DRIVING RESEARCH AND INNOVATION FOR
VEHICLE EFFICIENCY AND ENERGY SUSTAINABILITY

Partnership Plan

July 2014

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Foreword

This document describes the vision, mission, scope, and governing policies of the U.S. DRIVE Partnership ("Partnership"). Other key Partnership documents and information are available online at www.vehicles.energy.gov/about/partnerships/index.html or www.uscar.org.

Definition

U.S. DRIVE stands for Driving Research and Innovation for Vehicle efficiency and Energy sustainability. It is a non-binding, non-legal, voluntary government-industry partnership focused on advanced automotive and related energy infrastructure technology research and development (R&D).[1] Members are referred to as "partners" and include the U.S. Department of Energy and companies in the automobile, energy, and electric utility industries. Specifically, the Partnership facilitates pre-competitive technical information exchange among experts who interact as equal partners to discuss R&D needs, develop joint goals and technology roadmaps, and evaluate R&D progress.

The Partnership itself does not conduct or fund R&D; each partner makes its own decisions regarding the funding and management of its projects. By bringing together technical experts in a common area of expertise and by providing a framework for frequent and regular interaction, the Partnership –

- Accelerates technical progress; peers in the technical community discuss pre-competitive, technology-specific R&D needs and challenges, identify possible solutions, and evaluate progress toward jointly-developed technical goals.
- Focuses on technology that creates national benefits while avoiding duplication of efforts to ensure that publicly-funded research delivers high-value results and overcomes high-risk barriers to technology commercialization.

Partners

- Automobile industry: U.S. Council for Automotive Research LLC (USCAR, the cooperative research organization for Chrysler Group, Ford Motor Company, and General Motors Company); Tesla Motors
- Electric utility industry: DTE Energy Company, Southern California Edison Company, and the Electric Power Research Institute
- Federal government: U.S. Department of Energy
- Fuels industry: BP America, Chevron Corporation, Phillips 66 Company, ExxonMobil Corporation, Shell Oil Products US

U.S. DRIVE Vision

American consumers have a broad range of affordable personal transportation choices that reduce petroleum consumption and significantly reduce harmful emissions from the transportation sector.

[1] U.S. DRIVE is a non-legal entity. "Partnership" and "partners" are used in an informal sense to denote participants working together toward the stated goals of the group.

U.S. DRIVE Mission

Accelerate the development of pre-competitive and innovative technologies to enable a full range of efficient and clean advanced light-duty vehicles, as well as related energy infrastructure.

Scope

The following elements comprise the Partnership's scope:

Technical Scope

The Partnership examines a portfolio of pathways and precompetitive technologies that fall into four broad categories:

- Vehicles: Advanced combustion and emission control, electric drive and power electronics, electrochemical energy storage, fuel cells, lightweight materials, and vehicle systems and analysis
- Fuels: Hydrogen production, hydrogen delivery, fuel pathway integration, or other sustainable mobility fuel as agreed to by the Partnership
- Joint Vehicles/Fuels: Hydrogen codes and standards, hydrogen storage
- Joint Vehicles/Electric utility: Electric grid interaction

Pre-Competitive R&D

The Partnership focuses exclusively on pre-competitive R&D. No government- or company-confidential information is introduced in the Partnership process. The Partnership does, however, coordinate with other related programs for information exchange, as appropriate. One example of such coordination is between the Partnership's Grid Interaction Technical Team and the Department of Energy's Clean Cities Program on issues of mutual interest related to electric vehicle market introduction barriers.

