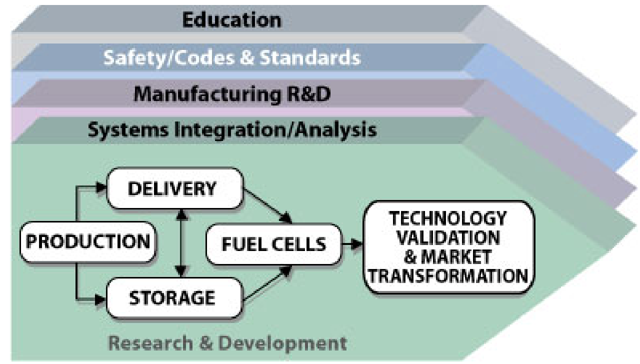
3.7 Hydrogen Codes and Standards



The United States and most countries in the world have established laws and regulations that require commercial products to meet all applicable codes and standards to demonstrate that they are safe, perform as designed and are compatible in the systems in which they are used. Hydrogen has an established history of industrial use as a chemical feedstock, but its use as an energy carrier on a large-scale commercial basis remains largely undeveloped and untested. The development and promulgation of codes and standards are essential to establish a market-receptive environment for commercial, hydrogen-based products and systems for energy use.

The Hydrogen Codes and Standards subprogram (subprogram) focuses on the research and development needed to strengthen the scientific basis for technical requirements incorporated in national and international standards, codes and regulations. The subprogram also sponsors a national effort by industry, standards and model-code development organizations and government to prepare, review and promulgate hydrogen codes and standards needed to expedite hydrogen infrastructure development and to help enable the emergence of hydrogen as a significant energy carrier. In addition, DOE supports the global harmonization of codes and standards through the International Partnership for the Hydrogen Economy (IPHE).

The aim of the subprogram is to help identify those codes and standards that will be necessary and useful for the commercialization of hydrogen energy technologies, facilitate the development of those codes and standards and support publicly available research that will be necessary to develop a scientific and technical basis for such codes and standards.

3.7.1 Goal and Objectives

Goal

Perform underlying research to enable the development of codes and standards for the safe use of hydrogen in energy applications. Facilitate the development and harmonization of international codes and standards.

Objectives

- Develop a robust supporting research and development program to provide critical hydrogen behavior data and a detailed understanding of hydrogen combustion and safety across a range of scenarios, needed to establish setback distances in building codes and minimize the overall data gaps in code development.
- Support and facilitate the completion of technical specifications by the International Organization for Standardization (ISO) for gaseous hydrogen refueling (TS 20012) and

standards for on-board liquid- (ISO 13985) and gaseous- or gaseous blend- (ISO 15869) hydrogen storage by 2007.

- Support and facilitate the effort, led by the National Fire Protection Association (NFPA), to complete the draft Hydrogen Technologies Code (NFPA 2) by 2008.
- With experimental data and input from Technology Validation Program element activities, support and facilitate the completion of standards for bulk hydrogen storage (e.g., NFPA 55) by 2008.
- Facilitate the adoption of the most recently available model codes (e.g., from the International Code Council [ICC]) in key regions by 2007.
- Complete preliminary research and development on hydrogen release scenarios to support the establishment of setback distances in building codes and provide a sound basis for model code development and adoption.
- Support and facilitate the development of Global Technical Regulations (GTR) by 2010 for hydrogen vehicle systems under the United Nations Economic Commission for Europe, World Forum for Harmonization of Vehicle Regulations and Working Party on Pollution and Energy Program (ECE-WP29/GRPE).
- Support and facilitate the completion by 2012 of necessary codes and standards needed for the early commercialization and market entry of hydrogen energy technologies.

3.7.2 Technical Approach

The Hydrogen Program recognizes that domestic and international codes and standards must be established along with affordable hydrogen and fuel cell technologies to enable the timely commercialization and safe use of hydrogen as an energy carrier. The lack of codes and standards applicable to hydrogen as an energy carrier is a major institutional barrier to deploying hydrogen technologies. It is in the national interest to eliminate this potential barrier. As such, the subprogram works with domestic and international standards development organizations (SDOs) to facilitate the development of performance-based standards. These standards are then referenced by building and other codes to expedite regulatory approval of hydrogen technologies. This approach ensures that U.S. consumers can purchase products that are safe and reliable, regardless of their country of origin, and that U.S. companies can compete internationally.

The key U.S. and international SDOs developing and publishing the majority of hydrogen codes and standards are shown in Table 3.7.1. These organizations typically work with the public and private sectors to develop codes and standards.

Table 3.7.1. Organizations Involved in Codes and Standards Development and Publication	
Organization	**Responsibility**
Domestic Codes and Standards	
American Society for Testing and Materials (ASTM)	Materials testing standards and protocols
American National Standards Institute (ANSI)	Certifies consensus methodology of and serves as clearinghouse for codes and standards development
American Petroleum Institute (API)	Equipment standards
American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)	Equipment design and performance standards
American Society of Mechanical Engineers (ASME)	Equipment design and performance standards
Compressed Gas Association (CGA)	Equipment design and performance standards
CSA America (CSA)	Equipment standards
U.S. Department of Transportation	Vehicle standards and regulations
International Association of Plumbing and Mechanical Officials (IAPMO)	Mechanical building code
Institute of Electrical and Electronic Engineers (IEEE)	Electrical standards
International Code Council, Inc. (ICC)	Family of model-building codes

Table 3.7.1. Organizations Involved in Codes and Standards Development and Publication (continued)

Organization	Responsibility
National Fire Protection Association (NFPA)	Model building codes, standards
Natural Gas Institute (NGI)	Natural gas vehicle standards
Society of Automotive Engineers (SAE)	Vehicle system and subsystem design and performance standards
Underwriters Laboratories (UL)	Equipment and performance testing standards
International Codes and Standards	
International Electrotechnical Commission (IEC)	International performance standards
International Organization for Standardization (ISO)	International performance standards

A national agenda for hydrogen codes and standards has been adopted through a collaborative effort among DOE, industry, SDOs and model-code development organizations (CDOs). This collaboration has enabled significant progress in the development of codes and standards for hydrogen energy applications. For example, provisions for hydrogen use are included in the International Code Council's (ICC) International Building, Residential, Fire, Mechanical and Fuel Gas model codes. Additional provisions, such as underground storage of liquid hydrogen and canopy storage of gaseous hydrogen, have been incorporated in the most recent edition of the ICC model codes. The National Fire Protection Association (NFPA) is developing a Hydrogen Technologies Code (NFPA 2) and has joined with the ICC and the National Hydrogen Association (NHA) to form the Hydrogen Industry Panel on Codes (HIPOC) that will further harmonize requirements for hydrogen facilities.

