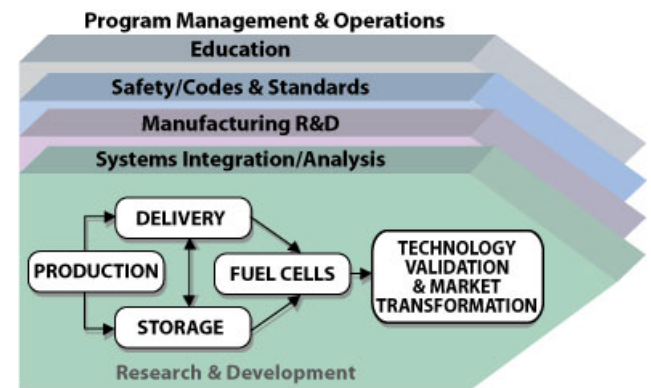


6.0 Program Management and Operations

The DOE Hydrogen Program is composed of activities within the Offices of Energy Efficiency and Renewable Energy (EERE); Fossil Energy (FE); Nuclear Energy, Science and Technology (NE); and Science (SC). EERE's Hydrogen, Fuel Cells & Infrastructure Technologies Program represents a major component of this effort. To maintain a cohesive overall program and to be consistent with the National Academies recommendations, the DOE Hydrogen Program is being managed by a single Program Manager located within EERE. This allows for clear lines of communication, and integrates the many participating offices, agencies, laboratories, and contractors.



DOE's Hydrogen Program includes RD&D, systems analysis, systems integration, safety, codes and standards, and education activities, requiring the integrated efforts of Washington, D.C., offices, field offices, national laboratories, academic institutions, and numerous contractors spread across the country. Many individuals and organizations take part in the Program through partnerships with automotive and power equipment manufacturers, energy and chemical companies, electric and natural gas utilities, building designers, diverse component suppliers, other federal agencies, state government agencies, universities, national laboratories, and other stakeholder organizations. The diversity and size of the program requires a Program management and operations approach based on a uniform set of requirements, assumptions, expectations, and procedures.

6.1 Program Organization

The organizational structure of the DOE Hydrogen Program is shown in Figure 6.1.1. Program management takes place at DOE Headquarters in Washington, D.C. Project management is conducted in the field office locations in Golden, CO; Morgantown, WV (National Energy Technology Laboratory); Idaho Falls, ID; and Chicago. Project implementation is carried out at the national laboratories, industry and universities, and through coalitions with state and local government agencies.

The management approach is grounded in the following results-oriented management principles:

- A vertical organization with clear lines of responsibility and authority
- Top-down (to project) program planning from conception to technology validation, and time-phased technical, cost and schedule baselines
- Centralization of key functions to ensure effective integration of the Program's projects
- Independent Program control systems ensuring maximum visibility/transparency.

