



## I. PLUG-IN HYBRID ELECTRIC VEHICLES (PHEVs) SUMMARIZED

*Note: This is an evolving document. We would like to hear comments: [fkramer@calcars.org](mailto:fkramer@calcars.org) (Felix Kramer)*

### **PHEVs are regular hybrids – with extension cords**

- There are 11 hybrid-electric vehicles (HEVs) on the market with 52 announced models. Toyota expects HEV option for most models soon after 2010. Automakers surprised by HEVs' success
- Near future vision is a PHEV option for all regular hybrids, allowing 120-volt off-peak recharging using increasingly cleaner, cheaper, domestic electricity
  - Combines best features of battery-electric vehicles (EVs) and conventional gasoline hybrids
- 20-60 miles of all-electric range (HEV 20, HEV 40, HEV 60)
  - Electric fuel tank you use first for local travel/commute
  - Then standard HEV: best of both worlds; no performance/range sacrifice
  - Experience is the same as today's hybrids, but quieter and with fewer trips to the gas pump
- PHEVs can average well over 100 miles-per-gallon of gasoline (+ electricity)
  - Electric miles cost the equivalent of under \$1/gallon
- No new infrastructure; existing technology; prototypes already here
  - Currently available batteries meet PHEV requirements. Costs can be reduced through mass production; promising new batteries will result in even better PHEVs.
  - Andy Frank at UC Davis has built PHEVs for more than a decade
  - CalCars' PRIUS+ prototypes use lead-acid and nickel-metal hydride (Ni-MH) batteries
  - Aftermarket conversion companies EDrive and Hymotion use lithium-ion (Li-Ion)
  - Daimler-Chrysler-EPRI Sprinter test vans use both NiMH and Li-Ion
  - Eaton working with EPRI, PG&E, SCE and others on utility trouble truck

### **Flex-Fuel PHEVs: 500+ MPG (of gasoline) vehicles are in sight**

- Cellulosic ethanol PHEVs approach oil-free, "zero-carbon" cars
- Beneficial pairing: plug in for local miles, E85 for range extension fuel

### **What's happening with PHEVs? (see [CalCars.org](http://CalCars.org) News Archive for the latest)**

- Bi-partisan, bi-cameral Vehicle and Fuel Choices legislation: S. 2025 with 11 sponsors and co-sponsors including Bayh/Brownback/Coleman/Graham/Lieberman/Lugar/Obama/Salazar and H.R. 4409 with 47 including Kingston/Saxton/Engel
- Conversion companies emerging to meet growing fleet and consumer demand
- Focus on bringing OEMs into process: Ford, Toyota others show some receptivity
  - With increasing market pressures (political, cost of oil, climate change issue, consumer demand) automakers will benefit from modifying existing hybrid programs relatively quickly
  - CalCars working to demonstrate existing technology, create the market, partner with OEM
- Additional media coverage expected in coming months; see animation at [www.bettah.org](http://www.bettah.org)
- Washington, DC day of "demonstration/rides" for Members of Congress in May or June
- Despite greatly increased awareness and support, PHEVs not a "done deal" – additional efforts needed to involve automakers, first in demonstration programs, then production vehicles

### **Plug-In Partners (see [pluginpartners.org](http://pluginpartners.org))**

- Nationwide effort launched January 2006 has four-pronged approach:
  - Government/municipal resolutions
  - Soft fleet orders from nonprofits/corporations/government
  - Petitions from individuals
  - Incentive programs