The Codes and Standards Technical Team (Tech Team) under the FreedomCAR and Fuel Partnership has developed and maintains a RD&D roadmap to establish a firm scientific and technical basis for codes and standards. The roadmap identifies key experimental and analytical needs to support codes and standards development. Data and information obtained through implementation of the roadmap are provided to the appropriate standards and model code development organizations. The Tech Team also reviews the DOE RD&D projects annually so that the results generated effectively support codes and standards development.

Research to Facilitate Domestic Codes and Standards Development

A primary role of the subprogram is to support R&D to provide a technical basis for the development of hydrogen codes and standards. This R&D focuses on basic hydrogen properties and behavior, as well as the testing of materials and components that support standards development.

The Codes and Standards subprogram also facilitates and supports the codes and standards development process. One result of DOE's effort is the creation of "National Templates," which identify players and establish relationships to facilitate codes and standards development. Through these relationships, DOE and the major SDOs and CDOs coordinate the preparation of critical standards and codes for hydrogen technologies in vehicular and stationary applications. The structure provided by the templates is implemented through the National Hydrogen and Fuel Cell Codes and Standards Coordinating Committee (Coordinating Committee) formed by the DOE, NHA, and the U.S. Fuel Cell Council. The Coordinating Committee provides a single national forum for the codes and standards community to keep participants aware of progress in implementing the templates and to discuss issues and concerns that may arise.

The subprogram has also assumed a communication role so that timely, accurate and relevant information is prepared and disseminated to stakeholders. An important part of implementing the National Templates is to maintain an awareness of the status of and changes in hydrogen codes and standards. The DOE has worked with ANSI to create a hydrogen portal on ANSI's national standards network. The portal (www.hcsp.ansi.org), is linked to a matrix (posted at www.fuelcellstandards.com) that lists codes and standards by application area and for each code and standard listed, provides a brief description, technical contacts and current status. The portal also facilitates electronic access to key hydrogen standards and model codes.

Information about current codes and standards issues is also provided through the Hydrogen Safety Newsletter published monthly by the National Hydrogen Association (NHA) and available at www.hydrogensafety.info. The Newsletter also tracks activities in codes and standards and provides a convenient site for information on codes and standards, such as the minutes of the monthly teleconference meetings of the Coordinating Committee.

The ICC and the NFPA are the two major organizations that develop model codes in the U.S. Typical model codes available for adoption by state and local governments are listed in Table 3.7.2. Many of these model codes have been or are being amended to incorporate requirements for hydrogen applications.

Table 3.7.2. Typical Model Codes	
Model Code	**Content**
Fire Code	Regulations affecting or relating to structures, processes, premises and safeguards regarding fire and explosions.
Building Code	Ensures public health, safety, and welfare as they are affected by repair, alteration, change of occupancy, addition and location of existing buildings.
Electrical Code	Ensures public safety, health, and general welfare through proper electrical installation, including alterations, repairs, replacement, equipment, appliances, fixtures and appurtenances.
Property Maintenance Code	Ensures adequate safety and health as they are affected by existing building structures and premises.
Zoning Code	Enforces land use restrictions and implements land use plan.
Energy Conservation Code	Ensures adequate practices for appliances, HVAC, insulation and windows for low cost operation.
Residential Code	Applies to the construction, alteration, movement, enlargement, replacement, repair, use and occupancy of one- and two-family dwellings.
Plumbing Code	Regulates the erection, installation, alteration, repairs, relocation, and replacement, in addition to use or maintenance, of plumbing systems.
Mechanical Code	Regulates the design, installation, maintenance, alteration and inspection of mechanical systems that are permanently installed and used to control environmental conditions and related processes.
Fuel Gas Code	Regulates the design, installation, maintenance, alteration, and inspection of fuel gas piping systems, fuel gas utilization equipment and related accessories.
Performance Code	Establishes requirements to provide acceptable levels of safety for fire fighters.

Table 3.7.3 summarizes the various roles that the private sector and the federal government have in the codes and standards development process. The federal government's traditional role has been to serve as a facilitator/developer for standards that cover technologies or applications that are of national interest. Examples include the involvement of the U.S. Coast Guard in standards for marine use; the Department of Transportation (DOT) for interstate pipelines, tunnels, railroads and interstate highways; and DOE for appliances (e.g., voluntary ENERGY STAR Program). In each case, the private sector plays a significant role in the process. It is also important to note that state and local governments must incorporate standards and model codes in regulations for the standards and codes to be enforceable.

The federal government also plays an important role in the adoption process, which involves converting a voluntary standard or model code into a law or regulation. Congress may pass laws governing both residential and commercial building design and construction to ensure public safety. Certain agencies of the federal government may also be granted authority by Congress to adopt and implement regulatory programs.

Table 3.7.3. Private and Federal Sector Role in Codes and Standards Development

Private Sector		Government Sector		
Standard/Model Code Development Organizations	Other Private Sector Firms	Federal	State	Local
Develop consensus-based codes and standards with open participation of industry and other stakeholders.	Develop hydrogen technologies and work with SDOs to develop standards.	Perform underlying research to facilitate development of codes and standards, support necessary research and other safety investigations, and communicate relevant information to stakeholders (including state and local government agencies).	Evaluate codes and standards that have been developed and decide whether to adopt in whole, part, or with changes.	Evaluate codes and standards that have been developed and decide whether to adopt in whole, part, or with changes.

International Codes and Standards Development

The Hydrogen, Fuel Cells and Infrastructure Technologies Program supports the development of international codes and standards that facilitate trade between the U.S. and other countries. The Codes and Standards subprogram coordinates and supports the participation of U.S. experts at key international codes and standards development organization meetings sponsored by ISO, IEC and ECE-WP29/GRPE. The subprogram also supports the International Partnership for a Hydrogen Economy in collaborative R&D with other member governments to provide the technical basis for the development of codes and standards.