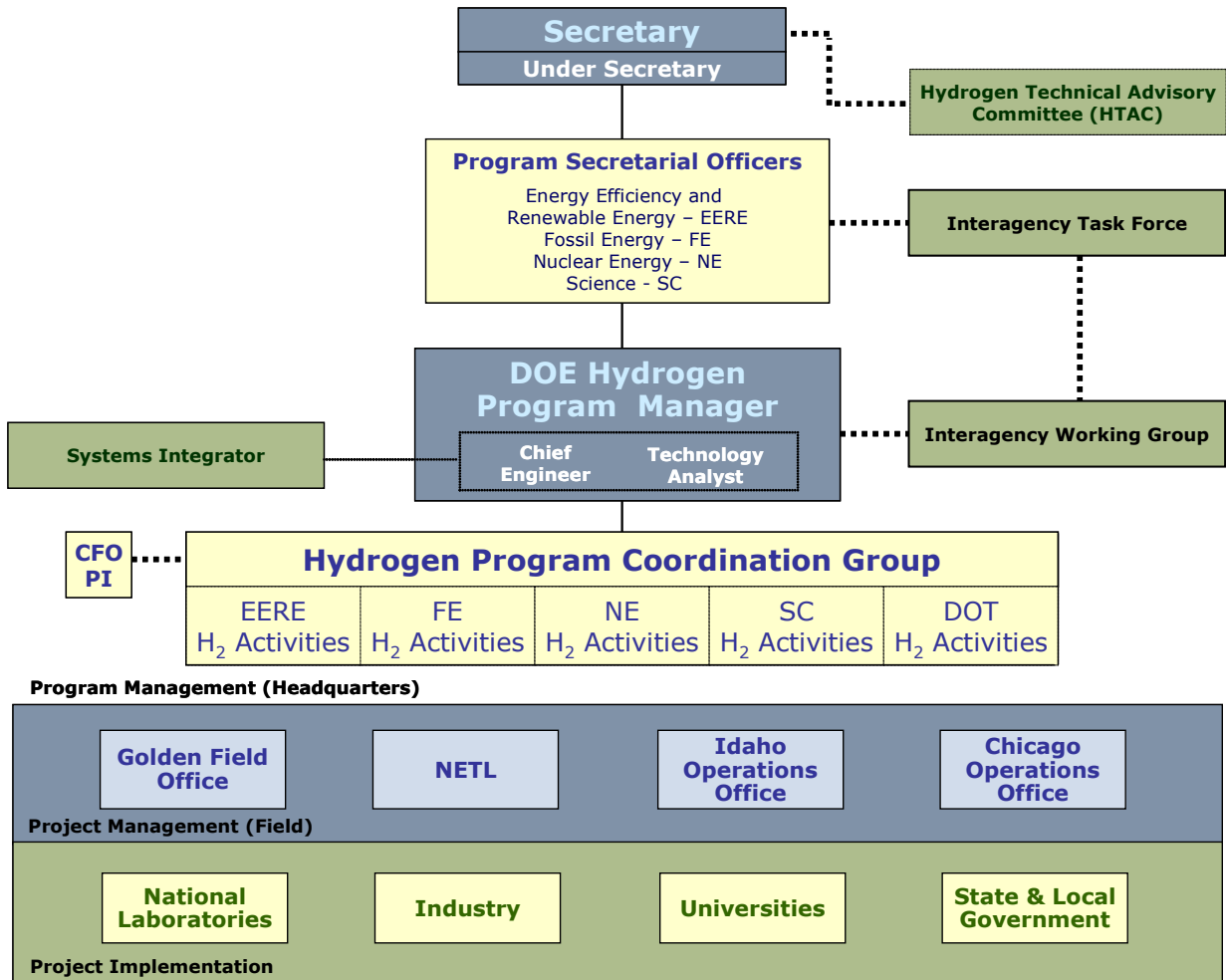


Figure 6.1.1 DOE Hydrogen Program organization chart

Advisory Groups

The Hydrogen Program seeks the best available information from experts in a variety of fields, such as chemistry and chemical engineering, materials science, environmental sciences, biology, physics, mechanical engineering, and systems engineering. Since the creation of the DOE Hydrogen Program, a variety of groups have been identified or created to oversee, review, or advise Program activities. Two examples of DOE Hydrogen Program advisory groups include the following:

National Academies

At DOE's request, the executive arm of the National Academy of Engineering appointed a committee in September 2002 to conduct a study of Alternatives and Strategies for Future Hydrogen Production and Use. The study evaluated the status and cost of technologies for production, delivery, storage and end-use of hydrogen, as well as reviewed DOE's hydrogen research, development and demonstration strategy. The final report is available at <http://books.nap.edu/books/0309091632/html/index.html>. The initial evaluation was followed up with a second analysis in 2004 to evaluate technology costs and barriers and R&D needs in the Hydrogen Program. The final report for this evaluation is available at <http://books.nap.edu/catalog/10922.html>. The Energy Policy Act of 2005 (EPACT) requests that the National Academy of Sciences conduct a review of the Program every fourth year from the date of enactment.

Hydrogen and Fuel Cell Technical Advisory Committee (HTAC)

HTAC was established under Section 807 of the Energy Policy Act of 2005 to provide technical and programmatic advice to the Energy Secretary on hydrogen research, development, and demonstration efforts. Announced in June 2006, HTAC is composed of 25 members representing domestic industry, academia, professional societies, government agencies, financial organizations, and environmental groups, as well as experts in the area of hydrogen safety. HTAC is tasked with reviewing and making recommendations to the Secretary in a biennial report on:

- The implementation of programs and activities under Title VIII of EPACT 2005;
- The safety, economic, environmental and other consequences of technologies for the production, distribution, delivery, storage and use of hydrogen energy and fuel cells;
- The plan under section 804 of EPACT 2005 (i.e., Hydrogen Posture Plan (www1.eere.energy.gov/hydrogenandfuelcells/posture_plan04.html)).

