

Beyond New Plug-Ins: Fixing Gas Guzzlers

January 19, 2010

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For updated PDF of presentations:
www.calcars.org/downloads



2008: First preview of a new industry
*Ali Emadi, Felix Kramer,
Andy Grove, Andy Frank*



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Nonprofit Startup: CalCars' successes & challenges

- **2004: “no technical/business case for PHEVs—and no one wants to plug in.”**
- We always saw conversions as a strategy to build support & awareness:
 - Hybrid retrofits previewed validated, mass-produced PHEVs.
 - Education and coalitions crossed multiple constituencies and ideologies.
 - Open-source exchange germinated conversion company ecosystem.
 - Public and influencers pressured industry and government.

Technology
(demos)

Advocacy
(buyers)



2004



2006



2009

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Conversions: line extensions: new: back to retrofits!

Ford BOLD MOVES

MODELS

Escape XLT \$22,895*	Escape Hybrid FWD \$26,215*	Escape Hybrid 4WD \$27,820*	Escape Plug-In Hybrid \$30,000+

... & from
**GROUND-UP
NEW DESIGNS:**

Chevy "Volt"

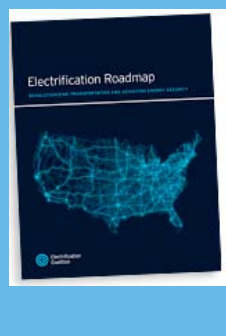
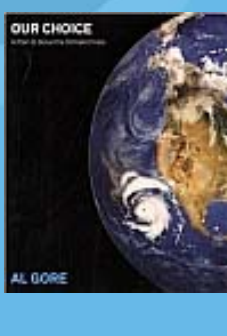
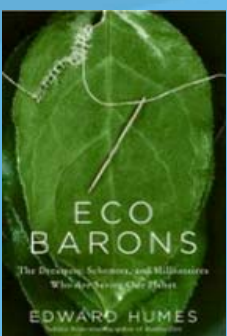
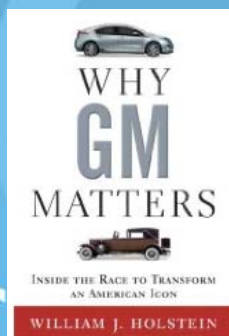
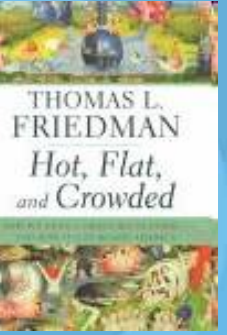
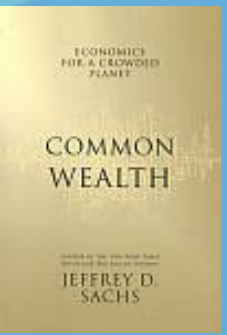
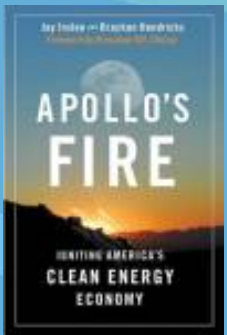
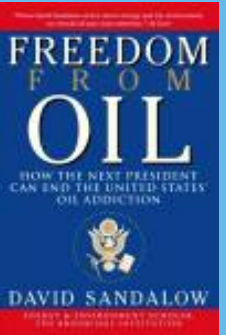
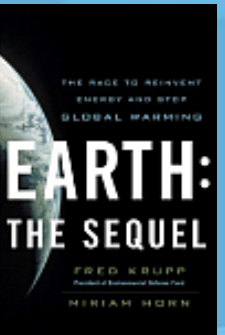
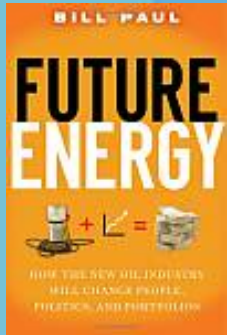
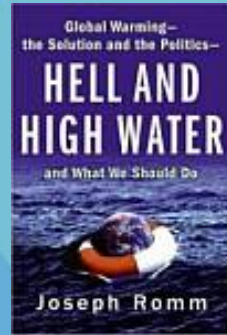
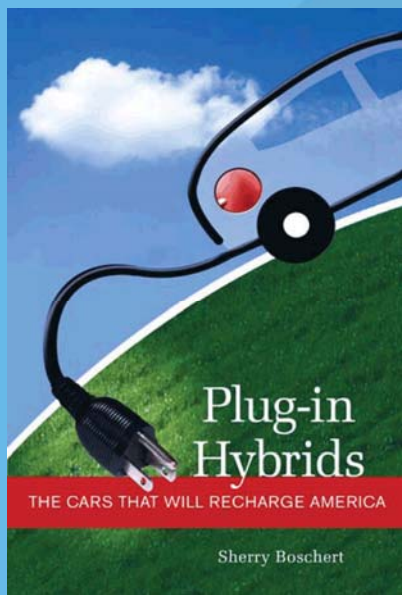
Bright "Idea"

