

Commercializing Plug-In Hybrids

July 21, 2008

**Felix Kramer, Founder
The California Cars Initiative
info@calcars.org**

***PDF of latest presentation always at
www.calcars.org/downloads***



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THE CALIFORNIA CARS INITIATIVE

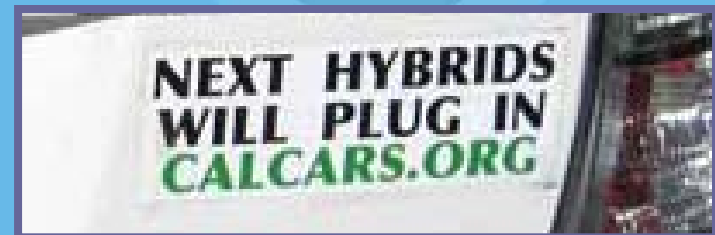
www.calcars.org

“Nonprofit Startup”: CalCars’ hybrid goals/members

Technology
(demos)

Advocacy
(buyers)

- Entrepreneurs
- Engineers
- Environmentalists
- Consumers/drivers
 - *Expand decisionmaking*
 - *New models for partners/
open source innovation*
 - *Approach success!*
 - *Give messages of hope*



Progress since October 2003

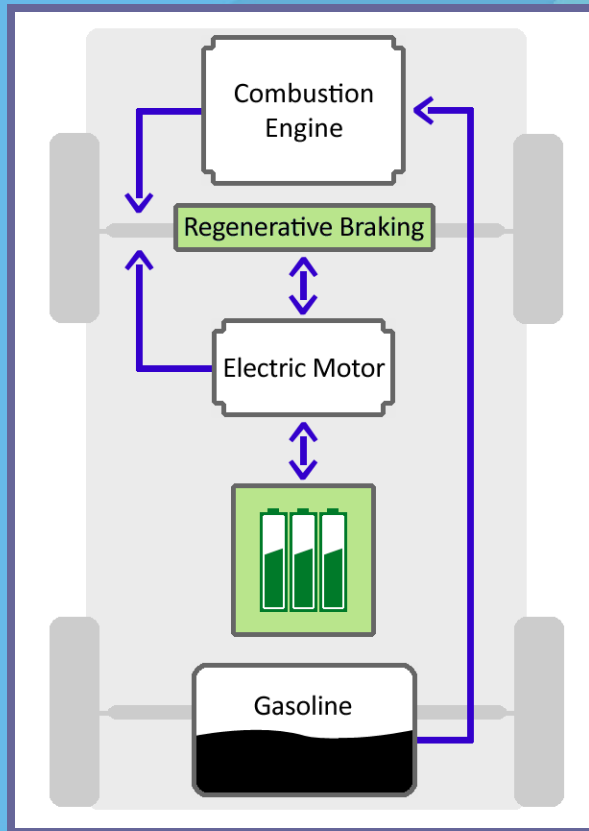


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Today's hybrid evolves into the plug-in hybrid



HYBRID to PLUG-IN HYBRID

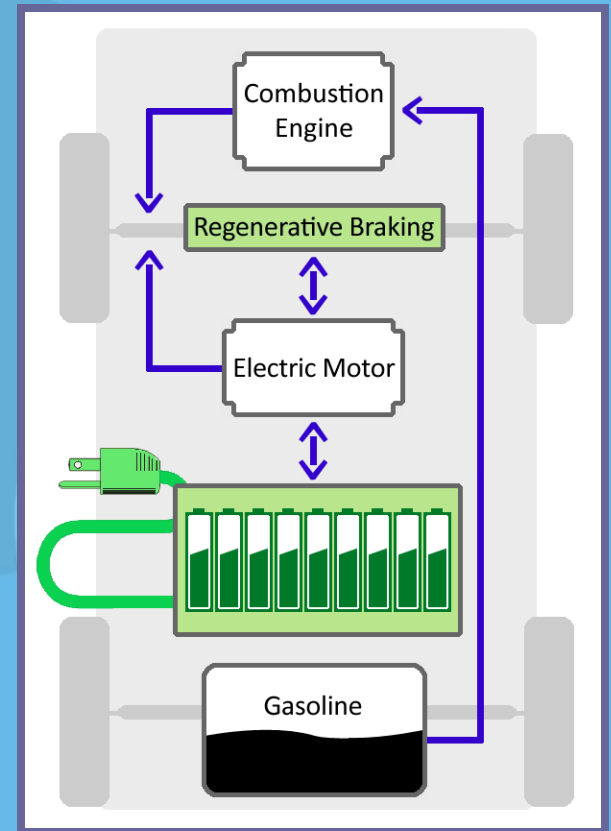
SMALLER gasoline engine
(same regeneration)