The Secretary will consider, but is not required to adopt, HTAC recommendations and will either describe the implementation of each recommendation or provide an explanation to Congress for the reasons that a recommendation will not be implemented. The Secretary also provides the resources necessary for HTAC to carry out its responsibilities.

Partnerships

Through cooperative partnerships, the DOE Hydrogen Program leverages the capabilities and experience of stakeholders in industry, state and local governments, and international organizations. The roles of these groups vary, as does the nature of their collaboration with DOE. In broad terms, the roles that these stakeholder groups play are as follows:

- **Industry.** Partnerships in developing, validating and demonstrating advanced fuel cell and hydrogen energy technologies
- **State and Local Governments.** Partnerships in codes and standards, field validation and education
- **International.** Partnerships in R&D, validation, codes and standards and safety.

Industry

The FreedomCAR and Fuel Partnership includes the Department of Energy, United States Council for Automotive Research (USCAR) and five energy companies (BP America, Chevron Corporation, ConocoPhillips, ExxonMobil Corporation, and Shell Hydrogen) to develop the technologies and the infrastructure for hydrogen fuel cell vehicles to emerge in the transportation sector. The Executive Steering Group (ESG) governs and manages the Partnership (see Figure 6.1.2). The ESG is comprised of the DOE Under Secretary and a senior executive responsible for R&D from each of the Partnership member companies.

The Partnership’s operations groups are responsible for oversight of Partnership activities and serve as primary information channels to the ESG and include the DOE Program Managers for the Hydrogen, Fuel Cells & Infrastructure Technologies Program and the FreedomCAR and Vehicle Technologies Program. The FreedomCAR Operations Group includes the senior technical managers from the automotive companies, while the Fuel Operations Group includes senior level technical directors from energy companies. The operations groups are responsible for identifying and managing their respective technical teams.

