab. (6)	Penske Truck Rental (1,843)
5	Pacific Enterprises (7)	Westcoast (5)	St Jude Medical (1,794)
6	JET Propulsion Lab. (6)	Kaiser Permanente (5)	Boeing Co (1,680)
7	Westcoast (6)	Walt Disney Co (5)	Superior Truck Supply (1,600)
8	Walt Disney Co (6)	Kaiser Foundation Hospital (5)	Tri-Star Pictures (1,407)
9	Kaiser Foundation Hospital (5)	Pacific Enterprises (4)	Lockheed Martin (1,382)
10	Kaiser Permanente (5)	VA Greater Los Angeles Health (4)	Westcoast (1,380)
Sum	(99)	(81)	(44,841)
% of county	2.3%	3.3%	5.2%

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2. Jurisdictional analysis

Los Angeles County Case Study[a]

[a] Aggregated and calculated from 2007 Infogroup employment data

Employees: Potential PEV drivers[a]

Ranking	# of employees (thousands)	# of white-collar employees (thousands)
1	Los Angeles (1,683)	Los Angeles (1,005)
2	Long Beach (154)	Long Beach (83)
3	Torrance (114)	Pasadena (72)
4	Pasadena (110)	Torrance (66)
5	Glendale (91)	Burbank (59)
6	Burbank (91)	Glendale (57)
7	Santa Monica (84)	Santa Monica (53)
8	Carson (75)	Carson (43)
9	Industry (68)	Beverly Hills (38)
10	Santa Clarita (66)	Santa Clarita (37)

[b] U.S. Census

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Employers: Workplace-charging potential[a]

Ranking	# of workplaces (thousands)	# of high-tech workplaces	Ave. # of employees per employer
1	Los Angeles (169)	Los Angeles (3,089)	Vernon (27)
2	Long Beach (13)	Torrance (286)	Commerce (26)
3	Glendale (10)	Glendale (247)	Industry (24)
4	Torrance (9)	Industry (194)	Irwindale (21)
5	Pasadena (8)	Santa Monica (175)	Carson (19)
6	Santa Monica (8)	Pasadena (172)	Hawaiian Gardens (17)
7	Beverly Hills (7)	Burbank (158)	Cerritos (17)
8	Burbank (7)	Long Beach (155)	Santa Fe Springs (16)
9	Santa Clarita (6)	Santa Clarita (143)	El Segundo (16)
10	Ingelwood (4)	El Segundo (111)	Duarte (16)

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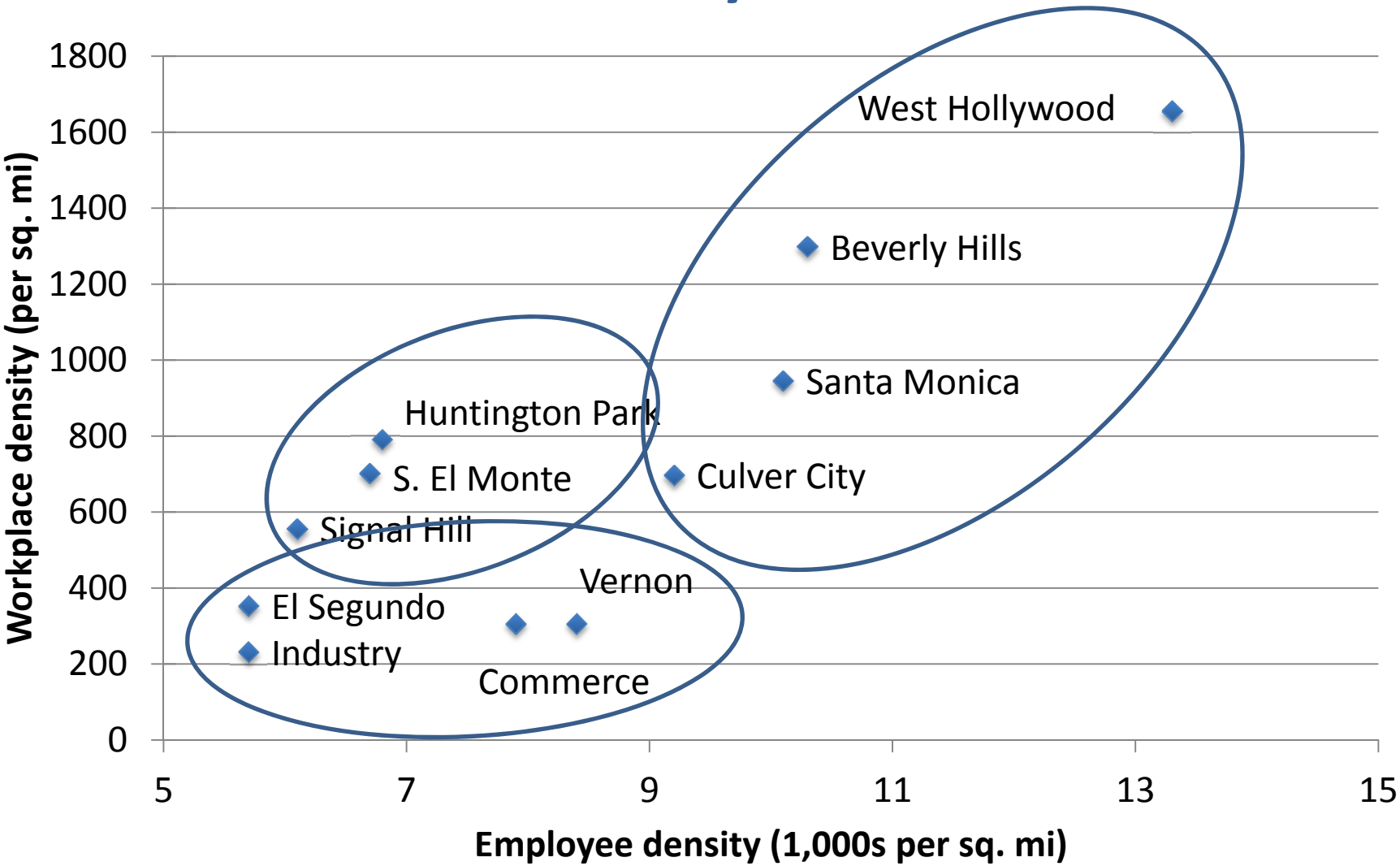
Further detail: LA County densities[a]



