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Renewable Energy Policy: Tax Credit, Budget, and Regulatory Issues

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Renewable Energy: Tax Credit, Budget, and Electricity Production Issues

Summary

High gasoline and natural gas prices have rekindled interest in the role that renewable energy may play in producing electricity, displacing fossil fuel use, and curbing demand for power transmission equipment. Also, worldwide emphasis on environmental problems of air and water pollution and global climate change, the related development of clean-energy technologies in western Europe and Japan, and technology competitiveness may remain important influences on renewable energy policymaking.

The Bush Administration's FY2007 budget request for the Department of Energy's (DOE's) Renewable Energy Program seeks $359.2 million, which is $84.0 million, or 30.5%, more than the FY2006 appropriation. In support of the President's proposal for an Advanced Energy Initiative (AEI), the request includes major funding increases for solar energy (to support the Solar America initiative) and biomass (to support the Biorefinery Initiative). The main increases are for Solar Photovoltaics ($79.5 million) and Biomass ($59.0 million). Some significant cuts were also proposed, and the request sought to eliminate earmarks.

Appropriations actions by the House and the Senate Appropriations Committee have approved most of the requested FY2007 funding increases for AEI and greatly reduced earmark funding. Compared with House-passed funding, the Senate Appropriations Committee recommendation seeks an increase of $66.1 million (5%). **Table 3** shows other differences, most notably those for Biomass & Biorefinery, Geothermal, Hydro, and Weatherization programs.

Important regulatory issues have surfaced for wind energy. A major debate has erupted over the safety and economic and environmental aspects of a proposal by Cape Wind Associates to develop an offshore wind farm near Cape Cod, Massachusetts. The parties to the debate are waiting for the results of a Department of Interior (DOI) environmental impact statement and a Coast Guard study of navigational safety aspects. Also, concern that large wind turbines may disrupt radar systems led to federal actions to halt several wind farm developments, pending the results of a study by the Department of Defense (DOD) that was due in early May 2006. In late June 2006, the Sierra Club filed suit to compel completion of the DOD radar study. An agency of the United Kingdom has studied modifications to turbines and radar systems that may help solve the problem.

Also, high gasoline prices have stimulated a DOE proposal for aggressive development of cellulosic ethanol as an alternative to gasoline and corn-based ethanol. The focus is on using biotechnology to simplify processes and reduce costs.

This report replaces CRS Issue Brief IB10041, *Renewable Energy: Tax Credit, Budget, and Electricity Production Issues*, by Fred Sissine. It will be updated as events warrant.

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Most Recent Developments

On June 29, 2006, the Senate Committee on Appropriations reported H.R. 5427, the Energy and Water Appropriations bill for FY2007 (S.Rept. 109-274). This bill includes funding for the Department of Energy (DOE) Renewable Energy Program, which is conducted by the Office of Energy Efficiency and Renewable Energy (EERE). Compared with House-passed funding, the FY2007 Senate Appropriations Committee recommendation seeks an increase of $66.1 million (5%). **Table 3** shows other differences, most notably those for Biomass & Biorefinery, Geothermal, Hydro, and Weatherization programs.

Compared with FY2006 funding, the Senate Committee recommends an increase of $240.4.8 million for R&D and deployment programs. This reflects support for the Advanced Energy Initiative, including increases for Hydrogen ($34.2 million), Biomass/Biorefineries ($59.3 million), and Solar ($65.3 million). The main cuts include the Weatherization program (-$42.6 million), Facilities (-$20.2 million), Industrial programs (-$9.3 million), and Program Management (-$9.9 million).

(The renewable energy provisions in the Energy Policy Act of 2005 [P.L. 109-58, H.R. 6] and other bills of the 109th Congress are discussed in the "Renewables in the 109th Congress" and "Legislation" sections below. A list of all renewable energy bills introduced in the 109th Congress is provided in CRS Report RL32860, *Energy Efficiency and Renewable Energy Legislation in the 109th Congress*, by Fred Sissine.)

Background

Renewable Energy Concept

Renewable energy is derived from resources that are generally not depleted by human use, such as the sun, wind, and water movement. These primary sources of energy can be converted into heat, electricity, and mechanical energy in several ways. There are some mature technologies for conversion of renewable energy such as hydropower, biomass, and waste combustion. Other conversion technologies, such as wind turbines and photovoltaics, are already well developed, but they have not achieved the technological efficiency and market penetration that many expect they will ultimately reach. Although geothermal energy is produced from geological rather than solar sources, it is often included as a renewable energy resource (and is

treated as such in this report). Commercial nuclear power is not generally considered to be a renewable energy resource.[1]

Contribution to National Energy Supply

According to the Energy Information Administration's (EIA's) *Annual Energy Outlook 2006*, renewable energy resources (excluding wood used for home heating) supplied about 5.7 Q (quadrillion Btu's, or quads) of the 99.7 Q the nation used in 2004, or about 6.0% of national energy demand. More than half of renewable energy production takes the form of electricity supply. Of this, most is provided by large hydropower. However, from 1998 through 2001, a drought-driven decline in hydroelectric availability led to a major drop in national renewable energy use. Industrial use of renewables, supplied primarily by biofuels, accounts for most of the remaining contribution.[2]

Some note that renewable energy, after more than 25 years of federal support, has achieved neither a high level of market penetration nor a growing market share among other energy sources. A 1999 review of renewable energy studies by Resources for the Future (*Renewable Energy: Winner, Loser, or Innocent Victim?*) concludes that the lower-than-projected market penetration and flat market share were due primarily to declining fossil fuel and electricity prices during most of that period. In contrast, however, it notes that the costs for renewable energy technologies have declined by amounts equal to or exceeding those of earlier projections.[3] Nevertheless, the costs are still higher than those for conventional energy.[4] Even wind energy, which has a much lower cost than solar energy technologies, owes its recent commercial success to support from the federal renewable energy production tax credit and the renewable portfolio standard (RPS) that many states have put in place.[5]

EIA's *Annual Energy Outlook 2006* projects that current policies would yield a 1.8% average annual increase in renewable energy production to 9.0 Q through 2030, resulting in a 57% total increase. This would amount to about 6.7% of the projected 134 Q total demand in 2030.[6]

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[1] For further definitions of renewable energy, see the National Renewable Energy Laboratory's website information on "*Clean Energy 101*" at [http://www.nrel.gov/learning/].

[2] EIA has prepared a brochure entitled *Renewable Energy Sources: A Consumer's Guide* that shows information about the energy contribution of several renewable energy sources. It is available at [http://www.eia.doe.gov/neic/brochure/renew05/renewable.html].

[3] The report by Resources For the Future is available at [http://www.rff.org/Documents/RFF-Resources-135-renewenergy.pdf].

[4] See the historical trend *Cost Curves* at National Renewable Energy Laboratory, Energy Analysis, at [http://www.nrel.gov/analysis/newsletters/2006_january.html]

[5] Information about the 20 states that have established an RPS is available online from the Database of State Incentives for Renewable Energy at [http://www.dsireusa.org/].

[6] Detailed breakdowns of renewable energy use appear in EIA's *Renewable Energy Trends 2004*, at [http://www.eia.doe.gov/cneaf/solar.renewables/page/trends/ rentrends04.html].

Role in Long-Term Energy Supply

Our Common Future, the 1987 report of the United Nations World Commission on Environment and Development, found that "energy efficiency can only buy time for the world to develop 'low-energy paths' based on renewable sources."[7] Though many renewable energy systems are in a relatively early stage of development, they offer "a potentially huge primary energy source, sustainable in perpetuity and available in various forms to every nation on Earth." The report suggested that a research, development, and demonstration (RD&D) program of renewable energy projects is required to attain the level of primary energy now obtained from a mix of fossil, nuclear, and renewable energy resources.

The *Agenda 21* adopted at the 1992 United Nations Conference on Environment and Development (UNCED, "Earth Summit") concluded that mitigating urban air pollution and the adverse impact of energy use on the atmosphere — such as acid rain and climate change — requires an emphasis on "clean and renewable energy sources." The U.N. Division on Sustainable Development oversees implementation of *Agenda 21*. The 2002 U.N. World Summit on Sustainable Development (Johannesburg Earth Summit) adopted a *Political Declaration* and a *Plan of Implementation*,[8] which includes "Clean Energy" as one of five key policy actions.[9] Subsequently, in 2003, the U.S. Department of State implemented a $42 million Clean Energy Initiative[10] and the European Union committed to a $700 million energy partnership. Nevertheless, EIA estimates that renewable energy's share of global energy consumption through 2030 will remain limited to less than 9% for the next two to three decades.[11]

History

The oil embargo of 1973 sparked a quadrupling of energy prices, major economic shock, and the establishment of a comprehensive federal energy program to help with the nation's immediate and long-term energy needs. During the 1970s, the federal renewable energy program grew rapidly to include basic and applied R&D and federal participation with the private sector in demonstration projects, commercialization, and information dissemination. In addition, the federal government instituted market incentives, such as business and residential tax credits, and created a utility market for nonutility-produced electric power through the Public Utility Regulatory Policies Act (P.L. 95-617).

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[7] The United Nations resolution (A/RES/42/187) that accompanied release of the report is available at [http://www.un.org/documents/ga/res/42/ares42-187.htm].

