

# Commercializing Plug-In Hybrids

**July 14, 2009**

**Felix Kramer, Founder  
The California Cars Initiative  
[info@calcars.org](mailto:info@calcars.org)**

***PDF of latest presentation always at  
[www.calcars.org/downloads](http://www.calcars.org/downloads)***



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[www.calcars.org](http://www.calcars.org)

## Nonprofit Startup: CalCars' hybrid goals/members

Technology  
(demos)

Advocacy  
(buyers)

- Entrepreneurs
  - Engineers
  - Environmentalists
  - Consumers/drivers
- *Expanding decisionmaking*
  - *New models for partners/  
Open Source innovation*
  - *Approaching success!*
  - *Giving messages of hope*



*Progress since October 2003*

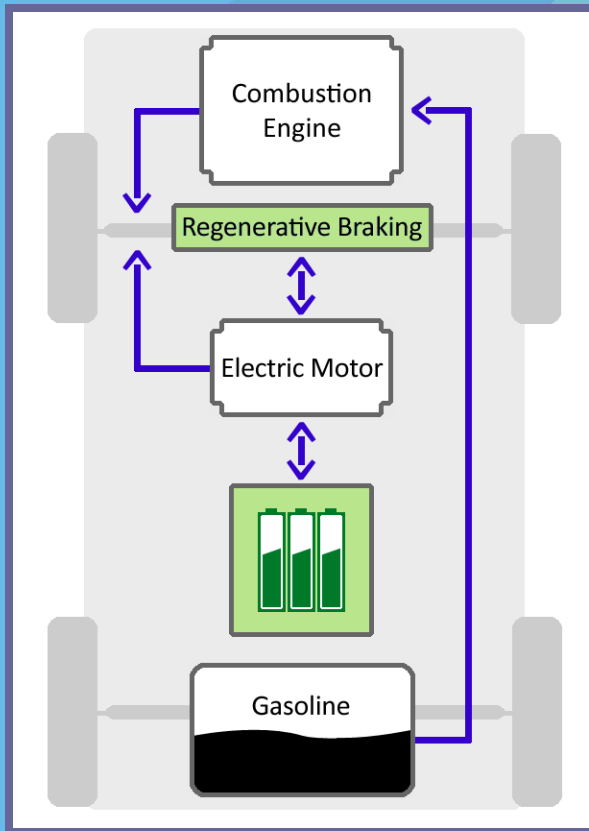


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# Today's hybrid evolves into the plug-in hybrid



## HYBRID to PLUG-IN HYBRID

**SMALLER gasoline engine**  
(same regeneration)

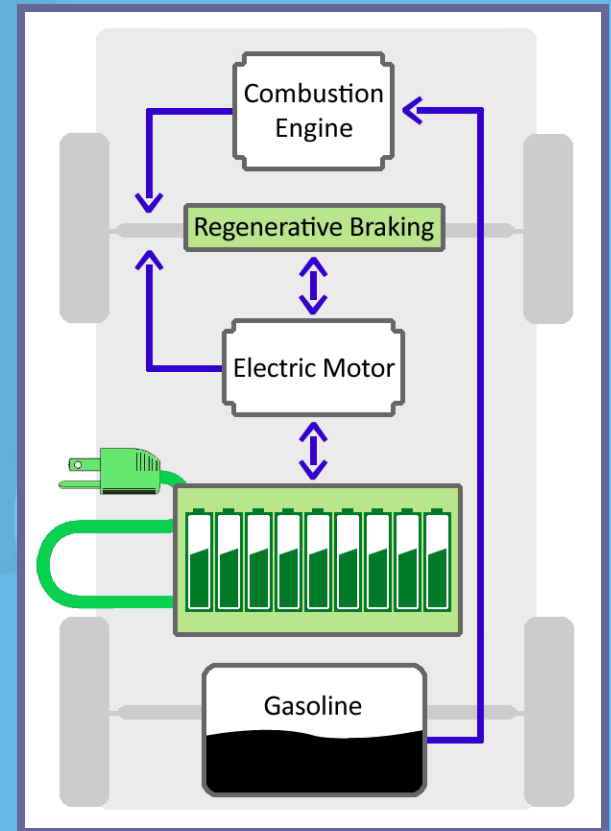
**SAME/LARGER electric motor**

**MUCH LARGER battery**

**NEW: Plug into the grid**

(same gas tank)

(**SERIES PHEV**  
"EREV" is simpler)



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Modified from an EDTA diagram concept

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# Expand driver choice via line extensions...