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Initial thoughts

1. Individual workplaces:

- Several of the largest employers have missions arguably consistent with PEV adoption for innovation and/or health reasons: research, health care, entertainment/marketing, and (taking out fossil-fuel firms) trucking/transport.

2. Jurisdictions:

- Differences between employee and population (residential) distributions are important for workplace-charging planning
  - Cities with expected high potential include LA, Long Beach, Glendale, Santa Clarita, Torrance, Pasadena
  - Others notable for employment include Burbank, Santa Monica, Carson
- Clustering/network effects may draw attention to densities (e.g., West Hollywood, Beverly Hills, Santa Monica, Culver City)
- Additional groups of large average employer size: Vernon, Industry, Commerce, El Segundo
- White-collar employees happen to align reasonably well with employees, high-tech workplaces with overall workplaces (but less so)

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Wrap-up and next steps

Thoughts?

- What are more or less useful ways to think about workplace charging from your planning perspective?
- What questions need answering?

Related next steps

1. **Planner**: Analyzing a database of existing stations
   - Characterizations, comparisons to potential
   - Regional context influences installation costs and effort…
2. **Employer**: Workplace installation investment analysis
   - Station installation costs and pricing methods affect workplace refueling costs…
3. **Employee driver**: Employee-driver total cost of refueling
   - Comparison to residential charging and gasoline refueling (especially for PHEVs)

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Additional Slides

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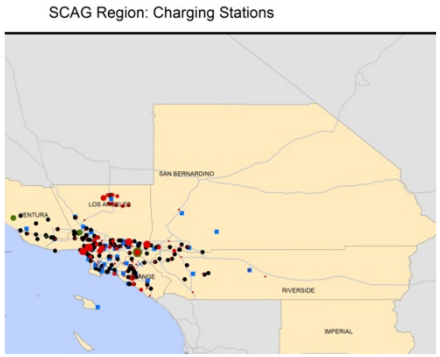
EV Program Sampler

1. Plug-in Electric Vehicle (PEV) regional planning for Southern California
   - Modeling/mapping PEV demand, built environ. (e.g., multi-unit dwellings, workplaces, public charging), travel destinations, etc.
2. Analysis of charging challenges for multi-unit dwellings and workplaces
3. Analysis of real-world use of PEVs
4. Battery secondary use (V2G and B2G)

Note: Symposium next year on locating, managing, and pricing charging infrastructure?

1.



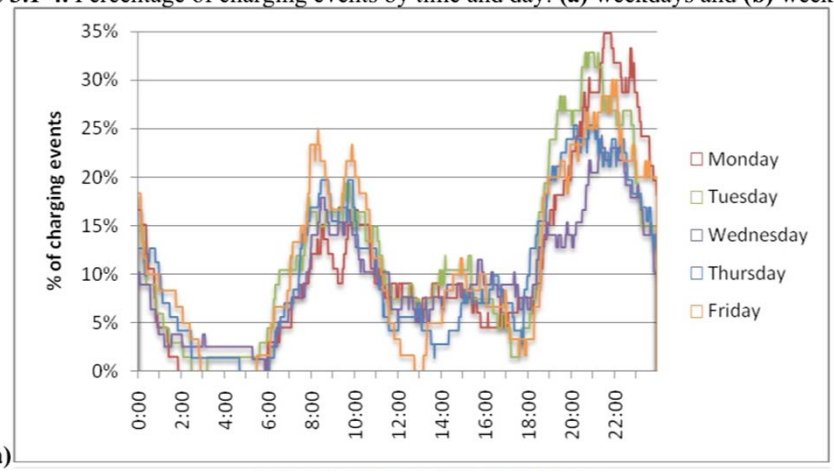
2.