SAME/LARGER electric motor

MUCH LARGER battery

NEW: Plug into the grid

(same gas tank)



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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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CalCars ...and from the ground-up vehicles

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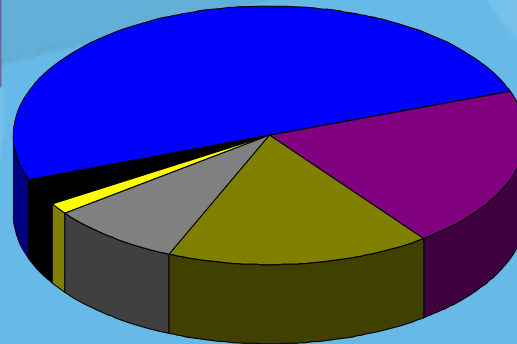
Electricity isn't just different—it's better than gas

Gasoline	Self Serve
Today's Car	3.00 ¹ / ₁₀ ⁹
Plug-In Hybrid	.75 ¹ / ₁₀ ⁹

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

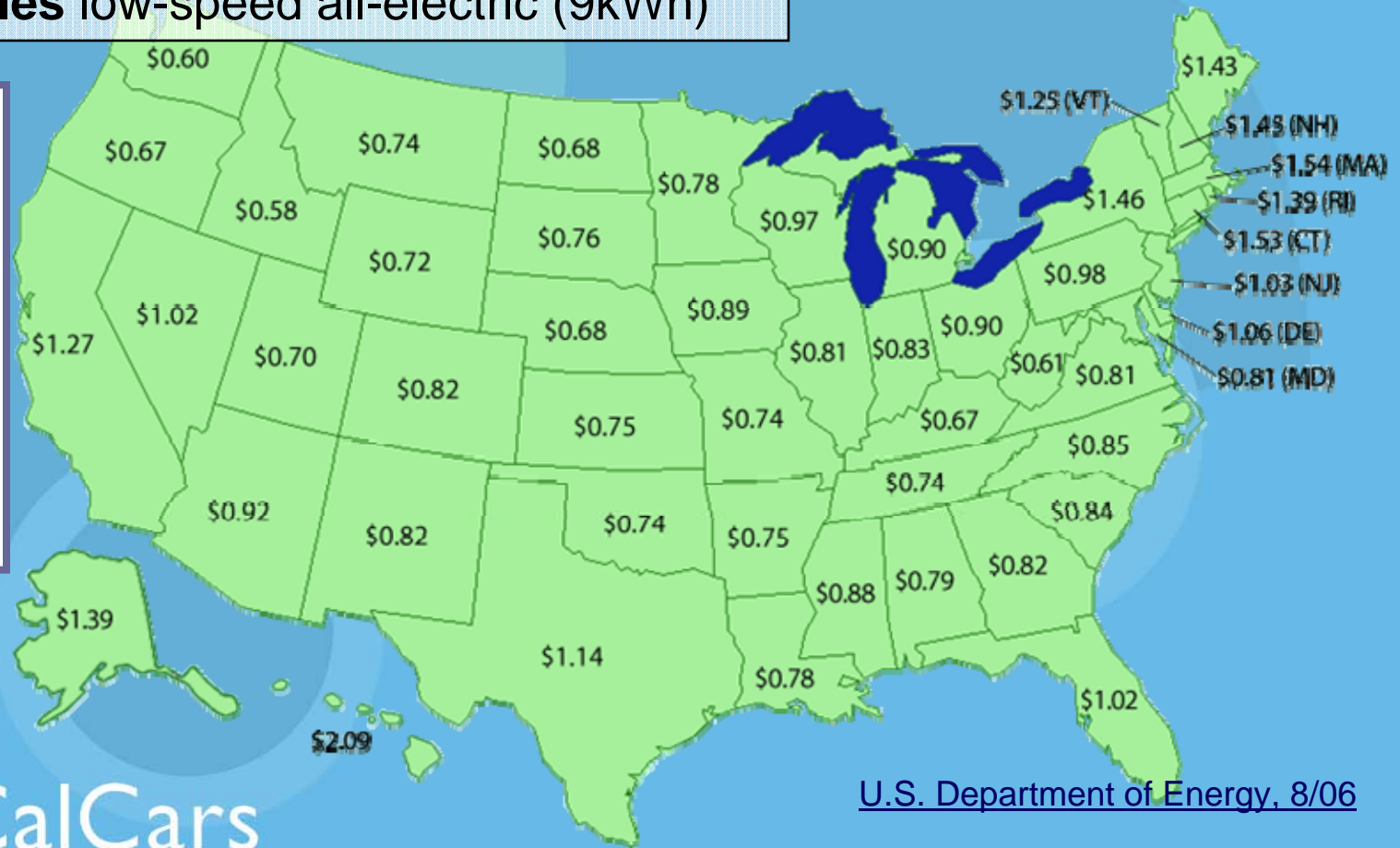


How much cheaper per day?

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 oil prices, hybrids actually save money, potentially making them a more attractive alternative for makers of cars powered by fossil fuels.

But fuel efficiency is not the only reason for reinventing the car. The technology to power a car away from fossil fuels is available.

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 is a national emergency."

However, says the plug-in for prime time.

"This is the next great thing, but it just isn't," said David H. Johnson, an executive engineer at the electric utilities really want electricity and they want the transportation sector to expand their market.

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



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Media avalanche 2005



SCIENTIFIC AMERICAN

HYBRID VEHICLES GAIN TRACTION

By Joseph J. Romm and Andrew A. Frank

As car buyers turn to fuel-sipping gasoline-electric hybrid vehicles, a new generation of greener hybrids is just coming over the horizon

