EMERGING ISSUES RELATING TO THE BURGEONING HYDROGEN ECONOMY

Peter M. Crofton[*]

Energy affects, and even defines, how people live their lives. Everyday, people consume energy to cook, clean, and travel. The darkness is conquered by lights, the indoor temperature is controlled by heating and air conditioning, and clean water is available on demand. The elevators people ride, the traffic lights under which people pass, and the telephones people use to communicate all require energy of one form or another.

Since the late 1800s, the United States has relied on water, petroleum, natural gas, and coal as the primary sources of the energy consumed. The United States' ever increasing demand for energy has demonstrated that these sources of energy are finite, and using these sources entails growing financial and other costs. Thus, the search for alternative energy sources has increasingly focused on hydrogen as a fuel source.[1]

In his January 2003 State of the Union address, President George W. Bush committed the United States to having a viable hydrogen fuel transportation system within a generation:

> A single chemical reaction between hydrogen and oxygen generates energy, which can be used to power a car—producing only water, not exhaust fumes. With a new national commitment, our scientists and engineers will overcome obstacles to taking these cars from laboratory to showroom, so that the first car driven by a child born today could be powered by hydrogen, and pollution-free.[2]

The lure of hydrogen as a fuel is the promise of a cheap, clean and virtually endless supply of energy.[3] While it remains to be seen if hydrogen fuels can satisfy their advance billing, it is clear that hydrogen will be an important, if not predominate, energy source in the future, as reflected in the recently enacted Energy Policy Act of 2005.

The generation time frame set by President Bush reflects the reality that the hydrogen fuel technology simply is not currently ready for such a momentous change. Nevertheless, government and industry are well on the way to developing the technology to fulfill the President's vision. But technology is not the only roadblock in the development of the hydrogen economy.

Many legal and regulatory issues must be resolved before hydrogen fuel can be a viable alternative energy source. Unfortunately, many of these critical non-technical issues are not yet being addressed.[4] This article outlines some of the

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* Mr. Crofton is a member of the law firm of Toler & Hanrahan, LLC where he practices construction litigation, dispute resolution, and pre-construction services for clients, including those in the energy sector. Mr. Crofton has practiced construction litigation and dispute resolution for over fifteen years, and much of his work has been on energy related projects. Mr. Crofton has an undergraduate degree in computer engineering, and is a member of the Institute of Electrical and Electronics Engineers.

1. CAL. ENVTL. PROT. AGENCY, CALIFORNIA HYDROGEN BLUEPRINT PLAN 5 (2005) [hereinafter HYDROGEN BLUEPRINT].

2. President George W. Bush, State of the Union Address (Jan. 28, 2003), *available at* http://www.whitehouse.gov/news/releases/2003/01/20030128-19.html; *see also* 42 U.S.C. §§ 12401–12408 (2000) (laying out the Hydrogen Research, Development, and Demonstration Program).

3. *See, e.g.*, Georgia Cappleman, *Fuel Cells Providing Clean Energy Source*, FLA. ENVTL. COMPLIANCE UPDATE (Jan. 2001).

4. Prior articles discussing hydrogen fuel topics have not generally addressed the broader policy and

areas that need thoughtful debate to establish the right rules for this soon-to-be-major component of everyday life. The purpose of this article is not to ask questions without answering them but to present alternative approaches without advocating a position. In short, this article is to start the debate that will answer these and many other questions about hydrogen fuels.

I. THE ENERGY POLICY ACT OF 2005

The Energy Policy Act of 2005 (EPAct 2005) codifies the federal government's commitment to developing a hydrogen economy. EPAct 2005 has wide ranging hydrogen fuel related provisions for technology research and development as well as fostering the development of a hydrogen fuels infrastructure. In addition, EPAct 2005 sets forth specific hydrogen fuel related goals, including:

1. "to enable and promote comprehensive development, demonstration, and commercialization of hydrogen and fuel cell technology in partnership with industry";[5]
2. "to build a mature hydrogen economy that creates fuel diversity in the massive transportation sector of the United States";[6]
3. "to sharply decrease the dependency of the United States on imported oil, eliminate most emissions from the transportation sector, and greatly enhance our energy security";[7] and
4. "to create, strengthen, and protect a sustainable national energy economy."[8]

In light of these goals and the number of specific hydrogen fuel programs addressed by EPAct 2005, EPAct 2005 is the single most comprehensive and significant piece of federal legislation for the development and commercialization of hydrogen fuels. EPAct 2005 also foreshadows significant growth in the hydrogen economy because EPAct 2005's goals cannot be accomplished with substantial and sustained private investment in hydrogen fuel-related facilities and equipment.

A. *Time Table for Mass Production of Hydrogen Fueled Vehicles*

One of the most important hydrogen-related provisions in EPAct 2005 is the establishment of specific targets for the deployment of hydrogen fuel vehicles. The timetable essentially tracks the generation timeframe announced by Pres. Bush in the 2003 State of the Union address. EPAct 2005's time table is:

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regulatory issues, focusing instead on narrower issues such as tax incentives, global warming and other environmental impacts, and possible tort considerations. *See, e.g.*, Robert F. Mann, *On the Road Again: How Tax Policy Drives Transportation Choice*, 24 VA. TAX. REV. 587 (2005); Bruce Yandle & Stuart Buck, *Bootleggers, Baptists, and the Global Warming Battle*, 26 HARV. ENVTL. L. REV. 177 (2002); Russell Moy, *Tort Law Considerations for the Hydrogen Economy*, 24 ENERGY L.J. 349 (2003); William Vincent, *Hydrogen and Tort Law: Liability Concerns are Not a Bar to a Hydrogen Economy*, 25 ENERGY L.J. 385 (2004); *but see* Andrew R. Thomas et al., *Regulation of Power Generated by Stationary Fuel Cells in the United States*, 18 TUL. ENVTL. L.J. 141 (2004).

5. Energy Policy Act of 2005, Pub. L. No. 109-58, § 802(1), 119 Stat. 594.
6. *Id.* § 802(3).
7. Energy Policy Act of 2005 § 802(4).
8. *Id.* § 802(5).

1. Produce and deploy "100,000 hydrogen-fueled vehicles in the United States by 2010";[9]
2. Provide "sufficient" hydrogen fueling stations by 2010;[10]
3. Enable commitments by automakers by 2015 to offer safe and affordable hydrogen-fueled automobiles, with mass market availability by 2020;[11]
4. Enable commitments by 2015 for an infrastructure that will provide "widespread availability" of hydrogen fuels to be available by 2020;[12] and
5. Produce and deploy "2,500,000 hydrogen-fueled vehicles in the United States by 2020."[13]

Notably, EPAct 2005's timetable complements that of the State of California's Hydrogen Highway initiative, which targets placing 2,000 light-duty vehicles, 10 heavy-duty vehicles, and 50–100 fueling stations in service in California by 2010.[14]

EPAct 2005's year 2020 target of 2.5 million hydrogen-fueled vehicles represents a notable portion of the total market. Given that commitments to mass production are not envisioned until 2015, it is likely that a significant number of the targeted 2.5 million hydrogen fuel vehicles will be produced in the year or two immediately prior to 2020. By way of comparison, for 2002, Cadillac sold 150,100 passenger cars, which represented 1.9% of total new passenger car sales, and Mercedes sold 170,400 passenger cars, which represented 2.1% of total new car sales.[15]

B. Establishment of Inter-Agency Task Force

Another significant hydrogen-related component of EPAct 2005 is the requirement that the Department of Energy establish an interagency "task force" to plan for the development of a "safe, economical and environmentally sound [hydrogen] fuel infrastructure."[16] That task force is to include representatives of the Departments of Transportation, Defense, Commerce and State, the Environmental Protection Agency, National Aeronautical and Space Administration, and the White House.[17] The task force's responsibilities include:

1. Working towards "a safe, economical, and environmentally sound [hydrogen] fuel infrastructure";[18]
2. Working towards "uniform hydrogen codes, standards, and safety protocols";[19]

9. Energy Policy Act of 2005 § 811(a)(4)(A).
10. *Id.* § 811(a)(5).
11. Energy Policy Act of 2005, Pub. L. No. 109-58, § 805(f)(1)(A)–(B), 119 Stat. 594.
12. *Id.* § 805(f)(2).
13. Energy Policy Act of 2005 § 811(a)(4)(B).
14. *See* HYDROGEN BLUEPRINT, *supra* note 1, at 2–3.
15. Peter Koudal et al., *General Motors: Building a Digital Loyalty Network Through Demand and Supply Chain Integration*, Exhibit 1 (2003), *available at* http://www.deloitte.com/dtt/cda/doc/content/StanfordGMCase.PDF.
16. *See* Energy Policy Act of 2005, Pub. L. No. 109-58, § 806, 119 Stat. 594.
17. *Id.*
18. Energy Policy Act of 2005 § 806(b)(1)(A).
19. *Id.* § 806(b)(1)(D).