[8] The declaration is available at [http://www.johannesburgsummit.org/].

[9] More information about the United Nations' role in Energy for Sustainable Development is available at [http://www.un.org/esa/sustdev/sdissues/energy/enr.htm].

[10] The Department of State document is available at [http://www.state.gov/g/oes/sus/wssd/].

[11] EIA, *International Energy Outlook 2006*, Table A8 (World Consumption of Hydroelectricty and Other Renewable Energy, 1990-2030) and Table A1(World Energy Consumption, 1990-2030), at [http://www.eia.doe.gov/oiaf/ieo/ieorefcase.html].

The subsequent failure of the oil cartel and the return of low oil and gas prices in the early 1980s slowed the federal program. Despite Congress's consistent support for a broader, more aggressive renewable energy program than any Administration, federal spending for these programs fell steadily through 1990. Until 1994, Congress led policy development and funding through legislative initiatives and close reviews of annual budget submissions. FY1995 marked a noteworthy shift, with the 103rd Congress for the first time approving less funding than the Administration had requested. The 104th Congress approved 23% less than the Clinton Administration request for FY1996 and 8% less for FY1997. However, funding turned upward again during the 105th and 106th Congresses, and stayed relatively flat through the 107th and 108th Congresses and the first session of the 109th Congress.[12]

From FY1978 through FY2005, the DOE spent about $13.4 billion (in 2005 constant dollars) for renewable energy R&D. Renewable energy R&D funding grew from less than $1 million per year in the early 1970s to more than $1.4 billion in FY1979 and FY1980, then declined steadily to $148 million in FY1990. By FY2005, it reached $380 million in 2005 constant dollars.

This spending history can be viewed within the context of DOE spending for the three major energy supply R&D programs: nuclear, fossil, and energy efficiency R&D. From FY1948 through FY1977 (in 2005 constant dollars), the federal government spent about $42.6 billion for nuclear (fission and fusion) energy R&D and about $14.1 billion for fossil energy R&D. From FY1978 through FY2005, the federal government spent $33.9 billion for nuclear (fission and fusion), $21.1 billion for fossil, $13.4 billion for renewables, and $12.4 billion for energy efficiency. Thus, total energy R&D spending from FY1948 to FY2005, in 2005 constant dollars, reached $140.0 billion, including $76.5 billion, or 55%, for nuclear; $35.2 billion, or 25%, for fossil; $13.4 billion, or 10%, for renewables; and $12.4 billion, or 9%, for energy efficiency.

In FY2006, as part of a restructuring of the appropriations committees, Congress merged appropriations accounts for the DOE Energy Efficiency Program, which previously had been under the Department of Interior and Related Agencies Appropriations Bill, with the appropriations accounts for the DOE Renewable Energy Program under the Energy and Water Development Appropriations Bill. As a result, appropriations for some subprograms of the Renewable Energy Program, such as Hydrogen and Program Management, are commingled with those for the Energy Efficiency Program and are no longer reported separately. In place of the former totals for the Renewable Energy Program, this report now shows a subtotal of appropriations for all of the renewable energy technology subprograms, namely Biomass and Biorefinery, Solar, Wind, Geothermal, and Small Hydro subprograms (see **Table 3**). The total for these subprograms was $242.5 million for FY2005 and $236.2 million for FY2006.

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[12] A detailed description of DOE programs appears in DOE's *FY2007 Congressional Budget Request*, DOE/ME-0053, v. 3, February 2006, at [http://www.mbe.doe.gov/budget/07budget/Content/Volumes/vol_3_ES.pdf].

Tax Credits. The Energy Tax Act of 1978 (P.L. 95-618) created residential solar credits and residential and business credits for wind energy installations; it expired on December 31, 1985.[13] However, business investment credits were extended repeatedly through the 1980s for solar, geothermal, and ocean thermal energy technologies. Section 1916 of the Energy Policy Act of 1992 (P.L. 102-486) extended the 10% business tax credits for solar and geothermal equipment indefinitely.[14] Also, Section 1914 created a "production" tax credit (PTC) of 1.5 cents/kwh (adjusted annually for inflation) for electricity produced by wind and closed-loop biomass.[15] P.L. 106-170 expanded this credit to include poultry waste. The JOBS Act (P.L. 108-357) expanded the PTC (adding solar, geothermal, and open-loop biomass, landfill gas, trash combustion, and certain small hydro) and extended it through the end of 2005. In August 2005, the Energy Policy Act of 2005 (EPACT, P.L. 109-58) made the PTC retroactively effective to the beginning of 2005 and extended it through the end of 2007. In addition, P.L. 96-223 created an income tax credit for alcohol fuels; section 9003(a)(3) of P.L. 105-178 extended the 40-60 cents/gallon credit through December 31, 2007. Further, the Energy Tax Act created a 4.0 cents/gallon federal excise tax exemption for gasohol (gasoline blended with alcohol). The JOBS Act (P.L. 108-357) reformed this subsidy, converting the exemption to an equivalent tax credit, which now stands at 5.1 cents/gallon for a 10% ethanol blend.

Public Utility Regulatory Policies Act. The Public Utilities Regulatory Policies Act (PURPA, P.L. 95-617) required electric utilities to purchase power produced by qualified renewable power facilities. Under PURPA, the Federal Energy Regulatory Commission (FERC) established rules requiring that electric utilities purchase power from wind farms and other small power producers at an "avoided cost" price based on energy and capacity costs that the utility would otherwise incur by generating the power itself or purchasing it elsewhere. However, Section 1253 of P.L. 109-58 terminated the mandatory purchase and sale requirements for a new renewable power facility, provided that FERC finds that the new facility has access to wholesale power markets and transmission services.

State and Local Government Roles. State and local governments have played a key role in renewable energy development. For example, in the early 1980s, a generous state investment tax credit for wind energy in California combined with PURPA and the federal tax credit to stimulate industry development of the first wind farms. California and New York have invested some state funds in renewable energy R&D. Recently, Texas and about 20 other states have used a regulatory tool, the renewable energy portfolio standard (RPS), to encourage renewable energy. Also, in 2001, the city of San Francisco enacted a $100 million revenue bond (Proposition

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[13] DOE's Energy Information Administration has a historical summary of tax provisions affecting renewable energy in an article entitled *Legislation Affecting the Renewable Energy Marketplace*, available at [http://www.eia.doe.gov/cneaf/solar.renewables/page/legislation/impact.html].

[14] The credit for ocean thermal energy expired at the end of 1988.

[15] By definition, closed-loop biomass is derived from energy crops or trees grown only for use as a fuel. It does not include, for example, wood wastes from a lumber mill.

B, "Vote Solar") to support solar and wind energy implementation. In 2004, the city of Honolulu approved a $7.85 million solar and energy efficiency bond.[16]

Renewables in the 109th Congress

Action in the Second Session

DOE Budget, FY2007. On February 6, 2006, President Bush issued the Administration's budget request for FY2007. The DOE request seeks $359.2 million for renewables, which is $84.0 million, or 30.5%, more than the FY2006 appropriations (excluding inflation). The Administration's request includes funding for an Advanced Energy Initiative (AEI) as part of its American Competitiveness Initiative (ACI), which includes accelerated funding for the Solar America and Biorefinery initiatives under DOE's Renewable Energy Program. For more budget details, see "DOE Budget, FY2007" and **Table 3**.[17]

The House Appropriations Committee report (H.Rept. 109-474) includes several policy directives to the Office of Energy Efficiency and Renewable Energy (EERE). First, it says (pp. 72-73) that EERE could have avoided employee layoffs at the National Renewable Energy Laboratory (NREL) through better management of uncosted balances, and directs EERE to report by January 31, 2007, on steps taken to identify prior year balances and account for all out-year commitments. Second, the report directs (p. 73) EERE to report by January 31, 2007, on the progress of implementing the Inspector General's recommendations (IG audit report DOE/IG-0689) to improve the management of cooperative agreements. Further, the report directs (pp. 74-75) EERE to fully fund a biomass R&D grant to Natureworks LLC, strengthen recruiting from Historically Black Colleges and Universities, and to prepare a report on solar water heaters by January 31, 2007, that covers potential energy savings, market impediments, and deployment strategy. Also, one DOE-wide directive that would directly affect EERE involves funding for the Asia Pacific Partnership (APP), which would support clean, energy-efficient technologies. The report directs (pp. 67-68) DOE to submit a reprogramming request if it intends to support APP with FY2006 funds and to submit a detailed budget justification (which would be considered by the conference committee) if it proposes to use FY2007 funds.

The Senate Appropriations Committee report (S.Rept. 109-274) on Energy and Water Development Appropriations for FY2007 includes several policy directives to EERE for the Renewable Energy Program. First, it recommends (p. 116) that DOE complete unfinished awards for biorefineries before funding new ones. It urges

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[16] For more information on federal, state, and local policies (incentives, grants, standards) for renewable energy, see Database of Incentives for Renewable Energy, at [http://www.dsireusa.org/].