Through its coordination of the domestic codes and standards agenda, the subprogram facilitates national consensus positions on international standards. The subprogram also supports and coordinates the U.S. Technical Advisory Groups (TAGs) for ISO TC197 (Hydrogen Technologies), IEC TC105 (Fuel Cell Technology) and other key ISO and IEC technical committees. The TAGs provide a national forum for industry and government experts to develop consensus positions on proposed ISO and IEC documents and actions. The subprogram also works with the EPA and DOT/NHTSA to provide technical expertise on issues before the WP29/GRPE.

3.7.3 Programmatic Status

Current Activities

The current Codes and Standards subprogram activities are summarized in Table 3.7.4.

Table 3.7.4. Ongoing Activities for Hydrogen Codes and Standards		
Activity	**Objective**	**Organizations**
U.S. Domestic Codes and Standards Development Activities		
Stakeholder Meetings and Technical Forums	Supports technical and coordination meetings to ensure communications among key stakeholders.	NREL, PNNL, LANL, SNL, NHA, USFCC
Technical Expertise	Supports hydrogen safety research and provides expert technical representation at key industry forums and codes and standards development meetings, such as the ICC and NFPA model code revision process	SNL, NREL, LANL
Consensus Codes and Standards Development	Supports coordinated development of codes and standards through a national consensus process	NREL, SNL, ANSI, API, ASME, ASTM, CGA, CSA, ICC, NFPA, NHA, SAE, UL
Information Dissemination	Supports information forums for local chapters of building and fire code officials and the development of case studies on the permitting of hydrogen refueling stations.	PNNL, NREL, NHA, SNL, LANL
Research, Testing and Certification	Supports focused research and testing needed to verify the technical basis for hydrogen codes and standards and for certification of components and equipment.	SNL, NREL
National Template for Standards, Codes and Regulations	Identifies key areas of standards, codes, and regulations for hydrogen vehicles and hydrogen refueling/service/parking facilities and designates lead and supporting organizations.	NREL
Codes and Standards Matrix Database	Provides inventory and tracking of relevant domestic codes and standards: ensures that a complete set of standards is available.	NREL, ANSI, NHA

Table 3.7.4. Ongoing Activities for Hydrogen Codes and Standards (continued)		
Activity	**Objective**	**Organizations**
U.S. International Codes and Standards Development Activities		
International Stakeholder, Consensus Development and Harmonization Meetings	Supports the international codes and standards development activities of ISO TC197, IEC TC105 and the International Partnership for a Hydrogen Economy (IPHE)	LANL, NREL
Technical Expertise and Underlying Research Activities	Provides representation and technical expertise in support of U.S. concerns at key international codes and standards development organization meetings and forums, including ISO, IEC, and United Nations Economic Commission for Europe (WP29/GRPE).	LANL, NREL, SNL

Status of Equipment Standards

Domestic Standards

The status of domestic standards in each application area is described below. Up to date information on the development of fuel cell equipment standards is maintained at www.fuelcellstandards.com.

Stationary Fuel Cell Standards

Stationary fuel cell standards are the most comprehensively available standards within hydrogen technologies, as the phosphoric acid fuel cell has been commercially available for more than 20 years. Standards are being revised or developed to more adequately represent emerging fuel cell technologies. Figure 3.7.1 illustrates the significant efforts underway for standards development related to stationary fuel cells.

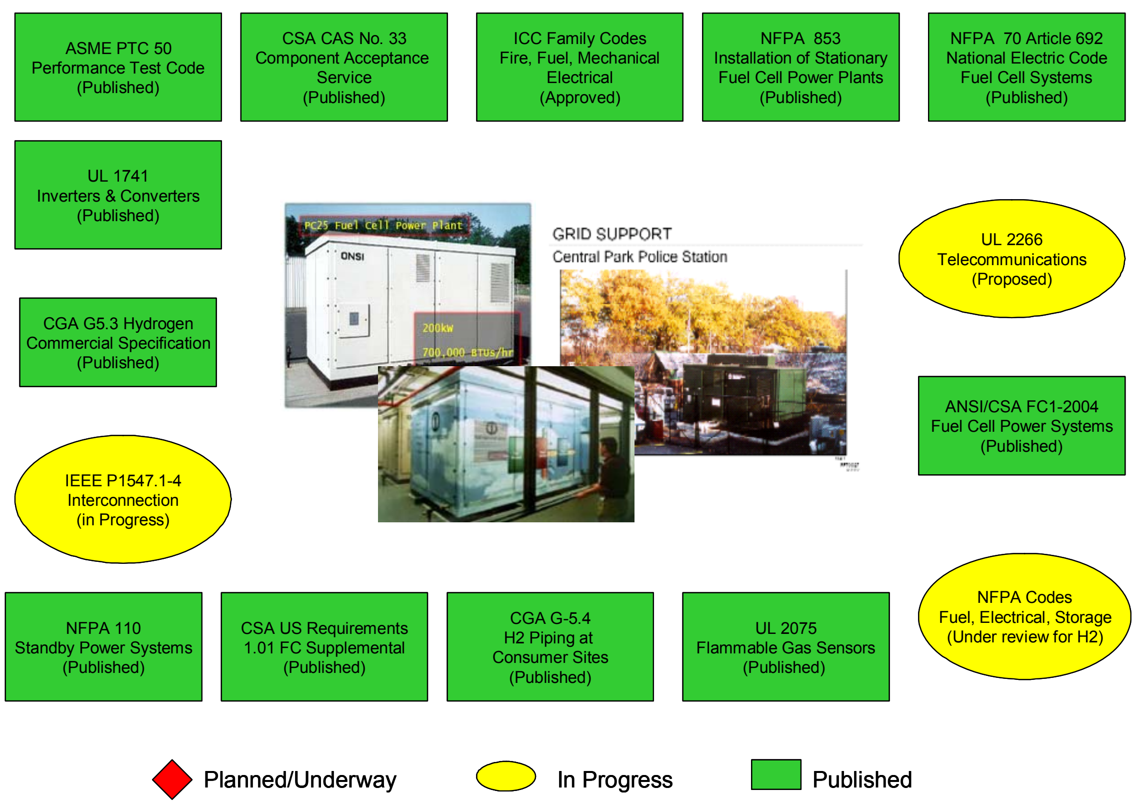


Fig. 3.7.1 Domestic Codes and Standards for Stationary Fuel Cells

Fuel Cell Vehicle Standards

A comprehensive effort is underway for the development of standards for automotive technologies. SAE, working with technical experts from automotive, industrial gas and fuel cell companies, has developed a list of the standards that are needed for the commercialization of fuel cell vehicles. Figure 3.7.2 shows the standards under development for fuel cell vehicle applications.

