



PHEV Market Introduction Study

Summary of Workshop Results

January 2009

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**Plug-in Hybrid Electric Vehicle
Market Introduction Study**

SUMMARY OF WORKSHOP RESULTS

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INTRODUCTION

The Plug-In Hybrid Electric Vehicle (PHEV) Market Introduction Study Workshop, held at the Hotel Helix in Washington, D.C. on December 1-2, 2008, was attended by approximately forty representatives from various stakeholder organizations. The purpose of this workshop was to build upon last year's PHEV Value Proposition Study, which showed that, indeed, a viable and even thriving market for these vehicles can exist by the year 2030. This workshop aimed to identify immediate action items that need to be undertaken to accelerate the market introduction of PHEVs into the U.S. automotive fleet.

PHEVs stand to benefit the personal transportation sector and our society in many ways. The primary advantages that PHEVs hold over vehicles that run exclusively on gasoline or diesel are a potentially significant reduction in operating costs for the driver, accompanied by a reduction in imported petroleum consumption. This transition to powering vehicles from the electrical grid could also provide more incentives for increased domestic clean energy production. Additionally, replacing oil consumption with often cleaner electric generation could play an integral role in solving the climate change dilemma by reducing CO₂ emissions. However, many steps need to be taken to make PHEVs a sustainable transportation option: in the short term, developing better, cheaper, and more reliable batteries; in the long term, developments of supporting infrastructure and grid interface to further enhance the benefits of this technology. In targeting action items to this end, one must first identify obstacles and barriers, or "pinch points" to a successful market introduction, followed by essential steps to overcome them, i.e. policies, incentives, and regulations.

Welcoming remarks for the workshop were given by Lee Slezak and Pat Davis, both representatives of the U.S. Department of Energy's (DOE) Office of Energy Efficiency and Renewable Energy's (EERE) Vehicle Technologies Program. Next, Bob DeVault of Oak Ridge National Laboratory (ORNL) briefed the participants on last year's Value Proposition Study results, and Karen Genung of Sentech provided an overview of the task at hand. The participants were then divided into two parallel breakout groups, labeled "Red Team" and "Blue Team," for intense brainstorming sessions. Day one of the workshop was spent identifying and analyzing market pinch points, while day two was spent identifying and analyzing the most effective policies, incentives, and regulations to help overcome these pinch points. Workshop participants reconvened in the afternoon of day two to present the outcomes for each breakout group. A volunteer from each group was selected to present the summary of their group's brainstorming efforts. Bob DeVault and Lee Slezak wrapped up the workshop with closing remarks on behalf of ORNL and DOE, respectively.

This workshop was co-funded by DOE's Vehicle Technologies Program and the Office of Electricity Delivery and Energy Reliability (OE). Its aim was to bring together stakeholders knowledgeable in these fields, including automotive suppliers and manufacturers, utilities, national laboratories, universities, and government agencies, to discuss an immediate path forward for PHEVs. Many key participants were also attendants of last year's DOE-sponsored PHEV Value Proposition Study Workshop. Select members of these organizations comprise the PHEV Market Introduction Study Guidance and Evaluation Committee, several of whom were in attendance.¹ The final workshop agenda is in Appendix A, and the complete participant list can be found in Appendix B. The participants of each "breakout" group are listed in Tables 1 and 8. Summary presentations and additional reference documents can be found at www.sentech.org/phev.

¹ For a complete list of Guidance and Evaluation Committee members, visit http://www.sentech.org/phev/pdfs/Guidance_Committee.pdf

SUMMARY OF RESULTS

The brainstorming process consisted of participants from both groups selecting and discussing their top five pinch points of concern as well as their top five policies, incentives and regulations to address them. The Red Team's focus was slightly broader, focusing on the market introduction of *all* plug-in electric vehicles (PEVs), whereas the Blue Team's focus was more specific to plug-in *hybrid* electric vehicles. That is an important distinction to make, considering that several significant differences exist between the two: PEV development places more emphasis on batteries with a longer all-electric range (AER); they use virtually no petroleum throughout their lifetime; and they have significantly larger infrastructure requirements. However, the Project Team concluded during post-workshop analysis that for the intent of this study, all plug-in vehicles will face similar impediments to market introduction, and the modeling results will be comparable.

On both days of the workshop, ideas suggested by the participants were categorized, voted upon, and narrowed down to the ideas that received the most votes. Voting selections were based on the level of impact that the proposition would have on the PHEV industry. Every idea mentioned has been documented under the most appropriate headings. Tables 4 through 7 and 11 through 14 represent the Red and Blue Teams' ideas, respectively. Once the top priority topics were identified, each group divided into smaller teams to discuss their assigned topic in detail. The criteria for discussion consisted of the recommended time frame for implementation, organizations that should be involved, level of funding and effort required (low, medium, or high), and immediate next steps.

“...the PHEV market introduction must be approached from a national energy policy perspective, not just from a market development perspective.”

After both groups had presented their findings, it was evident that several recurring themes existed. The most pervasive theme was that the PHEV market introduction must be approached from a national energy policy perspective, not just from a market development perspective. A historical example of such an event is the interstate highway system, initiated during the Eisenhower administration. Although the National System of Interstate and Defense Highways was primarily established to support military

objectives, civilians benefited greatly for personal transportation. Additionally, with the current economic crisis, the creation of sustainable “green” jobs could help provide the economic boost that this country urgently needs. These jobs would be created through ramping up production of PEVs and PHEVs, retrofitting existing infrastructure with charging stations and the means for handling increased electric-load capacity, and training dealers and technicians to service these vehicles.

All participants agreed that the most imperative pinch point to address is the need for improved battery cost, performance, reliability and availability. Manufacturing batteries to last the entire life-expectancy of the vehicle, without needing replacement, is of utmost importance. A warranty or guarantee should be provided to encourage consumer confidence and their investment in this technology. At the current state of the technology and present production levels, batteries are so expensive that PHEVs will simply not be affordable for the average American. Continued research and development plus scale-up for manufacturing of battery packs, power electronics, and other vehicle components is essential to making these items affordable. This could place stress on international commodity markets and cause prices for key raw materials to rise. It is worth noting that as the market for hybrid vehicles has increased, there has been much debate over whether

lithium supply will be able to meet the increased demand for its use in batteries. However, during a recent convention of global experts, the consensus opinion was that supply will not be an issue until roughly 250 million of these vehicles are on the road.² By this time, battery recycling programs will likely be in place to conserve lithium supplies and reduce stress on the market.

Consumer acceptance and education proves a sizeable issue as well. In order to achieve wide adoption across the board, these vehicles must be designed to meet the needs and desires of consumers, while offering a greater overall value than the competition. Most consumers have little to no prior knowledge or experience with this type of vehicle in terms of grid connections and expectations of performance. They must be educated on these issues such as how driving behavior, e.g., jack rabbit starts and stops, impact their efficiency and cost. PHEV and PEV charging equipment must be easy to use so that consumers can maximize their efficiency and reduce their operating costs by keeping the battery charged and running on electric power as much as possible. Also, they need to understand how the time of day at which they recharge impacts the utilities and their operating costs. Participants of the workshop agreed that implementation of international codes and standards for interoperability, grid interface, communications protocols, and components manufacturing would help address this. Such standardization would accomplish this by accelerating market introduction, encouraging commoditization, and decreasing production costs.