**Ford BOLD MOVES**

MODELS

 <p>Escape XLT \$22,895*</p>	 <p>Escape Hybrid FWD \$26,215*</p>	 <p>Escape Hybrid 4WD \$27,820*</p>	 <p>Escape Plug-In Hybrid \$30,000+</p>
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Chevy Volt



CalCars ...and from the ground-up vehicles

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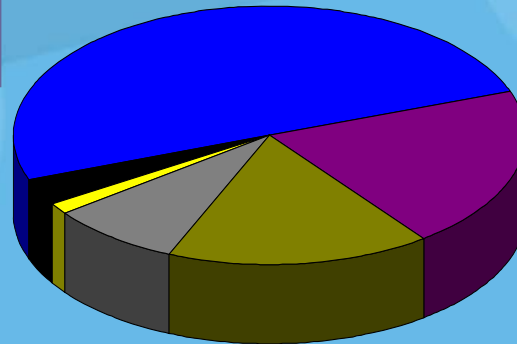
# Electricity isn't just different—it's better than gas

Gasoline	Self Serve
Today's Car	3.00 <sup>1</sup> / <sub>10</sub>
Plug-In Hybrid	.75 <sup>1</sup> / <sub>10</sub>

**1. ECONOMICS: CHEAPER -- electric miles at a quarter the cost**



**2. CLIMATE: CLEANER -- 50% less CO2, even on our half-coal national power grid**



**3. ENERGY SECURITY: DOMESTIC -- Only 1.5% of electricity comes from oil in US**



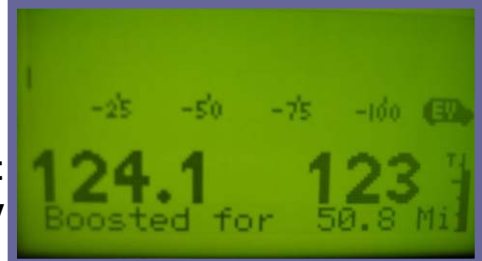
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Day range: 50 miles  
at mixed-speeds,  
124 MPG gasoline  
+1/8 kiloWatt (about  
\$.01/mile) electricity