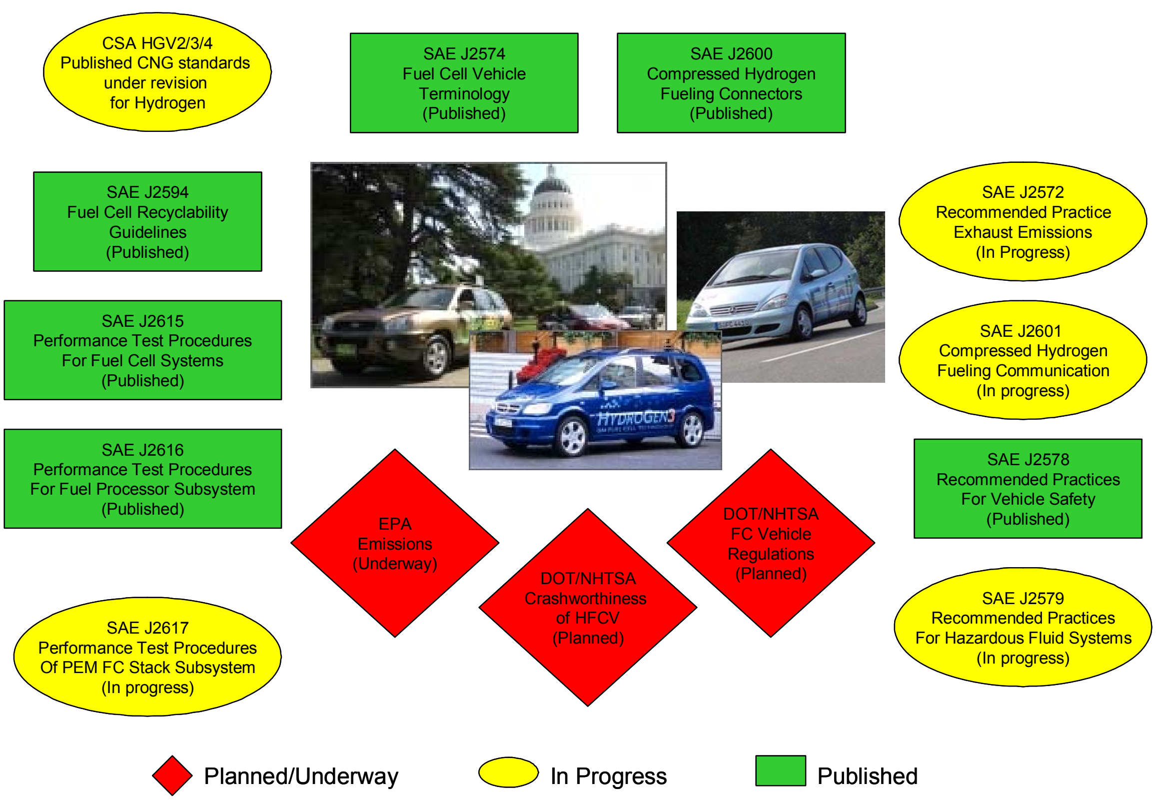


Fig. 3.7.2 Domestic Codes and Standards for Hydrogen-fueled Vehicles

Refueling Station Standards

The development of standards for hydrogen refueling stations is currently in progress. Although standards have been developed for commercial production, delivery and use of hydrogen, these industry-based design requirements and standard operating procedures are not suitable for dealing with hydrogen in a consumer environment. Efforts are focused on developing new standards, or clarifying the language or constraints in established standards to account for the significant differences in hazards and risks. Figure 3.7.3 shows the standards development efforts for refueling stations. In all cases, safety is ensured through comprehensive engineering reviews, hazard evaluations and risk mitigation plans.

3.7.3 Domestic Codes and Standards for Hydrogen Fueling Stations

Hydrogen Quality Standards

Hydrogen quality guidelines have been developed both domestically (SAE) and internationally (ISO), with final balloting expected in late 2006 or early 2007. The guidelines (SAE and ISO) are closely harmonized, with only minor differences in requirements. These initial guidelines were developed with primary consideration given to preventing fuel cell damage or poisoning and additional consideration given to the testing methods available to measure individual constituents at the given levels. It is expected that these guidelines will change significantly before adoption as standards. This subprogram's objective is to support and facilitate the testing and analysis required for input to future standards in the 2010 timeframe. The subprogram supports several activities in this area: a comprehensive examination of fuel cell system design and tolerance to individual constituents, the development of the technology required to measure hydrogen quality and a review of the impact of hydrogen quality requirements on production technologies and on the optimization of the overall cost and performance of the entire chain (production through end-use).

Hydrogen Transportation Standards

Since the 1950s, hydrogen has been transported across the U.S. using DOT federal regulations for the safe transport of hydrogen in pipelines as well as in bulk and small portable containers. These standards are regularly updated to address the range of technologies now available. Figure 3.7.4 illustrates the status of standards for the transport of hydrogen.