3. Working towards distributed hydrogen fueled power generation and useful fuel cells in "portable, stationary, and transportation applications";[20]

4. Promoting the "marketplace introduction of [an] infrastructure for hydrogen fuel vehicles";[21] and

5. Fostering the exchange of hydrogen fuel "information and technology among industry, academia, and government."[22]

In fulfilling its mission, this interagency task force will inevitably address the issues that will determine what the federal government's long term role will be in the hydrogen economy. The work of this task force is likely to shape federal policies and regulations that will impact the hydrogen economy, and possibly the entire economy, for many years. Consequently, this task force will need to consider, and answer, many of the questions posed by this article.

C. Funding for Energy Programs that Facilitate Hydrogen Fuels

EPAct 2005 provides funding for several alternative or clean fuel energy programs that facilitate the production and use of hydrogen fuels. Those programs include:

1. Developing clean coal projects that provide "a ready source of hydrogen for near-site fuel cell demonstrations";[23]

2. Demonstration projects for the "commercial production of hydrogen at existing nuclear power plants";[24]

3. Establishment of the Next Generation Nuclear Plant Project to design and construct by September 30, 2021 an advanced technology nuclear facility to generate electricity, hydrogen or both;[25] and

4. Demonstration projects for the production of hydrogen using solar and wind power technologies.[26]

EPAct 2005's associating hydrogen production with nuclear power is noteworthy. Nuclear energy is one of the promising technologies for producing hydrogen without releasing greenhouse gases.[27] Under EPAct 2005, the Next Generation Nuclear Plant Project could be built solely for the purpose of producing hydrogen, rather than electricity. A nuclear powered hydrogen production facility would expand nuclear energy into industrial uses from its traditional role in naval propulsion and electrical power generation.

D. Funding for Hydrogen Fueled Application

EPAct 2005 includes several provisions that promote the practical uses of hydrogen fuels. Those provisions include:

20. Energy Policy Act of 2005 § 806(b)(1)(B)–(C).

21. *Id.* § 806(b)(2)(D).

22. Energy Policy Act of 2005, Pub. L. No. 109-58, § 806(b)(2)(A), 119 Stat. 594.

23. *Id.* § 411(a)(3).

24. Energy Policy Act of 2005 § 634(a).

25. *Id.* §§ 641(a), 641 (b)(2), 643, 645(c).

26. Energy Policy Act of 2005 § 812.

27. NAT'L RESEARCH COUNCIL & NAT'L ACAD. OF ENG'G, THE HYDROGEN ECONOMY: OPPORTUNITIES, COSTS, BARRIERS, AND R&D NEEDS 94–97 (2004) [hereinafter THE HYDROGEN ECONOMY].

1. Funding a Clean School Bus program that encourages the use of hydrogen-fueled school buses;[28]

2. Requiring federal agencies to use fuel cell powered vehicles when possible beginning January 1, 2010;[29]

3. Required federal agencies to use fuel cell powered stationary, portable, and micro portable electrical generators when possible beginning January 1, 2006; [30] and

4. Assorted, unspecified demonstration projects using hydrogen fuels at existing federal facilities.[31]

EPAct 2005's requirement that the federal government begin using fuel cell powered vehicles and generators is significant. The federal government is the single largest energy consumer in the United States.[32] In 2002, the federal government spent over $1.3 billion on gasoline, diesel fuel, and other distillate products used to power vehicles and equipment, exclusive of jet fuel usage.[33] By making a commitment to use fuel cells whenever possible, the federal government is leading from the front, instead of just telling the private sector what it should do.

E. Financial Incentives for Using Hydrogen Fuels

EPAct 2005 provides new or expanded financial incentives for private entities to switch to hydrogen fuels. The incentives include:

1. A tax credit of up to $40,000 per vehicle for placing fuel cell-powered vehicles "in service";[34]

2. An additional tax credit of up to $4,000 per vehicle for fuel cell-powered automobiles and light trucks, based on the amount by which the vehicle's fuel efficiency exceeds the 2002 "model year city fuel economy" rating for vehicles in that weight class;[35]

3. A tax credit for up to 80% of the increased cost of an alternative fuel vehicle, including hydrogen fuel;[36] and

4. A tax credit of up to $30,000 for installing alternative fueling stations, including hydrogen.[37]

One of the significant barriers to the widespread use of hydrogen fueled vehicles is the incremental cost of such vehicles, as compared with petroleum powered vehicles.[38] Likewise with installing hydrogen fueling equipment.[39]

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28. Energy Policy Act of 2005, Pub. L. No. 109-58, § 741, 119 Stat. 594.

29. *Id.* § 782.

30. Energy Policy Act of 2005 § 783.

31. *Id.* § 808(a).

32. FED. ENERGY MGMT. PROGRAM, U.S. DEP'T OF ENERGY, ANNUAL REPORT TO CONGRESS ON FEDERAL GOVERNMENT ENERGY MANAGEMENT AND CONSERVATION PROGRAMS FISCAL YEAR 2002 12 (2004).

33. *Id.* at 17, Figure 2.

34. Energy Policy Act of 2005, Pub. L. No. 109-58, § 1341(a), 119 Stat. 594.

35. *Id.*

36. Energy Policy Act of 2005 § 1341.

37. *Id.* § 1342(a).

38. THE HYDROGEN ECONOMY, *supra* note 27, at 17.

EPAct 2005 attempts to lower these barriers through financial incentives to organizations and individuals willing to make an early commitment to using hydrogen fuels.

F. Miscellaneous Support for Hydrogen Fuels

EPAct 2005 provides a number of other provisions that promote the use of hydrogen fuels either directly or by facilitating the development of a hydrogen fuel infrastructure. Those provisions include:

1. Requiring federal agencies to designate corridors for hydrogen pipelines through federal land in the western United States;[40]
2. Requiring federal agencies to identify corridors for hydrogen pipelines through federal land in other states;[41]
3. Declaring a national policy of supporting fusion energy research and commercialization for the production of electricity or hydrogen to ensure global competitiveness;[42]
4. Supporting research into hydrogen production using biological methods;[43] and
5. Studying the impact on total employment in the United States of "a transition to a hydrogen economy . . . ."[44]

The federal government owns a substantial amount of land—so much so that even it cannot determine exactly how much it owns.[45] It is commonly estimated that the federal government owns approximately 670 million acres of land, which is approximately 29% of the total national land mass.[46] That percentage is dramatically larger in the western United States, where, for example, the federal government owns approximately 79% of Nevada's total lands.[47] Given the extent of these land holdings, EPAct 2005's provision for using federal lands for hydrogen pipelines is likely to be of major assistance to companies developing hydrogen pipeline networks.

II. HOW WILL HYDROGEN FUELS BE REGULATED?

All forms of energy are regulated to some extent. Some energy forms such as nuclear energy are extensively regulated by the federal government, while other forms are subject to a less extensive mix of federal and state regulations. At present, hydrogen fuels are not clearly addressed by most regulations.

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39. *Id.*

40. Energy Policy Act of 2005, Pub. L. No. 109-58, § 368(a)(1), 119 Stat. 594.

41. *Id.* § 368(b)(1).

42. Energy Policy Act of 2005 § 972(a).

43. *Id.* § 977.

44. Energy Policy Act of 2005 § 1820.

45. U.S. GEN. ACCOUNTING OFFICE, HIGH RISK SERIES: FEDERAL REAL PROPERTY 26–29 (2003).

46. *See, e.g.*, Statement of Paul J. Gessing, Director of Government Affairs, National Taxpayers Union before the House Resources Subcommittee on Forests & Forest Health on Federal Land Ownership and Management (June 15, 2005), *available at* http://www.ntu.org/main/testimonies_detail.php?testimony_id=30.

47. *Id.*

A. Federal versus State Regulation

The threshold question concerning the regulation of hydrogen fuels is whether regulation should be exclusively by the federal government, exclusively by the states, or a shared regulatory environment.

Some issues that should be examined include:

1. Do hydrogen fuels necessarily involve interstate commerce, or could individual states create independent hydrogen fuel infrastructures, such as the California Hydrogen Highway initiative?

Several states have undertaken hydrogen fuels initiatives, such as the California Hydrogen Highway program (CHH) and the Florida Hydrogen Program (H2 Florida). The CHH involves installing hydrogen fueling stations along key highways to provide a network of fueling stations in and between the major traffic centers.[48] The H2 Florida program encompasses stationary hydrogen fuel uses as well as vehicles.[49]

Federal regulation of energy markets rests upon their interstate nature. It is certainly possible, if not probable, that hydrogen fuels will become interstate, but that could be many years in the future. Nevertheless, EPAct 2005 essentially declares a national interest in developing an interstate hydrogen fuel infrastructure.[50]

Given the potential widespread and numerous uses of hydrogen fuels, it is very unlikely that federal regulations will not be imposed. The real question is when will those regulations take effect? Successful commercialization of hydrogen fuels requires stability and certainty in the regulatory arena, and thus, early development of federal hydrogen fuel regulations is preferable.

2. Should the federal government have exclusive jurisdiction over some aspects of the hydrogen fuel economy

3. Should the states have exclusive jurisdiction over some aspects of the hydrogen economy, such as by creating regulated monopolies to distribute hydrogen fuels at the retail level?