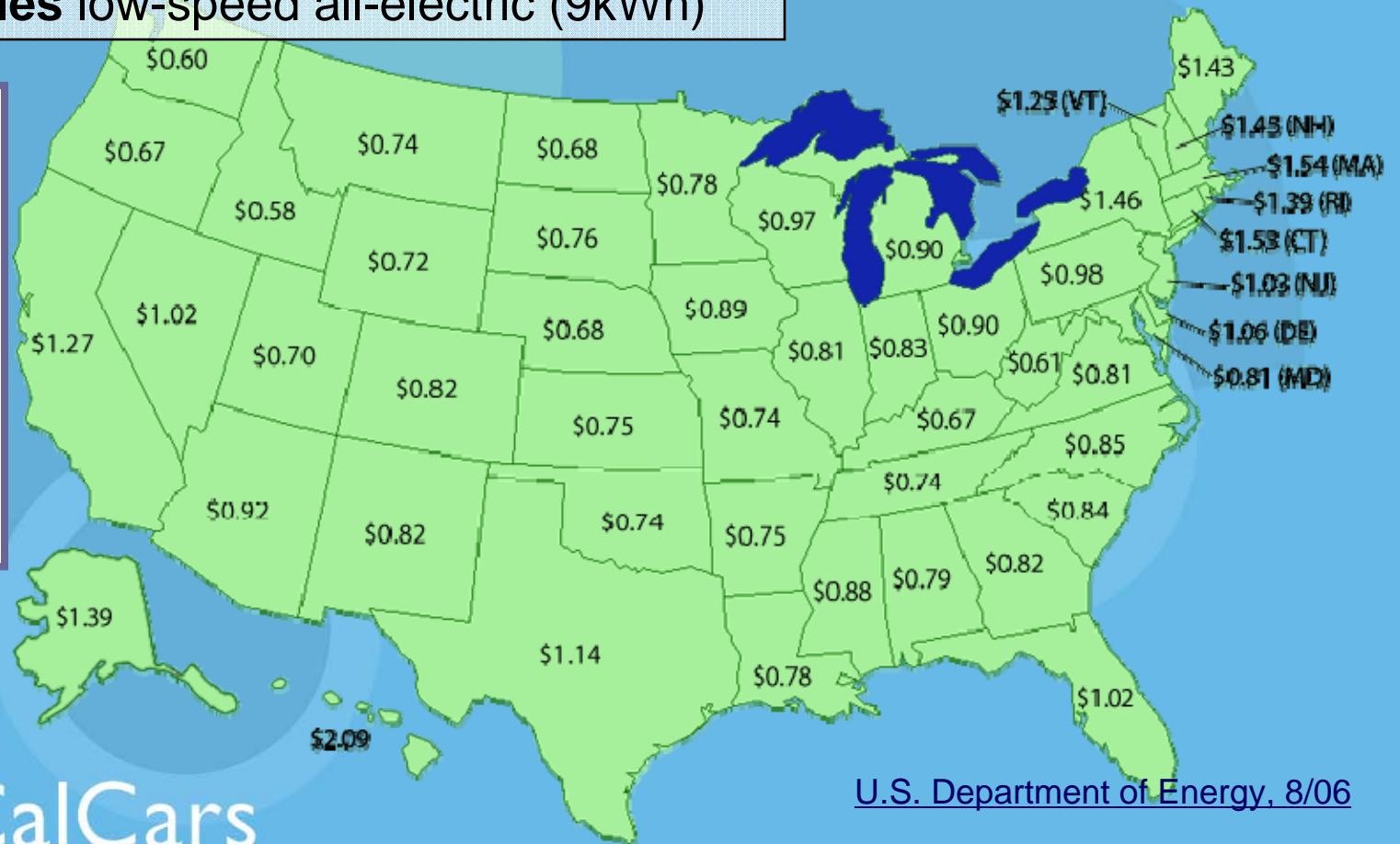


## How much cheaper per day?

Cost for **30 miles** low-speed all-electric (9kWh)

National  
average:  
\$0.94

Off-peak  
as low as  
**\$0.45**



U.S. Department of Energy, 8/06



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## November 2004: open-source PRIUS+ demo



The New York Times

### Hybrid-Car Tinkerers Scoff at No-Plug-In Rule

By DANNY HAKIM

DETROIT, March 31—Ron Gremban and Felix Kramer have modified a Toyota Prius so it can be plugged into a wall outlet.

This does not make Toyota happy. The company has spent millions of dollars persuading people that hybrid electric cars like the Prius never need to be plugged in and work just like normal cars. So has Honda, which even ran a commercial that showed a guy wandering around his Civic hybrid fruitlessly searching for a plug.

But the idea of making hybrid cars that have the option of being plugged in is supported by a diverse group of interests, from neoconservatives who support greater fuel efficiency to utilities salivating at the chance to supplant oil with electricity. If you were able to plug a hybrid in overnight, you could potentially use a lot less gas by cruising for long stretches on battery power only. But unlike purely electric cars, which take hours to charge and need frequent recharging, you would not have to plug in if you did not want to.