Electricity Markup

Installed Project Cost: Project Cost	$ -	$ 0.10	$ 0.15	$ 0.20	$ 0.25	$ 0.30
$ 1,000.00	$ (195.72)	$ 2,038.45	$ 3,155.54	$ 4,272.63	$ 5,389.71	$ 6,506.80
$ 3,000.00	$ (2,603.77)	$ (369.59)	$ 747.49	$ 1,864.58	$ 2,981.67	$ 4,098.76
$ 5,000.00	$ (5,011.81)	$ (2,777.64)	$ (1,660.55)	$ (543.46)	$ 573.62	$ 1,690.71
$ 7,000.00	$ (7,419.86)	$ (5,185.68)	$ (4,068.60)	$ (2,951.51)	$ (1,834.42)	$ (717.33)
$ 9,000.00	$ (9,827.90)	$ (7,593.73)	$ (6,476.64)	$ (5,359.55)	$ (4,242.47)	$ (3,125.38)
$ 11,000.00	$ (12,235.95)	$ (10,001.77)	$ (8,884.68)	$ (7,767.60)	$ (6,650.51)	$ (5,533.42)
$ 13,000.00	$ (14,643.99)	$ (12,409.82)	$ (11,292.73)	$ (10,175.64)	$ (9,058.56)	$ (7,941.47)
$ 15,000.00	$ (17,052.04)	$ (14,817.86)	$ (13,700.77)	$ (12,583.69)	$ (11,466.60)	$ (10,349.51)
$ 17,000.00	$ (19,460.08)	$ (17,225.91)	$ (16,108.82)	$ (14,991.73)	$ (13,874.65)	$ (12,757.56)
$ 19,000.00	$ (21,868.13)	$ (19,633.95)	$ (18,516.86)	$ (17,399.78)	$ (16,282.69)	$ (15,165.60)

3.

Figure 3.1-4. Percentage of charging events by time and day: **(a)** weekdays and **(b)** weekends



(a)

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1. PEV Regional Planning

PEV Sales & Demand

Light-duty PEVs on the U.S. market

Model	Make	U.S. sales start	Electric fuel econ (mpge)	Electric range - EPA (mi)	Range, total (mi)	Base MSRP
LEAF	Nissan	11-Dec-10	99	73	73	$35,200
Chevy Volt	GM	15-Dec-10	98	38	382	$39,145
smart fortwo ed	Daimler	Jan-11	87	63	63	$599/mo for 48 mo. + $2,500
Karma	Fisker	18-Oct-11	52	32	232	$102,000
i	Mitsubishi	13-Dec-11	112	62	62	$29,125
Active E	BMW	22-Dec-11	102	94	94	$499/mo. for 24 mo. + $2,250
Focus Electric	Ford	Dec-11	105	76	76	$39,200
Prius Plug-In	Toyota	Mar-12	95	11	540	$32,000
Sedan	Coda	16-Mar-12	73	88	88	$37,250
Model S	Tesla	22-Jun-12	89	265	265	$97,900