The massive amount of investment that original equipment manufacturers (OEMs) will require to retool their facilities for large-scale production is another obstacle. Capital investment must not only be attracted, but sustained, to continue research and development (R&D), and also to mitigate scale-up risks. High cost would be a significant barrier to entry for some automakers, but ultimately could be worth the investment if executed properly. This is demonstrated by the market success of several hybrid vehicles, such as the Toyota Prius, that currently comprise a noteworthy portion of the light-duty vehicle market.

PHEV Pinch Points Primarily Exist in:

- Battery-related and other supply chain inefficiencies
- Infrastructure readiness
- Consumer acceptance and education

Low fuel prices could prove to be a pinch point by reducing consumers' incentive to purchase PHEVs. If consumers are not paying a premium for their conventional gasoline or diesel, the financial benefits associated with PHEVs may not be as evident. Most consumers are not solely motivated by the knowledge that they are reducing their CO₂ emissions or the nation's dependence on foreign oil. A policy discussed by both groups to address this pinch point was, although politically unpopular, the implementation of a gasoline tax. This could be accomplished in one of three ways: taxing on a flat basis, a percentage basis, or placing a floor on the price of gasoline.

A small additional tax on vehicle fuel consumption could be used as a source of funds for PHEV research and development, consumer education on PHEVs, and other PHEV initiatives. It was estimated that taxing a gallon of gasoline just one additional cent would generate one billion dollars a year. In 2006, the average passenger car consumed 554 gallons of fuel, corresponding with a \$5.54 annual increase in fuel cost.³ This demonstrates that an increase could be structured to have a

²Conclusion from Annex X & XV Workshop. World's Supply of Lithium. Charlotte, NC, USA. December 3-4, 2008.

³Research and Innovative Technology Administration, Bureau of Transportation Statistics.

“Table 4-11: Passenger Car and Motorcycle Fuel Consumption and Travel.”

http://www.bts.gov/publications/national_transportation_statistics/html/table_04_11.html

minimal impact on families, including those in lower income brackets. However, to more effectively relieve this pinch point, the gas tax would need to be much higher to actually alter consumer driving behavior, resulting in a need to purchase more fuel efficient vehicles.

The consensus was that even a minimal tax would be highly effective in raising money to fund incentives. The money raised could be used in a variety of ways, from subsidizing battery production to funding a feebate program. A feebate program would reward efficient vehicles by discounting the price, and penalize those that do not attain the CAFÉ standard, as per a fee. Collected fees could also contribute to OEM's retooling efforts, or training programs for service technicians. This program could be designed to make PHEV purchase incentives revenue neutral, as a transfer payment, rather than simply as a tax increase. The other suggested mechanism for gasoline taxation was placing a floor on the price of gasoline, which would ensure that gasoline would never again be "cheap," thereby discouraging wasteful consumption. Some other suggestions to remedy this situation were to limit the amount of imported oil or apply a tax to it, and reducing the tax breaks that Big Oil receives.

Key Policies, Incentives, and Regulations Ranked by Priority:

1. Subsidies to lower initial vehicle price
2. "Feebate" program relative to fuel efficiency
3. Federal gasoline tax increase applied as flat rate, percentage, or floor on price
4. Investment tax credits for domestic battery production facilities
5. Efficiency incentives and regulations, e.g., high performance mandate for government agency vehicle fleet
6. State sales tax exemption
7. Financial incentives for infrastructure, e.g., for businesses that allow customers and employees to charge
8. Battery warranty or guarantee to boost consumer confidence

Other incentives considered to accelerate PHEV acceptance include exempting the first million sold from sales tax and toll fees, and subsidizing the sticker price by an amount based on reduced greenhouse gas (GHG) emissions. Also, investment tax credits for domestic battery production facilities were discussed, first on a pilot basis, and then expanded into full scale production. Providing financial incentives for charging infrastructure in residential, commercial, and public applications was also agreed to likely be effective. This may entail giving tax credits to businesses that allow customers or employees to charge while they work or shop in their establishments.

The stakeholders agreed that implementation of these technologies, policies, and market strategies is instrumental in addressing important national issues, such as energy security, climate change, job creation, and electric system reliability. While some benefits are achievable during the market introduction phase on a smaller scale, the potential for PHEVs to contribute to electric system planning and operations is a long term goal. Electric system contributions and functionality such as vehicle-to-building (V2B), vehicle-to-grid (V2G), rapid charging, and battery swapping will not be needed for market introduction to be successful but will be necessary to reach sustainability in the future marketplace. To produce a fleet turnover of any significance, policy-makers, regulatory agencies, educators, and utilities will need to act together to initiate this monumental shift in the transportation sector. Getting the legislative and executive branch involved in such policy-making will not require much capital, but will require political commitment to change the status quo.

RESULTS OF INDIVIDUAL BREAKOUT SESSIONS

“RED TEAM” BREAKOUT SESSION RESULTS

As previously mentioned, the Red Team’s focus comprised all PEVs, which included but was not limited to PHEVs. The market introduction phase for PEVs in North America will be accomplished over the next 5-10 years and will involve the purchase of millions of vehicles from multiple auto manufacturers. This effort will be part of a global enterprise with many international challenges and opportunities. The stakeholder representatives from the Red Team that participated in the discussion are listed below.

TABLE 1. LIST OF PARTICIPANTS

Name	Organization
Mike Andrew	Johnson Controls – Saft
Britta Gross	General Motors Corp.
Joe Gracia	Oak Ridge National Laboratory
Ken Huber	PJM Interconnection
Donald Karner	Electric Transportation Engineering Corp.
Jim Kliesch	Union of Concerned Scientists
Eric Lightner	U.S. Department of Energy – OE
Phillip Misemer	California Energy Commission
Mitch Olszewski	Oak Ridge National Laboratory
Jim Saber	NextEnergy
Scott Schramm	Chrysler, LLC
John Sullivan	Univ. of Michigan Transportation Research Inst.
Dean Taylor, Group Spokesperson	Southern California Edison
Bob Thomas	Cornell University
Jacob Ward	U.S. Department of Energy - EERE
Robert Wimmer	Toyota Motor North America
Dick Ziegler	Sentech, Inc.
Stephen Zimmer	Sentech, Inc.
Rich Scheer, Facilitator	Energetics Incorporated
Tenley Dalstrom, Note Taker	Energetics Incorporated

There are a number of significant pinch points that could interfere with successful market introduction of PEVs. Of major concern is making the vehicles affordable to consumers. The biggest pinch point in this regard concerns the battery pack and its cost, reliability, durability, and safety. Addressing battery costs involves other issues related to battery design and manufacturing scale-up. For example, there are currently a limited number of domestic battery manufacturers, and raw materials such as lithium are mainly available overseas and are subject to supply, demand, and price fluctuations often associated with international commodity markets.