"I've gotten anywhere from 65 to over 100 miles per gallon," said Mr. Gremban, an engineer at CalCars, a small nonprofit

group based in Palo Alto, Calif. He gets 40 to 45 miles per gallon driving his normal Prius. And EnergyCS, a small company that has collaborated with CalCars, has modified another Prius with more sophisticated batteries; they claim their Prius gets up to 180 m.p.g. and can travel more than 30 miles on battery power.

"If you cover people's daily commute, maybe they'll go to the gas station once a month," said Mr. Kramer, the founder of CalCars. "That's the whole idea."

Conventional hybrid electric cars already save gas. But if one looks at growth projections for oil consumption, hybrids will slow the growth rate of oil imports only marginally.

pending on... actually s... potentially... makers h... powered b...

But fuel... reinvention... tion the na... nology to p... way from... brids say... is availab...

building them in garages.

"All of the relevant technology is at hand," said Frank Gaffney, founder of the Center for Security Policy and an assistant defense secretary in the Reagan administration. His group was among a coalition of right-leaning organizations that released an energy plan this year promoting plug-ins as one way to increase fuel efficiency in light of the instability of the Middle East.

"If you're thinking about this as an environmental issue first and foremost, you're missing the point," Mr. Gaffney said. Curbing dependence on oil, he added, "is a national emergency."

However, says the plug-in for prime time.

By this is the next great... just isn't," said David... an executive engineer at... e electric utilities really... electricity and they want... he transportation sector... t expands their market... n agenda."

plug-in hybrid is not just... of the garages of enthusi...

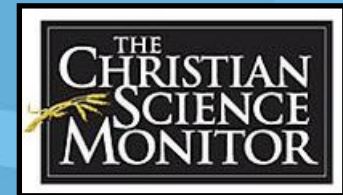


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## Media avalanche 2005



**Detroit Free Press**

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# Plug-in hybrids go to Washington 2006



*Amazing breakthrough...*



*You pull in and  
you plug it right  
into the wall...*



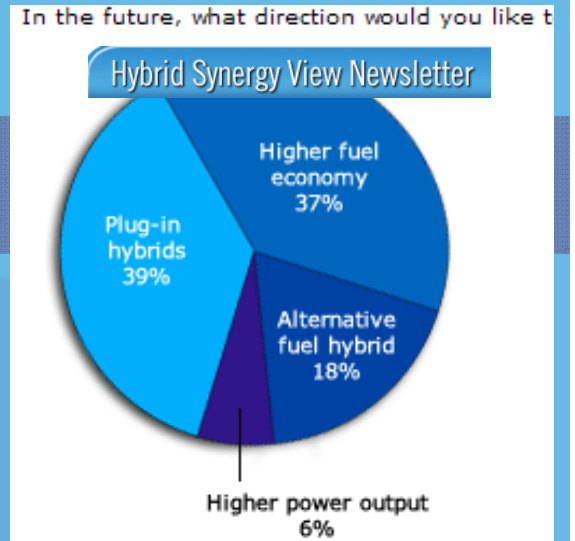
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## Momentum grows 2006-2007

The legendary CEO says he's become a big fan of the hybrid cars that Toyota has been marketing for years. Plug-in hybrids are the wave of the next five years, Iacocca predicts.



### Special Report: The Truth About Plug-in Hybrid Cars



Garage tinkers have been turning hybrids into clean-car alternatives (like those below) got all But, really—hydrogen? Maybe, someday. Now, carmakers say plug-in hybrid electric vehicles are coming, if the engineers can get the batteries recharged. Because it's hard to argue with 100 mpg.

- BACK STORY: PM's Reporter on Hybrid Skepticism
- QUIZ: Test Your Plug-in Smarts!
- COMPARISON: How Much Are Hybrids Saving?
- HOW IT WORKS: GM's Volt Concept (with Animation)

**Popular Mechanics**  
Cover Story May 2007



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## VentureBeat

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### Google gives \$200,000 to plug-in hybrid car group

BY MATT MARSHALL 05.2.07



Google's for-profit foundation Google.org has granted \$200,000 to CalCars.org, a group that advocates for plug-in hybrid electric cars.