The current mix of federal and state regulation of the energy markets resembles a patchwork quilt. For example, the federal government regulates hydropower[51] and nuclear electric[52] power generation, and the wholesale distribution of that power through the electrical grid.[53] At the same time, some states treat electric power as a regulated monopoly, with corresponding regulation of electric rates and construction of coal and gas-fired generating facilities.[54] Notably, this is without considering the environmental regulations that also apply.

If hydrogen fuels become a significant component of U.S. energy markets,

48. Cal. Exec. Order No. S-7-04 (Apr. 20, 2004), *available at* http://www.governor.ca.gov/state/govsite/gov_htmldisplay.jsp?sFilePath=/govsite/executive_orders/20040420_S-7-04.html&sCatTitle=Executive%20Order.

49. The Florida Hydrogen Energy Technologies Act, H.B. 1597, Reg. Sess. (Fla. 2005).

50. Energy Policy Act of 2005, Pub. L. No. 109-58, §§ 802, 806, 119 Stat. 594.

51. *See generally* 18 C.F.R. pt. 4 (2005).

52. *See generally* 10 C.F.R. pts. 1–171 (2005).

53. *See generally* 18 C.F.R. pt. 35 (2005).

54. *See, e.g.*, Julie Fox Gorte et al., *Electricity Restructuring, Innovation, and Efficiency* (2001), *available at* http://www.nemw.org/restruc_innov_effic.htm#N_1_.

then a national approach to hydrogen fuels might be the most efficient way to regulate, i.e., control, the development of the market, while also spurring its development. Alternatively, state governments are uniquely suited to developing regulatory systems that address the specific and differing needs of each state when a "one size fits all" approach is difficult. (The use of interstate compacts allows states to collectively address interstate issues without involving the federal government.)

One unique aspect of hydrogen fuels that may affect any regulations is that hydrogen can be viewed as a storable form of electrical energy, while electrical energy can be viewed as a transmittable form of hydrogen fuel.[55] The clearest example of this interchangeability is the fuel cell, which can generate electricity from hydrogen, or generate hydrogen from electricity.[56] Because of this interchangeability, hydrogen is unlike petroleum, natural gas, nuclear power, solar power, wind power, and virtually all other sources of electrical power, which cannot be converted into their original form.

In light of this interchangeability, and in anticipation of continued improvement in the efficiency of the interchange between hydrogen and electricity, regulations concerning the production and use of hydrogen fuels should be coordinated with those concerning electrical energy. Otherwise, the two markets can become "out of synch," resulting in inefficient use of either hydrogen or electricity to make up for a shortage of the other. The federal government is uniquely suited to developing the comprehensive regulations necessary to prevent market imbalances across the states.

A regulatory scheme for hydrogen fuels should keep several goals in mind. First, any regulations must be flexible to accommodate the many ways that hydrogen fuels could be produced and used in light of the still developing technologies. Second, the regulations should maximize reliance on competitive markets to even out price and supply factors. Third, the regulations should promote the open exchange of cost, price, and supply information to maximize transparency in the energy markets.

4. Should federal antitrust law be used to limit integration of hydrogen fuels production and distribution even if states want hydrogen fuel "monopolies"?

The competitive structure of the U.S. petroleum market is a legacy of the development of the Standard Oil trust, and the resulting government anti-trust effort that ended that trust. At the same time, some states continue to permit regulated monopolies that deliver electricity or natural gas. Likewise, interstate natural gas distribution is largely accomplished via regulated monopolies,[57] in part due to the difficulty and expense of building competing gas distribution systems. This raises issues of whether, or to what extent, "anti-competitive" conduct, such as requiring wholesale hydrogen purchasers to transport the fuel through a distribution network designated, or perhaps owned, by the seller,

55. *See, e.g.*, Dr. Geoffrey Ballard, Remarks at the World Nuclear Association Annual Symposium: Hydrogen Fuel and Electricity in Transportation (Sept. 5, 2002), *available at* http://www.world-nuclear.org/sym/2002/ballard.htm.

56. The economic viability of interchanging hydrogen and electricity will greatly depend on the efficiency of the process. With current technology, the process may not be viable. However, ongoing research is projected to continue improving the efficiency of the interchange process. *See, e.g.*, Ballard, *supra* note 55.

57. *See generally* 18 C.F.R. pts. 152–84 (2005).

should be permitted or encouraged to spur the development of a hydrogen fuels infrastructure.[58]

In the hydrogen context, one way to encourage infrastructure investment might be to permit regulated monopolies for a limited time for capital intensive projects. For example, a particular state might want to partner with a given energy company to develop a statewide hydrogen fuel production and distribution network. By granting the energy company an exclusive franchise on hydrogen fuels within that state, the state ensures that it will have access to hydrogen fuels, and the energy company is assured that it will recover its costs, plus a sufficient profit, to make this capital intensive project attractive. After the hydrogen market is firmly established, the monopolies could be transitioned to a competitive and deregulated market.

B. FERC

The Federal Energy Regulatory Commission (FERC) is the primary federal agency charged with overseeing the development and operation of the United States' energy markets. The FERC is part of the Department of Energy, but is considered quasi-independent. The FERC regulates:

1. Aspects of the production and transmission of electric power;[59]
2. Aspects of the construction and operation of hydropower facilities;[60]
3. Aspects of the transmission and storage of natural gas;[61] and
4. Aspects of the transmission of petroleum products.[62]

The FERC's role is, at best, unclear concerning regulating the production, storage or distribution of hydrogen fuels.[63] Given the FERC's role concerning other fuels and energy products, it seems likely that the FERC will eventually be charged with regulating some aspects of hydrogen fuels. The scope of the FERC's role will depend upon the answers to questions such as:

1. If hydrogen fuels are produced at large, centralized facilities (like current refineries), should the FERC have veto/approval authority concerning the location or need for those facilities (as it does with hydropower facilities)?
2. If hydrogen fuels are used to generate electricity, either at centralized or at distribution facilities, should the FERC have veto/approval/certification authority concerning the location, need or compliance with standards for those facilities?

One factor that may impede the development of a hydrogen fuels infrastructure is the "Not-In-My-Back-Yard" (NIMBY) syndrome. This syndrome can delay or even prevent major infrastructure projects that are critical to the nation as a whole, because of opposition from local interests. An example of this has been the lengthy delay in the opening of a national repository for high

58. *See generally* Richard J. Pierce, Jr., *The Antitrust Implications of Energy Restructuring*, 12 NAT. RESOURCES & ENV'T 269 (1998).

59. *See generally* 18 C.F.R. pts. 4–149, 287–301, 358–65 (2005).

60. *See generally id.* pts. 4, 12.

61. *See generally* 18 C.F.R. pts. 152–84.

62. *See generally id.* pts. 340–57.

63. *See generally* Andrew R. Thomas et al., *Regulation of Power Generated by Stationary Fuel Cells in the United States*, 18 TUL. ENVTL. L.J. 141 (2004).

level nuclear waste,[64] currently planned for Yucca Mountain, Nevada.

The federal government has attempted to minimize NIMBY problems in some markets by exercising exclusive jurisdiction over the permitting of major energy facilities. (For example, EPAct 2005[65] authorized the FERC to take over from state and local governments deciding most issues relating to the location of new liquefied natural gas (LNG) import facilities.) Nevertheless, opponents of such facilities have used the federal courts to slow down the process, such as with Yucca Mountain. This raises issues of whether the federal government should have exclusive jurisdiction over determining the location of major hydrogen fuels facilities, such as centralized hydrogen generating stations or hydrogen fuel import terminals.[66] This also raises issues of whether the federal government should allow the use of its power of eminent domain to facilitate the construction of such facilities.[67]

Additionally, the FERC has traditionally played a role in regulating the generating and distribution of electricity. This has included limited oversight of regional grid operators,[68] and permitting the construction of certain new or increased generation capacity.[69] While the development of electrical generation facilities is now largely driven by the free market, the FERC continues to play a role in guiding that development.[70] This raises the issue of what role the FERC should play in planning or controlling the development of hydrogen fueled electrical generating facilities.

One possible approach to addressing these questions is to take advantage of the interchangeability of the production of hydrogen and electric power.[71] This approach would regulate the production of hydrogen and electricity in the same fashion. The current mix of state and local regulations could be extended to apply to the siting and licensing of hydrogen production facilities, including facilities that utilize nuclear power. An advantage to this approach is that it allows traditional utilities and independent power producers to easily integrate distributed power generation concepts with the use of hydrogen fuels as a means of "banking" electricity during off-peak periods.

This approach would entail vesting the FERC and state public utility commissions with the authority to permit and license hydrogen production facilities. This might extend the jurisdiction of the FERC and the state Public Utility Commission's to encompass production of hydrogen as an industrial chemical and as a transportation fuel. However, unified regulations addressing all hydrogen production might be easier to satisfy than differing regulations based on the intended use of the product.

3. If hydrogen fuels are produced in smaller, geographically dispersed

64. *See generally* David H. Topol, *Rethinking Who is Left Holding the Nation's Nuclear Garbage Bag: The Legal and Policy Implications of* Nevada v. Watkins, 1991 UTAH L. REV. 791 (1991).