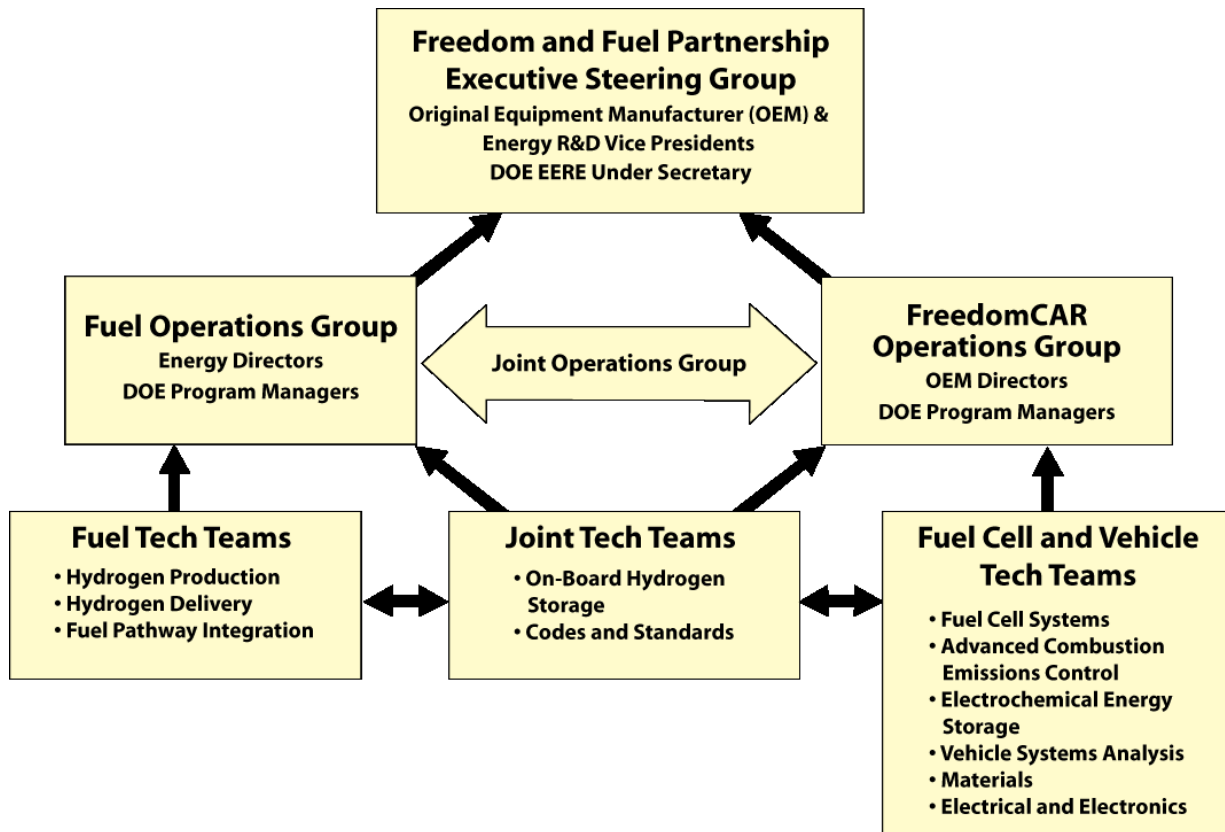


Figure 6.1.2 FreedomCAR and Fuel Partnership Executive Steering Group

The Partnership's technical teams consist of scientists and engineers with technology-specific expertise from the automotive and energy partner companies, DOE, national laboratories, and other organizations on an as-needed basis, such as the supplier community and other government agencies. The primary purpose of the technical teams is to identify and recommend comprehensive technical goals and evaluate progress and the achievement of technical milestones of the program. Each of the partners considers information developed by the technical teams in implementing its respective R&D programs. In addition, the technical teams assist DOE in reviewing the Hydrogen Program.

State, Local, and Regional Entities

The DOE Hydrogen Program collaborates with State and local government organizations and various regional entities to promote development and demonstration of hydrogen technologies. For example, the California Fuel Cell Partnership is a unique collaboration of auto manufacturers, energy companies, fuel cell technology companies and government agencies that is placing fuel cell vehicles on the roads in California. This partnership is showcasing new vehicle technology that could move the world toward practical and affordable environmental solutions. In addition to DOE, the other government partners include the California Air Resources Board, the California Energy Commission, the South Coast Air Quality Management District, the Upper Midwest Hydrogen Initiative, DOT and EPA.

The U. S. Fuel Cell Council has developed a comprehensive database that catalogues initiatives, policies and partnerships involving stationary fuel cell installations, hydrogen fueling stations and vehicle demonstrations in the United States (www.fuelcells.org/info/charts/h2fuelingstations.pdf; www.fuelcells.org/info/statedatabase.html). State and local partnerships are the primary vehicle through which DOE meets the needs of individual citizens, cities, counties and states across the nation. The Program will do the following:

- Work with states and communities to promote the Program
- Identify and engage community and state partners
- Coordinate with public and private sector activities.

International

On April 23, 2003, the Secretary of Energy called for an International Partnership for the Hydrogen Economy. As a result of the Secretary's vision, efforts were initiated with 16 countries and the European Commission in the areas of codes and standards, fuel cells, hydrogen production, hydrogen storage, economic modeling, and education. These efforts led to formation of the International Partnership for a Hydrogen Economy (www.iphe.net).

The Secretary's call for an international partnership built on the efforts of the previous several years, during which DOE coordinated international activities to advance hydrogen and fuel cell technologies. DOE continues to take a leadership role in the International Energy Agency Hydrogen Implementing Agreement (www.iea.org) and Advanced Fuel Cell Implementing Agreement (see Table 6.1.1).

In addition, the Program is working with international groups, such as the International Organization of Standards, to develop a comprehensive set of codes and standards, which will facilitate the global demonstration and commercialization of hydrogen and fuel cell technologies.

Table 6.1.1 International Energy Agency Hydrogen and Advanced Fuel Cell Implementing Agreement Tasks	
Hydrogen	Fuel Cells
Hydrogen from Carbon-Containing Materials	Polymer Electrolyte Fuel Cells
Solid and Liquid State Storage	MCFC Towards Demonstration
Integrated Systems Evaluation	Solid Oxide Fuel Cells
Hydrogen Safety	Fuel Cells for Stationary Applications
Water Photolysis	Fuel Cell Systems for Transportation
Biohydrogen	Fuel Cells for Portable Applications