[17] CRS Report RL33294, *DOE Budget Earmarks: A Selective Look at Energy Efficiency and Renewable Energy R&D Programs*, by Fred Sissine, provides more details about earmarks for DOE's renewable energy programs. Also, the DOE budget document is online at [http://www.cfo.doe.gov/budget/index.htm].

that DOE focus on cellulosic ethanol to reduce oil imports, and directs DOE to recommend ways to implement the cellulosic biomass production incentive in EPACT (P.L. 109-58, §942). Second, the Committee joins with the House in requiring (p. 117) a report on solar water heaters. Third, it urges (p. 117) DOE to focus on non-silicon materials and directs DOE to prepare a report by March 31, 2007, on short- and long-term silicon market conditions and the potential impact on the photovoltaic market. Fourth, it recommends (p. 117) a $9 million increase to support deployment of a solar-hydrogen pilot plant that would fulfill certain sections of EPACT. Fifth, the Committee directs (p. 117) that funding for a 1 MW solar thermal facility can only be used for deployment in New Mexico. Sixth, it requests (pp. 117-118) that EERE and the Office of Electricity (OE) provide a report by March 2007 that identifies the most promising locations for wind resources and the best opportunities for integrating these potential power generation facilities into the electric grid. Seventh, it encourages (p. 118) DOE to form an interagency group to promote renewable energy use in all aspects of federal agency operations, especially those on federal lands. In particular, this group should address the issue of wind energy project delays due to Department of Defense concerns about radar interference. Eighth, it recommends (p. 118) that $2.4 million be provided as a competitive award for development of a 2 MW permanent magnet motor wind turbine, which has the potential to eliminate the need for gearboxes. Ninth, it directs (p. 118) that funding for Hydropower include a study of advanced techniques for ocean energy, including an assessment of locations for demonstration plants, with a report by May 1, 2007. Tenth, it directs (pp. 118-119) DOE to study possible impacts of plug-in hybrids on electricity supply and distribution networks, including urban areas, and to study environmental aspects of fuel-switching. Eleventh, it directs (p. 119) DOE to provide a strategy to accelerate the development of zero energy buildings by five to seven years.

U.S. Department of Agriculture (USDA) and Other Appropriations Action, FY2007. At least three other appropriations bills include some funding for renewable energy programs. These actions are summarized in **Table 1**, below, and program descriptions follow. First, the Farm Security Act of 2002 (§9006) created the USDA Renewable Energy Program to provide grants and loans to agriculture producers and rural small businesses for renewable energy systems and energy efficiency improvements. Second, under the Department of State, the Clean Energy program was created to support the use of renewable energy and energy efficiency to reduce greenhouse gas emissions in developing countries. In addition, the Clean Energy Technology Exports Initiative (CETEI) was created by language in the conference report on the FY2004 Energy and Water Development Appropriations bill.[18] Further, in January 2006, the Bush Administration announced that it would seek $50 million in FY2007 for the Asia Pacific Partnership on Clean Development

[18] The conference report (H.R. 5427, H.Rept. 108-357, p. 142) created an interagency group led by DOE, which was directed to provide a report to Congress by January 15, 2004, on the status of the implementation of the CETEI strategic plan and specific actions that each of the participating agencies had taken in FY2003 and planned to take in FY2004 to engage non-governmental, private sector, and other international partners. In addition, the conferees directed DOE to make $400,000 available to establish an interagency CETEI center in the Office of International Energy Market Development.

and Climate. Third, the Defense Appropriations Bill would fund a wind turbine demonstration project at a military base.

Table 1. Other Appropriations Bills
($ millions)

Department/Agency	Bill Number	FY2006 Appns.	FY2007 Request	FY2007 House	FY2007 Senate
Agriculture	H.R. 5384	23.0	10.2	20.0	25.0
State	H.R. 5522				
Clean Energy		180.0	—	—	180.0
Exports		—	—	—	3.0
Asia-Pacific Partnership		—	26.0	0.0	26.0
Defense	H.R. 5631	—	—	6.3	—

Offshore Wind Farms and the Cape Wind Issue. Major commercial wind farm developments in the United States and some European nations have expanded from land-based operations to offshore coastal areas. Offshore wind farms have grown rapidly in Europe, especially in the coastal areas of Germany, the United Kingdom, and Ireland. In the United States, proposals have been made primarily for offshore areas near Texas and the mid-Atlantic and northeast states.

A major issue erupted over the Cape Wind Associates proposal for a $1 billion offshore development that would install 450 megawatts (millions of watts) of wind turbine capacity in federal waters, the Horseshoe Shoal area, near Cape Cod in Massachusetts.[19] Cape Wind made the initial project application to the U.S. Army Corps of Engineers in November 2001. The development would include 130 wind turbines, each rated at 3.6 megawatts, reaching 420 feet high (with the hub 260 feet above the surface of the water), and spread over a 24 square-mile area about six miles offshore.[20] The Corps of Engineers prepared a draft environmental impact statement that was released in November 2004.[21] In August 2005, the Energy Policy Act

[19] A summary of the Cape Wind Project plan materials is available at [http://www.mms.gov/offshore/PDFs/CapeWindProjectPlanFiling.pdf].

[20] Minerals Management Services (MMS). A map of the proposed location is available on the MMS website at [http://www.mms.gov/offshore/RenewableEnergy/CapeWindAlternativeSites3b.pdf]. Also, the Alliance to Save Nantucket Sound has a map posted online at [http://www.saveoursound.org/Cape/Overview].

[21] U.S. Army Corps of Engineers, "Corps to Release Draft EIS on Proposed Wind Energy Project in Nantucket Sound," news release, Nov. 8, 2004, p. 4. The Corps says it examined a broad array of "public interest factors" and considered four alternative locations; see [http://www.nae.usace.army.mil/news/2004-105.htm].

(EPACT, §388) shifted regulatory responsibility to the Minerals Management Service at the Department of Interior.[22]

Cape Wind Associates and other proponents say the project is a safe, clean way to develop renewable energy and create jobs. Cape Wind lists supporters that include local towns and citizen groups, renewable energy groups, labor organizations (including the Seafarers International Union), academic and scientific leaders, and college organizations. Other proponents include national environmental groups, such as the Natural Resources Defense Council (NRDC)[23] and the Union of Concerned Scientists.[24] In regard to energy development, they claim that the project would reduce air pollutants and greenhouse gases that would otherwise be generated by conventional power plants. Regarding jobs, they contend that dozens of construction jobs will be created for an 18-month period, with spin-off benefits to local businesses, and that afterwards, year-round jobs will be created to monitor, operate, and maintain the wind farm. In regard to the environment, they claim that from the shore, there will be only a minimal impact on the viewshed. Regarding the tourism industry, they argue that new opportunities will be created for up-close, "majestic views" of the wind towers, which will only be possible from tour boats. Further, they argue that charter fishing boats, sailboat tours, and scenic cruises may include the wind farm as part of the Cape Cod experience.[25]

Opponents of the Cape Wind project have collaborated to create the Alliance to Protect Nantucket Sound, which includes several local towns, business and tourism organizations, commercial fishing groups, recreational fishing and boating groups, and boating safety and navigation organizations.[26] The opponents say that the proposed development poses dangers to the area's ecosystem, maritime navigation, and the Cape Cod tourism-based economy. Regarding the viewshed, the Alliance

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[22] EPACT transferred federal regulatory authority over the project to the U.S. Department of Interior's Minerals Management Services (MMS). MMS already had jurisdiction for oil and gas development in the offshore region of the Outer Continental Shelf, and EPACT expanded this authority to include renewable energy development, covering wind and wave energy; see [http://www.mms.gov/offshore/RenewableEnergy/RenewableEnergyMain.htm].

[23] In a press release, NRDC stated qualified support for the project: "... it is crucial for us to set the bar [for environmental standards] in the right place. The air quality, public health, and global warming benefits of the project are significant and beyond rational dispute. It is also critical to ensure that the project will protect marine wildlife and comply with all applicable laws ... We also recommend additional steps for the project to take...." NRDC, *NRDC Submits Comments on Cape Wind Project as Public Comment Period Closes*, Feb. 24, 2005, at [http://www.nrdc.org/media/pressreleases/050225.asp].

[24] Union of Concerned Scientists (UCS), *Comments on the Cape Wind Draft Environmental Impact Statement.* UCS says it was encouraged by the Army Corps Draft EIS findings of the project's "significant positive" benefits and that the majority of potential negative impacts would be "minor, temporary, localized, mitigated ... or will not occur." See [http://www.ucsusa.org/clean_energy/renewable_energy_basics/cape-wind-comments-on-draft-environmental-impact-statement.html?print=t].

[25] Cape Wind, *Boosting Cape Cod's Economy*, at [http://www.capewind.org/article2.htm].