65. Energy Policy Act of 2005, Pub. L. No. 109-58, § 311, 119 Stat. 594.

66. *See also* Section D *infra* (concerning the role of The Department of Homeland Security).

67. *See, e.g.*, 15 U.S.C. § 717(f) (2000) (allowing use of eminent domain to facilitate the construction of natural gas pipelines).

68. 18 C.F.R. §§ 2.21, 35.34 (2005).

69. 18 C.F.R. § 5.6 (2005).

70. *See generally* Alan S. Miller, *Energy Policy From Nixon to Clinton: From Grand Provider to Market Facilitator*, 25 ENVTL L. 715 (1995).

71. *See, e.g.*, Ballard, *supra* note 55.

facilities, should the FERC have veto/approval/certification authority concerning the location, need or compliance with standards for those facilities?[72]

The near term development of hydrogen fuel generation is likely to focus on local or regional hydrogen fuel production facilities, in part due to the high cost of developing a wide spread distribution network.[73] Traditionally, the FERC has less heavily regulated local facilities, such as small independent power generating stations.[74] However, the hydrogen fuels market might benefit from coordination of the development of local/regional facilities being undertaken by unrelated entities in multiple states. EPAct 2005 directs the Department of Energy (DOE) to implement programs intended to promote the development of a hydrogen fuel infrastructure by 2020.[75] EPAct 2005 also expressly directs the interagency task force on hydrogen fuels to work towards distributed hydrogen fuel power generation.[76] However, imposing FERC authority might impede the current efforts of states such as California and Florida to accelerate the use of hydrogen fuels. Given the existing division of responsibility between the FERC and the states, it is likely that the FERC will not have a significant, direct role in regulating the development of small, decentralized hydrogen fuel generation facilities; however, the FERC can assist the states with coordinating the work of each state to avoid overcapacity or undercapacity.[77]

4. If hydrogen fuels are transported through pipelines, should the FERC regulate the location or operation of the pipelines (as it does for natural gas and petroleum pipelines)?

The FERC is charged with regulating petroleum and natural gas pipelines and the transport of fuels in those pipelines.[78] The Department of Transportation's (DOT) Pipeline and Hazardous Materials Safety Administration regulates pipelines that transport hazardous materials, including intrastate gas pipelines.[79] It is likely that hydrogen fuels will eventually be distributed through pipelines, although the extent of that distribution will depend on the form of the fuels (i.e., gas or liquid) and the cost of creating the pipeline network.[80]

Hydrogen fuels, which might be distributed in the form of solid or liquid chemicals such as sodium borahydride, might be considered a hazardous material under the Environmental Protection Agency (EPA) guidelines.[81] Collectively, these concerns give rise to issues concerning whether the FERC (or the DOT) is the most appropriate agency to regulate intra- and interstate pipelines that transport hydrogen fuels, and the extent to which any federal agency should regulate these pipelines.[82]

In addition, the state and local governments can impose additional

72. The FERC certifies small independent power generating plants.

73. THE HYDROGEN ECONOMY, *supra* note 27, at 43.

74. *See generally* 18 C.F.R. pt. 292 (2005).

75. Energy Policy Act of 2005, Pub. L. No. 109-58, §§ 802–805, 119 Stat. 594.

76. *Id.* § 806(b)(1)(C).

77. *See generally* Thomas, *supra* note 63.

78. *See generally* 18 C.F.R. pts. 284, 341 (2005) (addressing natural gas and petroleum respectively).

79. *See generally* 49 C.F.R. pts. 186–99 (2005).

80. THE HYDROGEN ECONOMY, *supra* note 27, at 44.

81. *Id.* at 43.

82. *See* Energy Policy Act of 2005, Pub. L. No. 109-58, §§ 802–806, 119 Stat. 594.

regulations on the intrastate pipelines used for "retail delivery" of natural or LP gas.[83] This gives rise to issues concerning the extent to which state and local governments should regulate hydrogen fuel pipelines.

Gaseous hydrogen has many similar characteristics to that of natural gas. The current natural gas regulatory scheme, including that for liquefied natural gas, can be extended to hydrogen gas. In general, this scheme entails federal regulation of import facilities and interstate pipelines, with local regulation of intrastate pipelines, including "last mile" distribution piping. Extending the existing regulations also allows the regulated and the regulators to use their experience with the natural gas distribution regulations to predict the cost, time and effort associated with building a hydrogen fuel distribution network.[84]

5. If hydrogen fuels are transported via trucks, rails or ships, should the FERC regulate that transportation?

The FERC and the DOT split the responsibility for regulating the transport of petroleum fuels. The FERC regulates petroleum transported through pipelines, although it has not generally regulated the surface transport of fuels such as coal or petroleum. The DOT regulates the surface transport of petroleum; however, it does not regulate petroleum pipelines.[85] However, if the FERC is charged with playing an active role in promoting the development and use of hydrogen fuels, and in particular if the FERC is charged with regulating hydrogen fuel pipelines, then it raises the issue of whether the FERC should have a role in regulating the surface transport of hydrogen fuels. The answer to this question is likely to depend on which specific hydrogen fuels are ultimately introduced into the marketplace, and whether those fuels lend themselves to surface transport.

6. Should the price of hydrogen fuels be regulated?

The recent history of U.S. energy markets reflects a commitment to using market forces to both ensure adequate energy supplies and to avoid excessive energy prices. The hurricanes that struck the U.S. Gulf Coast in 2004 and 2005, and the resulting fluctuations in energy supplies and prices, demonstrate that the competitive markets are an adequate, if not preferred, way to deliver energy under most circumstances. As a result, the FERC or other federal price regulations on hydrogen fuels appear unlikely, although mandatory reporting of price, cost and quantity data may be advisable, at least in the initial years, to ensure market transparency.

There is, however, one factor for hydrogen fuels that is different from other common energy forms. Hydrogen fuels will require building a distribution infrastructure essentially from the ground up, which the oil, gas and electric producers have already accomplished. One way to address this problem would be for the government, most likely the state governments, to set prices that ensure an adequate return. This is the franchise approach discussed above. However, because the speed at which hydrogen fuels are commercialized will likely be dramatically affected by the cost of the fuels, a better alternative may

83. *See, e.g.*, 29 C.F.R. § 1910.103 (2005) (covering OSHA regulations on certain hydrogen delivery systems).

84. *See* Gunnar Birgisson & William Lavarco, *An Effective Regulatory Regime for Transportation of Hydrogen*, 29 INT'L J. OF HYDROGEN ENERGY 771–80 (2004).

85. 49 C.F.R. § 195.1 (2005).

be tax incentives, government subsidies, or low cost use of federal, state, and local government property as ways that hydrogen fuel prices can be reduced without involving the government in setting prices.

C. EPA

The EPA and the state agencies that operate with the EPA are the primary sources of environmental regulation for energy generation and consumption.[86] These regulations generally fall into three categories:

1. Issuing permits for the discharge of air and water pollutants for stationary sources;[87]
2. Regulating the storage of petroleum products;[88] and
3. Setting and enforcing emission standards for vehicles (i.e., "mobile sources").[89]

Under the current laws and regulations, the EPA and associated state agencies control the issuance of permits that may be necessary for the construction of hydrogen fuel facilities. However, several of the agencies' rules and regulations may need to be modified to address new issues presented by hydrogen fuels.

1. How will the National Environmental Policy Act affect the commercialization of hydrogen fuels?

The National Environmental Policy Act (NEPA) requires federal agencies to consider environmental impacts as part of their decision-making process under certain circumstances (e.g., the impact on endangered species of a proposed dam construction project).[90] NEPA requires that agencies prepare an environmental impact statement (EIS) for every "major Federal action[] significantly affecting the quality of the human environment . . . ."[91] Drafting regulations can be a "major Federal action" that triggers the NEPA's EIS requirement.[92]

It is not clear whether federal agencies such as the FERC would be required to prepare an EIS in conjunction with promulgating hydrogen fuel regulations. Likewise, it is not clear whether an EIS would determine that hydrogen fuels are "cleaner" or "greener" than other fuels when all impacts are factored into the review.[93] Notwithstanding NEPA, EPAct 2005 requires the federal government

86. Generally, federal environmental regulations and state regulations are closely aligned. However, states are free to adopt more stringent environmental standards which has, in fact, occurred. For example, California has regulated used oil as a "hazardous waste" which EPA and most other states do not. Accordingly, a state could elect to regulate hydrogen fuel or hydrogen waste more stringently than other states so long as constitutional issues are not raised (e.g., the Commerce Clause).

87. *See generally* Clean Air Act (codified as amended at 42 U.S.C. §§ 7401–7661 (2005)); Clean Water Act, 33 U.S.C. §§ 1251–1387 (2005).

88. *See generally* 40 C.F.R. pts. 280–81 (2005).

89. *See generally* 40 C.F.R. pts. 50, 60, 63, 72, 75, 85, 86 (2005). *See also* Clear Skies Act of 2005, S. 131, 109th Cong. (2005).