Coordination

Interagency Task Force and Interagency Working Group

The Hydrogen and Fuel Cell Interagency Working Group, which has been meeting regularly since early 2003, provides a key mechanism for collaboration among federal agencies involved in hydrogen and fuel cell research, development, and demonstration. Co-Chaired by DOE and the White House Office of Science and Technology Policy (OSTP), the working group has now focused its activities more specifically on fulfilling the responsibilities assigned to it in the Energy Policy Act of 2005 (Section 806). Principal activities involve education and information-sharing across federal agencies to promote the development of safe, economical, and environmentally friendly hydrogen energy systems. The working group is also responsible for assisting the Secretary of Energy with decisions related to federal agency procurements of fuel cells and hydrogen energy systems and with support for the development of hydrogen and fuel cell safety codes and standards. The working group has also created two ad hoc committees to help carry out its duties: (1) an ad hoc committee to develop a regulatory framework (led by the Department of Transportation), and (2) an ad hoc committee on biomass-to-hydrogen production and fuel cells for rural applications (led by DOE and the Department of Agriculture). The working group web site, www.hydrogen.gov, provides additional information and a portal to details about federal activities to advance the development of hydrogen and fuel cell technologies.

In August 2007, a high level Interagency Task Force was established to assist the Secretary with decisions related to improving efficiency in the federal government by promoting federal agency deployment of fuel cells and hydrogen energy systems.

6.2 Program Management Approach

The overall management of the DOE Hydrogen Program consists of a performance-based planning, budgeting, analysis and evaluation system:

Program Planning

The Energy Policy Act provides the foundation for the DOE Hydrogen Program. The Program integrates the hydrogen planning in EERE, SC, FE, and NE, which is reflected in the DOE Hydrogen Posture Plan. Each office has its own research plan, which supports the Posture Plan and provides more technical detail. These plans are coordinated to ensure consistency throughout the Program and to avoid duplicative research efforts.

Program Budgeting

The budget for DOE’s Hydrogen Program falls under the jurisdiction the Energy and Water subcommittees. The key activities by DOE office are shown in Table 6.2.2.

Table 6.2.2 DOE Hydrogen Program Key Activities	
<p>EERE</p> <ul style="list-style-type: none"> ▪ Hydrogen Storage ▪ Hydrogen Production and Delivery ▪ Fuel Cell Stack Components ▪ Technology Validation ▪ Transportation Systems ▪ Distributed Generation Systems ▪ Fuel Processing ▪ Safety, Codes and Standards ▪ Systems Analysis ▪ Education ▪ Manufacturing 	<p>Office of Fossil Energy</p> <ul style="list-style-type: none"> ▪ Fuels, Hydrogen from Coal ▪ Carbon Sequestration ^a ▪ Pipeline Infrastructure ^a <p>Office of Nuclear Energy</p> <ul style="list-style-type: none"> ▪ Generation IV Nuclear Systems Initiative ^a ▪ Nuclear Hydrogen Initiative <p>Office of Science</p> <ul style="list-style-type: none"> ▪ Chemical Science, Geoscience, and Energy Science ▪ Materials Science and Engineering
<p>^a These appropriations support the DOE Hydrogen Program, but are not directly a part of it, and would be funded even without it.</p>	

Analysis and Evaluation

Program budget performance is regularly evaluated by OMB, in consultation with the Office of Science and Technology Policy. The OMB evaluation includes both the OMB R&D Investment Criteria and the OMB Program Assessment Rating Tool (PART) process. The criteria are used to guide Program budget planning, management review, and performance goals and targets. Each year, the Program reports its current status against pre-established Program goals. In addition, projects are evaluated through both the Program’s Annual Merit Review and Peer Evaluation and also FreedomCAR and Fuel Partnership technical team review.

6.3 Program Elements

Using hydrogen as an energy carrier will require successfully addressing RD&D challenges including lowering the cost of hydrogen production, delivery, storage, and fuel cells; establishing effective codes and equipment standards to address safety issues; and education to raise awareness, accelerate technology transfer, and increase public understanding of hydrogen energy systems. To ensure the success of the hydrogen infrastructure, DOE’s Hydrogen Program has established the Program elements that are shown in Figure 6.3.1. The complex interdependencies of these elements and technology options need to be understood and their interfaces managed to achieve overall Program objectives. Consequently, as research provides new insights and as markets and policies evolve, the Program will refine Program elements accordingly (the role of the Systems Integration function). To provide this research feedback loop effectively, it is essential that a continuum of basic and applied research, technology development, and learning demonstrations be incorporated into the Program’s portfolio.