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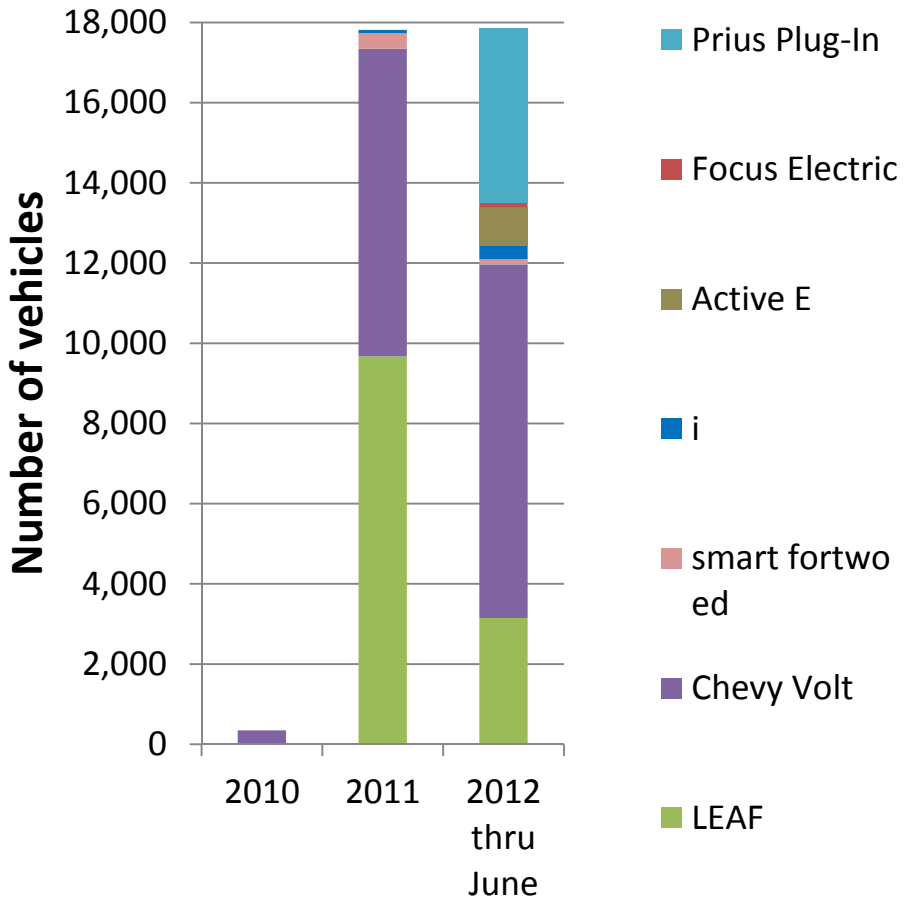
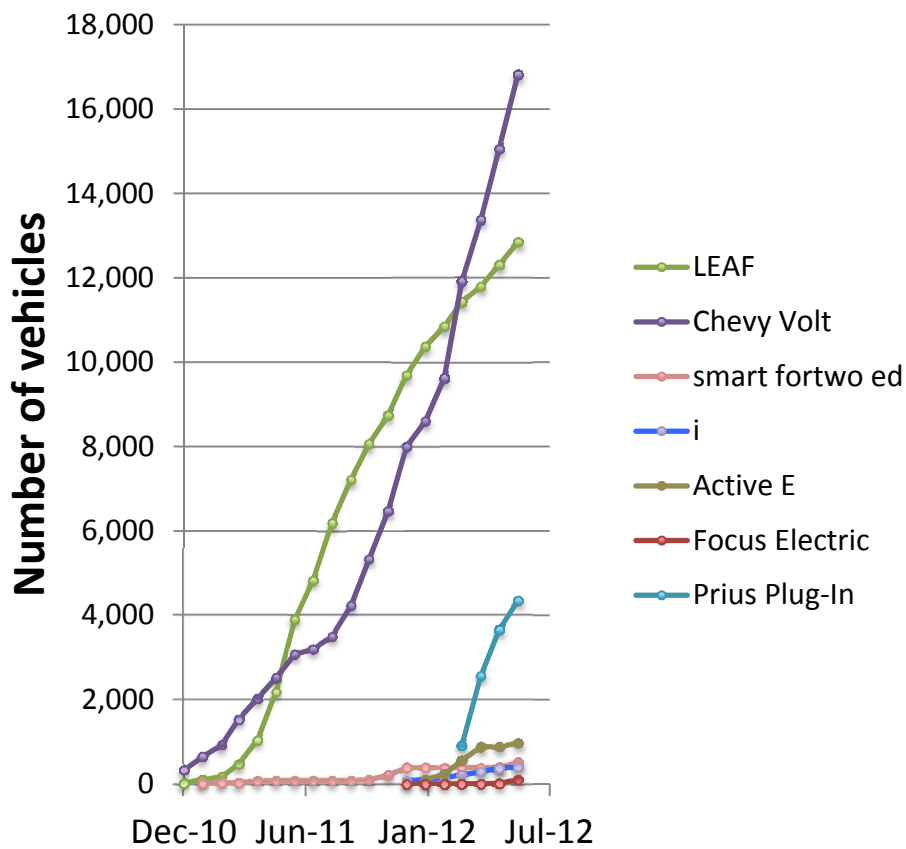
U.S. PEV sales thru June by model