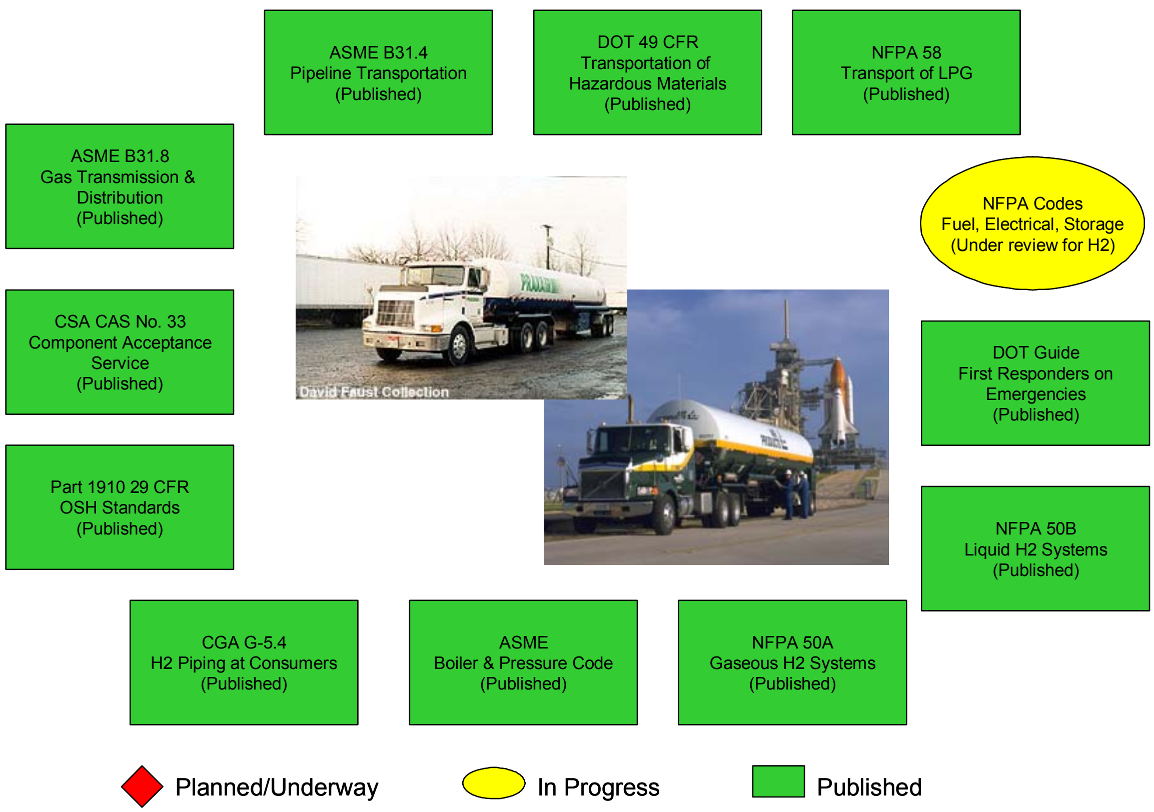


Fig. 3.7.4 Domestic Codes and Standards for Hydrogen Transport

International Standards

Three separate but related international efforts are underway to develop new technology standards through the International Organization for Standardization (ISO), the International Electrotechnical Commission (IEC) and the World Forum for Harmonization of Vehicle Regulations.

International Organization for Standardization

ISO is a worldwide federation of national standards bodies from more than 140 countries. Established in 1947, its mission is to promote standardization to facilitate the exchange of goods and services, and to facilitate cooperation in intellectual, scientific, technological and economic activities. ISO standards are developed through a consensus process.

The following ISO Technical Committees are working on standards related to hydrogen and fuel cells:

TC 197 - Hydrogen Technologies

Systems and devices for the production, storage, transport, measurement, and use of hydrogen. Working groups address standards and guidelines for gaseous and gaseous blends and liquid fuel tanks for vehicles, hydrogen safety, hydrogen fuel quality, water electrolysis, fuel processing and transportable gas storage devices.

TC 22 - Road Vehicles

Compatibility, interchangeability, and safety, with particular attention to terminology and test procedures for mopeds, motorcycles, motor vehicles, trailers, semi-trailers, light trailers, combination vehicles and articulated vehicles. The Electric Road Vehicle Subcommittee (SC21) is addressing operation of vehicles, safety, and energy storage.

TC 58 - Gas Cylinders

Fittings and characteristics related to the use and manufacture of high-pressure gas storage. The working group on gas compatibility and materials coordinates with TC 197.

International Electrotechnical Commission

IEC is a leading global organization for preparing and publishing international standards for electrical, electronic and related technologies. The IEC is developing standards for the electrical interface to fuel cells. IEC Technical Committee 105 is primarily addressing stationary fuel cell power plants, but has also addressed portable and propulsion fuel cells. The working groups in TC 105 include the following: Terminology, Fuel Cell Modules, Stationary Safety, Performance, Installation, Propulsion and Safety and Performance of Portable Fuel Cells.

World Forum for Harmonization of Vehicle Regulations

Within the U.N. framework on GRPE, the European Union recognized a need to harmonize vehicle regulations. The original agreement was signed in 1958, with contracting parties including most European countries, Australia, Japan and South Africa, but not the United States. Contracting parties have two years to adopt standards developed under the 1958 agreement. Requirements ("regulations" or "directives") under this agreement are based on the "type" approval process, wherein an authority works with a technical service to assess compliance of components and systems (such as a vehicle). European countries use the "type" approval process, while the U.S. uses a self-certification process.

Since the initial agreement, the ECE WP29 developed a new "accelerated" agreement to allow the development of global legal requirements. The 1998 agreement has most European countries, Canada, China, Japan, Korea, South Africa and the U.S. as contracting parties. This new concept is termed Global Technical Regulations (GTR). These regulations are essentially technical requirements; therefore, they allow the use of different approval processes and global harmonization of legal requirements for all vehicles. The GRPE established an Ad Hoc Group to draft regulations for gaseous and liquid hydrogen systems. The ISO process and that instituted by the GRPE will harmonize the differences between both standards. In June 2002, the GRPE voted to move all actions for the introduction of fuel cell vehicles under the 1998 agreement to accelerate the development and adoption of a GTR. The subprogram will monitor and participate in this process in support of the EPA and DOT/NHTSA lead responsibilities.

3.7.4 Challenges

A major challenge to the commercialization of hydrogen technologies is the lack of available data necessary to develop and validate standards. The Program sponsors a comprehensive, long-term RD&D effort to develop the scientific and technical basis for requirements incorporated in standards and model codes.