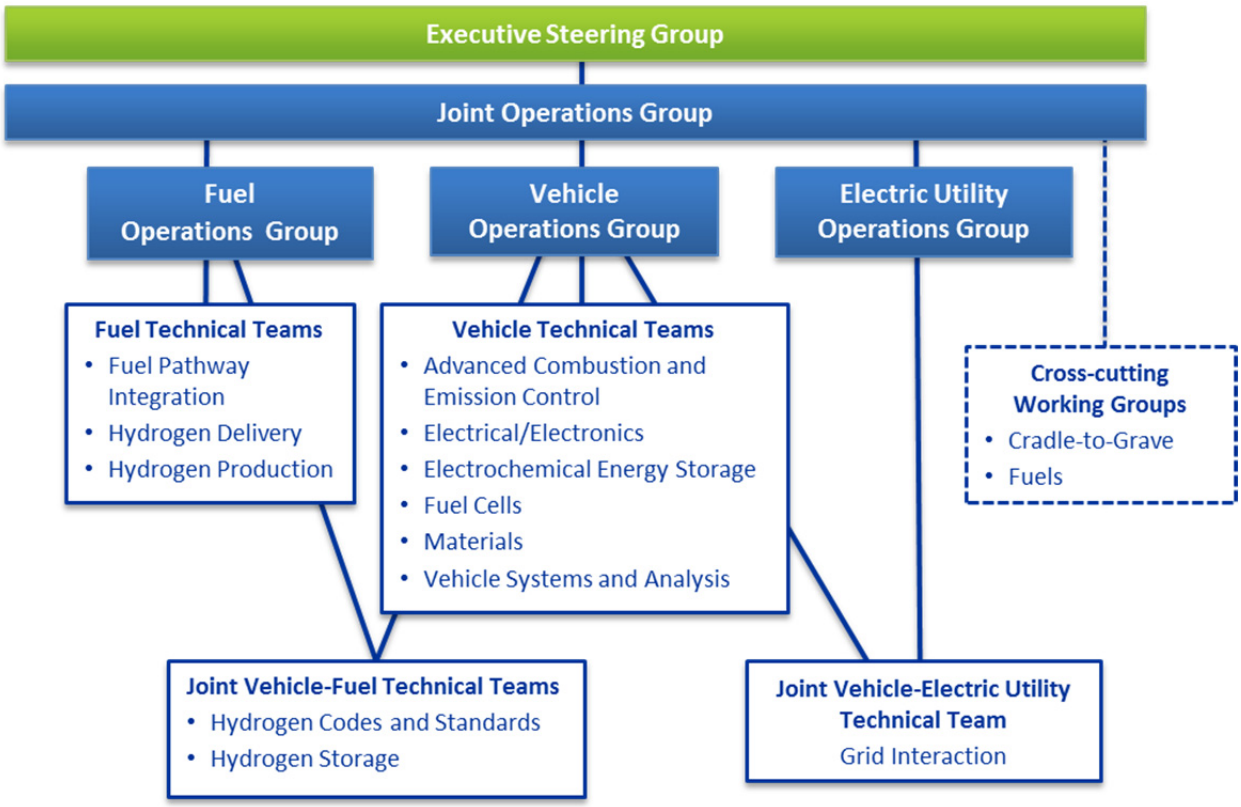
Light-Duty Vehicles

The Partnership focuses exclusively on technologies for cars and light trucks. When appropriate and on a case-by-case basis, the Partnership will coordinate and exchange information with the 21st Century Truck Partnership, which focuses on medium- and heavy-duty vehicles.

Governance

Organization

Figure 1. U.S. DRIVE Organizational Structure (July 2014)



Executive Steering Group

The Executive Steering Group (ESG) oversees the Partnership, with responsibility for high-level technical and management priorities as well as Partnership policy decisions. Each partner organization has a representative in the ESG – for industry partners, a vice presidential-level executive, and for DOE, the Assistant Secretary for Energy Efficiency and Renewable Energy.

ESG members participate as peers with no designation of officers. The ESG meets annually. (Should an unavoidable schedule conflict arise, ESG members are permitted to send a delegate with decision-making authority.) ESG meetings provide for an exchange of objectives, concerns, and issues in order to achieve a mutual understanding among partners.

Operations Groups

Operations Groups support the ESG and manage Partnership function, enable regular and strong coordination across all of the partner organizations, and exchange information on areas of mutual interest at a management level, as appropriate. They are responsible for managing and enabling effective technical team and working group operation, solving problems that may arise, reviewing and endorsing Partnership work products, and providing guidance to technical teams and working groups on Partnership deliverables and other matters as necessary. Participants are director-level representatives of partner companies; DOE participation includes Vehicle Technologies and Fuel Cell Technologies Office Directors as well as DOE's U.S. DRIVE Partnership director. Each of the three industry-related Operations Groups – Fuel, Electric Utility, and Vehicle – meets regularly on a schedule determined to suit its needs. A Joint Operations Group (JOG) meets monthly, bringing together the Fuel, Electric Utility, and Vehicle Operations Group participants for an exchange of information and views on issues of mutual interest, discussion of issues related to Partnership management, and decision-making on guidance and other communication to Partnership participants.

Technical Teams

Technical teams ("tech teams") are the core of the Partnership, bringing together partners' top scientists and engineers in each of twelve key focus areas.

1. Advanced Combustion and Emission Control
2. Electrical/Electronics (electric drive)
3. Electrochemical Energy Storage
4. Fuel Cells
5. Materials
6. Vehicle Systems and Analysis
7. Grid Interaction
8. Fuel Pathway Integration
9. Hydrogen Production
10. Hydrogen Delivery
11. Hydrogen Storage
12. Hydrogen Codes and Standards

Tech teams identify technology gaps, develop R&D targets, develop roadmaps to achieve technical targets and goals, and evaluate technical status and R&D progress. Each team has a unique set of objectives, technical issues, position on the research-development-deployment continuum, and relation to industry and government needs. These differences necessitate flexibility in how teams are structured and operate, but several common factors provide consistency across the Partnership

- All teams meet on a regular basis, typically monthly. The ability to quickly, easily, and routinely convene experts in different fields on issues of mutual interest is a benefit of the Partnership framework. Teams hold joint meetings as needed on cross-cutting topics.
- All teams have a DOE co-chair and at least one industry co-chair – joint tech teams, with participation from more than one industry group, have more than one industry co-chair (e.g., vehicle co-chair and fuel co-chair, or vehicle co-chair and electric utility co-chair).
- All teams are strongly encouraged to include associate members, adding incremental expertise, as needed.
- Each team develops and maintains a roadmap specific to its focus area; all roadmaps are publicly available.