Annual



Cumulative



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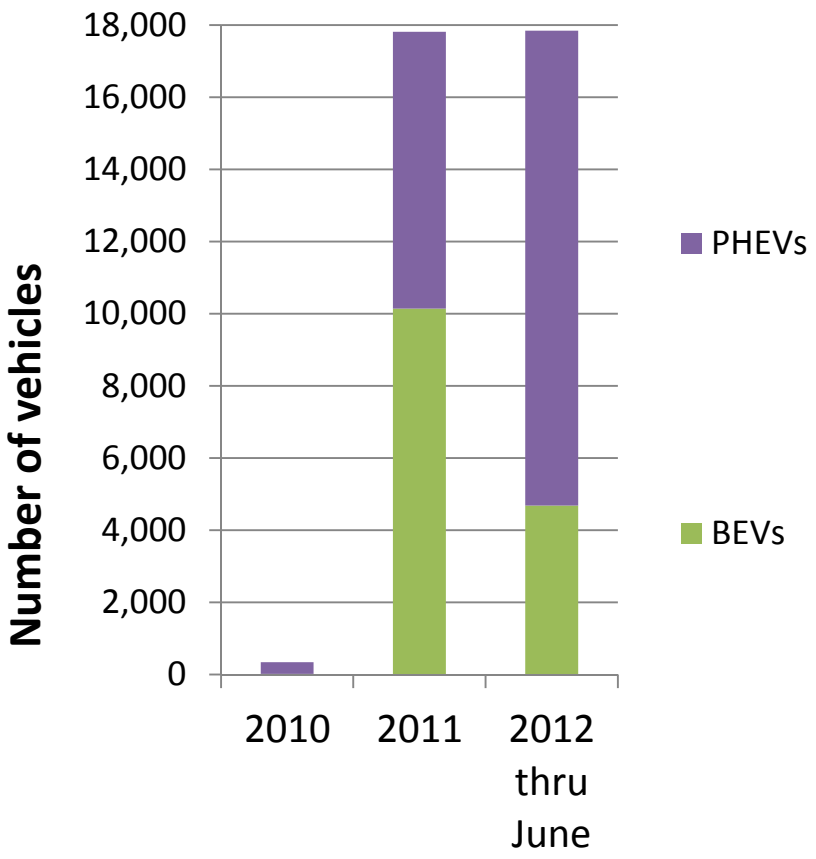
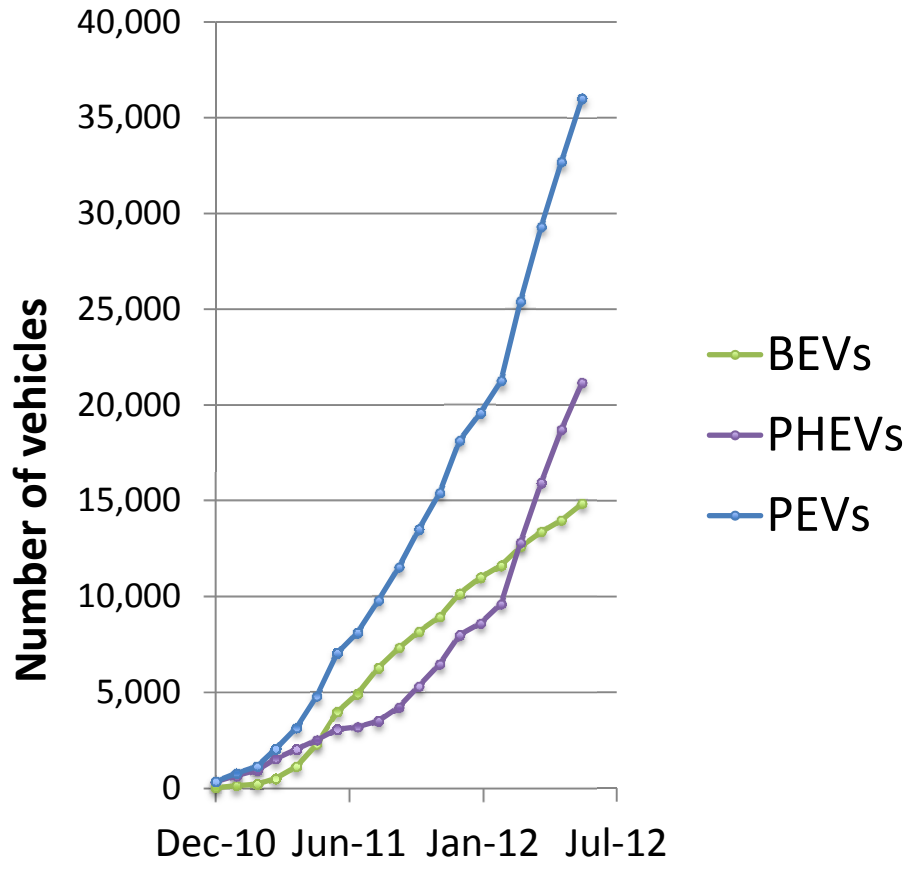
U.S. PEV sales by type (BEV vs. PHEV)