## II. THE IMPACT/BENEFITS OF PHEVS

### **Plug-In hybrids have diverse and far-reaching benefits for global warming, energy security, jobs:**

- Significant emissions gains from PHEVs with 20 to 60 mile grid-connected range (HEV 20-60)<sup>1</sup>
  - Can reduce greenhouse gases (GHGs) by 42 to 85% (depending mix of renewables).
  - Can reduce gasoline use and trips to gas station by 60 – 85%.
    - Mid-size PHEV 60 can meet the 1990s' "Partnership for a New Generation of Vehicles 80 mpg goal" even without diesel, lower mass or better aerodynamics, and including the electricity as "equivalent" energy.
  - Potential for more rapid impact on GHG reductions because vehicles are replaced much more quickly than many other sources such as buildings.
  - Can reduce NOx and ROG by 40 to 80% vs. the cleanest California conventional gasoline car (called a partial ZEV); even more compared to the cleanest car required by USEPA.
  - PHEVs and EVs are the only vehicles that get cleaner as they age (grid will green with more use of renewable energy and as coal technologies improve)
- Electric "fuel" for a PHEV 20-30% the cost of gasoline.
  - Driver of a PHEV60 would use about 75 gallons/year, go to gas station four times annually and save about \$5,500 in fuel and oil changes over 100,000 miles
- Job creation potential: directly if production facilities are domestically sited, indirectly from component suppliers and advanced vehicle technology infrastructure at companies and universities
- **Vehicle-to-Grid (V2G)**
  - PHEVs can serve as mobile generators during power outages and emergencies
  - Future V2G vision integrates parked cars into electric power system for regulation services, load leveling (peak shaving, valley filling)
- No sacrifice in vehicle performance/utility
- No "new" infrastructure (uses 120v outlets)
- Could utilize significant national excess off-peak generation capacity. Utilities have a large excess of night-time power. PHEVs are a small night time load, but millions of them will make better use of an underused existing utility asset and help utilities use nighttime wind power.

### **The U.S. should establish future PHEV target goals.**

(California alone could accomplish 100,000 PHEVs on the road by 2012; 1,000,000 by 2016)

### **By about 2025 or 2030 - The US could accomplish:**

- **40,000,000 PHEVs (about 16% of all vehicles on the road) would remove:**<sup>2</sup>
  - 180 million tons/year GHG (based on 4- 5 tons/year from HEVWG studies)
  - 19 billion gallons/year gasoline
  - 42,000 tons/year NOx and ROG (smog-forming air pollution)
  - 5,200 tons/year PM (air toxic particulate matter)

### **What are automakers' concerns?**

- Automakers reluctance to add additional costs to hybrids; not convinced of market (hence our campaigns).
- Toyota/Honda "own" hybrid market and see little need to launch next-generation PHEV
- Some automakers still highly focused on longer-term fuel cells and hydrogen
- Focusing on current energy mix in national power grid (half coal), unconvinced that PHEVs are lower in GHGs than gasoline cars or hybrids in most geographic areas.
- Batteries: minimize potential of Ni-MH batteries for PHEVs; question over Li-Ion battery cost/life

<sup>1</sup> HEVWG consensus study for a national scenario with a HEV 20 and a HEV 60 compared to a conventional vehicle. Similar data exists for California scenario from CEC and TIAX studies as well as the CEC/ARB Petroleum Dependence Study

<sup>2</sup> Extrapolated from Oct 2005 TIAX study – using HEV Working Group data on national emission and petroleum benefits, annual miles traveled for new car buyers, etc. Based on HEV 40 compared to conventional vehicle.

### III. POLICY OPTIONS TO CONSIDER

#### What should government do?

- Consider a “gas guzzler” feebate to help fund deployment of advanced PHEV vehicles capable of achieving 125 MPG+ petroleum fuel economy, while reducing GHG emissions by 60%+
- Establish a PHEV working group to identify and address barriers, and other actions
- Require federal fleets to “order” and be early adopters of PHEVs
- Provide manufacturer incentives for early PHEV production (e.g. manufacturer tax credits, RD&D, a winner-take-all prize, or more CAFE credits)
- Provide consumer incentives (e.g. tax credits, low-interest loans, revenue-neutral feebates, or incentives directed to the salesperson / dealership)