90. *See generally* 42 U.S.C. §§ 4321–4370(a) (2000).

91. *Id.* § 4332(2)(c).

92. *See, e.g.*, Greenpeace Action v. Franklin, 14 F.3d 1324 (9th Cir. 1993) (setting forth the plaintiff's argument that negative public comments on proposed regulations triggered environmental impact statement requirement).

93. THE HYDROGEN ECONOMY, *supra* note 27, at 113–14 (discussing the possible negative environmental impacts of hydrogen fuels).

to "enable and promote comprehensive development, demonstration, and commercialization of hydrogen and fuel cell technology . . . ."[94]

2. Will hydrogen fuels be considered a hazardous waste?

Gaseous hydrogen, while highly flammable,[95] is non-toxic and is not currently classified as a hazardous waste.[96] However, the DOT regulations classify many forms of hydrogen as hazardous materials, including compressed, cryogenic liquid and metal hydrides.[97] The disposal of hazardous materials often creates hazardous waste; however, this is not generally true for hydrogen because it is a gas with a high diffusion rate. However, some hydrogen fuels (such as hydrogen borahydride) might not have a high diffusion rate, or might degrade over time leaving other by-products.[98]

A hydrogen gas discharge would cause substantially less, if any, environmental damage than would a discharge of many widely used fuels such as petroleum products.[99] Accordingly, environmental concerns are unlikely to significantly impede the development of hydrogen fuel technologies. However, the early promulgation of environmental standards for hydrogen fuels will eliminate uncertainty, and facilitate commercialization of these fuels.

3. Will oxygen be considered a hazardous waste?

One potential source of hydrogen is water. Each molecule of water is composed of two hydrogen atoms bonded to one oxygen atom. When a water molecule is broken down, hydrogen *and oxygen* atoms are released.

Free oxygen is found in several forms, which are combustible but not considered harmful. The notable exception is ozone, which is one of the principal sources of "smog."[100] The DOT classifies several forms of oxygen as hazardous materials, including compressed and cryogenic liquid.[101]

Additionally, if the concentration of free oxygen in the atmosphere were increased, plants could be affected.[102] Specifically, increased carbon dioxide is reported to have increased the "lushness" of some vegetation.[103] Reduced carbon dioxide concentrations might decrease lushness and reduce crop yields, raising the issue of whether oxygen released in the generation of hydrogen could be considered a hazardous waste.

Conversely, fuel cells and hydrogen combustion consume oxygen which is

94. Energy Policy Act of 2005, Pub. L. No. 109-58, § 802, 119 Stat. 594.

95. THE HYDROGEN ECONOMY, *supra* note 27, at 109.

96. Federal hazardous regulations do apply to gaseous materials and could theoretically be applied to hydrogen. *See, e.g.*, 40 C.F.R. § 261 (2005). If a gaseous hydrogen "waste stream" were available, it would probably be collected and burned, thereby limiting the application of these regulations in most circumstances.

97. 49 C.F.R. pt. 172 (2005).

98. THE HYDROGEN ECONOMY, *supra* note 27, at 109.

99. *See generally* William Vincent, *Hydrogen and Tort Law: Liability Concerns Are Not a Bar to a Hydrogen Economy*, 25 ENERGY L.J. 385 (2004).

100. However, high altitude ozone plays a beneficial role in helping to shield the earth from ultraviolet radiation.

101. 49 C.F.R. pt. 172 (2005).

102. Although the United States has not ratified the Kyoto Accord, the U.S. Government includes the impact on Global Climate Changes when setting the National Energy Policy. *See* 42 U.S.C. §§ 13381–13388 (2005).

103. *See* Liming Zhou et al., *Variations in Northern Vegetation Activity Inferred from Satellite Data of Vegetation Index During 1981 to 1999*, 106 J. GEOPHYSICAL RES. 20,069 (2001).

combined with hydrogen to produce water. Consequently, the complete hydrogen fuel cycle (for hydrogen generated from water) results in no net change in the amount of oxygen in the air. However, the use of hydrogen fuels produced from non-oxygen releasing processes, such as reforming natural gas, might decrease atmospheric oxygen concentrations as this hydrogen combines with free oxygen. This raises the issue of whether a reduction in atmospheric oxygen concentrations could be considered an environmental harm.

Current environmental standards do not classify oxygen as environmentally hazardous. The concern over global warming has focused attention on the issue of whether changes in the concentration of non-hazardous emissions like carbon dioxide can itself cause environmental harm. The use of hydrogen fuels is unlikely to significantly affect free oxygen concentrations; however, further study in this area may be required.

4. Is a permit required to discharge water produced in the use of hydrogen fuels? If so, what discharge volume will trigger the permit requirement?

5. What is the environmental impact of widespread water discharge by hydrogen fueled vehicles? (i.e., will it create non-point source or runoff pollution issues?)

Fuel cells and hydrogen combustion release energy by bonding hydrogen atoms to oxygen atoms to create water molecules. This pure water is then discharged as a by-product. Generally, clean water is not considered a pollutant, although in some instances a permit is required to discharge pure water. However, if the volume of discharged water is sufficiently large, it could create detrimental side effects ranging from slippery highways from fuel cell powered automobiles to excessive downstream water flows.

The environmental and other impacts, if any, of the widespread discharge of pure water are not anticipated in current regulations. Excessive pure water discharge is primarily a concern for waste water treatment systems that require a minimum concentration of organic or other materials to properly function. It is likely that any concerns about quantities of discharged water resulting from hydrogen fuels will be localized, or confined to certain weather conditions.

6. Are Underground Storage Tank regulations applicable to hydrogen fuel storage tanks?

The EPA and associated state agencies have developed extensive regulations on underground storage tanks (UST's) for petroleum and certain other hazardous substances.[104] It is unclear whether existing UST regulations will apply to hydrogen fuel storage tanks.[105] The general rationale for the UST regulations may not apply to underground hydrogen storage facilities, because it is unlikely that hydrogen leaking into the subsurface would pose a threat of groundwater contamination. Accordingly, existing regulations should be clarified as to whether hydrogen fuel storage tanks are subject to the same regulations and standards that apply to petroleum storage tanks, even if hydrogen fuels are not classified as a pollutant.

104. *See generally* 40 C.F.R. pts. 280–81 (2005).

105. Shell is using a hydrogen UST at its Washington, D.C. demonstration service station, which is the first retail hydrogen fueling facility in the eastern United States. *See* U.S. Dep't of Energy, Energy Efficiency and Renewable Energy, *Washington, D.C., Opens Hydrogen Fueling Station* (Dec. 2004), *available at* http://www.eere.energy.gov/state_energy_program/project_brief_detail.cfm/pb_id=806.

7. Is the Leaking Underground Storage Tank Trust Fund applicable to hydrogen fuel-related cleanups?

Congress created the Leaking Underground Storage Tank (LUST) Trust Fund to fund certain costs associated with cleaning up "releases" from UST's. The LUST trust fund is financed by a tax on motorfuels. It is unclear, for the reasons set out above, whether this tax will apply to hydrogen fuels, and whether the clean up of a release from a hydrogen fuel UST could be funded from the trust fund. Accordingly, the existing regulations should be clarified as to whether the LUST trust fund applies to hydrogen fuels, and whether hydrogen fuels are subject to the LUST trust fund fuel tax.

D. Department of Homeland Security

One of the newest agencies involved in the energy markets is the Department of Homeland Security (DHS). This agency was created in the aftermath of the September 11, 2001 terrorist attacks in the United States. The DHS is charged with protecting the United States' "critical infrastructure," which includes energy production and distribution facilities.[106]

At present, the DHS is working with private industry to identify physical security concerns and to develop methods for addressing those concerns. The DHS is also working with state and local authorities to prepare and implement emergency response plans to address man-made or natural disasters affecting critical infrastructure facilities. Given the pivotal role that hydrogen fuels may play in the future U.S. economy, the DHS's role in regulating the hydrogen economy must be considered:

1. Should the DHS have approval/veto authority over the location of large hydrogen fuels facilities, such as production plants or centralized electrical generation facilities? Specifically, should the DHS have the ability to restrict the locating of such facilities near large population centers?

2. Should the DHS have review and approval authority over the physical security features and operational plans of new or existing hydrogen fuels facilities?

The DHS is responsible for coordinating the federal government's efforts to both protect critical infrastructure from terrorist attack and to minimize the damage to life and property in the event of such an attack.[107] For example, one particularly significant terrorist concern prompted the Federal Bureau of Investigation (FBI) to warn of possible terrorist attacks on Texas refineries.[108]

Hydrogen fuels, and the infrastructure to produce those fuels, may become critical components of the nation's economy and lifestyle.[109] There is likely to be economic pressure to locate hydrogen fuels production facilities close to the users of those fuels both to reduce transportation costs and to address limitations in the hydrogen fuel distribution network.[110] However, placing hydrogen fuel

106. THE WHITE HOUSE, THE NATIONAL STRATEGY FOR THE PHYSICAL PROTECTION OF CRITICAL INFRASTRUCTURES AND KEY ASSETS 50–53 (Feb. 2003), *available at* http://www.whitehouse.gov/pcipb/physical.html [hereinafter CRITICAL INFRASTRUCTURES].