Annual



Cumulative



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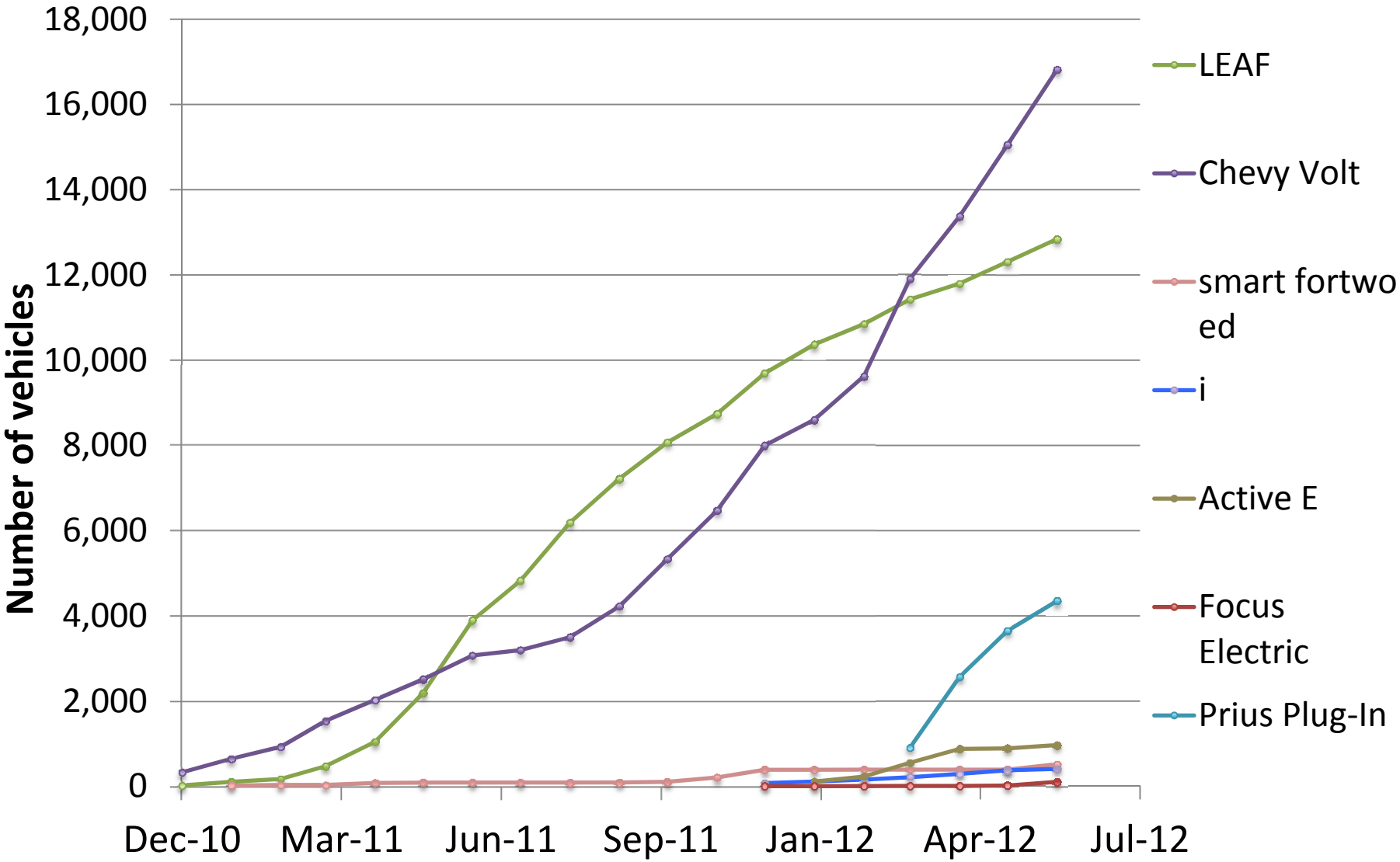
Cumulative U.S. sales by PEV model (through June 2012)



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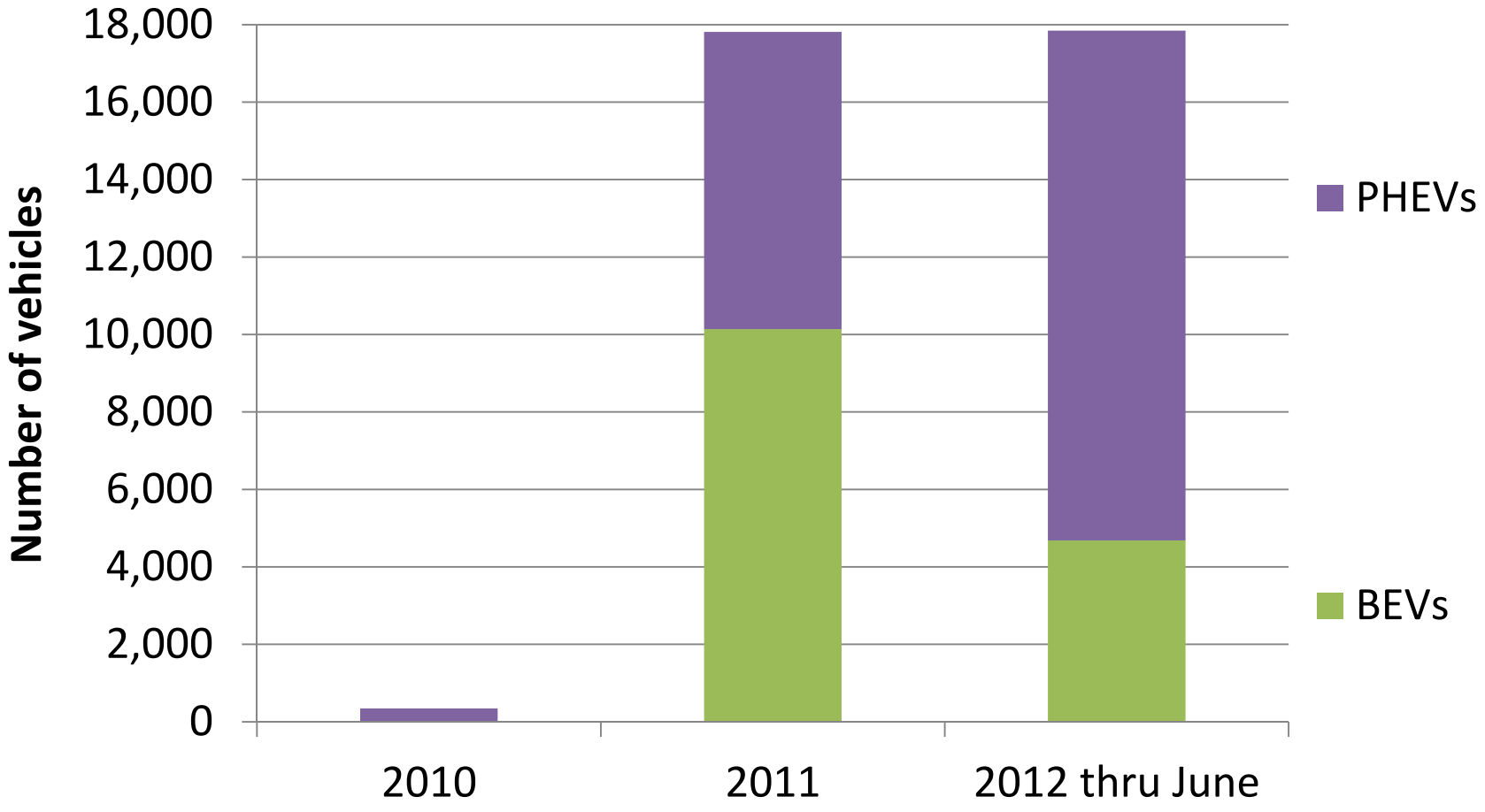
Annual U.S. sales by type