Retooling by auto makers is another substantial pinch point that will have to be addressed as factories and manufacturing processes respond to changes in government policies and new business models during PEV scale-up. The lack of trained engineers, technicians, factory workers, sales, and maintenance personnel will be a substantial impediment to the retooling process.

Another consumer acceptance concern involves charging. PEV charging practices and equipment must be simple and seamless, with substantial access for consumers whether they are at home, at work, or traveling. Addressing the charging issue will involve the development of standards for interoperability, grid interface, communications protocols, and PEV components. Billing the customer also must be easy and seamlessly address peak load and location issues. For example, billing (and pricing) should discourage charging during peak periods and accommodate long distance trips no matter where the drivers charge their vehicles, e.g., as is done today with cell phone roaming charges or toll road “easy passes.”

TABLE 2. TOP PRIORITY PINCH POINTS

- Battery costs, reliability, durability, and safety
- Limited availability of domestic suppliers for battery cell raw materials and other critical PEV components
- Standards for interoperability, grid interface, communications protocols, and components
- Need for simple and seamless PEV charging equipment and practices for consumers
- Need for technical and engineering workforce to design, manufacture, and maintain PEVs
- Retooling OEMs for large scale manufacturing

There are a number of possible policies, incentives, and regulations that can be implemented by federal, state, and local government agencies to address these pinch points and otherwise help ensure a successful market introduction phase of PEVs. A potential source of funds for various PEV and infrastructure scale-up efforts involves federal taxes on gasoline. These could be increased with the specific purpose of funding PEV development, including retooling, vehicle/battery costs, and/or charging infrastructure. There could also be specific incentives or policies aimed at batteries, since batteries are such key components. Warranties, resale guarantees, or guarantees for secondary markets could help boost financial attractiveness for battery packs, encourage alternative business models and secondary markets for batteries to develop and aid with disposal issues.

TABLE 3. TOP PRIORITY POLICIES, INCENTIVES, AND REGULATIONS

- Phase in gas taxes to fund PEV development (e.g., 15 cents a gallon to pay for batteries)
- Investment tax credits for domestic battery production facilities
- Financial incentives for charging infrastructure at residential, commercial and public locations (e.g., tax credits to businesses for customers or employees)
- Subsidies to lower initial vehicle prices (e.g., tax credits tied to oil/GHG reductions)
- Exemption from tolls and sales taxes for first million PEVs sold
- Battery warranty/guarantee by non-OEMs

Tables 4 - 7 provide the details of the results of the breakout group discussions.

TABLE 4. LIST OF PINCH POINTS (CONTINUED)

Education	Components	Vehicles
<ul style="list-style-type: none"> • Engineering and technical workforce to design, manufacture, and maintain large PEV fleets ◆◆◆◆◆◆◆◆ • Customer confusion ◆◆◆◆◆◆◆◆ <ul style="list-style-type: none"> – Many types: electric vehicle (EV), hybrid electric vehicle (HEV), PHEV, and extended range electric vehicle (EREV) – Technical complexity 	<ul style="list-style-type: none"> • Standardization of components for initial economies of scale ◆◆◆◆◆◆◆◆ <ul style="list-style-type: none"> – Balancing and consolidating emerging supply chain of key components • Manufacturing power electronics switches (e.g. IGBT) ◆◆◆◆◆◆◆◆ • Thermal management, subsystem complexity, volume/mass penalties, and cost issues 	<ul style="list-style-type: none"> • Initial design for PHEV/EREV system integration versus retrofit of existing products • Automakers may need much more HEV experience before scale-up of PHEV <ul style="list-style-type: none"> – However, EVs may be easier to make than PHEVs • Intergenerational technology migration without obsolescence • Development of durability and reliability criteria based on customer duty cycles

TABLE 5. ANALYSIS OF TOP PRIORITY PINCH POINTS

Pinch Point Topic	What needs to be done to eliminate the pinch point and during what time frame?	What organizations need to be involved?	How much money and effort will be needed? (low, medium or high)	What would be an immediate next step(s)?
Retooling OEMs for Large Scale Manufacturing	Federal funding to supplement OEM investment to accelerate implementation (2-6 months)	DOE, Office of Management and Budget (OMB), Federal Financing Bank (FFB), Congress, new administration	High	DOE award of Energy Independence and Security Act of 2007 authorized Sec. 136 advanced tech. vehicle mfg. loan program funds
	State and local government tax incentives to modernize plants including jobs training programs (0-3 years)	State/ local governments, economic dev. agencies, manufacturing equipment coalitions (e.g. National Association of Manufacturers (NAM))	Medium	Prepare/submit tax proposals and state/local government (grassroots) campaign
	Tooling and manufacturing process and equipment advances (0-3 years)	DOE (ITP), DoD (MANTECH), OEMs – assembly line, equipment suppliers - USCAR	Medium	Convene national summit on PEV-related manufacturing technologies; develop demonstration pilot plant
Engineering and Technical Workforce to Design/ Manufacture/Maintain PEVs	Retraining of existing automotive technical workforce (now)	OEM, Universities (such as GATE), Feds	Low – Medium	Federal and/or State funding to initiate program
	Continued and increased support for university programs and aggressive recruitment (now)	Feds, OEMs, Universities	Low – Medium	Expand current activities
	Target specialists in other industries (now)	OEM, suppliers	Low	Identify/target recruitment effort
	Sponsorship programs for those desiring training	Fed and State	Medium	Establish program (Fed or State) now
Home Charging/Inspection Installation Costs	Prior to PHEV purchase buyer is informed about home based requirements (next 2 years)	OEMs, dealers, municipalities, utilities, electrical contractors	Low to medium, incentivization would be helpful. Rebate? Local or State. If the dealers can handle it, the cost could be rolled into the purchase price of the car	Quantify total cost to the consumer Develop/recommend level of initiatives to accelerate infrastructure build out <ul style="list-style-type: none"> • Federal incentives • State incentives through RPS • Local?

TABLE 5. ANALYSIS OF TOP PRIORITY PINCH POINTS (CONTINUED)

Pinch Point Topic	What needs to be done to eliminate the pinch point and during what time frame?	What organizations need to be involved?	How much money and effort will be needed? (low, medium or high)	What would be an immediate next step(s)?
	Ideally, all conversion actions are bundled with a single cost. This could possibly be a dealer package (next 2 years)	OEMs, dealers, municipalities, utilities, electrical contractors	Low to medium, incentivization would be helpful Local or State rebate? If the dealers can handle it, the cost could be rolled into the purchase price of the car	Quantify total cost to the consumer Develop/recommend level of initiatives to accelerate infrastructure build out <ul style="list-style-type: none"> • Federal incentives • State incentives through RPS • Local?
	OEMs provide web based information on required actions (next 2 years)	OEMs, dealers, municipalities, utilities, electrical contractors	Low to medium, incentivization would be helpful Local or State rebate? If the dealers can handle it, the cost could be rolled into the purchase price of the car	Quantify total cost to the consumer. Develop/recommend level of initiatives to accelerate infrastructure build out. <ul style="list-style-type: none"> • Federal incentives • State incentives through RPS • Local?
Interoperability Standards	Reach out to all appropriate standards organizations and stakeholders to agree on a common set of standards	National Institute of Standards and Technology (NIST), Electric Power Research Institute (EPRI), auto manufacturing, utilities, Society of Automotive Engineering (SAE), Institute of Electrical and Electronics Engineers (IEEE), Gridwise architecture, communications industry (invisible segment), IBM, national labs	Primary voluntary; need to fund the leadership and facilitation (low \$5 million)	<ul style="list-style-type: none"> • Identify resources/funding to deliver • Put someone in charge • Learn and share leading efforts in U.S. and internationally
	Need a single agency to own the deliverable. NIST has been designated, they need to deliver	NIST	Low cost → high impact	Must be resolved within 5 years Plug/physical standard first, communications second, and back office third
Supply Chain – Very Limited Ability of Domestic Suppliers for Cell Raw Materials and Key Components	Identify the key components and key raw materials that are not currently available domestically (benchmark international competition) (3 months)	DOE study, OEMs labs, National Academy of Science (AS), (benchmarking)	Low	Gap analysis