Plug-in hybrids are cars you can plug into a wall to recharge their batteries, and national auto manufacturers are beginning to develop them. PG&E and GM plan to enter the market over the next few years.



CalCars' Felix Kramer (left) is the group's executive director based around Palo Alto, Calif. that he claims the Google grant comes seven months after support plug-in hybrids first leaked. That piece was speculative and did not mention the grant.



www.calcars.org

# Unprecedented broad support & alliances

## HYBRID CONVERSION COMPANIES



## SUPPLIERS & COMPONENT-MAKERS



## JOBS & FACTORY CONVERSIONS

Editorial: Minnesota lays a bet on cars of the future



## ENVIRONMENTALISTS & EV FANS



## UTILITIES & FLEET BUYERS



## NEO-CONS / GEO-GREENS



## RechargeIT



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A coalition between the tree-huggers, the do-gooders, the sod-busters, the cheap hawks, and the evangelicals. – former CIA Director James Woolsey



**More @ CalCars  
Photos pages**



**Gore, Stanford's Schneider,  
Batter Place's Thesen, Google's  
Brin+Page, Toyota's Knight+Miller,  
Costa Rica Env Minister Dobles**



**Schwarzenegger, GM's Weverstad, Clinton,  
Intel's Grove, SF's Newsom,  
Rainforest's Krill, Friends of Earth's Fugere**



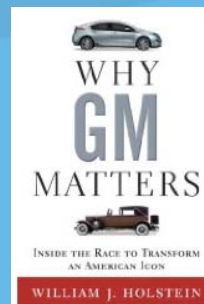
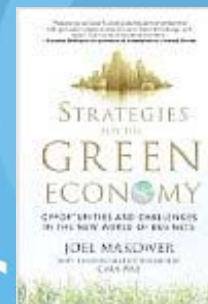
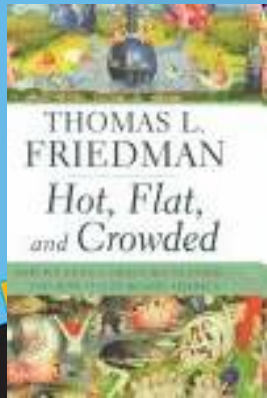
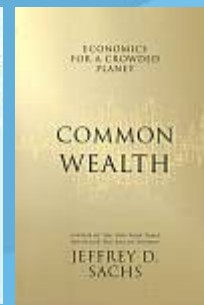
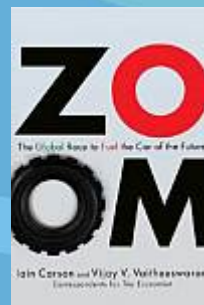
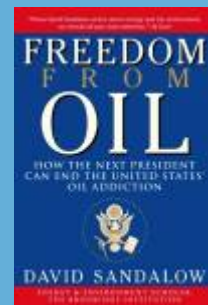
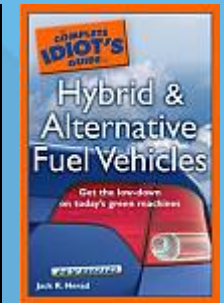
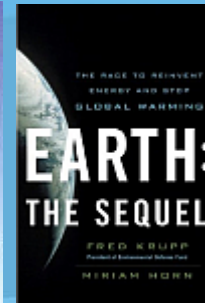
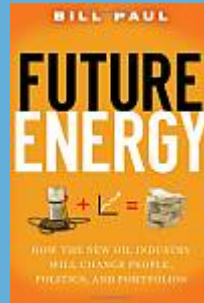
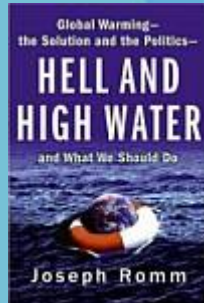
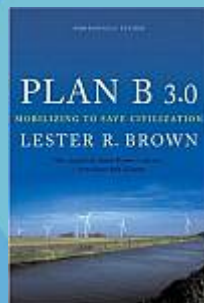
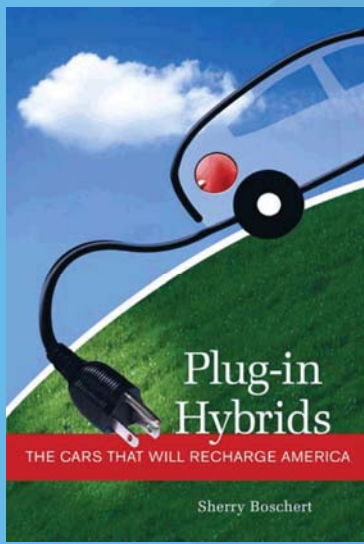
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Link for info and to order at [CalCars.org](http://CalCars.org) home page

