Climate Change Zero Carbon Energy Sustainability by the PHEV

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# The problems

 Global warming due to heavy CO2 Emissions

 Global Peak Oil due to continued heavy use of carbon fuels

 How to move toward a new Zero Carbon Society while improving lifestyle and productivity with no change in energy infrastructure.

#### World Oil reserves USGS: Techno-Optimism or Pessimism?? Either way we are in trouble!!



# **Goals of Energy Sustainability**

- Unify Energy use in Society to using Only <u>Renewable Sources</u> that can be created instantly or at most in one year. Such as Solar, Wind, Hydro, Ethanol, Bio-diesel.
- Utilize the current energy distribution systems in our society, 120 volt Plugs @ 15 amps and gas stations.
- Start by individual personal energy independence with zero carbon.

## Don't step back in technology When we move forward to individual Energy Sustainability





# What is needed to accomplish Energy sustainability from Solar and Wind??

- Electrical energy storage is needed
- Only batteries can store electric energy at better than 95% efficiency
- With stored battery energy we can drive our cars, power our houses, shops, industry, and most of society.
- Stored energy will allow us to create an all electric Zero Emission Society with Wind, Solar, hydro and Zero CO<sub>2</sub>
- THE PLUG-IN HYBRID VEHICLE will provide the batteries for all the storage needed by society "FREE".

## **OVONCSOLAT** Charging Shelters for <u>cars, homes, offices</u>



3.5 kW EV Charging Station



**10 kW EV Charging Station** 



12 kW School Lunch Shelter



30 kW Parking Shade Structure

#### Wind mills that can use PHEV batteries to store generated energy rather than "waste it" or reducing power plant efficiency



#### Wind farms on the sea or Plains can also use large numbers of PHEV's for temporary storage to avoid Back Up Electric Plants



60 mile AER PHEVs with CVTs constructed at UCDavis to show technology is here today !! Supply Chain for parts already Developed!!



2000 Suburban 60 mi AER, 28 mpg New automatic CVT Being installed New PHEV that will run on Sunshine and a little Ethanol 4000 lb Chevrolet Equinox 210hp electric 90hp ethanol Lithium batteries,120v charging, 80%elect. 20% ethanol. Can be ZERO gasoline or diesel Now!!!



#### Greenhouse Gas Emissions for all light duty cars & trucks–grid. PHEV Solar is "O" CO2!!



#### **Annual Gasoline Consumption for 12,000** miles of driving-all L/D vehicles



Increasing Hybridization  $\rightarrow$ 

#### **Annual Gasoline saved** for the average car & Truck for Conv., HEV, PHEV's as a function of AER on <u>FUDC</u> (suggested standard for AER specification) <u>Conventional car uses 740 gals gasoline/yr.</u>



Annual oil savings for <u>10% fleet penetration</u> (<u>PHEV-40</u>) is about 300 million barrels saving 4.5% of the US oil used/year—Enough to Eliminate Middle Eastern Oil Imports !! Use of <u>Ethanol</u> in PHEV's further increases oil savings!! The best concept is to construct PHEV's with flex fuel capability.

# **Local** energy feed back <u>only</u> by V2G



The PIHEV can be used to balance the Electric Grid Integrating electric power and transportation energy There's enough generating power for 80% of Fleet with no more power plants!! -----20 years at least!! 20% penetration of the total car population- below



# **Summary and Conclusions**

- PHEVs are a low cost solution to environmental & Energy Security problems and could provide high profits and employment for early investors.
- These vehicles can be brought to production now with little investment in development. No change in manufacturing and fuel infrastructure is needed!!
- PHEVs can begin the integration of Society's Energy systems to move toward an all electric society by reducing petroleum consumption by 50% to 100%. New companies!!
- Can be an interim solution for the next 50 years to move society toward development of new vehicle and energy concepts such as H<sub>2</sub> Fuel Cells or other new energy systems ?? But "Bar" is much higher now due to PHEV !! For example, the fuel cell now must be 3X better to compete with today's PHEV!!!

# **Summary and conclusions Continued**

- PHEVs can get us out of the Middle East to provide National Security faster than any other solution Now!!
- PHEVs using Water, other Renewable Energy and Bio fuels--can begin our transition to <u>zero oil</u> consumption and Solve Global Warming <u>Now</u>!
- PHEVs will allow us to integrate our transportation and stationary energy systems for much higher efficiency thus reducing our per capita energy consumption by--individual energy independence!

Goal is to reduce our <u>per person</u> consumption of Carbon Fossil energy <u>Oil and Coal</u> while <u>Improving</u> our lifestyle with <u>greater</u> comfort and productivity

# **Summary and Conclusions**

- Government needs to fund 1500 fully designed Demonstration PHEV vehicles systems to show manufacturing feasibility and costs analysis including supply chain development for:
  - Passenger cars & trucks
  - Minibuses, delivery vans, Utility vehicles
- <u>Demonstrate V2G and Renewable Energy</u> projects integrated with solar and wind to develop needed hardware and software to take advantage of <u>"free"</u> energy storage.

#### The other problem Estimated Human Population Over the Past two Millennia (Cohen 1995)



# **Core EDI technologies for PHEV's**

- System Integration and vehicle design Know-How and analysis, and Intele. Prop.
- Battery control and management Know-How, design and construction.
- Design construction of CVT systems for durability and applications.
- Design of CVT systems for dynamic response and performance.
- Design of engine systems for HEV and PHEV's for efficiency and emissions.
- Altitude compensation for PHEV engines
- Electric motor/generator integration into the HEV's, PHEV's.

#### **EDI Patents**

- Basic Plug-In Hybrid patent
- Control of PHEV battery maintenance & fuel economy
- Control of hybrid vehicles for best fuel economy by use of the transmission.
- Prime mover Engine control concepts for best fuel economy and charge control in hybrid vehicles
- Exhaust gas driven generation of electric power and altitude compensation for conventional and hybrid vehicles.



#### **EDI Patents**

- The control of CVT transmissions for conventional and hybrid vehicles by the use of the rate of change of ratio of the CVT.
- The use of the Ideal Operating Line IOL for control of the Internal Combustion or prime mover of a vehicle
- Inline CVT for high horse power and wide ratio range (pending)
- Several other applications are pending and will be filed in 2007 and beyond



#### Customers

- Target Customers include:
  - Vehicle designers and manufacturers
  - Electrical vehicle designers and manufacturers
  - Vehicle conversion companies (PHEV & electrical)
  - Drivetrain systems and parts designers & manufacturers
  - Government and military contractors
  - Technology partners
- Multiple initial <u>business prospects</u> already identified

# **Business Models**

- IP and design licensing deals
  - \$50 to \$500/vehicle
- Drivetrain components and subsystems
  - \$50 to \$2000/vehicle
  - \$8 to \$80 referrals
- Consulting with objective of design win
  - \$2k to \$250k
- Sales of software and system controllers
  - \$50 to \$500/vehicle
- Vehicle conversions with objective of design win
  - \$5000 to \$20,000 labor
  - Opportunity for follow on licensing or component sales