[26] A detailed list of opponents is provided by the Alliance to Protect Nantucket Sound at [http://www.saveoursound.org/Cape/Opposition].

notes that many land-based landmarks smaller than the wind turbines — including a light house, radio antenna, and water towers — are easily seen from the project site. In regard to birds, it stresses that the area is one of the most important migratory staging areas on the East Coast, providing habitat for some endangered species. Regarding fishing, it says that it is one of the richest fishing grounds on the East Coast, many local fishermen make 60% of their income on Horseshoe Shoal, and no fishing or boating group supports the project. The Alliance cites a study that found tourist-related spending would be cut by nearly $200 million per year. Also, the group reports that commercial ferry lines see serious navigation hazards, local airport commissions see safety concerns, and the wind turbines may interfere with radar systems.[27]

Under its new authority,[28] MMS became the lead federal agency regulating the development of the proposed Cape Wind project.[29] As directed by EPACT (§388), MMS is preparing an environmental impact statement (EIS).[30] As part of the EIS activity, MMS is considering potential alternatives to the Cape Wind proposal, such as modifying the size of the development, phasing it, reconfiguring it, and relocating it to alternative sites.[31]

Section 414 of the Coast Guard and Maritime Transportation Act of 2006 (P.L. 109-241, H.R. 889) directs the Commandant of the Coast Guard to "specify the reasonable terms and conditions the Commandant determines to be necessary to provide for navigational safety" for the proposed Cape Wind energy facility in Nantucket Sound.[32] Further, it directs MMS to incorporate these terms and conditions into any lease, easement, or right-of-way for the facility.[33]

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[27] Alliance to Save Nantucket Sound. Save Our Sound. Impacts & Effects.

[28] Prior to EPACT, the U.S. Army Corps of Engineers had authority over th Cape Wind lease proposal, and the Corps had completed more than four years of reviews on the proposals, which will be considered by MMS.

[29] MMS has authority for issuing leases, easements, or rights-of-way for alternative energy projects on the Outer Continental Shelf (OCS). This authority is described in greater detail on the MMS website, available at [http://www.mms.gov/offshore/RenewableEnergy/OCSAlternativeEnergyAndRelatedUses.pdf].

[30] The May 30, 2006, *Federal Register* notice (p. 30693) of MMS's intent to publish an EIS is available at [http://www.mms.gov/federalregister/PDFs/NOI5_30_06.pdf]. MMS expects to publish a draft EIS in the winter of 2006, which will be followed by public hearings, with a final EIS expected in the fall of 2007. More information about the EIS is available at [http://www.mms.gov/ooc/press/2006/press0713.htm].

[31] MMS, *Outer Continental Shelf, Headquarters, Cape Wind Offshore Wind Development 2007, Federal Register,* v. 71, May 30, 2006, p. 30694. The MMS website home page is available at [http://www.mms.gov/offshore/RenewableEnergy/CapeWind.htm].

[32] The Coast Guard's study is being conducted by its Office of Navigational Standards.

[33] This language was inserted into the H.R. 889 by S.Con.Res. 103. It is the enacted compromise, reflecting a change from a proposed amendment to the Senate bill that would have given the Governor of Massachusetts the power to veto the project.

Wind Disruption of Radar Issue. There is a concern that tall wind turbines may create false signals that would be picked up by military and civilian radar.[34] Section 358 of the Defense Authorization Act for FY2006 (P.L. 109-163, H.R. 1815) requires the Department of Defense (DOD) to submit a report to Congress on

> ... the effects of windmill farms on military readiness, including an assessment of the effects on the operations of military radar installations ... and of technologies that could mitigate any adverse effects on military operations identified.[35]

The law was enacted on January 6, 2006, and Section 358 specifies that the report is due 120 days after enactment, which would have occurred in early May 2006. As of the date of this CRS report, the DOD report had not been issued.[36]

On March 21, 2006, the DOD and the Department of Homeland Security (DHS) issued an *Interim Policy on Proposed Windmill Farm Locations*, which states that

> [t]he DOD/DHS Long Range Radar Joint Program Office Interim Policy is to contest any establishment of windmill farms *within radar line of site* of the National Air Defense and Homeland Security Radars. This is to remain in effect until the completion of the study and publishing of the Congressional Report.[37]

The American Wind Energy Association (AWEA) contends that many wind farm projects have received a Notice of Presumed Hazard from the Federal Aviation Administration (FAA) and have halted development. This, it says, includes projects in Wisconsin, Illinois, North Dakota, South Dakota, and Minnesota.[38] Defense and FAA officials say the "proposed hazard" letters do not prohibit wind farms, they just delay them until any risks to military operations can be assessed and resolved.[39] However, the wind industry is anxious about any delay in construction because the

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[34] One study suggests that this problem may occur with some, but not most, wind farms. For a description and illustration of the technical aspects of the wind-radar issue, see Idaho National Laboratory, *Wind Radar Interference*, by Gary Seifert, June 2006, at [http://www.eere.energy.gov/windandhydro/windpoweringamerica/pdfs/workshops/2006_summit/seifert.pdf].

[35] P.L. 109-163, Section 358, p. 74.

[36] The DOD staff coordinator for the radar study is Mr. Andrew Kavaliunas. His phone number is 703-614-6375. The Coast Guard's study underway pursuant to P.L. 109-241 will also look at some radar-related issues.

[37] AWEA, *Wind Turbines and Radar: An Informational Resource*, Apr. 24, 2006, 3 p., at [http://www.renewwisconsin.org/windfarm/060424%20Wind%20Turbines%20and%20Radar.pdf]. [Emphasis added.]

[38] AWEA, *Wind Turbines and Radar: An Informational Resource*, 3 p., at [http://www.awea.org/pubs/factsheets/060602_Wind_Turbines_and%20_Radar_Fact_Sheet.pdf]

[39] *Washington Post*, "Wind Power Projects Halted," June 10, 2006, p. A2.

renewable energy production tax credit is set to expire at the end of 2007.[40] On June 2, six Senators from Illinois, Wisconsin, and North Dakota sent letters of concern to DOD about the interim policy of halting wind farms classified as within "radar line of sight" while the study is being completed.[41] On June 28, the Sierra Club filed suit against DOD for delaying the study of wind farm impact on radar mandated by the Defense Authorization Act.[42]

The British Department of Trade and Industry (DTI) has supported studies of the radar problem for wind farms in the United Kingdom. A 2003 DTI study found that there is a potential for wind turbines to significantly affect the performance of air traffic control radar. The two general categories of effects are reports of false targets (aircraft) to the radar operator and a reduction in the likelihood of detecting aircraft. This study recommended that the problem could be addressed by modifying the design and installation of both the turbines and the radar systems.[43] A 2005 DTI study modeled the use of radar absorbent materials (RAM) in wind turbine blades.[44] It found that RAM materials can be developed with minimal structural impact,[45] and recommended that a turbine outfitted with such materials be field-tested. Also, DTI formed a partnership with the British Wind Energy Association (BWEA) to fund research on an advanced digital tracker to mitigate the radar problem. Both the Ministry of Defence and the National Air Traffic Services began planning flight trials in late 2005.[46] In 2006, the two agencies decided to conduct tests with Royal Air Force (RAF) aircraft in a location in Wales near four working wind farms.[47]

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[40] *Washington Post*, "A New Blip on Wind Power's Radar Screen," June 20, 2006, p. D1.

[41] Honorable Richard Durbin, *Durbin and Other Midwestern Senators Object to Shut Down of Wind Farms*, press release, June 2, 2006, at [http://durbin.senate.gov/record.cfm?id=256426&&].

[42] Sierra Club, *Sierra Club Calls on Rumsfeld, DOD to Stop Blocking Wind Farms*, June 28, 2006, at [http://www.sierraclub.org/pressroom/releases/pr2006-06-28.asp]. The suit was filed in the U.S. District Court for the Northern District of California. It claims that DOD has violated the Administrative Procedure Act (5 U.S.C. §706[1]) and will seek to "compel agency action unlawfully withheld or unreasonably delayed."

[43] United Kindom, DTI, *Feasibility of Mitigating the Effects of Windfarms on Primary Radar*, 2003, Section 8, Conclusions and Recommendations, at [http://www.dti.gov.uk/files/file17878.pdf]

[44] DTI, Technology Programme: New and Renewable Energy, *Design & Manufacture of Radar Absorbing Wind Turbine Blades — Final Report*, February 2005, Executive Summary at [http://www.dti.gov.uk/files/file16010.pdf?pubpdfdload=05%2F1409].

[45] Specifically, the study modeled a single layer of fiberglass cloth with an electromagnetically modified version of the same blade material.

[46] BWEA Press Release, *Government and Industry Join Forces to Find Clear Path for Wind Farms: Trials Underway to Reduce Aviation Objections to Wind Farms*, July 2005, at [http://www.bwea.com/media/news/adt_trials.html]

[47] DTI, Government News Network, *The Trials of Climate Change — RAF Fly Past*, June 7, 2006, 3 p., at [http://www.gnn.gov.uk/environment/detail.asp?ReleaseID=206152&NewsAreaID=2&NavigatedFromDepartment=False].

Energy Policy Act of 2005 (EPACT, H.R. 6, P.L. 109-58)

Renewable Energy Portfolio Standard (RPS). For retail electricity suppliers, an RPS sets a minimum requirement (often a percentage) for electricity production from renewable energy resources or for the purchase of tradable credits that represent an equivalent amount of production. A growing number of states have enacted an RPS, currently including 19 states and the District of Columbia.[48]

The Senate Committee on Energy and Natural Resources held a hearing on RPS on March 8, 2005. Regional differences in the availability of renewable resources, particularly resource availability in the southeastern United States, was a key issue of the discussion. In the markup of a committee print (to be incorporated into H.R. 6) by the House Committee on Energy and Commerce, an amendment to add an RPS (1% in 2008, increasing by 1% annually through 2027) was rejected (17-30). Proponents noted a growing number of states with an RPS and that EIA reports show an RPS could reduce electricity bills.[49] Opponents raised concerns about the exclusion of existing hydropower facilities and resource limits for the southeastern United States.