TABLE 5. ANALYSIS OF TOP PRIORITY PINCH POINTS (CONTINUED)

Pinch Point Topic	What needs to be done to eliminate the pinch point and during what time frame?	What organizations need to be involved?	How much money and effort will be needed? (low, medium or high)	What would be an immediate next step(s)?
Why: <ul style="list-style-type: none"> • Reduce oil imports • Improve national security • Stimulate economy + create U.S. jobs for sustained health/ wealth 	Identify potential U.S. development suppliers and manufacturing suppliers (3 months)	OEMs, DOE and labs, Department of Commerce	Low	Set supplier direction
	Invest in RD&D to fill performance and cost gaps in materials and companies (protect IP!) (immediate, sustained and long term)	Congress, DOE, new administration, development suppliers, OEM (monitor development), venture capital	Medium	Line up sustained funding
	Invest in supply base/manufacturing capability (protect IP!) (immediate, sustained and long term)	Venture capital, Congress, DOE, new administration, States, cities, manufacturers, suppliers, OEMs (monitor)	High	Line up sustained funding
Battery Costs and Durability Third party warranty feasible? Possible to mandate state, gov., city, federal and utility fleets?	Automotive grade new stationary application for batteries/cells	OEMs, battery makers, stationary users	High	Summit on first item, task forces to follow with deep dive
	Long term forward pricing	OEMs, battery makers, stationary users	High	
	Large scale production = guaranteed market or warranties, or global market	Government, DOE, Congress, Internal Revenue Service (IRS)	High	
	Less than 10 Kwh products 3 “footprints” for batteries: cell, module and voltage level – helps in new, used and recycling	International Organization for Standardization (ISO)	Low	Temper expectations <=10kwh
	Durability: <ul style="list-style-type: none"> • Oversize batteries e.g., 10-40% DoD • “Blended” engine mode more as vehicle gets older 			Summit? Last item

TABLE 6. LIST OF POLICIES, INCENTIVES, AND REGULATIONS
 (◆ Indicates votes received from group participants)

For Battery Cost Reductions	Federal and State Energy Policies	Vehicle Buyers	OEMs
<ul style="list-style-type: none"> • Investment tax credits for domestic battery manufacturing facilities ◆◆◆◆◆◆◆◆◆◆ • Regulations to require standard battery packs ◆◆◆◆◆ <ul style="list-style-type: none"> – Dimensions – Communications – Recyclability, including guaranteed disposal price • Policies to credit battery use for state-level renewable portfolio standards ◆ • “Blue Rhino” approach to battery packs ◆ <ul style="list-style-type: none"> – Battery management company owns batteries and provides utilities with V2G storage to reduce financial risks to car owners • Regulations allowing utilities to own and include battery packs in rate base • Guaranteed secondary markets for battery packs • Tax credits, grants, incentives go to both stationary and mobile battery packs 	<ul style="list-style-type: none"> • Phase in increases in gasoline taxes to fund PEV development ◆◆◆◆◆◆◆◆◆◆ <ul style="list-style-type: none"> – e.g., add 15 cents to pay for battery development • Consumer education programs for PEVs modeled after “Ready Kilowatt” ◆◆ • Use fee bates ◆ <ul style="list-style-type: none"> – For vehicles and fuels • Large scale, multi-location demonstration programs ◆ • Establish minimum gasoline price of \$5 gallon or higher ◆ • Modify CAFÉ standards to allow full advantage of PEVs and AFVs ◆ <ul style="list-style-type: none"> – Develop scalable CAFÉ regulations – Develop realistic method to quantify MPG equivalent for PEVs • Fully appropriate existing Federal programs in EISA 2007 and EPACT 2005 • Eliminate state restrictions on utility involvement with new Federal legislation and benchmark to other countries • Implement attractive federal (FERC) tariffs for PEV participation in power markets • Establish national targets for PEV production • Backstop to OEM PEV purchase requirements federal, state, municipal, and private fleets • Phase in zero to very low emissions requirements for vehicles in non-attainment areas • High level government officials advocate buying PEVs 	<ul style="list-style-type: none"> • Financial incentives for building charging infrastructure ◆◆◆◆◆◆◆◆◆◆ <ul style="list-style-type: none"> – Residential, commercial, public locations – Greater access for on-street charging in urban areas – Tax credits to businesses that install charging stations for use by customers and employees • Subsidies to lower vehicle prices ◆◆◆◆◆◆◆◆◆◆ <ul style="list-style-type: none"> – Expand consumer tax credit eligibility – Tie tax credits to vehicle performance in reducing GHGs or oil imports • Exempt 1st 1 million PEVs from tolls and sales taxes nationwide ◆◆◆◆◆◆◆◆◆◆ • Incentivize development of ubiquitous billing systems so recharging can be billed like cell phones or highway toll “easy passes” ◆◆◆◆◆ • Implement new car loans that are compelling and attractive to consumers ◆◆ • Support businesses (start up funding or other incentives) for viable niche applications of PEVs ◆ • Implement non-OEM guarantees for vehicle re-purchases • Finance interest rate breaks for PEV purchases • Guaranteed technical support, servicing, and maintenance 	<ul style="list-style-type: none"> • Implement non-OEM battery warranties/guarantees ◆◆◆◆◆◆◆◆◆◆ • Create new legal consortium with all stakeholders to collaborate on PEV development ◆◆◆◆◆◆◆◆◆◆ <ul style="list-style-type: none"> – OEMs, utilities, equipment suppliers, federal and state agencies – Include anti-trust exemptions for automakers to work on PEV traction systems • Incentives to OEMs to fund the transition and minimize losses with each vehicle produced ◆◆◆◆◆◆◆◆◆◆ <ul style="list-style-type: none"> – Engineering and R&D tax credits from federal, state, and local government • Government financial incentives to increase domestic supplier content