- The Partnership's Technical Team Guide defines team roles and responsibilities, boundaries and expectations, the general scope of team activities, and common operational policies.

Associate Members

The Partnership also includes associate members representing non-partner organizations, who participate at the technical level for a designated period of time. All technical teams are strongly encouraged to include associate members, adding incremental expertise as needed. Associate membership provides additional experts with diverse perspectives, including technical knowledge uniquely relevant to a specific technical area. The Partnership's tech teams identify and select associate members in a consensus-based process among U.S. DRIVE partners (see below).

Working Groups

Working groups bring together subject-matter experts from U.S. DRIVE partner organizations to focus on a particular issue or task, as directed by the ESG. Working groups are task-oriented and do not have a roadmap or technical targets; rather, their work is guided by a charter or charter-like document that describes their objective and/or task scope.

- Each working group meets regularly, with a focus on deliverables consistent with its approved scope and on meeting its overall objective.
- Each working group has a DOE co-chair and at least one industry co-chair, depending on the cross-cutting nature of the effort (e.g., there may be one vehicle co-chair, fuel co-chair, and electric utility co-chair, as appropriate).
- Each working group reports to the JOG on a regular basis. Each working group updates the ESG on the status of its work and seeks ESG direction and approval of any proposed new work within its focus area.
- A working group's focus and tasking, participation, and status in the Partnership can evolve over time, as recommended by the JOG and/or approved by the ESG. This evolution can include the transition to a formal tech team with a roadmap and technical targets, or phasing out of a working group upon completion of a task or as directed by the ESG.

Operating Principles

1. U.S. DRIVE partners operate as equals in the Partnership.
2. U.S. DRIVE partners make a strong commitment to participating in the Partnership at all levels; this includes providing top technical expertise with the capacity to substantively contribute to technical team and working group operation, as well as engaging at the management- and senior-management levels to facilitate Partnership success.
3. U.S. DRIVE partners and associate technical team members must comply with all applicable laws and regulations, including U.S. anti-trust and competition laws; further, partners conduct activities in a way that avoids any appearance of anti-competitive behavior, even though no violation of law has occurred.

4. Each U.S. DRIVE partner makes its own decisions regarding its own funding of projects and programs, according to its own internal policies, requirements, and/or guidelines; similarly, each U.S. DRIVE partner directs and manages its own projects and programs according to its own internal policies, procedures, and requirements.
5. No proprietary or government- or company-confidential information is introduced in the Partnership process.
6. U.S. DRIVE is a voluntary, non-binding, and non-legal Partnership. Partners may choose to discontinue their participation at any time; should an organization choose to leave, however, it cannot resume U.S. DRIVE participation without consensus of the current partners.
7. U.S. DRIVE partners and associate technical team members abide by and conduct activities in accordance with the Intellectual Property and Proprietary Information provisions in the U.S. DRIVE Policies and Procedures Manual.

Decision-Making and Work Product Approval

1. U.S. DRIVE partners use a consensus process to make decisions about technical direction and Partnership targets, membership (new partners and tech team associate members), and other key matters that affect the Partnership. Partners have the option to abstain from participating in the consensus process for any given decision; by choosing to abstain, they agree to follow the decision made by the non-abstaining partners.
2. The Partnership's Executive Steering Group (ESG) approves the Partnership Plan and any substantive changes to the Plan. The ESG also approves Partnership goals and Partnership targets, as well as any changes to those goals and targets. Decisions are made using the consensus process described in section 6.c.1 above.
3. Technical teams develop their technology roadmaps and make decisions using the consensus process described above. Roadmaps are public documents. A new or revised roadmap must be reviewed and/or approved before publishing in a process appropriate to the degree of revision. All changes require review by at least the technical team. Substantive changes are previewed by the relevant operations group prior to publication, and if the roadmap change concerns a Partnership target, the Executive Steering Group must approve the change prior to publication. Other Partnership work products, such as the Annual Highlights of Technical Accomplishments Report, follow a similar consensus-based approval process.

For More Information

For more information about U.S. DRIVE, and to access Partnership documents including technology roadmaps, please see the U.S. Department of Energy web site, www.vehicles.energy.gov/about/partnerships/index.html or USCAR web site, www.uscar.org.