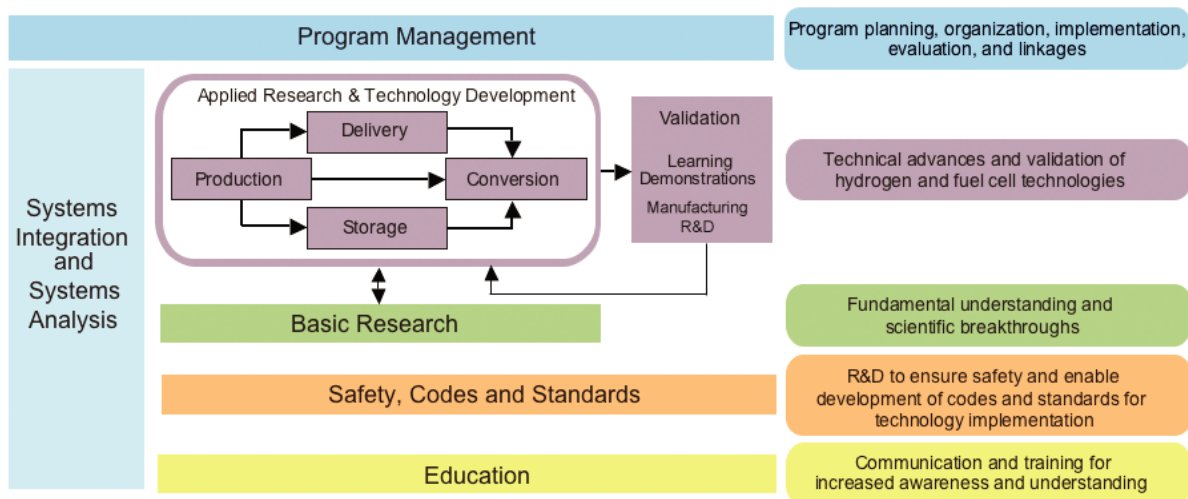


Figure 6.3.1. DOE’s Hydrogen Program elements

6.4 Program Implementation

The implementation strategy for the DOE Hydrogen Program is based on three guiding principles:

Linking the RD&D and Education Efforts to Policies, Requirements, and the Process for Selecting Options

The Hydrogen Program mission is to research, develop, and validate technologies for producing, storing, delivering and using hydrogen in an efficient, clean, safe, reliable, and affordable manner.¹ An implementation strategy has been developed to ensure that all Program activities and procedures are consistent with the overall mission and the requirements contained in the Hydrogen Posture Plan.

Organizing the Work

To ensure an appropriate master schedule and defensible budget requests for the Program through 2015, a detailed Work Breakdown Structure (WBS) was developed. The WBS is constantly updated to serve two main purposes: (1) to ensure that the right work is being done and (2) to ensure that the right work is done correctly. Program goals were imposed “top-down,” consistent with the policies and requirements contained in the Hydrogen Posture Plan, whereas detailed tasks, schedules, and budgets were established “bottoms-up.” The WBS divides the Program into manageable segments of work to facilitate program management, cost estimating and budgeting, schedule management, cost and schedule control, and reporting of cost and schedule performance. It ensures all required work is incorporated in the Program and that no unnecessary work is included.

Managing and Monitoring the Program

The DOE Hydrogen Program is managed in accordance with its approved integrated baseline: the technical baseline (i.e., a compilation of the Program’s technical requirements) and the programmatic baseline (i.e., the work scope, schedule, and cost deemed necessary to satisfy the technical requirements). The programmatic portion of the integrated baseline ensures the amount of work to be accomplished, the time allotted to accomplish the Program activities, and the resources required to complete the work scope are evenly balanced. It provides the Program Manager with the necessary insight to monitor and manage the entire Program. In addition, the Program is currently working towards providing an increased level of insight and control by implementing an Earned Value Management System in accordance with DOE Order 413.3, Program and Project Management for the Acquisition of Capital Assets.

¹ Hydrogen Posture Plan, August 2006 Draft

Program Control

To ensure that the DOE Hydrogen Program remains on schedule and within cost, a Program control system has been instituted with the following objectives:

- Provide assurance that all work has been planned and considered in developing the Program cost and schedule baselines
- Identify the necessary procedures and organizational measures required for effective, timely management of the effort
- Ensure that these measures are implemented and that the resulting information accurately reflects the status of the Program
- Establish a review and decision-making process that addresses Program dynamics.