## 2005-2009: 23 books with major focus on PHEVs



# Kudos for Plug-In Hybrids: **Serious/Funny**

- The plug-in hybrid approach, as being pursued by CalCars, seems to be our **best bet** for controlling vehicle CO2 emissions in the near-term. *Dr. James Hansen*
- “Felix Kramer has made plug-in electric cars not only his passion but an **imminent American reality.**” *Thomas Friedman, Hot, Flat and Crowded*
- We should help America's automobile industry to **convert quickly to plug-in hybrids** that can run on the renewable electricity that will be available. *Al Gore*
- The drumbeat of electrical transportation is **accelerating like nothing I've ever seen.** *Andy Grove*
- Plug in hybrids are a **really big deal...** practical, profitable and urgently needed. *John Doerr*
- The **most notable technological advancement** of the past 50 years, *David Cole/CAR*
- GM's **most important model in decades** -- and possibly the key to its survival. *Wall Street Journal*
- The first step toward a **new kind of car for everyone.** *Mark Phelan/Detroit Free Press*
- Possibly the **most sought-after technological innovation** since Captain Kirk first flipped open his communicator is the plug-in hybrid. *Matthew Wald, NY Times*
- The Volt has joined baseball and apple pie as an unassailable, non-partisan **symbol of American can-do and know-how...**the most important political accessory since the flag lapel pin. *Wired*



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## Beating the European Union's 120gm CO<sub>2</sub> target

Source-to-wheels CO<sub>2</sub> EMISSIONS and FUEL ECONOMY (litres/100km) for mid-sized passenger car:

216 gm/km, **gasoline** @ 9.2 l/100km (26 mpg)

194 gm/km, **diesel** @ 7.2 l/100km (33 mpg)

127 gm/km, **hybrid** @ 5.4 l/100km (44 mpg)

114 gm/km, **PHEV-20km** @ 3.8 l/100km at 30% EV -- with higher EV%, **conversions** can get

97 gm/km, **PHEV-96km** @ 1.6 l/100km at 70% EV <2.5 l/100km or 40 km/l or 100+mpg)

ElectGrid Location	EV g/kWh	EV g/km	PHEV-32 gm/km	PHEV-96 gm/km	EV as % of ICE	EV as % of diesel	EV as % of HEV
U.S. 2004	615	103	120	110	48%	53%	81%
U.S. 2010	500	84	114	97	36%	43%	66%
U.S. 2050	375	63	108	82	29%	32%	50%
Calif 2004	236	39	101	65	18%	20%	31%

2010/2050 grid emissions from 2007 EPRI/NRDC Study  
 EV/PHEV electric miles: 16.7 kWh/100km Analysis: CalCars Tech Lead Ron Gremban,  
 Presentations at EEET-2007(see Downloads Page)