... Next: GAS-GUZZLER CONVERSIONS!



Link for info and to order at CalCars.org home page

2005-2009: 27+ books highlight PHEVs



20+ carmakers interested; races to be first; first timetables
(see CalCars Carmakers page summary)

BYD AUTO
Build Your Dreams

selling in China

CHEVROLET

OPEL

Cadillac

GM

BRIGHT
AUTOMOTIVE™

*Volt 2010; Converj next;
Ampera; blended PHEV SUV?*

HYUNDAI

TOYOTA

2011 first sales to consumers

Karma 2010, Nira 2012

FISKER

Ford

2012

2005 prototypes

PERSU
mobility

SUZUKI

JAGUAR

VW

VOLVO

MITSUBISHI
MOTORS

aptera

Audi

SAIC

if & when?

CHRYSLER

RENAULT

NISSAN



More @ CalCars
Photos pages

For CalCars, after seven years, a challenging new campaign



**Gore;
Clinton**



**Plug-in drivers
with GM's
Tony Posawatz**



**Google's
Brin+Page,**

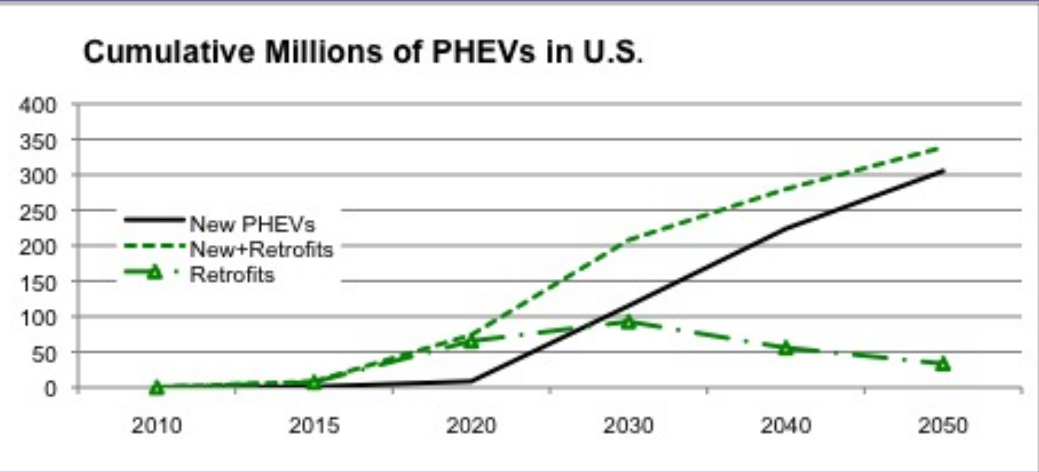
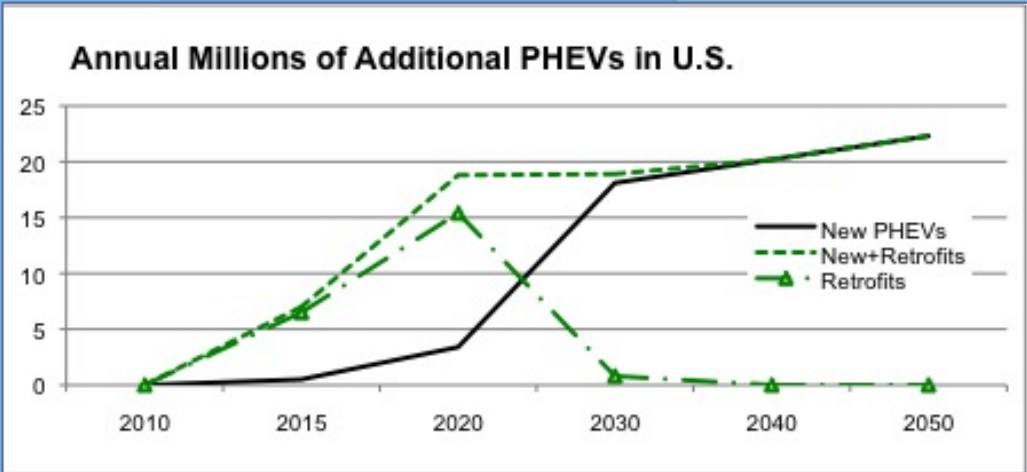
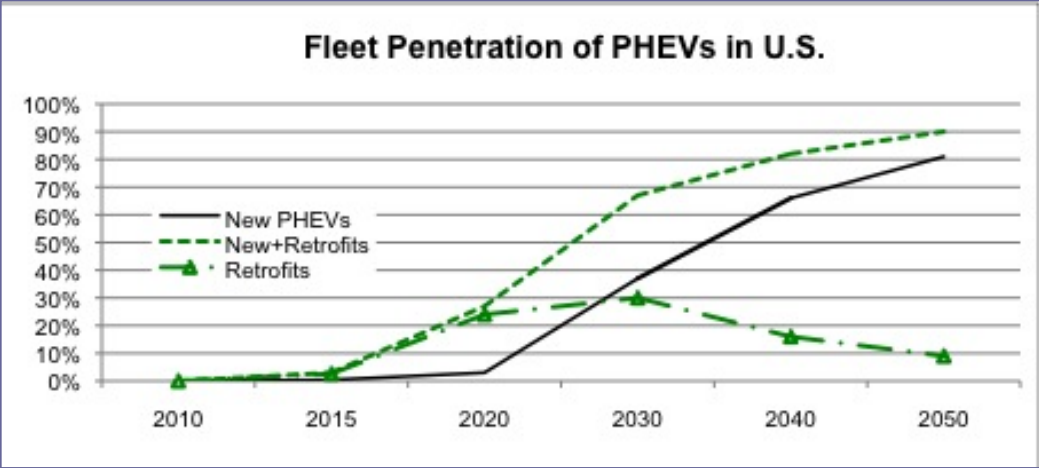
**HEVT's Ali Emadi, CalCars' Felix Kramer, Intel's
Andy Grove, Efficient Drivetrains' Andy Frank**



It's about penetrating a U.S. market of 250 million

New plug-ins, even at 10x faster rate than hybrids (21% vs. 2.2% in 10 years) won't be a significant percentage of fleet until 2025-2030