107. *Id.*

108. MSNBC Staff, *FBI Issues Terror Warning to Texas Refineries* (Mar. 25, 2004), *available at* http://www.msnbc.msn.com/id/4600580.

109. *See* Energy Policy Act of 2005, Pub. L. No. 109-58, § 802, 119 Stat. 594.

110. THE HYDROGEN ECONOMY, *supra* note 27, at 43, 62.

production facilities close to major population centers may enhance the attractiveness of those facilities for potential terrorist attacks. Further, placing hydrogen production facilities close to population centers increases the risk of bodily injury or evacuation in the event of an accident, natural disaster, or attack. This raises the issue of whether the DHS should have any authority to regulate the locating of hydrogen fuel production facilities. Additionally, this raises issues of whether the DHS, the DOE, or another federal agency should have any authority to regulate the security and operations of hydrogen facilities, like the Nuclear Regulatory Commission oversees these aspects of nuclear power facilities.[111]

One approach would be to have the DHS promulgate mandatory minimum facility design and operations standards. The DHS would establish mandatory minimum design criteria for critical physical security features, such as perimeter set backs and vehicle barriers to limit truck bomb damage.[112] The DHS would also establish mandatory minimum operations requirements relating to the training of security personnel and the security procedures to be utilized. The state and local authorities would retain their authority over facility siting determinations with the benefit of the DHS standards. The DHS could also provide comments, file objections, or provide other input to state and local siting authorities to address unique concerns about any particular proposed facility at a particular proposed location.

3. Should the DHS have approval/veto authority over the types or forms of hydrogen fuels that are made commercially available? Should the DHS have the authority to require that hydrogen fuels have 'signatures' that permit tracing to the source of origin?

Commercial fertilizers, when combined with diesel fuel, can be used to create powerful explosives, as demonstrated by the bombing of the Oklahoma City Federal building.[113] Tanker trucks loaded with gasoline are commonly discussed as potential terrorist targets.[114] It is not hard to imagine the misuse of hydrogen fuels when those become commercially available.

Some forms of hydrogen fuels may be harder to improperly use than other forms. For example, hydrogen fuels such as sodium borahydride consist of hydrogen bonded to another chemical that may be harder to misuse. Additionally, it might be possible to mix hydrogen fuels with minute quantities of other substances that create a chemical "signature" that allow the fuel to be traced to its point of manufacture.[115]

These circumstances raise issues of whether the DHS, or other law enforcement agencies, should have any regulatory authority over the form or composition of hydrogen fuels. However, given the very limited amount of

111. *See* CRITICAL INFRASTRUCTURES, *supra* note 106, at 74–76 (discussing nuclear power plant security).

112. *See, e.g.*, FEDERAL EMERGENCY MANAGEMENT AGENCY, U.S. DEPT. OF HOMELAND SECURITY, REFERENCE MANUAL TO MITIGATE POTENTIAL TERRORIST ATTACKS AGAINST BUILDINGS (2003).

113. *See* OFFICE OF GOVERNOR BRAD HENRY, STATE OF OKLAHOMA, GOV. HENRY APPROVES RULES ON FERTILIZER SALES (2005), *available at* http://www.gov.ok.gov/display_article.php?article_id=439&article_type=1.

114. Associated Press, *FBI Issues Fuel Truck Terror Warning* (Aug. 11, 2005), http://www.foxnews.com/story/ 0,2933,165474,00.html.

115. *But see* THE HYDROGEN ECONOMY, *supra* note 27, at 109 ("[T]he small size of the hydrogen molecules does not accommodate well the presence of chemical odorants.").

criminal misuse of fuels in the past 100 years, it would be hard to justify the expense of such requirements.

4. Should the DHS have the authority to restrict the sale or distribution of hydrogen fuels or hydrogen fuel technologies (like the Bureau of Alcohol, Tobacco and Firearms (ATF) regulates the sale and distribution of certain alcohol products and firearms)?

Hydrogen fuels will not be commercially successful unless they are widely available and widely used.[116] The need for widespread use of hydrogen fuels suggests that hydrogen and hydrogen technologies should be readily available in the marketplace. But if hydrogen fuels have a high potential for misuse, then restrictions on the distribution of hydrogen fuels or the technology to extract the hydrogen from those fuels might be prudent. This raises issues of whether the DHS or other state or federal agencies should regulate the distribution of hydrogen fuels and related technologies. Such regulations could take the form of licenses or permits, and could involve background security or criminal history checks, as required by the ATF when licensing firearms dealers.[117] However, given the historical lack of criminal misuse of fuels, it is questionable whether such procedures would be justified.

5. Should the DHS have the authority to restrict or prohibit the shipment, or the means and methods of shipping hydrogen fuels?[118]

There has been widespread discussion of the risk of a terrorist attack on an oil or LNG tanker.[119] Bulk shipments of hydrogen fuels are likely to raise the same concerns of terrorist attacks, or of a lowly accident. The DHS has taken steps to limit the likelihood of a catastrophic attack on an LNG tanker in a populated area by escorting such tankers when approaching certain ports.[120] This raises issues of whether the DHS or other federal, state or local law enforcement authorities should regulate the bulk shipment of hydrogen fuels. The answer to this question is likely dependent upon which specific hydrogen fuels and related distribution technologies are ultimately introduced in the market. However, existing regulations appear adequate, if extended to hydrogen fuel shipments.

E. DOE and DOT

The DOE and the DOT have an unclear long term role in the regulation of hydrogen fuels. Currently, the DOE is charged with administering the federal Hydrogen Fuels Initiative.[121] The DOE has primary responsibility for shepherding the development of the hydrogen fuels industry, and of determining which research and development projects receive federal funding. The DOE will have significant involvement in the hydrogen fuels area for many years to come, but it is unclear if it will have any regulatory role, separate from the FERC.

1. What role will the DOE play in deciding which technologies move from

116. *Id.* at 119.

117. *See generally* 27 C.F.R. pt. 478 (2005).

118. The Coast Guard currently escorts some LNG tankers on approach to terminals.

119. *See* Associated Press, *LNG Tanker Attack Would be Devastating* (Dec. 20, 2004), http://www.foxnews.com/ story/0,2933,142133,00.html.

120. *See generally* Maritime Transportation Security Act of 2002, Pub. L. No. 107-295, 116 Stat. 2064.

121. *See generally* 42 U.S.C. §§ 12401–12408 (2000); *see also* Energy Policy Act of 2005, Pub. L. No. 109-58, §§ 801–816, 902, 931, 933, 972, 119 Stat. 594.

the laboratory to commercialization?

2. What role will the DOE play with other agencies in advocating the granting of permits or other authorization to commercialize hydrogen fuel technologies?

EPAct 2005 charges the DOE with ensuring that hydrogen fuels and related technologies are in the mass market by the year 2020.[122] The portions of EPAct 2005 identified in section I, above, establish that the DOE is to play a role in supporting hydrogen fuels research, facilitating the commercialization of hydrogen fuel technologies, and stimulating the marketplace to create a demand for hydrogen fuels and a supporting infrastructure to deliver those fuels. However, EPAct 2005 does not provide for DOE to have an ongoing role in improving hydrogen fuels technologies once these initial goals are accomplished.[123]

The DOT's future role is likely dependent on the extent of the role of the FERC and other federal agencies. The DOT is responsible for the United States' transportation infrastructure. Working through state agencies, the DOT regulates the construction and maintenance of interstate highways, bridges, and tunnels.[124] The DOT regulates the movement of goods by railroads,[125] ships and barges,[126] and air transportation.[127] The DOT establishes safety standards for automobiles.[128] The DOT also regulates pipelines that transport hazardous chemicals.[129] Further, the DOT currently regulates some aspects of deepwater seaports.[130]

Given the breadth of the DOT's involvement in regulating the movement of goods in the United States, the DOT's role in regulating hydrogen fuels should be considered in light of the ambit of other relevant agencies:

3. Is the DOE (FERC) or the DOT (Pipeline and Hazardous Materials Safety Administration) the best agency to regulate the transportation of hydrogen fuels?

4. How can/should the DOT coordinate the intra-agency development of standards for the safe surface shipment of hydrogen fuels?[131]

5. Is the DOT the best agency to regulate the importation or exportation of hydrogen fuels?

122. *See generally* Energy Policy Act of 2005 §§ 802, 805–809.

123. *But see id.* § 972 (concerning the national policy on fusion energy).

124. *See generally* 23 C.F.R. pts. 1–940 (2005).

125. *See generally* 49 C.F.R. pts. 200–68 (2005).

126. *See generally* 46 C.F.R. pts. 201–391 (2005).

127. *See generally* 14 C.F.R. pts. 1–49, 61–139, 141–98 (2005).

128. *See generally* 49 C.F.R. pts. 501–97 (2005).

129. *See generally id.* pts. 190–95.

130. *See generally* 33 U.S.C. §§ 1501–1524 (2000).