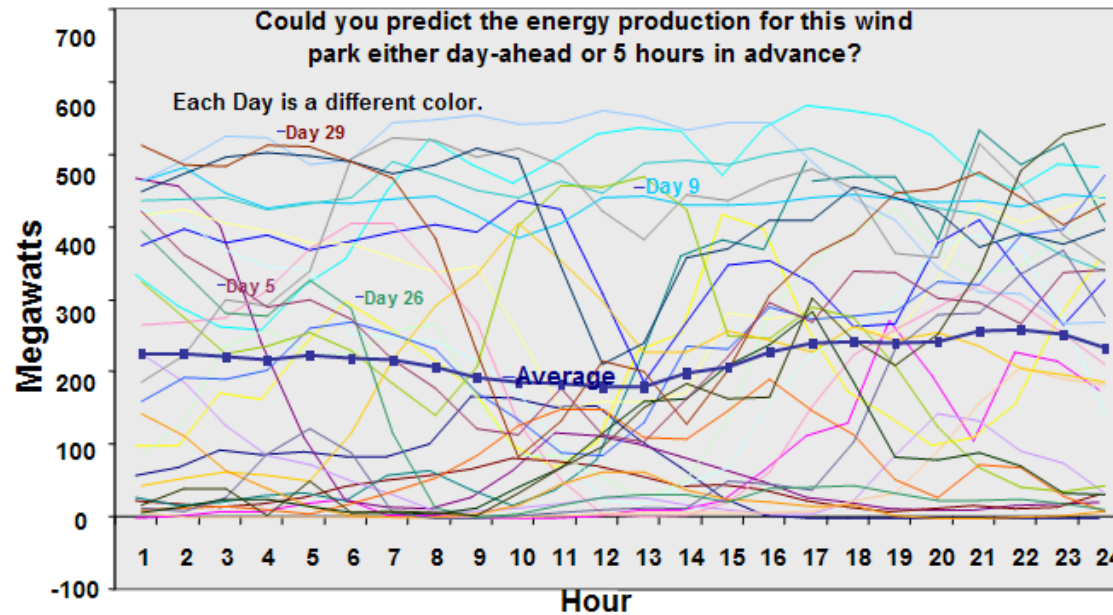
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# Car Batteries + Night Wind = 24/7 Clean Energy

## Wind Generation in April



 CALIFORNIA ISO



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18+ carmakers interested; race to be first; few timetables  
(see *CalCars Carmakers page summary*)



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### Automakers still holding out for perfect batteries

- **40 mile range/life of vehicle/price-competitive**
- **NiMH:** Proven in hybrid, RAV4 EV (125K+ miles)
- **Lithium-Ion (75K+ miles)**  
*Good enough for  
Version 1.0 demo fleets*



Left: nano-phosphate lithium (A123Systems)  
Above: lead-acid (EAA-PHEV/Plug In Supply)



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# What's taking so long? The wait for Version 1.0



**Toyota: hundreds to fleets only in 2010**



**Chevy Volt : production in 2010 -- 2009 demo fleets.**

**Without The Brick for \$3,995,  
would we have the Razr & iPhone?**

**Today's \$1,000 plasma TVs started at \$10,000.**

**Almost 2 dozen other automakers:  
plug-ins "a good idea" – someday.**



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# President Obama/Congress on PHEV Policies

### *Stimulus Package and Since*

- \$2,500-\$7,500 tax credit: 200,000 new plug-ins from each manufacturer
- 10% tax credits up to \$4,000 for plug-in conversions
- \$2 billion advanced battery research
- Plug-in cars as way to meet higher CAFE MPG standards
- \$400 million for infrastructure deployment, regional deployment
- \$300 million federal purchases
- 30% tax credits advanced manufacturing investments
- 1 million PHEVs by 2015
- Key element of Waxman-Markey global warming solutions bill



Nov '07 Googleplex; March '09 SoCalEd.  
'06: *"When it becomes possible in the coming years, we should make sure that every government car is a plug-in hybrid."*



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See our ICE Conversions page

# Conversions to electrify world's 900+ million cars



Chicago: F-150 PHEV, then ...transit buses etc. [hevt.com](http://hevt.com)



Supplementary drivetrains [evpowersystems.com](http://evpowersystems.com)