After 2030, additional retrofits taper off



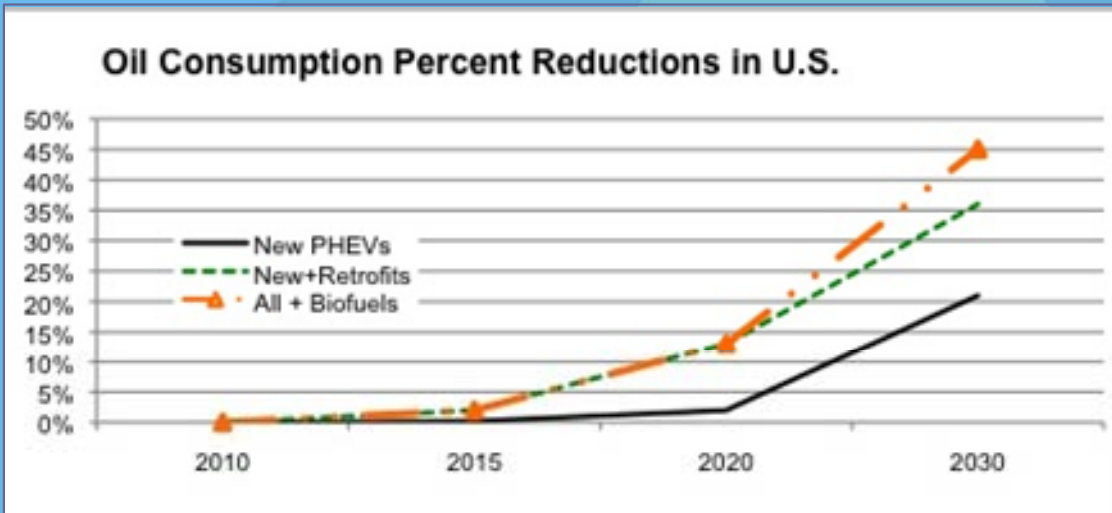
Retrofits, like new vehicles, will remain in the fleet for decades

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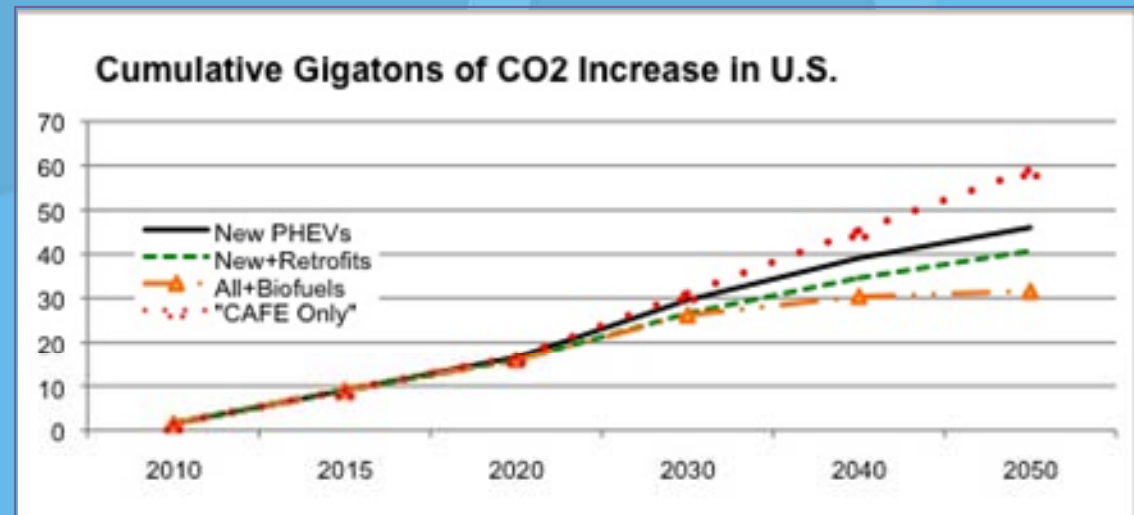
For near- & mid-term impacts, need retrofits



Virtually all near-term oil consumption benefits come from retrofits for a decade.

Maximum long-term CO2 reduction requires a combination of new vehicles, retrofits, and sustainable biofuels.

Source: White Paper, *"Cash For Clunkers Paves the Way to Retrofit Gas Guzzlers"* from CalCars Home Page.



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First retrofit prototypes validate the technology

- Prototypes provide a vision of a future.
- Several startups apply current technologies in innovative ways, turning gas-guzzlers into EVs; for PHEVs, adding to instead of replacing the existing drivetrain.
- Public tax incentives will help attract new players.
- Other companies, large integrators, develop more designs.
- Business models based on technologies and incentives.
- Partnerships with OEMs: Qualified Vehicle Modifiers (QVM) or licensing, bring new revenue streams to OEMs and dealers.
- Attract investors and, we hope, one or more serial entrepreneurs to develop global business opportunity.