Under the Program control system, integrated cost, schedule, and technology baselines are developed. The performance of the DOE Hydrogen Program offices and supporting organizations (contractors, national laboratories, etc.) in completing tasks is measured against these baselines and reported to their organizations, to track program performance or take corrective actions if necessary. The Program uses a change control process, a procedure by which changes to an accepted work product are carefully proposed, assessed, conditionally accepted, and applied. The change control process provides a measure of stability to the Program and ensures consistency across Program elements.

Responsibilities for Program Control

The Chief Engineer is responsible for Program oversight. The Systems Integrator – in support of the Chief Engineer – gathers, integrates, and analyzes information on the scope, schedule, and budget of elements of the Program. Element plans and schedules are integrated into a Program plan, work breakdown structure, and master schedule. Together these plans comprise the programmatic baseline that is associated with a specific version of the technical baseline. The Systems Integrator analyzes this information to ensure that all technical requirements are addressed and consistent, and to identify critical paths, milestones, and decision points. The Systems Integrator provides tools and information to support DOE in monitoring performance against schedule and budget and in identifying risk.

Implementation of Program Control

Figure 6.4.1 provides an overview of the DOE Hydrogen Program's control process. The primary inputs to Program control include the integrated baseline (see Chapter 5), budget guidance, and results of prior Program reviews.

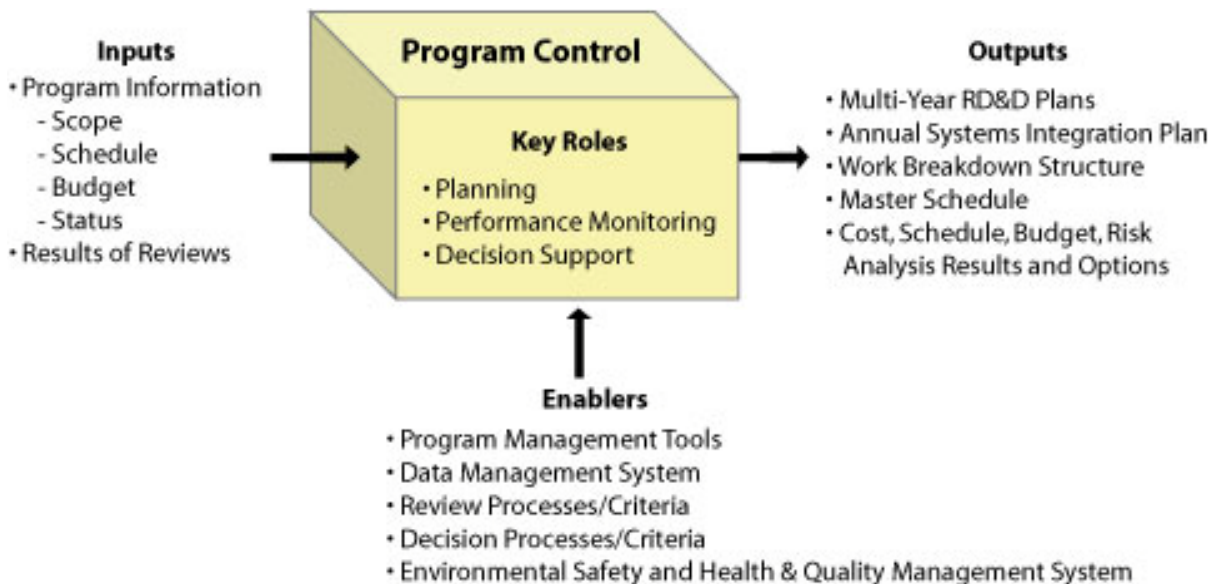


Figure 6.4.1 Program-control process

Decision-Making Process

A stage gate type process is being used to manage R&D investments. The stage-gate process is a disciplined approach for evaluating projects at key points. The stage-gate process being used includes go/no-go decisions and down-select points that must be passed before work on the next stage can begin. Reviews held at these key stages ensure that a project has met its milestones and satisfies the criteria for proceeding to the next stage of the program. Reviewers may include individuals from government agencies, national laboratories and the private sector.

Technical criteria are used at each stage and decisions are made to either:

- Advance the project to the next stage
- Continue the current effort because not all goals have been met
- Place the project on hold because the need appears to have gone away, but could re-emerge
- Conclude the project because it is unlikely to meet its goals or there is no longer a need for the effort.

Each of the gate reviews considers the impact on the direction of the overall Program of both new knowledge and insights that have been gained during the progression of the Hydrogen Program.