TABLE 7. ANALYSIS OF TOP PRIORITY POLICIES, INCENTIVES, AND REGULATIONS

Policies, Incentives and Regulations Topic	What needs to be done to eliminate the pinch point and during what time frame?	What organizations need to be involved?	How much money and effort will be needed? (low, medium or high)	What would be an immediate next step(s)?
Incentive for Charge Infrastructure Development	Make it convenient for people to plug in Motivate people with feedback about cost savings (timing is now)	<ul style="list-style-type: none"> • Utilities, PUCs • Standards setting bodies (IEEE, NFPA, SAE) • OEMs, dealers (certify contractors) • Building code officials • DOE needs to pull the pieces together (many stakeholders involved, need to <u>drive</u>) 	Effort: <ul style="list-style-type: none"> • low • legislation required • green jobs, electricians Cost: <ul style="list-style-type: none"> • low to the consumer • medium to society 	Propose legislation
	Increase tax credit from the current 30% for installing charge infrastructure Should be federal because coordinating states would not be practical			
	Develop technical standards for communications, metering and billing that are requisite for getting the credit SmartGrid standards			
Domestic Battery Production	Define what qualifies as a domestic manufacturer (now)	Feds, Commerce, Energy, Defense, Treasury	Low	Establish team to prepare definition
	Understand the international playing field (now)	Feds, USABC, OEM, Battery Manufacturers	Low	Establish team to evaluate field
	Establish tax credit for U.S. manufacturing equipment (1-3 years)	Treasury, DoD, DOE	Medium	Establish what the minimum tax credit is for the next three steps
	Establish tax credit for U.S. pilot scale production (2-4 years)	Treasury, DoD, DOE	Medium	Define dual use requirement to establish DoD purchase and market
	Tax credit for full scale production (3-5 years)	Treasury, DoD, DOE	High	Define dual use requirement to establish DoD purchase and market

TABLE 7. ANALYSIS OF TOP PRIORITY POLICIES, INCENTIVES, AND REGULATIONS (CONTINUED)

Policies, Incentives and Regulations Topic	What needs to be done to eliminate the pinch point and during what time frame?	What organizations need to be involved?	How much money and effort will be needed? (low, medium or high)	What would be an immediate next step(s)?
Lower Initial Vehicle Price Who pays: Tax on users/gasoline and diesel or reduce tax breaks to oil	Tax credits to consumer	Congress or legislature finance committee	Medium-High/High effort	Lift 250,000 cap extend sunset
	Grants to consumer, demonstration and deployment	Congress or legislature Energy committee Appropriations committee	Medium-High/High effort	Fund section 131 and 641 California 118 funds
	Low interest loans to OEMs	Congress or legislature Energy committee Appropriations committee	Low/High effort	Additional Fund section 136(a) modify existing metric
	Grants to OEMs	Congress or legislature Energy committee Appropriations committee	Medium /High effort	Fund section 136 (b) modify existing metric
	Low interest loans to consumers	Congress or legislature Energy committee Appropriations committee	Low/High effort	New legislation called AB118 funds
	Fleet requirement to buy (to get mass production)	Congress or legislature Executive order, Energy committee	Low/High effort	New legislation in Congress – expand California AB 236 executive order
	Stationary battery incentive to get mass production	Congress or legislature Executive order	Medium/High effort	New legislation, executive order, PUC action
Exempt first million PEVs from tolls and taxes	Federal government would need to fund states, local government, and private toll roads to reimburse for lost revenue Actual amount per vehicle is too modest → \$2,000 per vehicle Practical challenge w/ minimal benefit	Federal, States, local, private (more than 100 organizations) Bureaucratic nightmare	Medium 1-10 billion all federal	<ul style="list-style-type: none"> • Funding authorization – Energy Act, congressional committee • Replace or addition to income tax incentive
Battery Warrantee/Guarantee by non OEM	Establish federal fund to cover battery replacement costs, which will include liability coverage (10 yr warranty) (2 years)	EPA, DOE, Congress, EPAct, OEMs, underwriters	Medium \$, low effort	New law
	Electricity utility owns and leases battery packs, secondary use must be established. (10 yr warranty) (5 year implementation)	Electric utilities, PUCs, OEMs, underwriters	Medium \$, high effort	New law, new regulations, rate cases

TABLE 7. ANALYSIS OF TOP PRIORITY POLICIES, INCENTIVES, AND REGULATIONS (CONTINUED)

Policies, Incentives and Regulations Topic	What needs to be done to eliminate the pinch point and during what time frame?	What organizations need to be involved?	How much money and effort will be needed? (low, medium or high)	What would be an immediate next step(s)?
	3 rd party ownership, secondary use must be established, business case is high bar (10 year warranty) (5 years to implement)	OEMs, other corporate entities, financial institutions, underwriters	Medium \$, high effort	Compelling business case. Possible new regulations. Also could be a 4 th “hybrid” approach
Phase in an Increase in Gas Taxes	Identify legislative sponsor to draft preliminary bill language (position legislation – energy policy component, GHG, cap and trade, revenue bill)	OEMs, battery makers, legislative bodies, auto caucuses, Electric Drive Transportation Association (EDTA), DoD, DOE, EPRI, State economic development coalitions (e.g. Michigan Economic Development Corp.)	Low	Identify potential legislation sponsors (immediately)
	Develop Advocacy coalition (1-2 years) <ul style="list-style-type: none"> • create constituency • provision of education Craft bill language Submit to floor then committee/sub-committee with legislative authority			
	Develop appropriation/ allocation/disbursement stream (identify a lead agency to disburse)			Solicitations for grants or through existing entity

“BLUE TEAM” BREAKOUT SESSION RESULTS

The emerging PHEV industry is a multi-faceted marketplace comprised of a broad range of stakeholders that will need to begin collaborating. For the introduction of PHEVs to be successful, these inter-linkages must be conceptualized and implemented. In contrast with the Red Team, the Blue Team constrained their brainstorming efforts to focus only on PHEV issues, and did not expand the discussions to include all PEVs. Below is the list of participants that conducted the Blue Team’s analysis of the major obstacles to PHEV market introduction and what could be done to overcome them.

TABLE 8. LIST OF PARTICIPANTS

Name	Organization
Bob DeVault	Oak Ridge National Laboratory
Ben Echols	Georgia Power Company
Karen Genung	Sentech, Inc.
Nancy Gioia	Ford Motor Company
Tom Gross	Consultant
Steven Boyd	U.S. Department of Energy – EERE
Michael Kintner-Meyer	Pacific Northwest National Laboratory
Therese Langer	Amer. Council for an Energy Efficient Economy
Larry Markel	Sentech, Inc.
Walter McManus	Univ. of Michigan Transportation Research Inst.
Kevin McMurphy	Sentech, Inc.
Mike Rowand	Duke Energy
Amy Lilly	American Honda Motor Company
Lee Slezak	U.S. Department of Energy – EERE
Tom Turrentine, Group Spokesperson	University of California Davis
Rajat Sen, Facilitator	Sentech, Inc.
Adrienne Weber, Note Taker	Sentech, Inc.

Several barriers to market currently exist, the majority of which are present in the supply chain. Analogous to the Red Group, the primary pinch point for the Blue Group appeared to be battery production capacity, cost, and reliability. First, a sufficient supply of raw materials, such as lithium, and components needed to scale up facilities to meet demand must be met. How quickly battery manufacturers can expand production may prove to be an issue. Second, consumers need to be assured that the battery in their PHEV is reliable enough to last for its advertised lifetime.