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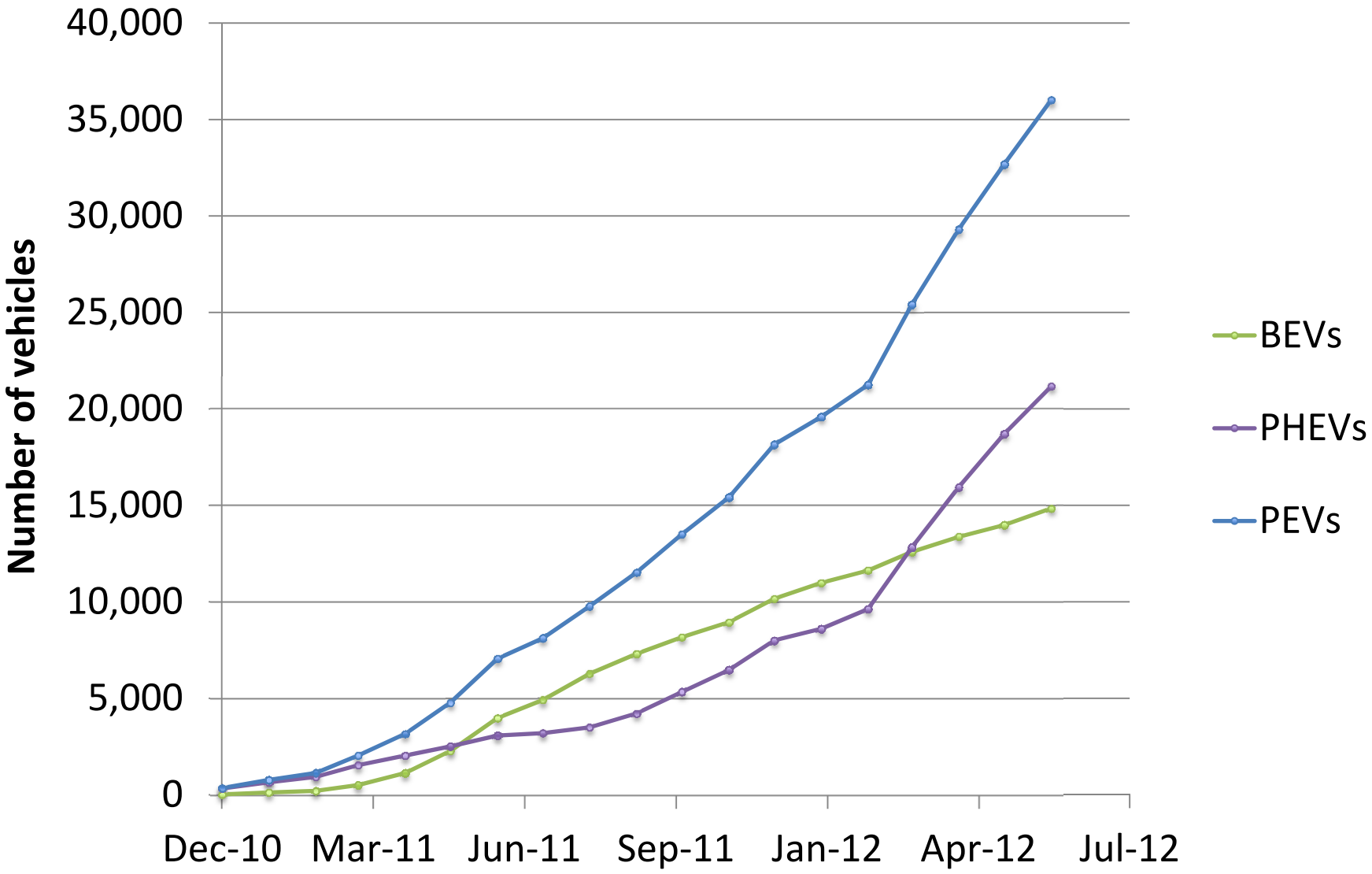
Cumulative U.S. sales by PEV type (through June 2012)