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Hybrid Electric Vehicle Technologies, Inc.



World's First Plug-in Hybrid Electric Pickup Truck, hevt.com Chicago IL

- Founder: IIT Prof. Ali Emadi, leading power electronics expert.
- 40 million trucks/buses in U.S; 2 million added annually.
- F-150 prototype design scales to F-250, 350, school and transit buses.
- Simple payback: 2-5 years.

- Uniquely converting America's most popular pickup truck, the Ford F-150, to a plug-in hybrid; more than 15 months of testing.
- Up to 30 miles all-electric range; up to 40% MPG improvement as a hybrid (beyond all-electric range).
- Up to 90 tons of CO2 savings in 12 years; V2G capability; increased low-speed torque for better towing.
- **ESTIMATED COST IN VOLUME PRODUCTION: \$15,000 OR LESS.**
- Seeking investment funding.



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Rapid Electric Vehicle Technologies, Inc.

rapidelectricvehicles.com
Vancouver British Columbia

- Developing partnerships with Canadian dealers.
- All-electric and PHEVs starting with Ford trucks and SUVs.
- Contracts pending with public and private fleets.
- Seeking investment funding.



REV 300ACX

Pure Electric

[Vehicle Details](#)

Max Speed: 100mph / 160 kmh
Range: Up to 200 km's
Acceleration: 0-100 <7 seconds
Charge time: 3.5 hrs at 240V



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Bright Automotive

Brightautomotive.com

Anderson, Indiana

- Interim demonstration of technologies in future Bright "IDEA."
- Platform is VW Transporter (world vehicle, not in U.S.)
- Company beginning first prototype.
- Future partnership with VW possible.
- Rocky Mountain. Inst. spinoff



A white Volkswagen Transporter van shown from a front-three-quarter view. The word "carga" is written below the van.



A technical diagram of the vehicle's chassis, labeled "Bright Inside". It shows the engine, battery pack, hybrid system controller, electric drive, and charger components.

Bright Inside

Engine, Battery Pack, Hybrid System Controller, Electric Drive, Charger

A PHEV conversion of an existing vehicle for improved fuel economy in your fleet operations

- Proven platform
- Plug in hybrid electric vehicle
- 22 mile all-electric (EV) range
- 57 mpg based on 50 mile daily cycle
- Cargo, cab-chassis & passenger versions
- Fleet integration Q2 2010



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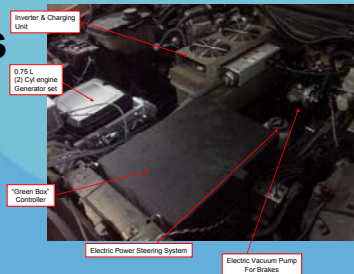
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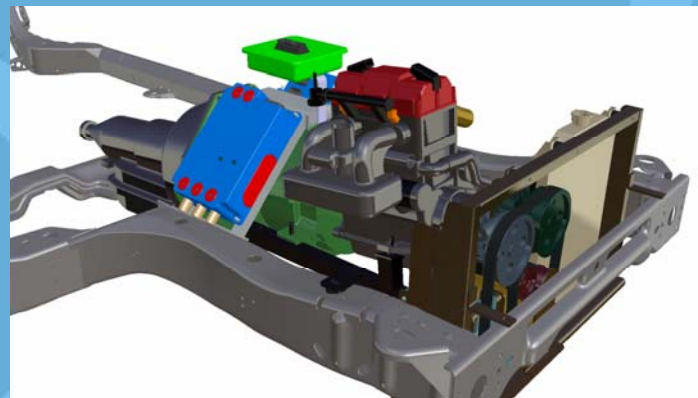
ALTe, LLC

Engineering and mass producing Series PHEV and EV complete powertrain conversion kits and platforms