ADDENDUM:
U.S. DRIVE Partnership Goals and Research Targets

In support of its vision and mission, U.S. DRIVE has identified Partnership goals and research targets for its portfolio of advanced vehicle technologies, as shown below. Goals are qualitative, reflect the Partnership's overall mission to accelerate the development of pre-competitive technologies, and guide the development of quantitative research targets.

Research targets, which focus on advanced technologies for vehicle systems and components, are based on the technical achievements needed to enable commercialization, subsequent market introduction, and long-term market penetration of advanced automotive technologies. Partnership research targets (shown below) represent the most significant technical metric(s) for each goal and serve as the focal point for multiple cascading and other additional Technical Team research targets.[2] These targets, as well as other technical requirements and parameters, are identified in publicly-available U.S. DRIVE technology roadmaps. The Partnership uses analytical tools to examine the links between various metrics and research targets in a vehicle-level context and to understand the relationship between targets across the technology portfolio.

Depending on their focus area and nature of activity, some U.S. DRIVE technical teams may work toward objectives, rather than research targets, that align with and support the Partnership's vision, mission, and goals. All U.S. DRIVE technical teams have roadmaps that include either research targets or objectives.[3]

Partnership Goal (1): Enable reliable hybrid electric, plug-in hybrid and range-extended electric, and battery electric vehicles with performance, safety, and costs comparable to or better than advanced conventional vehicle technologies, supported by charging technologies that can enable the widespread availability of electric charging infrastructure.

- **2020 Partnership Research Targets:**
    - *An electric vehicle battery at a cost of $125/kWh.*
    - *An electric traction drive system at a cost of $8/kW.*

[2] Cost-related Partnership research targets are expressed in 2012 dollars.
[3] U.S. DRIVE technology roadmaps, which identify barriers; research targets, objectives, and other technical requirements; and overall strategies, are publicly available online at www.vehicles.energy.gov/about/partnerships/index.html or www.uscar.org.

Partnership Goal (2): Enable reliable fuel cell electric vehicles with performance, safety, and costs comparable to or better than advanced conventional vehicle technologies, supported by viable hydrogen storage and hydrogen production and delivery pathways that can enable the widespread availability of hydrogen fuel.

- **2020 Partnership Research Targets:**
  - *An automotive fuel cell system at a cost of $40/kW.*
  - *An onboard hydrogen storage system at a cost of $10/kWh.*

Partnership Goal (3): Significantly improve the efficiency of vehicles (including hybrids) powered by advanced internal combustion powertrains and vehicle fuel systems while protecting the environment.

- **2020 Partnership Research Target:** *A 20% improvement in engine efficiency, compared to a 2010 baseline. Engine concepts shall be commercially viable and meet 2020 emissions standards.*

Partnership Goal (4): Improve the efficiency of all vehicle types by using lightweight materials to reduce vehicle mass.

- **2020 Partnership Research Target:** *An 18% glider[4] mass reduction, relative to comparable 2012 vehicles, at cost of $5.00/lb saved.*

In addition to the Partnership goals and research targets for advanced vehicle technologies listed above, the U.S. Department of Energy (DOE) has identified a hydrogen threshold cost of $2-4 per gallon of gasoline equivalent (gge) to indicate the cost at which hydrogen is projected to be competitive with gasoline.[5] The threshold cost, which is pathway independent and includes the cost of delivery and dispensing, helps guide DOE hydrogen production and delivery R&D activities[6] and remains important to the Partnership's goals and targets for fuel cell electric vehicles. It is important to note that the hydrogen threshold cost is a *DOE threshold cost* and not a Partnership goal or target. DOE determined the methodology and other assumptions used to identify the threshold cost with input from multiple stakeholders, including the Partnership's Fuel Pathway Integration Technical Team and others in an open and public process.[7]

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[4] For this purpose, glider is defined as the total vehicle, minus the propulsion system, fuel and energy storage, wheels, and tires.

[5] The threshold cost excludes taxes and is expressed as 2007 dollars. It is based on the Energy Information Administration's 2009 forecast of gasoline cost in 2020, as well as the fuel economy and incremental vehicle cost of hydrogen fuel cell vehicles relative to other advanced vehicle technologies in 2020, and is expressed as a range to reflect variability in future fuel efficiency improvement factors, competitive gasoline cost, and vehicle costs.

[6] For DOE hydrogen production and delivery technical targets, please see the DOE Fuel Cell Technologies Multi-Year Research, Development, and Demonstration Plan, www.eere.energy.gov/hydrogenandfuelcells/mypp/index.html.

[7] See DOE Fuel Cell Technologies Program Record #11007, "Hydrogen Threshold Cost Calculation," http://hydrogen.energy.gov/pdfs/11007_h2_threshold_costs.pdf