Lack of consumer acceptance also creates a significant barrier to the introduction of PHEVs. Most consumers have never been exposed to such technology in regards to grid connection, energy use, or charging practices. Also, the customer base could be smaller than desired, due to a limited selection of models from which to choose. Another significant pinch point in PHEV consumer acceptance is the fact that gasoline prices are currently low. Although this price reduction is likely temporary, it will undoubtedly prevent many consumers from seeing the financial benefits of PHEVs right away.

During this workshop, a consensus was reached that in order to spur PHEV acceptance, certain policies, incentives, and regulations would be required. National standards to which charging station manufacturing and installation must adhere should be implemented. For example, a code should be implemented requiring a dedicated PHEV outlet in all new home construction. Also, ensuring that battery warranties are available could help reduce customer anxiety over battery reliability and associated financial obligations.

TABLE 9. TOP PRIORITY PINCH POINTS

- Battery Issues
 - Production Capacity
 - Reliability and Warranty
- Consumer Acceptance/ Education
- Codes and Standards
- Charging Stations/ Locations
 - Home Charging
 - Standardized Charging Stations
- Low Gasoline Prices

Enhancing public education and awareness of benefits associated with owning PHEVs may be a key tool in addressing any questions or misconceptions about the new technology. Simple-to-use charging stations must be easily installed in homes of PHEV owners, and charging locations must be accessible to PHEV owners with no garages (e.g., in apartment complexes and parking garages). Ample charging stations must be installed throughout cities so that PHEV owners may charge between commutes and during errands. Implementing set codes and standards for implementation of PHEVs and charging stations would do much to advance acceptance of this technology.

TABLE 10. TOP PRIORITY POLICIES, INCENTIVES, AND REGULATIONS

- Energy Policy Driven Effort
 - Determine electrification role
- Efficiency Incentives (for OEMs, suppliers, utilities, and customers)
- Federal Gasoline/ Petroleum Tax and Rebate/ “Feebate” Program

One day, consumers will more readily accept the new technology as the greater financial benefits become more obvious. This will likely happen as the prices of PHEV technology become more competitive through economies of scale, at which point, consumers will no longer need to be enticed by incentives and rebates. The integrated solutions envisioned at this workshop will be economic, social, and environmental, and the sooner they are implemented, the better. Such strategies will need to range from the near- to long-term, and be continued with future administrations. With this continued support, PHEVs can become an integral part of our nation’s competitiveness in the global marketplace.

Tables 11-14 below provide the details of the results of the breakout group discussions.

TABLE 11. LIST OF PINCH POINTS
 (◆ Indicates votes received from group participants)

Charging Stations & Locations	Public Education & Consumer Acceptance	Codes & Standards	Energy Costs & The Economy	Smart Metering Technology/ Infrastructure
<ul style="list-style-type: none"> • Standardized charging stations/ plugs that will support Smart Grid and Advanced Meter Infrastructure (AMI) functions ◆◆◆◆ • ◆◆◆◆ <ul style="list-style-type: none"> – Accommodate different communications platforms (vary by utility) – Simple and user-friendly • Available to people w/o garages or living in apartments/ condos ◆◆◆◆ <ul style="list-style-type: none"> – Simple and user-friendly • Public charging station <ul style="list-style-type: none"> – Ensure enough charging stations to meet demand – Located close enough to encourage trips beyond the all-electric range (AER) 	<ul style="list-style-type: none"> • Public education ◆◆◆◆◆◆◆◆ <ul style="list-style-type: none"> – Metrics/ measures – No “social” instrumentation of vehicle energy use and cost – Consumers have no experience with grid connected vehicles – Must change driving cycle/ behavior – Lack of public education on PHEV performance – Lack of understanding of home infrastructure improvement to enable 240V charging • Consumer Acceptance ◆◆◆◆ <ul style="list-style-type: none"> – Overcome anxiety about new technology – Limited variety of models to choose from limits customer base – Acceptance of different vehicle attributes – Vehicle design that appeals to consumers – Celebrity endorsements 	<ul style="list-style-type: none"> • Not having a national standard would limit technology acceptance ◆◆◆◆◆◆◆◆◆◆ • Building code requiring dedicated PHEV outlet in new homes 	<ul style="list-style-type: none"> • Low conventional fuel cost prevents consumers from seeing financial benefits of PHEVs ◆◆◆◆◆◆◆◆ • Financial stability of OEMs • Depressed economy <ul style="list-style-type: none"> – Consumers not buying new cars • National Energy Policy Driven 	<ul style="list-style-type: none"> • Sufficient communication between vehicle and grid • Universally acceptable architecture for PHEV billing while roaming ◆◆◆◆◆◆◆◆◆◆ <ul style="list-style-type: none"> – Ability to accommodate dynamic pricing • Local utility distribution system upgrades to support “early adaptor” neighborhoods and subdivisions • Infrastructure: how much, when, and where, at initial deployment ◆◆◆◆◆◆◆◆◆◆ • Lack of 120V access at home compliant with National Electric Code (NEC) standard • Installation and maintenance of V2B and V2G technology • Companies allowing employees to charge during workday • PHEV service training and certification of technicians ◆◆◆◆◆◆◆◆◆◆

TABLE 12. ANALYSIS OF TOP PRIORITY PINCH POINTS

Pinch Point Topic	What needs to be done to eliminate the pinch point and during what time frame?	What organizations need to be involved?	How much money and effort will be needed? (low, medium or high)	What would be an immediate next step(s)?
Battery Production, Reliability, and Warranty (Assumption: Batteries will be good enough in PHEVs; R&D will lead to this)	Production: Manufacturing capacity needs developed, preferably domestic Understand the critical pinch point within battery production (e.g. manufacturing facilities, raw material availability, etc.) (2012 – 2015)	Primary: OEMs, battery manufacturers, federal and state government agencies	Production: Cost will be high- will require major capital investment with potentially high depreciation Effort will be moderate- scaling up of production has been done before	Production: DOE/ Industry understanding of ramping up critical paths to domestic production Guaranteed demand/ minimum orders of batteries so manufacturers know how to prepare
	Reliability and Warranty: Risk management; share the responsibility Reassurance of early market risk to boost market (FDIC- type of batteries) (2012 – 2015)	Others: Electric utilities as early adopters, 3 rd party business models	Reliability and Warranty: Cost will be variable (from nothing to total cost of battery) Depends on reliability of battery Effort will be low, this has been done before	Reliability and Warranty: Create “FBIC:” Federal Battery Insurance Corporation
Market Acceptance of PHEVs -Education on attributes and benefits - Institutions not yet worked together to realize benefits of PHEV in new business model	Facilitate partnerships Precompetitive (yes) Competitive (off the table) (Now – within 1 year)	OEMs, PUCs, DOE OEM, Utilities separately in marketplace	Federal: \$500K/ year for 4-5 years plus company investment	Establish the legal authority for a voluntary association as an entity
	Standardization of vehicle communications and advanced billing/infrastructure: EZ Pass billing (type metering) (Generations 2/3)	SAE standard bodies, PUCs, DOE, IEEE, OEMs, utilities, OEMs, National Association of Regulatory Utility commissioners (NARUC)	Federal money plus time and money from associations and companies for 10 years	Identify standards that are needed (SAE/EPRI infrastructure)- Establish structure/ prime pump <ul style="list-style-type: none"> • Find out what is going on • Identify gaps • Ensure communication and coordination
	Establish a simple Smart Grid application to support PHEV (Generations 2/3)	SAE standard bodies, PUCs, DOE, IEEE, OEMs, utilities, OEMs, NARUC, (Same as above)		Form group to design Smart Grid applications for PHEVs (i.e. how “Dumb” Grid can support PHEV and path to Smart Grid)