131. For example, DOT's Federal Highway Administration, Federal Railroad Administration, Maritime Administration, National Highway Traffic Safety Administration all set standards that might apply to surface shipments of hydrogen fuels.

III. HOW WILL HYDROGEN FUELS BE TAXED?

A. *The Current Tax Regime*

The current system of energy taxes is reminiscent of a Rube Goldberg machine. The federal, state, and local government entities apply a variety of taxes and fees to fuel and energy, including:

1. Excise Taxes

An excise tax is an *ad valorem* tax imposed on a specific good or service. The federal government and many states impose excise taxes on each gallon of gasoline and diesel fuel.[132]

2. Sales Taxes

A sales tax is a consumption tax that is charged as a percentage of the sales price of a good or service. State and local government entities apply sales taxes to a variety of energy products ranging from petroleum fuels to natural gas and electricity.[133]

3. Severance Taxes

A severance tax is an *ad valorem* tax imposed on natural resources extracted or severed from their natural state. Some states apply severance taxes to non-renewable energy products such as oil, natural gas and coal.[134]

4. Fees

A fee paid to the government is sometimes considered a form of tax, even though it is paid in exchange for some specific benefit, service or privilege. Common energy fees include royalties on oil drilling rights, harbor or terminal fees, lease fees, and trust fund fees (such as UST fees).[135]

5. Penalties

A tax sometimes takes the form of a penalty that is designed to discourage certain activities. An example is the "gas guzzler" tax for automobiles that do not attain the required fuel efficiency.[136]

B. *Possible Ways of Taxing Hydrogen Fuels*

Some of the current fuel taxes may not apply to hydrogen fuels. This presents the opportunity to impose taxes in entirely new ways, to adapt the existing taxes to apply to hydrogen fuels, or both. Some issues that should be

132. ENERGY INFO. ADMIN., TAXES, *available at* http://www.eia.doe.gov/pub/oil_gas/petroleum/analysis_publications/oil_market_basics/Price_taxes.htm (last visited Feb. 1, 2006).

133. *See generally* TAX FOUND., SPECIAL REPORT: THE TAXATION OF ENERGY IN THE U.S.: WHO PAYS? (1994).

134. *Id.*

135. *See generally* 40 C.F.R. § 280.101 (2005) and various state laws enacted pursuant to this code section.

136. *See* 26 U.S.C. § 4064 (2000) (establishing the "gas guzzler tax" on automobiles, which increases the amount of tax owed based on the fuel economy of the vehicle).

considered are:

1. Should energy taxes be imposed only by the federal government (and distributed to the states), only by the states (and shared with the federal government) or by both? What if the state and federal tax policies conflict?

2. If both the federal and state governments impose taxes, should the taxes be of the same type?

3. Should a national sales tax or value added tax be imposed on hydrogen fuels?

The current tax system is expensive and inefficient. The state and federal governments tax the same fuels in different ways, which increases the cost to both the taxpayers and the tax collectors to administer the tax schemes. This also creates the possibility of conflict between the policies underlying the federal and state taxes. For example, the federal government might impose an excise tax to discourage the use of high pollutant fuels, while a state might impose a severance tax on clean fuels extracted from that state.

One possible alternative to the current situation is to have either the states or the federal government impose and collect an exclusive tax on hydrogen fuels, and share it with the other. Another alternative would be to have the state and federal taxes be of the same type (e.g., a sales or value added tax), and then have both taxes administered by a single entity. Other alternatives abound.

4. Should an energy content tax, like the BTU tax proposed by the Clinton Administration, be imposed on hydrogen fuels?

The amount of energy released by the combination of hydrogen and oxygen atoms is constant, but the concentration of hydrogen atoms in a unit of hydrogen fuel is not constant. For example, a "gallon" of liquefied hydrogen gas contains more hydrogen, and thus more energy potential, than a 'gallon' of gaseous hydrogen. An energy content tax would equalize the tax regardless of the form of the fuel.

5. Should a pollution tax (i.e., carbon tax) be imposed on carbon based fuels once hydrogen fuels become commercially available?

Over the years, several fuel taxes have been proposed that tax the amount of pollution created by using that fuel. Pollution taxes are generally explained as intended to either change the way consumers act, i.e., use less pollution generating fuels, or to correct the imbalance in the market caused by the social cost of pollution externalities.[137] A pollution tax could be applied to hydrogen and other fuels to equalize the cost of the fuels. In the example of a carbon tax, it could be imposed on the carbon released by generating hydrogen fuels (such as the carbon dioxide generated when natural gas is reformed to produce hydrogen), and on the carbon pollution produced from using non-hydrogen fuels.[138]

The concept of a carbon tax has not received widespread support in the United States. Nevertheless, proponents contend that a tax of approximately $30

137. *See generally* John Carlin, *Environmental Externalities in Electric Power Markets: Acid Rain, Urban Ozone, and Climate Change*, *available at* http://cc.msnscache.com/cache.aspx?q=2810693815883&lang=en-US (last visited Feb. 1, 2006).

138. *See generally* Roberta Mann, *Waiting to Exhale?: Global Warming and Tax Policy*, 51 AM. U. L. REV. 1135 (2002).

per ton on carbon released into the atmosphere would essentially equalize the cost of hydrocarbon and non-hydrocarbon fuels.[139] An alternative to a carbon tax would be to require major carbon dioxide emitters to sequester, i.e. capture, the carbon.[140] Either way, the additional cost of the tax or the carbon sequestration would then be reflected as a cost of using carbon emitting fuels.

At present, it is unclear whether hydrogen fuels can be price competitive with hydrocarbon fuels without accounting for the "cost" of carbon emissions. Some studies have shown a rough equivalence in cost between gasoline and some forms of hydrogen fuels, based on current technologies, and estimate lower hydrogen than gasoline costs based on projected future technologies.[141] However, those studies are problematic for two reasons. First, the studies generally include either an "imputed" cost for carbon emissions, or a proposed direct carbon tax, that may not reflect the actual "cost" associated with the carbon. Second, those studies use energy cost assumptions that may understate the cost of hydrocarbon fuels, given current oil and natural gas pricing. Consequently, these comparisons will be subject to considerable criticism, unless the assumptions, and underlying cost information, are updated frequently.

6. Should tax revenues be "earmarked" to fund public expenditures on hydrogen fuels?

7. Should taxes on hydrogen fuels be used to encourage (or discourage) the use of hydrogen fuels? (For example, lower taxes on uses that make the greatest reduction in greenhouse gases.)

8. Should tax rebates or credits be used to encourage (or discourage) use of hydrogen fuels? (For example, EPAct 2005 provides tax credits for hydrogen fueled vehicles.)[142]

The current tax system is used both to raise revenue and to fund specific programs and services. Many gasoline taxes are used by the state and federal governments to pay for highway projects. The federal excise tax on coal funds the Black Lung program for coal miners. The states and federal government will have to address the political and social issues surrounding any taxes on hydrogen fuels, and any decrease in revenue from existing fuel taxes that are earmarked to fund ongoing programs such as the Black Lung program, that results from switching to hydrogen fuels.

IV. OTHER HYDROGEN FUEL CONCERNS

Hydrogen fuels will challenge the existing legal and regulatory framework for many years as the contours of the hydrogen economy are defined. These challenges will not prevent the commercialization of hydrogen fuels, but will affect the structure of the domestic and international hydrogen economy. Some of the legal and policy questions that may arise include:

1. Is hydrogen a commodity? Will hydrogen futures be sold on financial exchanges?

139. *See, e.g.*, Lord John Browne, Group Chief Executive of British Petroleum, Energy Security: Responding to the Challenge, Presentation to The Brookings Institution 29 (Nov. 29, 2005), *available at* http://www.brookings.edu/comm/events/20051129.pdf.

140. *See* THE HYDROGEN ECONOMY, *supra* note 27, Chapter 7 "Carbon Capture and Storage" at 84.

141. *See id.* at 49–63.

142. *See* Energy Policy Act of 2005, Pub. L. No. 109-58, § 1341, 119 Stat. 594, 1038.

The financial markets for energy products play an important role in satisfying the United States' current energy needs. Oil, gasoline, and natural gas futures are sold on commodity markets, and sophisticated energy buyers employ "hedges" to limit the financial impact of sudden increases in fuel costs.[143]

If hydrogen fuels attain widespread use, both domestically and internationally, some form of market for those fuels will be necessary. The current energy markets and financial products for those markets are likely to be used for hydrogen fuels, but other alternatives might exist as well. In addition, as demonstrated by the exploits of Enron and other companies, some form of regulatory oversight of the hydrogen fuels market might be necessary.

2. What are the domestic and international political effects of migrating to hydrogen fuels?

The political impact of a switch to hydrogen fuels is potentially quite large. Depending upon how widespread hydrogen fuels are used, it could impact everything from the cost of imported produce in the grocery store to the political and financial stability of the oil producing countries in the Middle East and Latin America.[144]

The domestic political issues are potentially equally significant. Nuclear power is potentially a cost effective method to produce "clean" hydrogen fuels without greenhouse gas emissions;[145] however, nuclear energy is often considered "unclean" because of the long-lived radioactive waste that it produces. It may be the case that hydrogen fuels are produced most efficiently at facilities with access to substantial quantities of water and near major population centers where the fuels will be used. In that event, what will be the impact on sparsely populated, arid, or semi-arid parts of the "oil patch?"