There was no RPS provision in the House version of H.R. 6. The Senate version had a 10% RPS provision. During the conference, there was an idea put out to compromise by including nuclear and hydropower facilities. Nevertheless, RPS was dropped in conference.[50]

Renewable Energy Production Tax Credit (PTC). The House version of H.R. 6 had no PTC extension, the Senate version had a three-year extension, and the enacted law (§1301) extends the PTC for two years, through the end of calendar year 2007.[51] For claims against 2005 taxes, the credit is valued at about 1.9 cents per kilowatt-hour (kwh) for electricity produced by facilities that use wind, closed-loop biomass, poultry waste, geothermal energy, or solar energy. Also, half credit (valued at about 0.9 cents/kwh in 2005) is available for electricity produced by facilities that use open-loop biomass, incremental hydropower, municipal solid waste (landfill gas), or small irrigation water flows.

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[48] The state RPS provisions are listed in the Database of State Incentives for Renewable Energy, at [http://www.dsireusa.org/]. Search by "incentive type," then "portfolio standards."

[49] See EIA's 2002 report *Impacts of a 10-percent Renewable Portfolio Standard*, at [http://tonto.eia.doe.gov/FTPROOT/service/sroiaf(2002)03.pdf], and its 2003 *Analysis of a 10-percent Renewable Portfolio Standard*, at [http://tonto.eia.doe.gov/FTPROOT/service/sroiaf(2003)01.pdf].

[50] For more background information on RPS, two memoranda are available from the author. For current status of RPS policies in the states, see Database of State Incentives for Renewable Energy, at [http://www.dsireusa.org].

[51] A detailed description of the PTC appears in the report *Description and Analysis of Certain Federal Tax Provisions Expiring in 2005 and 2006*, by the Joint Tax Committee, at [http://www.house.gov/jct/x-12-05.pdf].

Renewable Energy Production Incentive (REPI). Parallel to the PTC, there is a renewable energy production "incentive" (REPI) for state and local governments and nonprofit electrical cooperatives. This 1.5 cent/kwh incentive was created by the Energy Policy Act of 1992 (P.L. 102-486) §1212 and is funded by appropriations to DOE. Eligible facilities currently include solar, wind, biomass (except municipal solid waste), and geothermal energy (except certain types of dry steam geothermal energy). The Energy Policy Act of 2005 (§202) expands REPI to include ocean and wave energy and extends the authorization through FY2016.

Renewable Fuel Standard (RFS). P.L. 109-58 (H.R. 6, §1501) defines "renewable fuel" to include ethanol, biodiesel, and natural gas produced from landfills, sewage treatment plants, and certain other sources. Ethanol is the renewable motor fuel produced in greatest quantity. In 2004, about 3.9 billion gallons of ethanol were blended with gasoline.[52] In 2005, about 75 million gallons of biodiesel were used. In the House version of H.R. 6, the RFS provision called for renewable fuels (primarily ethanol) production to reach 3.1 billion gallons a year in 2005, and then increase stepwise to 5.0 billion gallons a year by 2012. In the Senate version of H.R. 6, the RFS called for 4.0 billion gallons in 2006, rising to 8.0 billion gallons in 2012. The enacted version (§1501) set a standard starting at 4.0 billion gallons in 2006 and rising to 7.5 billion gallons by 2012. Further, an increased incentive would encourage the use of cellulosic and waste-derived ethanol to help fulfill the RFS target.[53] The previous incentive was created by crediting 1.0 gallon of cellulosic or waste-derived ethanol as equivalent to 1.5 gallons of renewable fuel. Under EPACT, it becomes equivalent to 2.5 gallons of renewable fuel.

Renewable Hydrogen. P.L. 109-58 (H.R. 6, §933) would create a program to produce hydrogen from a variety of sources, including renewable energy and renewable fuels, as part of a broader effort to develop hydrogen fuels, vehicles, and infrastructure. The provision includes a focus on distributed energy that uses renewable sources. Another section (§812) also calls for use of renewable hydrogen as part of a hydrogen fueling and infrastructure demonstration program.

Renewables Tax Revenue Effect. **Table 2** shows the estimated 11-year revenue effect of renewable energy tax provisions in the House version of H.R. 6 (H.R. 1541), the Senate version of H.R. 6, and the enacted law.

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[52] Renewable Fuels Association, *Industry Statistics, Historic U.S. Fuel Ethanol Production 1980-2005*, at [http://www.ethanolrfa.org/industry/statistics/].

[53] Section 1501 requires the use of 250 million gallons per year of ethanol distilled from cellulosic materials, starting in 2012. EIA, *Annual Energy Outlook 2006*, "U.S. Demand for Ethanol Fuel Varies With World Oil Price Projections," at [http://www.eia.doe.gov/oiaf/aeo/gas.html].

Table 2. H.R. 6, Tax Revenue Effect
($ billions)

	House	Senate	Conference
Renewable Energy Production Tax Credit (PTC)	—	$4.577	$2.747
Clean Renewable Energy Bonds	—	$0.493	$0.411
Business Investment Tax Credit (Solar & Geo.)	—	$0.059	$0.024
Residential Solar Tax Credit (includes fuel cells)	$0.018	—	$0.031
Biodiesel Tax Credit	—	$0.402	$0.194
Total, Renewables Provisions	$0.018	$5.531	$3.407
Gross Total, All Tax Cut Provisions	$8.090	$18,421	$14.553
Renewables Share of Total	0.2%	30.0%	23.4%

Sources: Joint Committee on Taxation (JCT), *Estimated Budget Effects of the Conference Agreement for Title XIII of H.R. 6, July 27, 2005 (JCX-59-05); Estimated Revenue Effects of the Chairman's Amendment in the Nature of a Substitute to H.R. 1541, Scheduled for Markup by the Committee on Ways and Means, April 13, 2005* (JCX-17-05); *Estimated Revenue Effects of the Chairman's Amendment in the Nature of a Substitute to the "Energy Policy Tax Incentives Act of 2005," Scheduled for Markup by the Committee on Finance, June 16, 2005* (JCX-47-05).

Other Renewables Provisions. P.L. 109-58 (H.R. 6) covers additional areas of renewable energy policy, resources, and technology, including distributed energy, federal purchases, federal lands, Indian energy, net metering, alternative fuels (alcohol, biofuel, biodiesel), biopower/biomass, geothermal, hydropower, solar, and wind.[54]

Renewable Energy Production

Electricity Production from Renewables

The Public Utility Regulatory Policies Act (PURPA) was a key to the growth of electric power production from renewable energy facilities.[55] After 1994, state

[54] Additional bills with renewable energy provisions are identified in CRS Report RL32860, *Energy Efficiency and Renewable Energy Legislation in the 109th Congress*, by Fred Sissine.

[55] PURPA required electric utilities to interconnect with renewable energy power facilities and to pay a price (avoided cost) that was determined by each state.

actions to restructure[56] the electric utility industry dampened PURPA's effect.[57] At the same time, however, the renewable energy production tax credit (PTC) grew in importance as a major incentive, helping to spur the development of independent wind energy power producers.[58] In the 109th Congress, P.L. 109-58 (§1253) includes a conditional repeal of the mandatory renewables purchase requirement in Section 210 of PURPA.[59]

Renewables Under Electric Industry Restructuring. To encourage a continued role for renewable energy under restructuring, some states and utilities have enacted measures such as a renewable energy portfolio standard (RPS), public benefits fund (PBF), and/or "green" pricing and marketing of renewable power. The above section on "Renewable Portfolio Standard" summarizes the RPS action in H.R. 6, including a Senate proposal that was rejected in conference committee. Since the enactment of P.L. 109-58, several bills with an RPS provision have been introduced, including H.R. 4384 (§205), H.R. 5331 (§504), H.R. 5642 (§4), S. 2435 (§6b), S. 2571 (§504), and S. 2747 (§301).

Green Power. The term "green power" generally refers to electricity supplied in whole or in part from renewable energy sources. Green power marketing (retail or wholesale) is underway in California, Illinois, Massachusetts, New Jersey, New York, Pennsylvania, and Texas. Green pricing is an optional utility service that allows electricity customers who are willing to pay a premium for the environmental benefits of renewable energy to purchase green power instead of conventional power.

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[56] For a discussion of broader electricity restructuring issues, see CRS Report RL32728, *Electric Utility Regulatory Reform: Issues for the 109th Congress*, by Amy Abel.

[57] Electricity restructuring aimed to create competition in electricity markets, primarily by deregulating electricity generation and opening access to utility transmission lines (retail wheeling) for all electricity producers.

[58] Further, near the turn of the century, states began to establish a renewable energy portfolio standard (RPS) that required retail electricity suppliers to produce a fixed minimum amount of electricity from renewables. The RPS, working together with the PTC, has also become a significant incentive for renewable energy power production.