TABLE 12. ANALYSIS OF TOP PRIORITY PINCH POINTS (CONTINUED)

Pinch Point Topic	What needs to be done to eliminate the pinch point and during what time frame?	What organizations need to be involved?	How much money and effort will be needed? (low, medium or high)	What would be an immediate next step(s)?
	Investigate the function of specifications of PHEV operation/ charging (Now)	OEMs, dealers, PUCs, utilities, existing energy providers	Follow on to ORNL Value Proposition study- long term, ongoing- \$2 million/ year	Value Proposition study on steroids- draft specifications, hold workshops, and develop consumer education program
Low Fuel Prices	Raise cost of fuel tax (presently .47 cents/gal) using floor so that gas prices won't ever go below set amount Tax will pay for rebates on PHEVs	Federal Government: Congress, DOE, DOT, Economic advisors, CEQ (Consulate of Environmental Quality), Office of Mgmt. and Budget, Department of Commerce	Money: Could be structured to be revenue neutral, as money will come from tax Example: taxing 1 cent/gal would generation one billion dollars	Introduce environmental legislation Combine groups to form coalition; "hawk" organizations to help w/ national security Develop specific plan, translate input into legislative proposal
	Increase tax .10 cents/year relative to other policies in place (10 years)	Others: Oil Industry, Utilities, Environmental Groups, Auto Companies	Effort will be high, need political will and clout to defeat lobbyists	
	Limit amount of imports			

TABLE 13. LIST OF POLICIES, INCENTIVES, AND REGULATIONS (CONTINUED)

<p align="center">Federal Gas Taxes ◆◆◆◆◆◆ ◆◆◆◆◆◆</p>	<p align="center">PHEV Priority for Available Resources ◆◆◆◆</p>	<p align="center">National Energy Policy Driven Effort ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆</p>
<ul style="list-style-type: none"> • Use federal gas tax to “buy down” the sales price of PHEVs or offer tax credits • “Blenders” tax credit for battery kWh (equivalent to ethanol for gallons saved) • Increased federal gas tax as driver to reduce consumption of conventional fuel 	<ul style="list-style-type: none"> • Parking fee waivers or discounts locally • Federal and state purchase of PHEVs at set profit rate (procurement) • Organized “clubs” for industry w/ battery warranty program • PHEV fee waiver to national parks and museums • Require a percentage of federal fleet purchases to be PHEVs • PHEV CAFÉ credit 	<ul style="list-style-type: none"> • Energy policy driven effort that focuses on national priorities, not just marketing and development perspective

TABLE 14. ANALYSIS OF TOP PRIORITY POLICIES, INCENTIVES, AND REGULATIONS

Policies, Incentives and Regulations Topic	What needs to be done to eliminate the pinch point and during what time frame?	What organizations need to be involved?	How much money and effort will be needed? (low, medium or high)	What would be an immediate next step(s)?
Efficiency Incentives Addressing: <ul style="list-style-type: none"> • Faster market growth • Accelerating changeover of vehicle fleet • Accelerating changeover of grid/ smart/ renewable • Accelerating infrastructure access 	Technology must be ready <ul style="list-style-type: none"> • Vehicles • Battery • Grid, etc. Incentives to accelerate ahead not necessarily helpful (2013 for battery, vehicle, and grid first phase of readiness)	<ul style="list-style-type: none"> • OEM'S, suppliers, utilities, policy setters: federal, state, and local, DOE/ other regulatory agencies, education community at all levels, NGO'S, and media 	Technology: Cost will be high (\$100's of billions) Battery: need plants and research Vehicles: need re-tool and product development Grid-readiness	Analyze potential incentives such as consumer, OEM's, suppliers, and utilities
	Consumer education and policy maker education to develop and accept incentives <ul style="list-style-type: none"> • Recognize incentives need to be interconnected and address consumer, OEM, supplier, and utility needs/ participation • Fleets and real product plus examples of benefit (Now and continue on)		Education: Cost will be medium (\$100-300 million) Fleets: Cost will be medium (\$100 million) for 500-1000	Develop education plan <ol style="list-style-type: none"> 1. Policy makers: state of technology and challenges 2. Education community 3. Media (opinion-shapers)
	Identify funding sources for policy support		Funding source: Cost will be high (\$2-5 billion)	Fund an education/ demonstration fleet of vehicles
Federal Gas Taxes <ul style="list-style-type: none"> • Use as transfer payment rather than tax increase (revenue neutral) • Increase is for gasoline only, not diesel 	Temporary fuel tax increase to fund incentives for PHEVs and other highly efficient vehicles (reduce sticker price) <ul style="list-style-type: none"> • Don't set quotas by manufacturer • Amount of sticker price reduction is dependent on fuel efficiency of vehicle • Revenues may be used to finance OEM retooling/ service technician retraining (In effect for 5-10 years, phase out as national energy goals are met)	<ul style="list-style-type: none"> • Congress • OEMs • Consumer groups • Dealers 	Cost will be low- medium: Tax between 1-10 cents/ gallon (Example: 1 cent increase = \$1 billion dollars raised)	Study and work out the details <ul style="list-style-type: none"> • Develop metric to set rebate amount based on fuel efficiency/ oil savings

TABLE 14. ANALYSIS OF TOP PRIORITY POLICIES, INCENTIVES, AND REGULATIONS (CONTINUED)

Policies, Incentives and Regulations Topic	What needs to be done to eliminate the pinch point and during what time frame?	What organizations need to be involved?	How much money and effort will be needed? (low, medium or high)	What would be an immediate next step(s)?
National Energy Policy Driven Effort	Clearly define goals: Objectives: <ul style="list-style-type: none"> • Specific • High-level Potentials: <ul style="list-style-type: none"> • Efficiency • Petrol displacement • Diversification <ul style="list-style-type: none"> - environmental stewardship (3 months)	*Danger of politicalization <ul style="list-style-type: none"> • Executive (White House) 	Effort will be high: Issue is national will and commitment, not man-hours Money will be low	Citizens demand this direction and industry stresses that this direction is required
	Identify electric vehicle’s role in achieving goals: <ul style="list-style-type: none"> • HEV • PHEV • BEV (6 months)	<ul style="list-style-type: none"> • Executive (White House) 	Money and effort will be medium: priority given to electrification’s role will determine level of each.	Complete step one, then take the same next steps
	How does it happen? <ul style="list-style-type: none"> • See other group’s examples of incentives, regulations, etc. to put in place • Education • Taxes Similar examples: DOD technologies and the highway system	See other breakouts: Government, OEM’s, utilities, etc.	Money will be low: may NOT require more money, just more focused money Effort will be high	Refer to “next steps” from other breakout group’s top priority incentives

CONCLUSIONS AND PATH FORWARD

The objective of this workshop was to conduct a thorough analysis of what is needed for a successful PHEV market introduction. As demonstrated in the workshop results, key pinch points and market solutions associated with the PHEV market can, at times, overlap with other electric-powered vehicles or be broad enough to include all PEVs. It is critical to ensure that the key pinch points are properly identified, and that appropriate policies and incentives are put in place to address them. There is also a need at the national level for a comprehensive policy and clear priorities for the modernization of both the transportation and electricity sectors. This is necessary so that the role for PHEVs (relative to other energy and transport options) can be properly defined and funded. Listed below in Tables 15 and 16 are summaries of the most important pinch points and policies, incentives, and regulations identified in the workshop from both breakout groups.