3. What is the role of the World Trade Organization and the North and Central American Free Trade Agreements in the international hydrogen fuels markets?

The United States has been a major proponent of international free trade, and in the reduction or elimination of government subsidies that create "unfair" advantages in the international market place. Currently, the United States government is "investing" substantial money in the development of hydrogen fuels and related technologies.[146] Other countries are also funding hydrogen fuels research. If hydrogen fuels are traded internationally, how will these government expenditures affect the market and international trade agreements?

4. How to address the "Hindenburg Syndrome" as an impediment to public acceptance of hydrogen fuels?

The general public expresses reservations about the safety of hydrogen fuels. These reservations often take the form of a reference to the catastrophic

143. *See generally* Energy Information Administration, *Types of Transactions*, http://www.eia.doe.gov/pub/oil_gas/petroleum/analysis_publications/oil_market_basics/Price_transactions.htm (last visited Feb. 1, 2006).

144. *See, e.g.*, HYDROGEN BLUEPRINT *supra* note 1, at 5; FLA. ENERGY OFFICE, A PROPOSED LEGISLATIVE INITIATIVE BY THE STATE OF FLORIDA, GROWING FLORIDA'S ECONOMY WITH CLEAN HYDROGEN POWERED TECHNOLOGIES (2005), *available at* http://www.dep.state.fl.us/energy/ fla_energy/files/vision.pdf.

145. *See* THE HYDROGEN ECONOMY, *supra* note 27, at 94–97; *see also* Energy Policy Act of 2005, Pub. L. No. 109-58, §§ 641–43, 951–52, 119 Stat. 594.

146. *See, e.g.*, Energy Policy Act of 2005 §§ 805, 808–809.

fire that engulfed the airship Hindenburg.[147] Widespread acceptance and use of hydrogen fuels will require that people believe the hydrogen fuels are safe. Educational programs and media campaigns are proven methods of conveying safety information to the public, as exemplified by the Smokey the Bear fire safety campaign, but such campaigns require public or private funding.

5. Is the generation or distribution of hydrogen fuels an "ultra-hazardous activity" for tort liability purposes, and what insurance is available?

In addition to the public perception, hydrogen fuels will have commercial reasons for being classified as "safe." The law places special burdens on entities that engage in "ultra-hazardous" activities, such as blasting companies. These burdens translate into additional insurance costs and exclusions. The economics of hydrogen fuels may be substantially affected by tort law exposure and the availability and cost of insurance.[148]

6. What is the effect of the Kyoto Accord on hydrogen fuels, especially for multinational companies?

The Kyoto Accord resulted from international concern over the build-up of greenhouse gases in the atmosphere. The "burning" of carbon fuels is a major source of greenhouse gases. The United States did not ratify the Kyoto Accord, but many U.S. companies perform work in countries that have ratified the Kyoto Accord.

Hydrogen fuels may help reduce emissions of greenhouse gases. As hydrogen fuel technologies become commercially available, some countries may mandate the aggressive deployment of hydrogen fuels technologies to satisfy their obligation under the Kyoto Accord.

7. What are the displacement costs of migrating to hydrogen fuels? (i.e., retraining automobile mechanics to service hydrogen fueled automobiles.)

Fuel cells are very different from internal combustion engines. As automakers, and others, begin selling fuel cell powered devices, maintenance personnel will need to be trained to safely repair those devices and other hydrogen fuel components. These personnel will need to be trained, or in some cases retrained, to repair hydrogen powered devices. Businesses will incur costs to retrain some employees. Governments and trade associations such as labor unions may also have involvement in retraining programs. EPAct 2005 provides for a study of the effect on employment of migrating to hydrogen fuels.[149]

8. Should patent laws be changed to provide additional incentives for the development, and licensing, of hydrogen fuel technologies?

The use of hydrogen fuels is also heavily dependant on the development of additional technologies for producing, using, and transporting hydrogen fuels. But if widespread use of such fuels, and therefore the technologies relating to the fuels, is several years in the future, then the current patent term of twenty years from the date of the filing of the patent application[150] might discourage inventors

147. *See* CAL. HYDROGEN HIGHWAY, FREQUENTLY ASKED QUESTIONS, *available at* http://www.hydrogenhighway.ca.gov/facts/faq/faq.htm (last visited Feb. 1, 2006).

148. *See generally* Russell Moy, *Tort Law Considerations for the Hydrogen Economy*, 24 ENERGY L.J. 349 (2003); William Vincent, *Hydrogen and Tort Law: Liability Concerns are Not a Bar to a Hydrogen Economy*, 25 ENERGY L.J. 385 (2004).

149. Energy Policy Act of 2005, Pub. L. No. 109-58, § 1820, 119 Stat. 594, 1132.

150. *See* 35 U.S.C. § 154(a)(2) (2000).

from reducing their inventions to practice until commercialization of hydrogen fuels has occurred. Clearly, if all inventors delayed releasing their inventions, hydrogen fuels would never achieve widespread commercial use. This raises the issue of whether the twenty year term of patents should be extended, as has been done with products that have undergone certain lengthy regulatory reviews.[151]

Additionally, EPAct 2005 charges the interagency task force on hydrogen fuels with promoting the exchange of information and technology.[152] In the context of patentable technologies developed via publicly supported research efforts or programs, the exchange of information may be improved if standardized licensing terms could be established in advance, thereby eliminating the time and costs associated with individualized negotiations between parties. Such a system might resemble the music industry's American Society of Composers, Authors and Publishers (ASCAP) system for collecting and distributing royalties. Alternatively, the existing potential for negotiating large licensing fees might be a better incentive at fostering overall progress in hydrogen technologies than an ASCAP-type approach.

9. How is the United States' military impacted by the development of hydrogen fuels?

The US military uses energy to power equipment ranging from ships, planes and tanks in the field, to pencil sharpeners and florescent lights in the Pentagon. EPAct 2005 requires federal agencies to use hydrogen fuels when possible.[153] However, hydrogen fuels pose additional concerns for military planners, such as safety under battlefield conditions, durability of hydrogen fuel technologies under extreme conditions, and the costs and logistics associated with migrating to hydrogen fuels. Military use of hydrogen fuels also raises issues of whether hydrogen fuels technologies are subject to export controls for "dual use" technologies to restricted countries.[154]

V. CONCLUSION

The federal and several state governments have made the commitment to develop and deploy hydrogen fuels. Consequently, the question is not if hydrogen fuels will be available, but when.

The issues discussed in this article are a sample of those that will need to be addressed along the road to commercialized hydrogen fuels. The Energy Policy Act of 2005 requires the Department of Energy to establish an interagency "task force" to plan for the development of a "safe, economical, and environmentally sound [hydrogen] fuel infrastructure . . . ."[155] That task force is ideally suited to address the types of issues discussed in this article.

One way that the task force might choose to proceed is to reach out to the private sector, to interest groups, and to state governments for comments and suggestions, i.e., to partner with the other players in the hydrogen economy. The private sector has a vested interest in ensuring that any regulations employ the

151. *See* 35 U.S.C. §§ 155–156 (2000); *see also* 35 U.S.C. §155A (2000).

152. *See* Energy Policy Act of 2005, Pub. L. No. 109-58, § 806(b)(2), 119 Stat. 594, 848.

153. *See id.* §§ 781–783.

154. *See generally* Arms Export Control Act, 22 U.S.C. § 2778 (2000); Export Administration Act of 1979, 50 U.S.C. app. §§ 2401–2420 (2000).

155. *See* Energy Policy Act of 2005 § 806.

best practices of prior regulations, without repeating the burdensome and inefficient ones. The interest groups can help shape the policies and regulations in ways that will limit opposition and promote public acceptance of hydrogen fuels, thereby facilitating a smooth transition to a hydrogen economy. The state governments have practical experience with deploying hydrogen technologies under the challenges of the existing regulatory scheme.

The task force should also look for innovative ways to facilitate the transition to a hydrogen economy. An excellent example of this innovating-the-regulations is the State of Florida's efforts to modernize its regulations while establishing a "One-Stop" Uniform Hydrogen Siting Program.[156]

If properly implemented, Florida's one-stop permitting approach should make the process easier and less costly for the private sector, more transparent and understandable to the general public, and less duplicative and expensive to administer for the state. This type of innovation reflects a cooperative approach to regulation by the regulators—a model that the federal task force on hydrogen fuels should follow whenever possible.

156. FLA. ENERGY OFFICE, A PROPOSED LEGISLATIVE INITIATIVE BY THE STATE OF FLORIDA, GROWING FLORIDA'S ECONOMY WITH CLEAN HYDROGEN POWERED TECHNOLOGIES (2005), *available at* http://www.dep.state.fl.us/energy/fla_energy/files/vision.pdf.