Another challenge to the commercialization of hydrogen technologies is the need for appropriate codes and standards to ensure consistency and facilitate deployment. Certification to applicable standards facilitates approval by local code officials and safety inspectors. Uniform standards are needed because manufacturers cannot cost-effectively manufacture multiple products that would be required to meet different and inconsistent standards.

Domestically, competition between the individual SDOs could impact the adoption of new codes for hydrogen and fuel cell technologies. Because of the typical 3- to 5-year development cycle, some demonstration projects could be delayed or incur additional development costs. The DOE has worked with SDOs, CDOs and industry to minimize duplication in domestic codes and standards development. International standards developed by ISO and IEC will have an increasing impact on U.S. hydrogen and fuel cell interests. The U.S., Japan and Europe, among others, have accelerated efforts in this area, and the Program supports cooperative and coordinated development of international standards.

Targets

Since the development of the model codes or domestic and international standards is a voluntary, industry-led process, the federal government can facilitate but cannot direct this process. R&D activities supported by the subprogram will provide the data needed to accelerate the development of codes and standards to facilitate the commercial acceptance of hydrogen and fuel cell technologies.

Working with state and local code officials, the Codes and Standards subprogram will communicate the changes in the codes as they pertain to the new technology. The subprogram will also work with state and local government officials to assist in the adoption of approved model codes through education and outreach in cooperation with the Education subprogram.

The Codes and Standards subprogram will provide expertise and technical data on hydrogen properties, and hydrogen and fuel cell technologies to facilitate the development of standards and codes. Additionally, the subprogram will provide support for industry and laboratory experts to participate in critical international standards development meetings and workshops. The subprogram will continue to work directly with the SDOs, by providing technical support to facilitate identification and development of new standards for hydrogen technologies, fuel cell systems and system monitoring and safety. Table 3.7.5 lists additional areas of interest. Finally, the subprogram supports focused research for testing of hydrogen components and equipment.

Table 3.7.5. Additional Areas of Interest

Items	Content
Hydrogen Quality	Hydrogen specifications and testing methods.
Mass Measurement	Methods to quantify hydrogen mass measurement to determine appliance efficiency and consumer sales at refueling stations.
Materials Guide	Materials reference guide for design and installation.
Piping (Non-transport)	Hydrogen-specific piping design, installation, and certification standards.
Sensors	Hydrogen leak detection technology for vehicular and pipeline applications.
Storage	Hydrogen storage tank standards for portable, stationary and vehicular use.
Transport	Standards for pipelines, delivery and ancillary equipment.

Barriers

A. Limited Government Influence on Model Codes

The code development process is voluntary, so the government can affect its progression, but ultimately it is up to the CDOs.

B. Competition among SDOs and CDOs

The competition between various organizations hinders the creation of consistent hydrogen codes and standards.

C. Limited State Funds for New Codes

Budget shortfalls in many states and local jurisdictions impact the adoption of codes and standards because they do not always have the funds for purchasing new codes or for training building and fire officials.

D. Large Number of Local Government Jurisdictions (approximately 44,000).

The large number of jurisdictions hinders the universal adoption of codes and standards.

E. Lack of Consistency in Training of Officials

The training of code officials is not mandated and varies significantly. The large number of jurisdictions leads to variation in training facilities and requirements.

F. Limited DOE Role in the Development of International Standards

Governments can participate and influence the development of codes and standards, but they cannot direct the development of international standards.

G. Inadequate Representation at International Forums

Participation in international forums and meetings is voluntary and, to date, has been limited by budgetary constraints.

H. International Competitiveness

Economic competition complicates the development of international standards.

I. Conflicts between Domestic and International Standards

National positions can complicate the harmonization of domestic and international standards.

J. Lack of National Consensus on Codes and Standards

Competitive issues hinder consensus.

K. Lack of Sustained Domestic Industry Support at International Technical Committees

Cost, time and availability of domestic hydrogen experts have limited consistent support of the activities conducted within the international technical committees.

L. Competition in Sales of Published Standards

The development and licensing of codes and standards is a business. The competition among CDOs and SDOs for sales of codes and standards inhibits harmonization of requirements adopted by local jurisdictions.

M. Jurisdictional Legacy Issues

NFPA or ICC codes are historically adopted by state and local jurisdictions. Jurisdictions that adhere to a specific code family may not reference the most recent codes and standards available.

N. Insufficient Technical Data to Revise Standards

Research activities are underway to develop and verify the technical data needed to support codes and standards development, retrofitting existing infrastructure and universal parking certification, but are not yet completed.

O. Affordable Insurance is Not Available

New technologies, not yet recognized in codes and standards, will have difficulty in obtaining reasonable insurance.

P. Large Footprint Requirements for Hydrogen Refueling Stations

The existing set-back distances and other safety requirements result in large footprints.

Q. Parking and Other Access Restrictions

Complete access to parking, tunnels and other travel areas has not yet been secured. Appropriate Codes and Standards need to be developed to provide safe access to these areas.