When gasoline prices rise, hybrid vehicles—which can achieve improved fuel economy—become a more attractive option. Average U.S. car owners also...
Prius travel...
half a million...



Los Angeles
July 17, 2005

SPECIAL AUTO ISSUE

Slow Burn

A gallon of gas has never been more precious. Or provocative. Is it really possible to get 100—or 200 or even 500—mpg? Dan Neil puts a gallon in the tank and sees how far today's technology can take you.

TIME

npr

RED HERRING

THE CHRISTIAN SCIENCE MONITOR

The Economist

abc NEWS

WIRED NEWS

San Francisco Chronicle
NORTHERN CALIFORNIA'S LARGEST NEWSPAPER

BusinessWeek

AP Associated Press

Detroit Free Press



FREE VIDEO

Launch

MSNBC

Plug-in hybrids
Aug. 15: WNBC-TV's Chuck Scarborough looks at the experimental plug-in Prius, hoping to reach a wider audience.



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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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Unprecedented broad support & alliances

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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Momentum grows 2006-2007

npr | Hourly News Summary | 24-hour Program Stream | Schedule | Search NPR.org

May 6, 2007 | PROGRAMS | STATIONS | TRANSCRIPTS | ARCHIVES

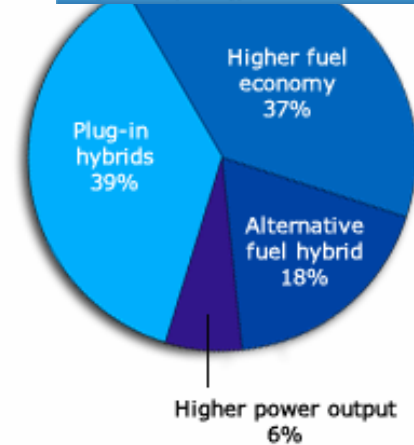
LOCAL STATIONS | THE LONG VIEW

Iacocca Says Detroit Is Living in the Past | Listen

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.

In the future, what direction would you like to see?

Hybrid Synergy View Newsletter



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

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 founder and CEO, 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.