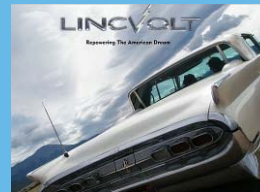
Partial power for sedans [poulsenhybrid.com](http://poulsenhybrid.com)

Vancouver: Ford trucks [rapidelectricvehicles.com](http://rapidelectricvehicles.com)

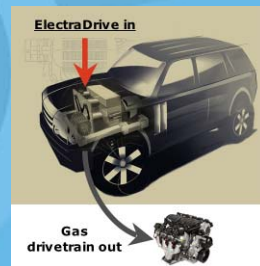
Andy Frank's company [efficientdrivetrains.com](http://efficientdrivetrains.com)

ElectraMount modular [electradrive.net](http://electradrive.net)

Neil Young [lincvolt.com](http://lincvolt.com)



Mexico City: Nissan EV taxis [clever-in.org](http://clever-in.org)



### Key themes: why we can't wait, must start now

- Slow Pearl Harbor: we didn't wait for perfect planes & tanks
- End BAU (Business As Usual): CO2 wedge; ChIndia & coal
- All products need to become cleaner/cheaper
- Successful PHEV Commercialization ASAP
- "Good enough" welcomes but doesn't require future technologies
- Build realistic public expectations for market success
- Version 1.0 conversions/demo fleets help v.2.0 cars succeed
- Small US & int'l startup competitors may speed large companies
- Without ICE conversions, market penetration too slow



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### Keeping up the pressure

#### Coming Up for CalCars:

- Gov't/corporate incentives
- Convert large ICEs
- Partners/companies/prize
- Int'l campaigns
- Solar V2B
- Tech demos
- Do-it-yourself



2002-04: What's a PHEV?

2005: Prove demand & pricing

2006: How/when can I get one?

2007: Expanding conversions;  
small company production plans

2008: Small demo & V2G fleets;  
plug-ins as campaign topic

**BEST CASE: requires campaign**

2009: Low-volume production; public  
incentives; ICE conversion support;  
battery warranties

2010-11: Mass production; large  
retrofit businesses

2012: Optimized PHEVs



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# CalCars: a resource for this broad campaign

Watch [News-Archive](#) & [Carmakers](#) pages

- 09/24/08: [CEOs & Generals Plug In: Iceland Giving Up on Hydrogen](#)
- 09/24/08: [Chrysler "Jolts" PHEV Race; PHEV Ads; V2Green Acquired](#)
- 09/23/08: [Senate OKs Plug-In Credits, Toyota Frets; Free Press Lyrical about Plug-Ins](#)
- 09/19/08: [TIME, Comedy Central, Chrysler Zeo, Another F-150; Another Book; Fisker \\$](#)
- 09/17/08: [The Volt's Redesign: Pro/Neutral and Suspect](#)
- 09/17/08: [Big-Picture Volt Coverage: Time/BizWeek/Forbes/Car+Green Sites](#)
- 09/17/08: [Our 1,000th Posting: A Moment to Celebrate](#)
- 09/16/08: [Big Day for GM Chevy Volt and Plug-In Cars](#)
- 09/14/08: [GM's 100th Anniversary to Feature Volt: Watch Tues Sept 16](#)
- 09/09/08: [Economist/Newsweek/Time on Plug-In Cars; Accenture on Biofuels vs. PHEVs](#)
- 09/09/08: [T. Friedman's New Bestseller Hot, Flat & Crowded Touts Plug-Ins](#)
- 09/04/08: [Presidential Candidates and PHEVs: Side-by-Side Matchup](#)
- 09/03/08: [Nissan and Chrysler have PHEV Prototypes: May Join Race](#)
- 09/02/08: [Hyundai/Mazda Developing PHEVs; GM Chooses Battery Supplier](#)
- 09/02/08: [Toyota to Dealers: Slow Down! Plus Demo Fleets Explained](#)
- 08/28/08: [GM Says "No Race" But One-Ups Toyota with Large '09 Volt Test Fleet](#)

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