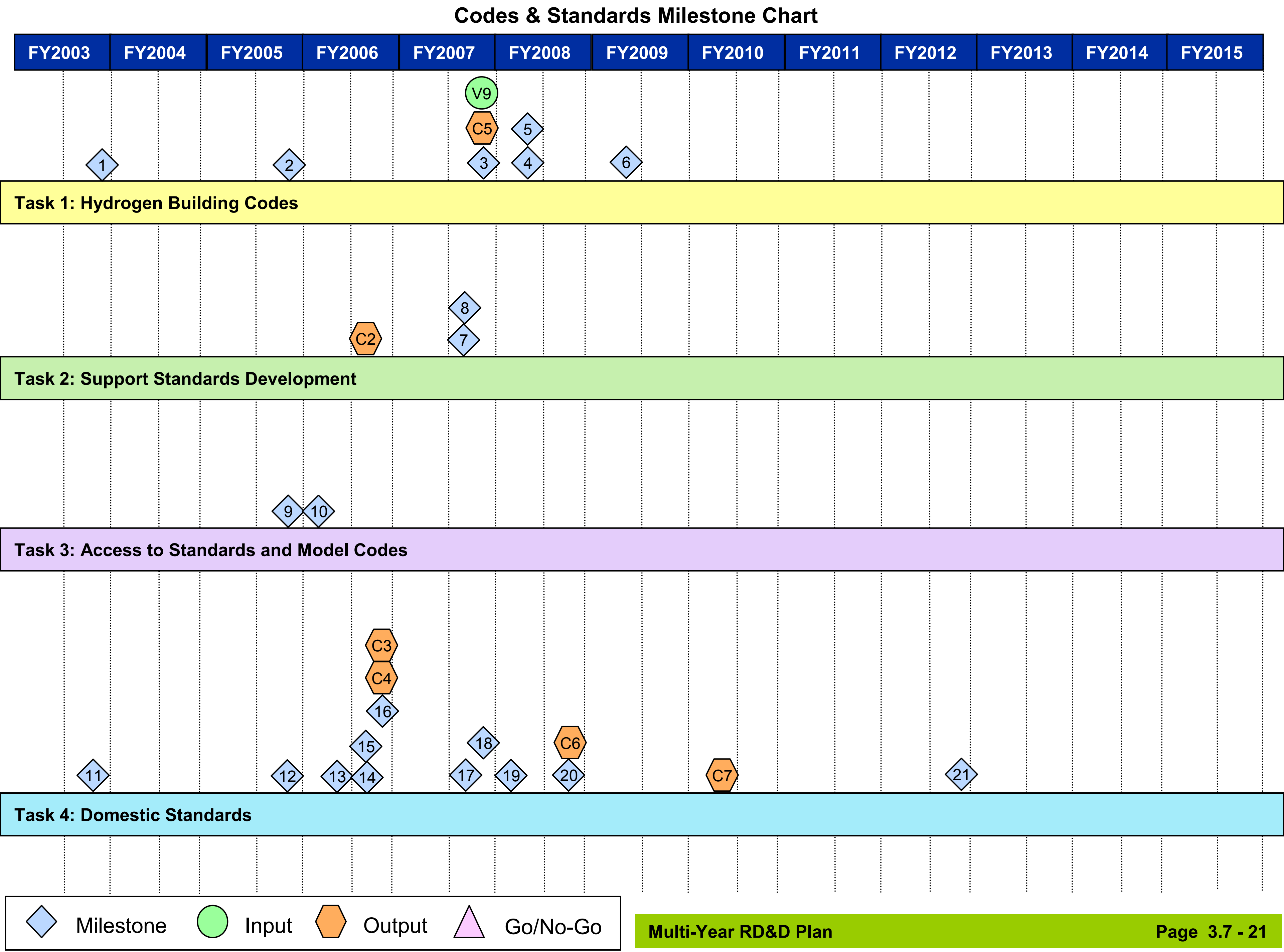
3.7.5 Task Descriptions

Task descriptions for the Codes and Standards subprogram are illustrated in Table 3.7.6. To complete these tasks, the subprogram will collect and analyze data from the Production, Delivery, Storage, Fuel Cells, Education and Technology Validation subprograms and coordinate with Systems Analysis and Systems Integration on an on-going basis.

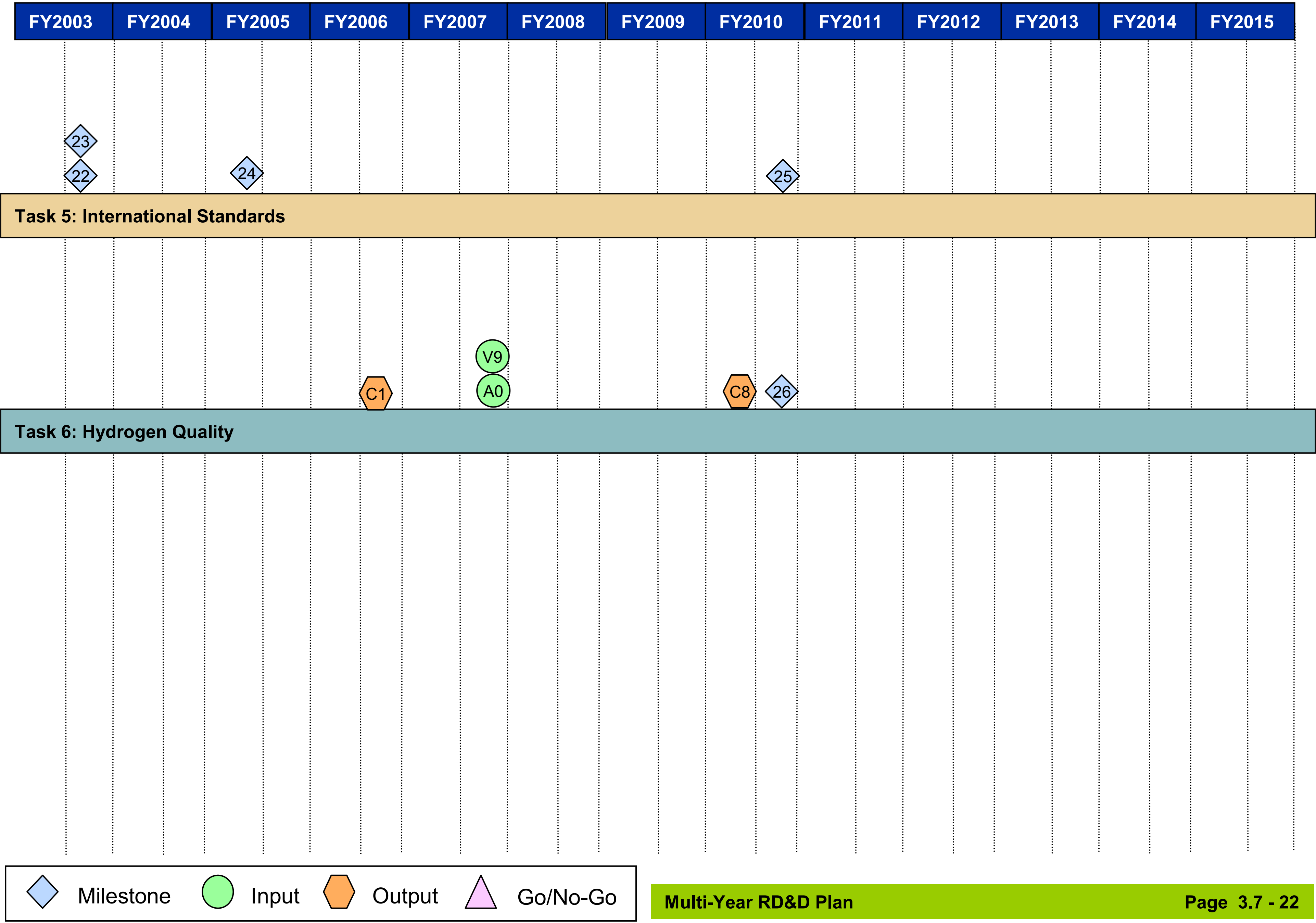
Table 3.7.6. Task Descriptions		
	Description	**Barriers**
1	Perform R&D of hydrogen properties and behavior and coordinate participating organizations to facilitate the adoption of the hydrogen building codes	N, P
2	Perform component R&D and integrated systems analysis to support the development of new standards for hydrogen systems	N, P
3	Implement a mechanism to improve access to standards and model codes related to hydrogen technologies	C, D, L, M
4	Support harmonization of domestic standards • Implement the National Codes & Standards Template • Design and develop an interactive refueling station template	A, B, C, D, J, L, M, O, P, Q
5	Coordinate the harmonization of international standards • Facilitate the development of U.S. consensus for international standards • Facilitate a unified approach to standards development among key countries in Europe and the Pacific Rim	F, G, H, I, J, K, L, M, O, P, Q
6	Perform hydrogen quality R&D and develop testing protocols and parameters required for the harmonization of hydrogen fuel quality standards	N, I