[59] The conditions are that the cogeneration or small power production facility has nondiscriminatory access to — A(i) independently administered, auction-based day ahead and real time wholesale markets for the sale of electric energy; and (ii) wholesale markets for long-term sales of capacity and electric energy; or (B)(i) transmission and interconnection services that are provided by a Commission-approved regional transmission entity and administered pursuant to an open access transmission tariff that affords nondiscriminatory treatment to all customers; and (ii) competitive wholesale markets that provide a meaningful opportunity to sell capacity, including long-term and short-term sales, and electric energy, including long-term, short-term and real-time sales, to buyers other than the utility to which the qualifying facility is interconnected. In determining whether a meaningful opportunity to sell exists, the Commission shall consider, among other factors, evidence of transactions within the relevant market; or (C) wholesale markets for the sale of capacity and electric energy that are, at a minimum, of comparable competitive quality as markets described in subparagraphs (A) and (B).

Utility green pricing programs are available to more than one-third of the nation's consumers.[60]

Distributed Energy. Distributed energy involves the use of small, modular electricity generators sited close to the customer load that can enable utilities to defer or eliminate costly investments in transmission and distribution system upgrades, and provide customers with quality, reliable energy supplies that may have less environmental impact than traditional fossil fuel generators. Technologies for distributed electricity generation use wind, solar, bioenergy, fuel cells, gas microturbines, hydrogen, combined heat and power, and hybrid power systems. A DOE study, *Structural Vulnerability of the North American Power Grid*, suggests that adding more distributed power generation could help reduce grid vulnerability.[61] Another DOE study, *Homeland Security: Safeguarding America's Future with Energy Efficiency and Renewable Energy Technologies*,[62] provides a broad look at the potential to address vulnerabilities.[63]

Net Metering. Net metering allows customers with generating facilities to "turn their electric meters backwards" when feeding power into the grid; they receive retail prices for the excess electricity they generate. This encourages customer investment in distributed generation, which includes renewable energy equipment. About 40 states have some form of net metering in place. P.L. 109-58 (§1251) provides for net metering.

Natural Gas and Renewables

In January 2005, the Senate Energy and Natural Resources Committee held a natural gas conference. Some participants described the potential for renewable energy to augment gas supplies, reduce gas demand, and thereby help reduce natural gas prices.[64] Some of these statements referred to a 2005 DOE study entitled *Easing the Natural Gas Crisis: Reducing Natural Gas Prices through Increased Deployment of Renewable Energy and Energy Efficiency*.[65]

Biomass-Generated Synthetic Natural Gas (Syngas). Continuing high natural gas prices have created interest in using renewables to dampen natural gas demand. Renewable energy (mainly biomass) can be used to produce methane (the

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[60] For more on green power, see [http://www.eere.energy.gov/greenpower/].

[61] DOE, *National Transmission Grid Study*, May 2002, p. 82 and 94, at [http://www.pi.energy.gov/pdf/library/TransmissionGrid.pdf].

[62] DOE, *Homeland Security: Safeguarding America's Future with Energy Efficiency and Renewable Energy Technologies*, Tenth Annual Report of the State Energy Advisory Board, August 2002, 26 p., at [http://steab.org/docs/STEAB_Report_2002.pdf].

[63] In the FY2006 appropriations process, Congress directed DOE to move the Distributed Energy program from EERE to OE. More information about DOE's Distributed Energy Program is available at [http://www.eere.energy.gov/de/].

[64] See [http://energy.senate.gov/conference/conference.cfm].

[65] This report is available at [http://eetd.lbl.gov/ea/ems/reports/56756.pdf].

main component of natural gas), which could possibly substitute directly for natural gas. DOE projects that by 2020, biomass and energy crops could produce 15% of natural gas needs. A 2005 Harvard University study, *The National Gasification Strategy*,[66] cites a Princeton University study, *A Cost-Benefit Assessment of Biomass Gasification Power Generation in the Pulp and Paper Industry*,[67] that says that biomass-generated "black liquor" and wood waste could produce enough syngas to support 25 billion watts (gigawatts) of natural gas-fired power plant capacity by 2020.

Substituting Electricity from Renewables for Gas-Fired Generation. Also, a variety of renewables can generate electricity that indirectly displaces natural gas use for power generation. For many utilities, the peak demand (often supported with natural gas peak-load plants) occurs during hot summer afternoons. In many regions, solar and wind energy reach high levels during summer peak periods. The American Wind Energy Association (AWEA) says that at the end of 2005, wind farms were saving more than 0.5 billion cubic feet (Bcf) of natural gas per day. DOE's 2000 report *Scenarios for a Clean Energy Future* projects that,[68] with some federal policy changes, biomass-based power production could be greatly accelerated through 2010.[69]

Transportation Fuels Produced from Renewables

Corn Ethanol. In the United States, ethanol is produced mainly from corn[70] and is most frequently used as a 10% blend with gasoline. Historically, high cost has been a key barrier to commercial use, which has been addressed mainly by a 51-cent per gallon tax credit for fuel use.[71] Due primarily to the use of fertilizer, which has natural gas as a key ingredient, there has been a debate over the net energy benefit of using corn ethanol. The perception that ethanol use has significantly lower emissions of some air pollutants than gasoline helps maintain support for its incentives.[72]

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[66] The Harvard study is available at [http://bcsia.ksg.harvard.edu/publication.cfm?program=CORE&ctype=paper&item_id=473].

[67] The Princeton study is available at [http://www.agenda2020.org/PDF/BLGCC%20FINAL%20REPORT%208%20OCT%202003.pdf].

[68] The projection is in Table 7.11; the report is at [http://www.ornl.gov/sci/eere/cef/].

[69] Also, see the 2005 DOE study noted above and the American Council for an Energy Efficient Economy's report *Impacts of Energy Efficiency and Renewable Energy on Natural Gas Markets*, available at [http://www.aceee.org/energy/efnatgas-study.htm].

[70] In other countries, such as Brazil, ethanol is often made from cane sugar.

[71] David Morris of the Institute for Local Self-Reliance says that, with recent high gasoline prices, ethanol is now price competitive. However, given the uncertainty about the stability of high prices, he proposes "that half the current 51 cent per gallon incentive be converted into an indexed incentive." See his article, *The New Ethanol Future Demands a New Public Policy*, June 21, 2006, at [http://www.ilsr.org/columns/2006/062106.html].

[72] For more information about ethanol developments and issues, see CRS Report RL33564, *Alternative Fuels and Advanced Technology Vehicles: Issues in Congress*, and CRS Report

(continued...)

However, compared with gasoline, ethanol can have higher emissions of volatile organic compounds (VOCs) per mile traveled.[73] Assuming that the net energy benefit of ethanol is clearly positive, then its carbon dioxide emissions are significantly lower than those for gasoline.[74]

National ethanol production was estimated at 4.0 billion gallons in 2005.[75] Due to ethanol's lower heat content,[76] this is equivalent to about 2.7 billion gallons of gasoline that year, or about 170,000 barrels of oil per day. In comparison, in 2005, U.S. transportation oil use averaged 13.82 million barrels per day (mb/d) and total U.S. oil use averaged 20.7 mb/d.[77] Thus, in 2005, ethanol production accounted for about 1.2% of transportation fuel use and about 0.8% of total oil use.

EPACT (P.L. 109-58, §1501) established a renewable fuel standard that sets a target to increase renewable fuel production to 7.5 billion gallons per year by 2012. This target is expected to be met primarily with ethanol, and it would be equivalent to about 330,000 barrels of oil per day (b/d). Further, EIA estimates ethanol production may reach 700,000 b/d by 2030.[78] This would be equivalent to about 470,000 b/d of oil use. In comparison, EIA estimates that total U.S. oil use will reach about 25 mb/d.[79] Using these estimates suggests that ethanol would displace about 1.9% of total oil use in 2030.

Cellulosic Ethanol. Corn and other starches and sugars are only a small fraction of biomass that can be used to make ethanol. Advanced bioethanol technology could allow fuel ethanol to be made from cellulosic (plant fiber) biomass,

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[72] (...continued)
RL33290, *Fuel Ethanol: Background and Public Policy Issues*, both by Brent Yacobucci.

[73] DOE. Clean Cities, *Low-Level Ethanol Fuel Blends*, Fact Sheet, April 2005, p. 1, at [http://www.eere.energy.gov/cleancities/blends/pdfs/37135.pdf].

[74] Net greenhouse gas emissions tend to follow the net energy balance. See Farrele et al., "Ethanol Can Contribute to Energy and Environmental Goals," *Science*, v. 311, Jan. 27, 2006, pp. 506-508.

[75] Renewable Fuels Association, *Annual Industry Outlook 2006*, February 2006, p. 3, at [http://www.ethanolrfa.org/industry/outlook/]. Also, DOE reports that in 2004, 3.4 billion gallons were produced. DOE, EERE, *Biomass Program: Ethanol*, at [http://www1.eere.energy.gov/biomass/ethanol.html].

[76] DOE, EIA, *Ethanol*. EIA reports that the heat content of ethanol is about 3.5 million Btu per barrel (42 gallons); see [http://www.eia.doe.gov/oiaf/ethanol3.html]. Also, EIA's *Monthly Energy Review*, at [http://www.eia.doe.gov/emeu/mer/append_a.html], reports that the heat content of motor gasoline is 5.25 million Btu per barrel. Thus, on a per volume basis, ethanol has about 67% of the heat content of gasoline.