- Staffed by auto industry and Tesla alumni
- Modular approach for vehicles from 2,000 lb to 16,000 lb
- Delivers 80% - 200% fuel economy improvement
- Customers/contracts/ 100 dealer nationwide network
- Aim: 90,000 powertrains annually starting Q1 2011
- Applied for DoE ATVM Loan & seeking \$5 M equity investment



Gen 1 Series PHEV Powertrain in a running Ford Crown Victoria



Gen 2 Series PHEV Powertrain in a running rolling chassis



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Raser Technologies

Rasertech.com.com

Provo, Utah

- Retrofit Hummer H2
- Precedent: General Motors provided technical support/contact with engineers.
- 40-mile range series PHEV developed with FEV
- Promotion for Raser's Traction Drive System; commercial plans unclear



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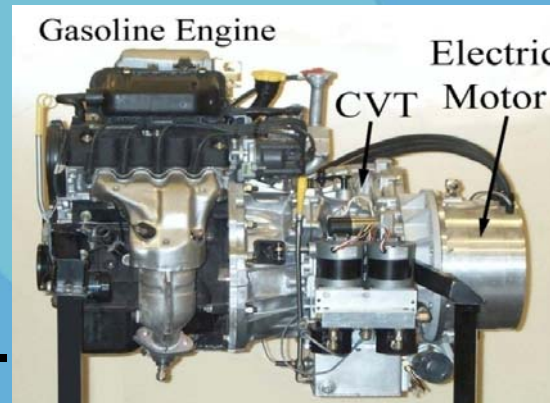


Efficient Drivetrains Inc.

efficientdrivetrains.com

San Francisco-
Sacramento region

- CoFounder & CTO Prof. Andy Frank, UC Davis, inventor of modern PHEV.
- Working with car/truck OEMs, conversions, first-tier suppliers to embed innovative drivetrain system designs, components -- parallel, series, and retrofit technologies.



- Patent portfolio: hybrid fundamentals, continuously variable transmissions, energy management systems.
- Projects in U.S., Europe, and Asia : two-wheeler, V2.0 parallel PHEV drivetrain for light and medium duty, inline CVT, CVT integration, and controllers.
- 2008/2009 operations funded from customer revenues.
- Seeking \$2-3M in expansion funding now.



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Poulsen Hybrid, LLC



poulenhybrid.com Shelton, CT

\$8,600 suggested retail price (before tax incentives) for complete Poulsen Hybrid System installed with 4.5 kWh Lithium-ion batteries, wheel motors and brackets.

- **Conversions for the most popular compact cars & SUVs.**
- **20-30 mile battery assisted range matches 70% of US daily commutes.**
- **Four-hour local installation.**
- **Business model scales to convert tens of thousands/year.**
- **Creates green authorized installer jobs in communities everywhere.**



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ElectraDrive, Inc.



electradrive.net San Jose, CA



- Extended-Range EV Dodge Pickup
- Overall fuel efficiency in mixed driving: 100-150 mpg; combined energy efficiency (including electricity): ~ 80 mpg equivalent.
- Battery pack: 5 kWh Li-ion, up to 15 miles electric range at urban speeds.
- Onboard generator delivers 30-40 kW
- Motor power: 25 kWc / 59 kWp; Motor torque: 2000 Nmp at the wheels.
- All factory auxiliary systems remain intact; acceleration same as or better than factory model.
- Seeking investment funding.



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LincVolt/HLine Conversions



lincvolt.com Woodside, CA

hlineconversion.com Wichita, KS

- Combines demonstration project and development of new business line.
- Neil Young: singer, advocate, technology experimenter; (current CD, "Fork in the Road," about getting off gasoline); forthcoming documentary, "Neil Young Truck Show," about converting his 1959 Lincoln Continental.
- Jonathan Goodwin: ICE conversions, including Hummers and other vehicles.



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EV Power Systems

Evpowersystems.com Rock Hill, SC

- Supplementary drivetrains for pickups, larger trucks, refuse and terminal vehicles.
- Retrofits for Chevy Colorado, Silverado.
- 25-40% improved MPG in start-stop driving.
- System transferable from vehicle to vehicle within fleets; one-day installation.
- Co-Founder/CEO John Dabels, automotive marketing, original GM EV-1 team.
- President/COO Terence Russell from Ryder Systems.
- Co-Founder/CTO James McGreen, former CEO of ZAP Motors (early days).