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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

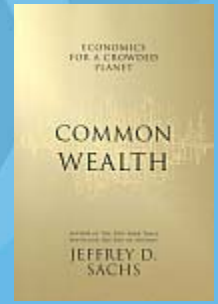
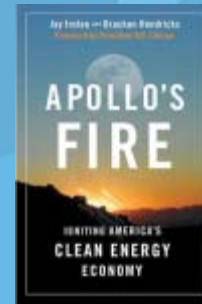
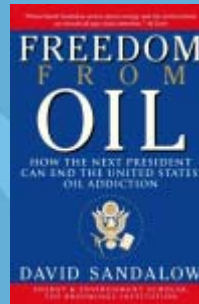
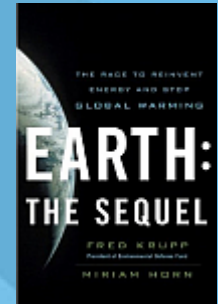
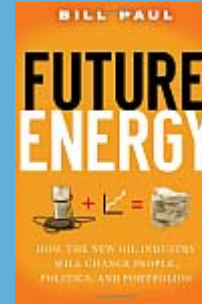
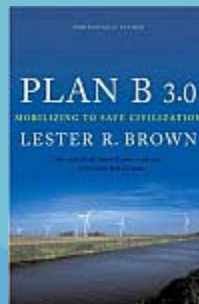
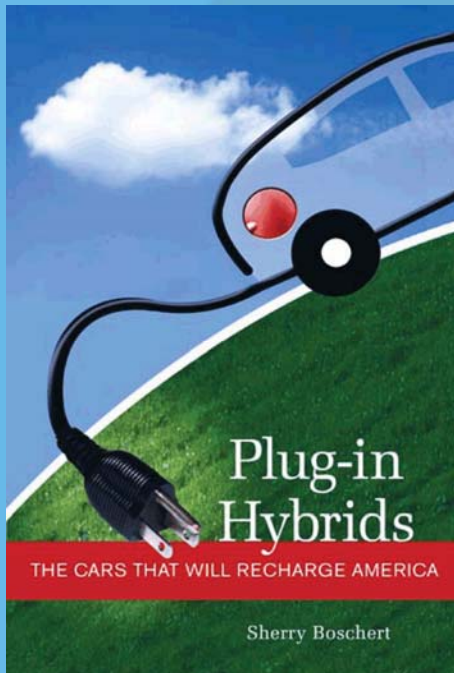


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2005-2008: 13 books with major focus on PHEVs



Order at www.calcars.org/books.html



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Beating the European Union's 125gm CO₂ target

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
Calif 2004	236	39	101	65	18%	20%	31%
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%

- **Source-to-wheels CO₂ emissions for a Prius-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)**
 - **PHEV-20** (32 km EV range): **3.8 l/100km** at 30% EV -- with higher EV%, my PHEV-25 often gets
 - **PHEV-60** (96 km EV range): **1.6 l/100km** at 70% EV 100+mpg (40km/liter or **<2.5 l/100km**)

*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)*



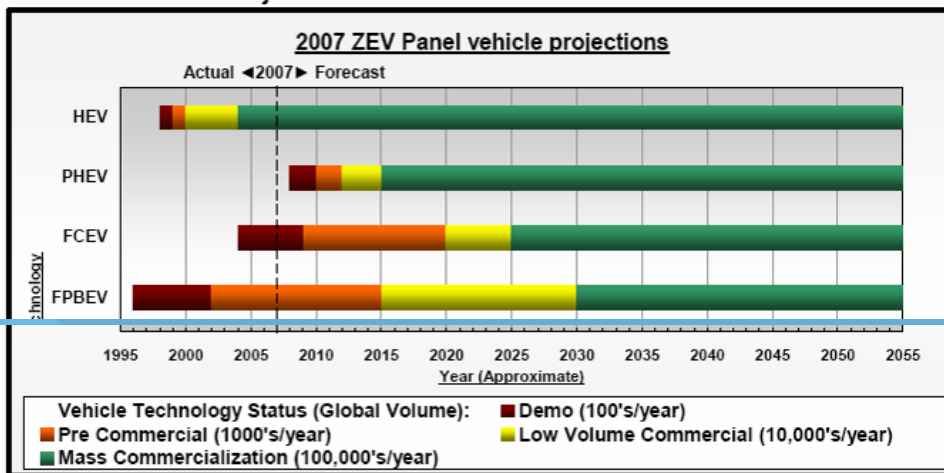
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Disruptive forecasts: CARB & Alliance Bernstein