3.7.6 Milestones

The following chart shows the interrelationship of milestones, tasks, supporting inputs and outputs from other subprograms from FY 2003 through FY 2015. This information is also summarized in Appendix B.


Codes & Standards Milestone Chart
FY2003
FY2004
FY2005
FY2006
FY2007
FY2008
FY2009
FY2010
FY2011
FY2012
FY2013
FY2014
FY2015
V9
C5
5
1
2
3
4
6
Task 1: Hydrogen Building Codes
8
C2
7
Task 2: Support Standards Development
9
10
Task 3: Access to Standards and Model Codes
C3
C4
16
15
18
C6
11
12
13
14
17
19
20
C7
21
Task 4: Domestic Standards
Milestone
Input
Output
Go/No-Go

Codes & Standards Milestone Chart



	Task 1: Hydrogen Building Codes
1	Workshop to identify and develop critical research objectives that impact model codes held. (4Q, 2003)
2	Initiate experimental validation of large hydrogen releases and jet flame tests completed. (4Q, 2005)
3	Complete detailed scenario analysis risk assessments. (4Q, 2007)
4	Complete analytical experiments and data collection for hydrogen release scenarios as needed to support code development (Phase 1). (2Q, 2008)
5	Complete model of unintended release in complex metal hydrides. (2Q, 2008)
6	Materials compatibility technical reference updated. (2Q, 2009)

	Task 2: Support Standards Development
7	Perform tests of walled hydrogen storage systems. (3Q, 2007)
8	Develop small leak characterization for building releases and pressure release devices (PRD). (3Q, 2007)

	Task 3: Access to Standards and Model Codes
9	Collaborate with ICC and NFPA to develop first- order continuing education for code officials. (4Q, 2005)
10	ANSI codes and standards portal established. (1Q, 2006)

Task 4: Domestic Standards	
11	Coordination Committee for hydrogen technical experts to support the code development process established. (4Q, 2003)
12	Draft standards for dispensing systems (dispenser, hoses, hose assemblies, temperature compensating devices, breakaway devices, etc.) completed (CSA America). (4Q, 2005)
13	Draft standards for micro fuel cells completed (UL). (2Q, 2006)
14	Technical assessment of metallic and composite bulk storage containers completed (ASME). (3Q, 2006)
15	Draft standards for vehicular fuel systems completed (NFPA). (3Q, 2006)
16	Final code changes that incorporate underground storage of liquid hydrogen and canopy-top storage of gaseous hydrogen for fueling stations (NFPC, ICC) completed. (4Q, 2006)
17	Templates of commercially viable footprints for fueling stations that incorporate advanced technologies developed. (3Q, 2007)
18	Implement research program to support new technical committees for the key standards including fueling interface, and fuel storage. (4Q, 2007)
19	Final draft standards completed for transportable composite containers for balloting (ASME). (1Q, 2008)
20	Draft standards for hydrogen detectors in stationary applications (UL). (4Q, 2008)
21	Completion of necessary codes and standards needed for the early commercialization and market entry of hydrogen energy technologies. (4Q, 2012)

Task 5: International Standards	
22	Negotiate agreement with DOT/NHTSA at Working Party on Pollution and Energy meeting. (3Q, 2003)
23	Mechanism to support appropriate U.S. Technical Advisory Groups (TAG) in place. (3Q, 2003)
24	Roadmap for global technical regulations (GTR) published. (2Q, 2005)
25	Draft regulation for comprehensive hydrogen fuel cell vehicle requirements as a GTR approved (UN Global Technical Regulation). (4Q, 2010)

Task 6: Hydrogen Quality	
26	Revised (SAE/ISO) hydrogen quality guidelines adopted. (4Q, 2010)

Outputs

C1 Output to Program: Hydrogen fuel quality standard as ISO Technical Specification. (3Q, 2006)

C2 Output to Program: Technical assessment of standards requirements for metallic and composite bulk storage tanks. (3Q, 2006)

C3 Output to Program: Final standards (balloting) for fuel dispensing systems (CSA America). (4Q, 2006)

C4 Output to Program: Draft standards (balloting) for refueling stations (NFPA). (4Q, 2006)

C5 Output to Program: Materials compatibility technical reference. (4Q, 2007)

C6 Output to Program: Final draft standard (balloting) for portable fuel cells (UL). (4Q, 2008)

C7 Output to Program: Codes and Standards for Delivery Infrastructure complete. (2Q, 2010)

C8 Output to Program: Final hydrogen fuel quality standard as ISO Standard. (2Q, 2010)

Inputs

A0 Input from Systems Analysis: Initial recommended hydrogen quality at each point in the system. (4Q, 2007)

V9 Input from Technology Validation: Final Report on safety and O&M of three refueling stations. (4Q, 2007)