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US measures supporting EV/PHEV conversions

Obama campaign and administration

1 million PHEVs by 2015; *“When it becomes possible in the coming years, we should make sure that every government car is a plug-in hybrid.”*

Stimulus measures

- 10% tax credits up to \$4,000 for conversions (needs to be higher).
- \$3,500-\$4,500 “cash for clunkers:” why not expand to convert, not crush?
- Precedent set by large new programs to retrofit buildings

Colorado State Tax Credit: \$6,000 for hybrid conversions

CalCars begins new advocacy program

- Engaging with stakeholders: small companies, integrators, fleets, NGOs, legislators, Energy Department – and, once credible, eventually OEMs -- to create a broad coalition to launch a new industry.



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Japan & Canada policies on conversions

Japan's Postal Fleet

- Converting 25% of 22,000 vehicles to plug in.

Canada's New EV Technology Roadmap provisions

- “Develop harmonized standards for the conversion of used vehicles to electric traction.”
- “Assess the resource requirements for training, education and certification in skills related to the emerging EV industry. Provide this information to organizations that can develop: 1. technical courses on EV repair, service and maintenance and on the conversion of ICE-based vehicles to EVs.”

Ontario's \$10,000 rebate for new plug-in vehicles

- We **propose and seek allies** to expand this incentive (based on battery size) to include safe, drivable, validated conversions, especially of large gas-guzzlers.



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Key themes: start now for market penetration

- End Business As Usual (BAU) to get near/mid-term impact.
- “Good enough to get started:” Hybrid converters moving to fixing heavy gas guzzlers can produce 4x the fuel saving/100 miles driven.
- Without ICE conversions, market penetration too slow.
- Equalize tax incentive if conversion matches new car fuel displacement.
- Conversions preserve energy embedded in vehicles.
- Conversions jumpstart component industry; help small companies go from lab to real world demos and selling to large customers.
- Prize or other strategies to identify & incentivize startups/experimenters.
- Spark giant new industry, local green retrofit jobs everywhere.



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Keep up with issues & companies @CalCars.org

Download flyer;
endorse campaign

10/1/09 DRAFT: The Big Fix: 16 Founding Points for the Campaign to Upgrade Gas Guzzlers

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- About CalCars
- Plug-In Hybrids
- Take Action
- News and Events

POPULAR: [Convert Big Gas-Guzzlers to Plug In \(24 slides\)](#) | [Endorse "Big Fix" Campaign](#)

Plug-In Hybrids Use Cheaper, Cleaner, Domestic Energy

Quick Takes

- All about [Gas-Guzzler Conversions](#)
- [Carmakers' Plans for New PHEVs](#)

Follow ICE Conversions campaign: news, emerging companies; download presentation & White Paper/Analysis

www.calcars.org/ice-conversions.html

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CalCars: a resource for a broad new campaign

- Subscribe to [CalCars-News](#) & watch [ICE-conversions](#) Page

09/01/09: [Important Developments on Hybrid and Gas-Guzzler Conversions](#)

08/21/09: [Plug-Ins: Industry Developments and Media](#)

08/11/09: [The 21st Century Car Industry: Fixed in the USA](#)

03/27/09: [Our New Guzzler Video; Other Media; Apply for US Billions; GM Book; Correction](#)

01/21/09: [Our Testimony on Conversions Bolstered by 140+ Thoughtful Appeals](#)

11/12/08: [Multiple PHEV Conversion Solutions Gain Momentum](#)

10/03/08: [Should We Crush Gas-Guzzlers? Or Convert Them to Plug In? An Analysis](#)

09/20/08: [Another F-150 Conversion company](#) (Envia Rapid Electric Vehicles)

08/04/08: [Andy Grove's Ambitious Conversions Goals at Plug-In 2008](#)

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- And thanks for all you've done—and will do!



Donate!



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