#### Specific policy initiatives:

##### 1. Immediately Create a Plug-In Hybrid Government/Industry Working Group

- Mission:
    - Identify PHEV barriers and opportunities and work to resolve them.
    - Establish 1, 3, 5, and 10-year landmark goals.
    - Develop PHEV Plan for rapid completion of RD&D leading to commercialization.
    - Coordinate with Plug-In Partners campaign.
    - Work to integrate E85 and/or other non-petroleum fuels.
    - Work to make state and federal smog and mileage testing protocols and regulations realistically favorable to PHEVs, flex-fuel vehicles and combinations.
    - Explore regulatory and financial incentives for PHEVs and broader programs to target multiple goals (GHG/PM, NO<sub>x</sub> + ROG, petroleum reduction). This should include consideration of feebates, battery leasing and other ways to mitigate market mechanisms that focus on up-front and ignore life-cycle costs.
  - Members would include:
    - Key Federal and State agencies (See California’s Integrated Energy Policy Report model for a similar State Working Group)
    - EPRI and utility organizations
    - Academics and research experts
    - NGOs: policy development and advocacy organizations promoting advanced vehicle solutions, environmental, economic development and energy security policy
    - Automakers, suppliers(e.g., Plug-In Hybrid Consortium of component suppliers), and other industry as decided by the working group
  - Workplan:
    - Schedule founding meeting, send out invitations, and host first meeting ASAP in 2006
    - Provide staffing and hire technical consultant
    - Group’s early work would initially culminate in a 2007 Report to the President and Congress, and follow-up reports every 2 years thereafter through 2020.
2. Require Federal Agencies to evaluate all environmental/energy impacts of vehicle technologies/fuel types before proceeding with future purchases using life cycle costs as a key factor (helps HEVs, PHEVs and flex fuel vehicles pencil out).
  3. Establish an incentive program (similar to the 1993 "Golden Carrot" program that gave us high-efficiency zero-chlorofluorocarbon refrigerators) specifically designed to spur PHEV development and production (One federal and some on a state participatory basis).

4. Implement flexible federal fleet requirements with a percentage of fleet purchases to be of currently available HEVs and later PHEVs (similar to or amending Federal EPACT of 1992).
5. Establish a special Zero Emissions Vehicle manufacturing incentive credit for that fraction of PHEV operation with no emissions (based on the battery range, before hybrid-gasoline engine kicks in).
6. Facilitate/require Federal (as well as State, County and Municipal) fleets to work together to negotiate lower bulk purchase prices through pooled buying for available hybrids and PHEVs. (Could be modeled on the efforts in Texas by the City of Austin and its public utility, Austin Energy, which passed a commitment to buy PHEV DaimlerChrysler Sprinter Vans and organized Plug-In Partners.)
7. Immediately commit the federal government to purchase demonstrate and evaluate several (ideally 5 or more) of the DaimlerChrysler PHEV Sprinter Van prototypes (developed in collaboration with EPRI), as well as aftermarket conversions of Prius, Escape and other hybrids by EDrive Systems and Hymotion.
8. Seek public-private partnerships (e.g. from foundations and corporations) to gain funding to supplement or match government funds for government fleet purchases of cleaner vehicles.
9. Amend the IRS code to provide a significant tax break for corporations, like Google, Timberland and others, who award employee benefits for the purchase of vehicles that get 45 MPG or more.
10. Amend the IRS code to provide a more robust personal income tax credit (e.g. \$3,000 for all individuals who purchase an HEV, and later \$6,000 for all who purchase a flex-fuel PHEV).
11. Consider creating a gas-guzzler emissions fee (or "feebate"), the proceeds of which would be used to provide incentives to manufacturers to develop and produce PHEVs and other LEVs, as well as to consumers of LEVs to help offset initial price differential (e.g. \$3,000 for a hybrid, about \$6,000 for a manufactured PHEV and about \$10,000 for individual conversion of an HEV to a PHEV).
12. Require electric utilities to provide economically attractive off-peak overnight rates for PHEVs.
13. Assemble a package of incentives to induce auto manufacturers to produce more hybrids and to start producing PHEVs, perhaps at decommissioned military properties. (An assembly plant for PHEVs designed in the U.S. but manufactured internationally is also a possibility.)
14. Sponsor additional battery programs: a testing program, for PHEV lifetime & vehicle safety, possibly in cooperation with US Advanced Battery Consortium, and a battery warranty assistance program, including evaluation and possible pilot program with utilities for "unbundling" vehicle components with leased batteries
15. Support a series of conferences in major US cities to educate the public about the importance of clean technologies like PHEVs for our future. Groups like Plug-In Partners, CalCars, California Electric Transportation Coalition (CalETC), EPRI and others could partner with federal and state governmental agencies and others to produce these conferences collaboratively.
16. Include mobile to stationary source credits in any carbon cap and trade system that might be implemented in the future.