[77] Also, EIA estimates that total U.S. petroleum consumption averaged 20.6 million barrels per day (mb/d) in 2005. EIA, *Basic Petroleum Statistics*, updated July 2006, at [http://www.eia.doe.gov/neic/quickfacts/quickoil.html].

[78] EIA, *Annual Energy Outlook 2006*, Issues in Focus, p. 58, at [http://www.eia.doe.gov/oiaf/aeo/index.html].

[79] EIA, *Annual Energy Outlook 2006*, Reference Case, Table A1, p. 58, at [http://www.eia.doe.gov/oiaf/aeo/index.html].

such as agricultural and forestry wastes, industrial waste, municipal solid waste (organic material), trees, and grasses.[80] Cellulosic ethanol can be made through gassification, thermochemical, and microbial processes. In the microbial process, cellulosic ethanol is made by breaking apart the cellulose (fiber) in plant cell walls into component sugar molecules, which microbes then convert to ethanol.[81]

In particular, ethanol can be produced from dedicated fuel crops, such as fast-growing trees and switchgrass. The latter is a native grass that grows well on cropland and marginal lands, needing little water and no fertilizer. Because fertilizer is not needed, the net energy production is much higher than that for corn ethanol. Due to its capacity for production on marginal lands, the potential growing area for switchgrass is much larger than that for corn. A provision in the Farm Security Act of 2002 (P.L. 107-171) encourages use of the Conservation Reserve Program lands for development of such biomass resources.[82]

Although cellulosic feedstocks may be cheaper and more plentiful than corn, they require more extensive processing that makes the conversion to ethanol more costly. Both DOE and USDA are conducting research to improve this technology and reduce costs. In particular, DOE is studying the use of enzymes and heat as catalysts to reduce the cost of the conversion process. Both the United States and Canada have pilot facilities for producing cellulosic ethanol, and Canada has the only commercial-scale plant in operation.[83]

The Administration's Biorefinery Initiative, part of its Advanced Energy Initiative (AEI), aims to increase funding for cellulosic ethanol development with the goal of accelerating its commercial use.[84] In response to the AEI, DOE set a goal of using biofuels to displace 30% of national transportation fuel use (at the 2004 level) by 2030. In July 2006, DOE announced a partnership between EERE and the Office of Science to pursue use of biotechnology to produce cellulosic ethanol. A report on

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[80] The advanced technology has been demonstrated in the laboratory but has yet to be incorporated into a successful commercial operation. DOE, EERE, *Biomass Program: Ethanol*, at [http://www1.eere.energy.gov/biomass/ethanol.html].

[81] DOE, *Fact Sheet: A Scientific Roadmap for Making Cellulosic Ethanol A Practical Alternative to Gasoline*, July 7, 2006, 3 p., at [http://www.doegenomestolife.org/biofuels/B2Bfactsheet.pdf].

[82] For more information about using cellulosic biomass for ethanol production, see CRS Report RL32712, *Agriculture-Based Renewable Energy Production*, by Randy Schnepf.

[83] *Agriculture-Based Renewable Energy Production*, pp. 12-14. However, in June 2006, the New York State Energy Research and Development Authority (NYSERDA) issued a request for proposals to build a pilot plant that included a requirement that the company show an ability to use the project experience to develop a commercial facility; see [http://www.ny.gov/governor/press/06/0615063.html]. Also, in July 2006, Xethanol Corporation announced plans to build a full-scale cellulosic ethanol plant in Georgia by mid-2007. The plant will use forest products to produce 50 million gallons per year. DOE, *EERE News*, July 26, 2006.

[84] The White House, *Fact Sheet: President Bush's Four-Part Plan to Confront High Gasoline Prices*, Apr. 26, 2005, at [http://www.whitehouse.gov/news/releases/2006/04/20060425-2.html].

the research strategy of the partnership says that the United States could produce up to 60 billion gallons of biofuels per year, which would be equivalent to about 2.6 million barrels of oil per day.[85] The research plan is focused on achieving breakthroughs in biotechnology to increase the quantity of biomass (e.g., corn plant waste and switchgrass) per acre and breeding the plants to have less lignin and more cellulose. The plan also aims to achieve biorefinery breakthroughs that would reduce the number of steps in the conversion process and shift the process focus from chemical steps to biological steps in order to reduce waste byproducts and cut costs.[86]

Biodiesel. Biodiesel has been produced and used in stationary applications (heat and power generation) for nearly a century, but its use as a transportation fuel is recent.[87] DOE notes that this alternative to petroleum-based diesel fuel is a domestically produced, renewable fuel that can be manufactured from vegetable oils, animal fats, or recycled restaurant greases.[88] Further, DOE says biodiesel is safe and biodegradable and reduces air pollutants such as particulates, carbon monoxide, hydrocarbons, and air toxics; but it also notes that biodiesel tends to increase emissions of nitrous oxides.[89] Blends of 20% biodiesel (B20) with 80% petroleum diesel can generally be used in unmodified diesel engines. Biodiesel can also be used in its pure form (B100), but it may require certain engine modifications to avoid maintenance and performance problems and may not be suitable for wintertime use.[90] Other challenges include resource availability and the establishment of a retail distribution network.[91]

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[85] DOE, *Factsheet on a Scientific Roadmap for Cellulosic Ethanol*, p. 1. Assuming that the 60 billion gallons per year is provided by ethanol, that would be equal to 3.9 million barrels per day of ethanol. Using the fact that ethanol has about 67% of the heat content of gasoline by volume yields an estimate of 2.6 million barrels of oil per day. See [http://www.er.doe.gov/News_Information/News_Room/2006/Biofuels/factsheet.htm].

[86] DOE, *Factsheet on a Scientific Roadmap for Cellulosic Ethanol*, p. 2.

[87] DOE, EIA, *Annual Energy Outlook 2006*, Issues in Focus, p. 58.

[88] About 90% of U.S.biodiesel is made from soybean oil.

[89] Air toxics are defined as any air pollutant for which a national ambient air quality standard (NAAQS) does not exist (i.e., excluding ozone, carbon monoxide, PM-10, sulfur dioxide, nitrogen oxide) that may reasonably be anticipated to cause cancer; respiratory, cardiovascular, or developmental effects; reproductive dysfunctions; neurological disorders; heritable gene mutations; or other serious or irreversible chronic or acute health effects in humans.

[90] DOE, EERE, Alternative Fuels Data Center, *Biodiesel*, at [http://www.eere.energy.gov/afdc/altfuel/biodiesel.html].

[91] EIA, *Biodiesel Performance, Costs, and Use*, 2004, 8 p., at [http://www.eia.doe.gov/oiaf/analysispaper/biodiesel/].

Biodiesel appears to have a net energy production much higher than that for corn ethanol and slightly higher than that for petroleum diesel.[92] U.S. biodiesel production has increased from less than 1 million gallons in 1999 to an estimated 75 million gallons in 2005.[93] The latter figure is equivalent to about 5,000 barrels of oil per day and is less than 1% of total diesel fuel use for transportation.[94] EIA projects that biodiesel production could reach the equivalent of 20,000 barrels of oil per day by 2030.[95]

The American Jobs Creation Act of 2004 (P.L. 108-357, §301) created an excise tax credit for biodiesel fuel blending. The credit is set at $1.00 per gallon of biodiesel used.[96] Because the credit is fixed on a volume (per gallon) basis, a 20% biodiesel blend (B20) would be eligible for a 20 cent per gallon credit, and a 100% biodiesel fuel (B100) would be eligible for a $1.00 per gallon credit.[97] EPACT (§1344) extended this credit through the end of 2008. Further, EPACT (§1501) created a renewable fuel standard (RFS),[98] which allows for biodiesel production to contribute to achievement of the standard.[99]

Climate Change and Renewables

Because in most cases renewable energy appears to release less carbon dioxide (CO_2) than fossil fuels,[100] renewables are seen as a key long-term resource that could

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[92] DOE, National Renewable Energy Laboratory, An Overview of Biodiesel and Petroleum Diesel Lifecycles, p. v., at [http://www.biodiesel.com/Biodiesel%20Life%20Cycle.pdf]; also see National Biodiesel Board, *Energy Content*, Fact Sheet, 1 p., at [http://www.biodiesel.org/pdf_files/fuelfactsheets/BTU_Content_Final_Oct2005.pdf].

[93] National Biodiesel Board (NBB), *U.S. Biodiesel Production Capacity*, May 2006, 1 p.

[94] National Biodiesel Board (NBB), *Biodiesel and Energy Security*, Fact Sheet, 2 p. NBB reports that on-road diesel fuel use stands at about 37 billion gallons per year; see [http://www.biodiesel.org/pdf_files/fuelfactsheets/Energy_Security.pdf].

[95] EIA, *Annual Energy Outlook 2006*, p. 52. This is the estimate for the reference case.

[96] The $1.00 per gallon credit is for biodiesel derived from first-use oils, such as soybean oil. For biodiesel obtained from second-use oils, such as recycled cooking oil, the credit is set at half that value.

[97] Thus, the maximum credit for biodiesel derived from second-use oils is 50 cents per gallon for B100.

[98] However, the share of RFS allocated to biodiesel and other details are to be determined through a rulemaking by the Environmental Protection Agency due August 8, 2006. Meanwhile, EPA has posted the default rule at [http://www.epa.gov/otaq/renewablefuels/420f05057.htm].