Projected Achievement of Global Volumes



Years to Achieve Penetration Rates

Technology/Innovation	of US Auto Sales		
	20%	50%	80%
Airbags*	3 yrs	5 yrs	7 yrs
Front-Wheel Drive	6	9	13
Fuel Injection	5	9	13
Multi-Valve Engine	3	10	20
Radial Tires	3	4	4

TOP: PHEVs soon -- or 25 years for fuel cells?" "CA Air Resources Board Staff Report," ZEV Technology Symposium, April 2007 (excerpt)

BELOW:

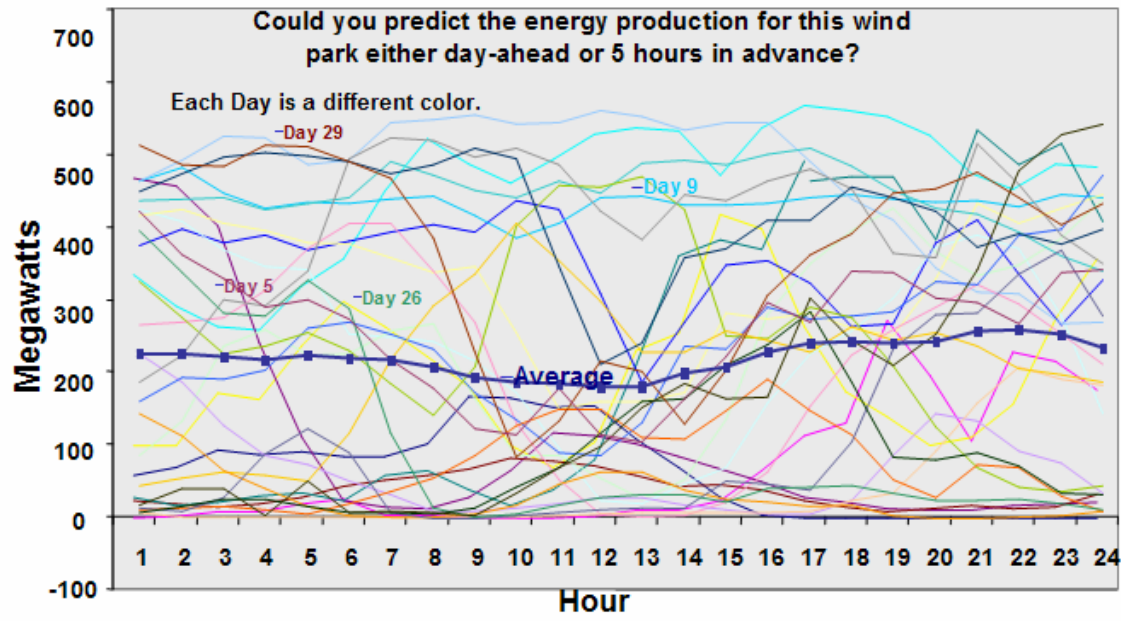
Alliance-Bernstein: "Mainstay"
Int'l Energy Agency: "Niche"
2030: Hybrid/PHEV Share of Vehicle Base: 72.0% not 0.7%
New Vehicles: 85.0% not 1.0%

"The Emergence of Hybrids"
 Alliance Bernstein June 2006
 (download at CalCars.org)



Car Batteries + Night Wind = 24/7 Clean Energy

Wind Generation in April



CALIFORNIA ISO



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14+ carmakers interested; race to be first; few timetables
(CalCars "Carmakers" page tracks statements)



DAIMLER Sprinter PHEV;
CHRYSLER electric division



TOYOTA

By 2010,
400-vehicle
demo fleet



"Within 5-10 years" –

Volvo may be sooner



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Build Your Dreams



aptera™

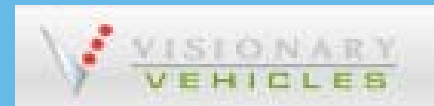
2500 pre-orders



Saturn Vue possible 2010; Chevy Volt: 2010 mass production; then Opel Flextreme



Fleet 2010,
production
2012



Interest/plans: Loremo,
Gordon Murray

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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 (100K+ miles)
- **Lithium-Ion (50K+ miles)**
*“Good enough” for
Version 1.0 demo fleets*