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PEVs slated for U.S. release

2012	
Model S variations	Tesla
2012 smart fortwo ed	Daimler
e6	BYD
Chevy Spark	GM
Scion iQ	Toyota
RAV4EV	Toyota
C-Max Energi	Ford
Fusion Energi	Ford
Fit EV	Honda
GCE	Amp
Mle	Amp
Accord PHV	Honda
F3DM	BYD
F6DM	BYD

2013-14	
500 Elettrica	Chrysler-Fiat
i3	BMW
Cadillac ELR	GM
Golf twinDRIVE	VW
Sonata Plug-In Hybrid	Hyundai
Outlander Sport PHV	Mitsubishi
A-class E-Cell	Daimler
PX-MiEV	Mitsubishi
Model X	Tesla
E-Golf	VW
i8	BMW
Atlantic	Fisker
A4 e-quattro	Audi
Infinity LE	Nissan
A3 e-tron	Audi (date unknown)

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PEVs Slated for U.S. Release (as of May 2012)

Model	Make	U.S. sales start*	Battery rated kWh	Electric range** ("mi")	Range, total ("mi")	Price indications
Model S variations	Tesla	2012	42	160+***	160+	$57,400+
2012 smart fortwo ed	Daimler	2012	17.6	86	86	$599/mo lease only + $2,500 at signing
e6	BYD	2012	60	150	150	$35k, on sale in China for $47.2k
Chevy Spark	GM	2012	20	100	100	?
Scion iQ	Toyota	2012	13?	50	50	?
RAV4EV	Toyota	2012	41.8	100	100	$49,800 MSRP
C-Max Energi	Ford	Sep-12	10?	17	>500	?
Fusion Energi	Ford	Sep-12	8?	17	>500	?
Fit EV	Honda	2012	20	?	?	$399/mo. lease only (based on $36,625)
GCE	Amp	2012	37.6	80	80	$57,400
Mle	Amp	2012	40	100	100	$79,500
Accord PHV	Honda	2012	6.0	15	>400	?
F3DM	BYD	2012	13.2	60	>300	$28,800
F6DM	BYD	2012	20	60	>300	~$22k in China
500 Elettrica	Chrysler-Fiat	2012	22?	90	90	$45,000
i3	BMW	Sep-13	22	75	75	$35,000
Cadillac ELR	GM	2013	16.5?	38?	>300	~$50-57k
Golf twinDRIVE	VW	2013	13.2	35	558	?
Sonata Plug-In Hybrid	Hyundai	2013	?	?	>300	?
Outlander Sport PHV	Mitsubishi	2013	?	?	>200	?
A-class E-Cell	Daimler	2013	?	?	?	?
PX-MiEV	Mitsubishi	31-Dec-13	12	30	>500	?
Model X	Tesla	2013	60	160+?	160+?	?
E-Golf	VW	2013	?	35	35	?
i8	BMW	2014	?	20	>200	$132,600
Atlantic	Fisker	2014	?	50?	282?	~$45-$60k
A4 e-quattro	Audi	2014	?	37	>300	?
Infinity LE	Nissan	2014	24	100	100	?
A3 e-tron	Audi	?	12	31?	>200	?

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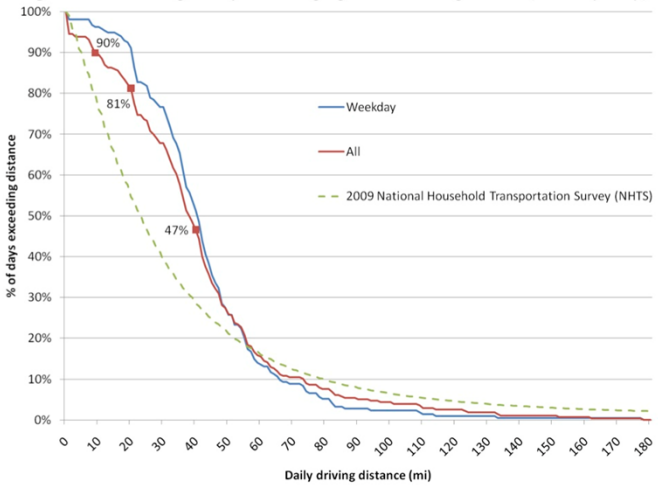
Figure 3.1-2. Percentage of days exceeding a given total driving distance (*travel days only*)