TABLE 15. SUMMARY OF TOP PRIORITY PINCH POINTS

- Battery Issues
 - Reliability, warranty, safety, and cost
 - Limited production capacity
 - Limited availability of domestic suppliers for raw materials
- Consumer Acceptance and Education
 - PHEVs must meet basic needs while offering greater value than competition
 - Need education on impacts of driving/charging habits and how to maximize efficiency
- Codes and Standards
 - Interoperability, grid interface, communications protocols, and components
 - Standardized charging equipment
- Need Simple and Accessible Charging Stations for Consumers
 - Stations must be plentiful and close together
 - Home charging must be available on-street to people without garages
- Low Gasoline Prices do not Provide Incentive to Increase Efficiency
- Need Development of Technical and Engineering Workforce
 - Design, manufacture, and maintenance of PHEVs and infrastructure
- Large Investment Required to Retool OEMs for Large Scale Manufacturing

TABLE 16. SUMMARY OF TOP PRIORITY POLICIES, INCENTIVES, AND REGULATIONS

- Energy Policy Driven Effort
 - Determine electrification role
- Phase in Gasoline Tax
 - Implement floor, or on a flat or percentage basis
- Implement Feebate Program
 - Fees collected from sale of inefficient vehicles will fund rebates for efficient vehicles
- Investment Tax Credits for Domestic Battery Production Facilities
- Subsidies to Lower Initial Purchase Price of PHEVs
- Financial Incentives for Charging Infrastructure at Residential, Commercial, and Public Locations
 - Tax credits to businesses allowing customers/employees to charge
- Exemption From Tolls and Sales Taxes for First Million PHEVs Sold
- Battery Warranty/Guarantee by Non-OEMs
 - Develop 2nd life market for batteries, e.g., recycling programs
- Efficiency Incentives (for OEMs, suppliers, utilities, and customers)

Toward this end, more extensive and effective coordination will be needed within the federal sector, including cooperation with state agencies, the electric power industry, auto manufacturers, equipment suppliers, universities, and national laboratories. DOE is well positioned to lead these efforts, but authorized funding will need to be appropriated by Congress. The Offices of EERE and OE will need to expand their efforts to coordinate activities. In summary, the key market pinch points identified in the workshop are associated with supply chain inefficiencies, infrastructure readiness, and consumer acceptance and education.

In the next phase of the PHEV Market Introduction Study, details on top priority policies, incentives and regulations will be provided to analysts at ORNL and Pacific Northwest National Laboratory (PNNL) / University of Michigan Transportation Research Institute (UMTRI) to be input into their respective PHEV consumer choice models. With these models, the project team will be able to estimate the overall impact of each policy, incentive or regulation on nationwide PHEV sales during market introduction. Characteristics that may be used to assess this include:

- Range of choice among makes and models
- Value of home refueling
- Availability of refueling infrastructure
- Subsidy and tax credit
- Housing type
- Vehicle and component supply constraint
- Consumer attitudes toward new technology
- Driving behavior among area types and among census divisions
- Vehicle attributes
 - Purchase price
 - Performance
 - Fuel economy
 - Fuel price
 - Vehicle capacity
 - Battery cost
 - Range

A preliminary version of the PHEV Market Introduction Study Report, scheduled for release in February 2009, will include results from initial modeling efforts by ORNL analysts on the aforementioned priority policies, incentives and regulations. A concept, estimated cost and timeframe for implementation will be provided for each mechanism that is analyzed. Key organizations and probable sources of funding will also be suggested in the preliminary version of the report.

The final version of the report, to be released later in 2009, will be expanded to include results from the PNNL/UMTRI consumer preference models. The addition of these models will help to develop a more thorough outlook for PHEV sales penetration and strengthen recommended action items, e.g. drafting of legislative proposals, which are believed to have the greatest impact on a successful market introduction while contributing to national energy goals.

APPENDIX A. WORKSHOP AGENDA

DECEMBER 1, 2008

- 12:30 pm Welcoming Remarks U.S. Dept. of Energy Representatives
Lee Slezak *Vehicle Technologies Program*
Pat Davis *Vehicle Technologies Program*
- 1:00 pm PHEV Value Proposition Study Results
Bob DeVault *Oak Ridge National Laboratory*
- 1:20 pm PHEV Market Introduction Study Overview
Karen Genung *Sentech, Inc.*
- 1:40 pm Charge to the Breakout Groups
Rich Scheer *Energetics Incorporated*
- 1:45 pm Break
- 2:00 pm Breakout Sessions Begin (2 groups of 25 participants each)
Breakout Discussion Topic #1
Identification of Top Priority “Pinch Points”
- 4:00 pm Break
- 4:15 pm **Breakout Session Discussion Topic #2**
Analysis of Top Priority “Pinch Points”
- 5:30 pm Adjourn for the day

DECEMBER 2, 2008

- 8:00 am Continental Breakfast
- 8:30 am Breakout Sessions Resume
Breakout Session Discussion #3
Identification of Top Priority Policies, Incentives and Regulations
- 10:00 am Break
- 10:15 am **Breakout Session Discussion #4**
Analysis of Top Priority Policies, Incentives and Regulations

DECEMBER 2, 2008 (CONTINUED)

11:30 am **Breakout Session Discussion #5**
Preparation of Breakout Group Reports

12:15 pm Breakout Sessions Adjourn

12:30 pm Lunch with Breakout Session Reports

1:30 pm Path Forward

Lee Slezak
Bob DeVault

Vehicle Technologies Program
Oak Ridge National Laboratory

2:00 pm Workshop Adjourns

APPENDIX B. PHEV MARKET INTRODUCTION STUDY PARTICIPANT LIST (* DENOTES MEMBERS OF GUIDANCE & EVALUATION COMMITTEE)

***Michael Andrew**

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Patrick Davis

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Oak Ridge National Laboratory

***Ben Echols**

Product Manager
Electric Mobility
Georgia Power Co. (Southern Company)

James Francfort

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Ken Huber

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Michael Kintner-Meyer

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Jim Kliesch

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Clean Vehicles Program
Union of Concerned Scientists

Therese Langer

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***Scott Schramm**
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Rajat Sen
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Lee Slezak
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