Left: lithium-phosphate (Valence).
Above: lead-acid (EAA-PHEV)



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



**Toyota: maybe 2011 –
why not in 2008-2009?**



**Chevy Volt : production in 2010 --
we urge 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.

**A dozen other automakers:
PHEVs a good idea – someday.**



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Presidential Candidates in Race on PHEV Policies



Nov '07 Googleplex



What if carmakers heard NOW that in early 2009 they'll get:

- Federal fleet order
- \$8K/PHEV 1st million
- \$4K/PHEV 2nd million
- Federal battery guarantee

-- Plan from book/roadmap "Freedom from Oil" by David Sandalow Brookings Institution



July '08 Warren, MI GM plant



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Conversions to electrify world's 900+ million cars



**Chicago: F-150 PHEV, then
...transit buses etc.** hevt.com



**Mexico City: 1,000 Nissans
become EV taxis** clever-in.org



**8 million US RVs
now plug in a little**



**Partial power
for sedans**
poulsen.com



**Supplementary
drivetrains**
evpowersystems.com



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Andy Frank's company
efficientdrivetrains.com

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

- Slow “Pearl Harbor:” we didn’t wait for “perfect” planes & tanks
- End 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 will help v.2.0 cars succeed
- Make OEMs offers so good they can’t refuse: orders/warranties
- Disruptive int’l & small startup competitors may help end “limbo”



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Keeping up the pressure

Coming Up for CalCars:

- CalCars 2.0
- Tech demos
- Do-It-Yourself
- Owners/drivers
- SolarV2H/ICEs
- Partners/companies
- Int'l campaigns



2002-04: What's a PHEV?

2005: Prove demand & pricing

FANS: George Bush-James Hansen-
Senators Brownback/Clinton/Obama-
Bill Ford-Bill Press-Bob Lutz-
John Doerr-Bill Clinton-Al Gore

2006: How/when can I get one?

2007: Expanding conversions;
small company production plans

BEST CASE: requires campaign

2008: Small demo fleets; vehicle-to-
grid experiments; public incentives
and battery warranties

2009: Low-volume production

2010: Mass production

2011: Optimized PHEVs



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CalCars: a resource for this broad campaign

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

07/14/08: [Obama Ups Ante on PHEVs in Candidates' Plug-In Race](#)
07/13/08: [Andy Grove in Washington Post: Volt, Tesla Other Reports](#)
07/09/08: [Andy Grove@PlugIn2008; PHEVs@Hybridfest; Cascadia in September](#)
07/06/08: [Mainstream Media Jaw-Droppers: Kiplinger and Car & Driver; WSJ vs. BizWeek](#)
07/01/08: [Obama/McCain/GM/Ford Maneuver for Support on PHEVs](#)
06/27/08: [AP Interviews Andy Grove on PHEVs; PBS Newshour on Plug-In Cars](#)
06/23/08: [Race for Plug-In Cars Shifts to Presidential Campaign; CalCars Responds](#)
06/20/08: [Wall St. Journal, Toyota, Edmunds on Hybrid Paybacks](#)
06/20/08: [Brookings/Google Conference Consolidates National Support for Plug-Ins](#)
06/19/08: [Fire Incident Raises Conversion Safety Issues; Batteries Not Cause](#)
06/15/08: [Chicago Battery Conference this Tuesday; Power-Up Presentations Online](#)
06/12/08: [Has Buzz Overstated News of Toyota's PHEV Production Plans?](#)
06/12/08: [GE in PHEVs as 3 US Automakers Get DOE Funds](#)
06/10/08: [Tech Giants Andy Grove and John Gage Promote PHEVs](#)
06/05/08: [Toyota Dealers Break Ranks with Company, Offer Conversions](#)
06/04/08: [GM's Chevy Volt Is a "Go" -- Production Vehicle, in Showrooms in 2010](#)

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