[99] EPACT has other provisions supporting biodiesel, including an authorization for an engine-testing program (§757), a 10-cent per gallon tax credit for small agri-biodiesel producers (§1345), and a requirement that DOE prepare a report on the future potential for biodiesel fuel (§1823).

[100] Because renewable energy is often developed for energy security, air pollution reduction, (continued...)

substitute for fossil energy sources used to produce vehicle fuels and electricity. The percentage of renewable energy substitution depends on technology cost, market penetration, and the use of energy efficiency measures to control energy prices and demand. DOE's November 2005 report *U.S. Climate Change Technology Programs — Technology Options for the Near and Long Term* compiles information from multiple federal agencies on more than 80 technologies.[101] For these end-use and supply technologies, the report describes President Bush's initiatives and R&D goals for advancing technology development, but it does not estimate emissions saving potentials, as some previous DOE reports on the topic had presented.

Climate Action Report — 2002 describes federal renewable energy programs aimed at reducing greenhouse gas emissions.[102] In *Climate Change 2001: Mitigation*, the Intergovernmental Panel on Climate Change looks at the role that renewables could play in curbing global CO_2 emissions.[103]

Since 1988, the federal government has accelerated programs that study the science of global climate change and has initiated programs aimed at mitigating fossil fuel-generated CO_2 and other human-generated emissions. The federal government funds programs for renewable energy as a mitigation measure at DOE, USDA, the Environmental Protection Agency (EPA), the Agency for International Development (AID), and the World Bank. The latter two agencies have received funding for renewable energy-related climate actions through Foreign Operations appropriations bills.

Because CO_2 contributes the largest greenhouse gas emission impact, the reduction of CO_2 has been the focus of studies of the potential for reducing emissions through renewable energy and other means. Except for biofuels and biopower, wherever renewable energy equipment displaces fossil fuel use, it will also reduce carbon dioxide (CO_2) emissions, as well as pollutants that contribute to water pollution, acid rain, and urban smog. In general, the combustion of biomass for fuel and power production releases CO_2 at an intensity that may rival or exceed that for natural gas. However, the growth of biomass material, which absorbs CO_2, offsets this release. Hence, net emissions occur only when combustion is based on deforestation. In a "closed loop" system, biomass combustion is based on rotating

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[100] (...continued)
or other purposes, it is an example of a "no-regrets" strategy for CO_2 emission reductions. Wind and solar energy have zero CO_2 emissions in operation but may need an energy storage back-up system (such as batteries or fuel cells) that do require fossil fuel use. When biomass is developed as an energy crop, the CO_2 emissions are near zero because each new crop absorbs the same amount of emissions as are released by combusting the previous crop.

[101] The report is available at [http://www.climatetechnology.gov/library/2005/tech-options/index.htm].

[102] U.S. Department of State, *U.S. Climate Action Report: The United States of America's Third National Communication Under the United Nations Framework Convention on Climate Change*, May 2002. The report is available online at [http://yosemite.epa.gov/oar/globalwarming.nsf/content/ResourceCenterPublicationsUSClimateActionReport.html].

[103] United Nations Environment Program (UNEP), *Climate Change 2001: Working Group III, Mitigation*, at [http://www.grida.no/climate/ipcc_tar/wg3/index.htm].

energy crops, there is no net release, and its displacement of any fossil fuel, including natural gas, reduces CO_2 emissions.

Legislation

In the 109th Congress, more than 260 bills with provisions for renewable energy or energy efficiency have been introduced. A general description of the renewable energy provisions in these bills, including those enacted into law, is available in CRS Report RL32860, *Energy Efficiency and Renewable Energy Legislation in the 109th Congress*, by Fred Sissine. The report also groups the bills by policy and issue areas, provides a table that identifies recent action on the bills, and discusses recent action on a month-by-month basis.

Appropriations Bills in the Second Session

H.R 5384 (Bennett)

Agriculture, Rural Development, Food and Drug, Administration, and Related Agencies Appropriations Bill, 2007. Under Title III, Rural Development Programs, the bill would provide funding for the USDA Renewable Energy Program. The House approved $20 million and the Senate Appropriations Committee recommends $25 million. The Senate report language (p. 113) includes earmark recommendations. House Committee on Appropriations reported (H.Rept. 109-463) May 12, 2006, and reported Part II on May 16. Passed House, amended, May 23. Senate Committee on Appropriations reported (S.Rept. 109-266) June 22.

H.R 5427 (Hobson)

Energy and Water Development Appropriations Act, 2007. Provides funding for DOE Renewable Energy Program. The details of House and Senate action are shown in **Table 3**. House Committee on Appropriations reported (H.Rept. 109-474) May 19, 2006, with amendments. Passed House, amended, May 24. Senate Committee on Appropriations reported (S.Rept. 109-274) June 29.

H.R 5522 (McConnell)

Department of State, Foreign Operations, and Related Programs Appropriations Bill, 2007. In the Senate version of the bill, under Title III, Bilateral Economic Assistance, the program for Development Assistance would include three types of support for renewable energy. First, the program for Energy, Biodiversity, and the Environment would, according to the Committee report (p. 65), provide $180 million "to support policies and programs in developing countries that promote energy efficiency, renewable energy, and cleaner energy technologies...." Also, $3 million would be provided for the U.S. Agency for International Development (USAID) partnership with DOE for the hydropower Clean Energy Technology Exports Initiative (CETEI). Second, under the USAID Development Assistance program, about $160 million would be provided (p. 59-60) for Energy, Biodiversity, and Other Environment programs for Africa ($73 million), East Asia/Pacific ($28 million), Near East ($2 million), South Asia ($18 million), and Western Hemisphere ($52 million). Third, under Other Bilateral Economic Assistance, the bill would provide $26 million for the Asia Pacific Partnership, and further specifies (p. 73) that the "...

Partnership activities will be coordinated with existing efforts to promote clean energy export and market development initiatives." House Committee on Appropriations reported (H.Rept. 109-486) June 5, 2006, with amendments. Passed House, amended, June 9. Senate Committee on Appropriations reported (S.Rept. 109-277) July 10.

H.R 5631 (Jerry Lewis)

Department of Defense Appropriations Bill, 2007. The House version of this bill would provide $6.3 million to the Office of the Secretary of Defense (OSD) for a wind energy demonstration project. House Committee on Appropriations reported (H.Rept. 109-504) June 16, 2006. Passed House, amended, June 20. Senate Committee on Appropriations reported (S.Rept. 109-292)) July 25.

Energy Policy Act of 2005 (EPACT, P.L. 109-58)

Title II has several renewable energy provisions: Section 202 reauthorizes the renewable energy production incentive (REPI), Title II (Subtitle C) authorizes increased hydropower at existing dams, Section 203 sets a goal for renewables use in federal facilities and fleets, and Section 206 establishes a residential renewable energy rebate program. Section 812 creates a program for using solar energy to produce hydrogen. Title IX provides funding reauthorizations for renewable energy R&D programs. Section 1253 would, under certain conditions, terminate PURPA cogeneration and small (renewable) power requirements. Title XIII has several tax incentives for renewables: Section 1301 extends the renewable energy production tax credit (PTC) for two years, Section 1303 creates $800 million in renewable energy bonds, Section 1335 creates a 30% residential solar investment credit for two years, Section 1337 increases the business solar investment credit from 10% to 30% for two years, and Sections 1345, 1346, 1347, and 1348 create or extend credits for ethanol and biodiesel fuels. Title XV (Subtitle A) has several renewable fuels provisions covering ethanol, biofuels, cellulosic biodiesel, and municipal waste. In particular, Section 1501 sets a renewable fuels standard of 7.5 billion gallons per year by 2012 for increased use of ethanol and biodiesel. Title XVII empowers DOE to provide loan guarantees for certain innovative renewable energy technology projects. Section 1826 requires a study of passive solar energy. Conference reported (H.Rept. 109-190) July 27, 2005. Signed into law August 8.

Other Public Laws of the 109th Congress

P.L. 109-148 (H.R. 2863)

Department of Defense Appropriations Bill, 2006. Title II, regarding Operation and Maintenance, includes $4.25 million for a wind power demonstration project on an Air Force base. Conference Committee reported (H.Rept. 109-359, p. 5) December 18, 2005. Signed into law December 30, 2005.

P.L. 109-171 (S. 1932)

Deficit Reduction Act of 2005. Section 1301 amends section 9006(f) of the Farm Security Act of 2002 to set a limit of $3 million in FY2007 funding for the USDA Commodity Credit Corporation to carry out renewable energy and energy efficiency projects. Section 1402 terminates FY2007 funding authorization for the

USDA Value-Added Producer Program (created by section 6401 of the Farm Security Act of 2002) to provide grants to renewable energy and energy efficiency projects. Conference reported (H.Rept. 109-362) December 19, 2005. Signed into law February 8, 2006.

Note: Three other public laws make appropriations for renewable energy programs. P.L. 109-97 (H.R. 2744), the Agriculture Appropriations Bill for FY2006, includes $23 million for USDA's renewable energy grant and loan program; P.L. 109-102 (H.R. 3057, Section 585[a]), the Department of State's Appropriations Bill for FY2006, provides $100 million for clean (renewable) energy and energy efficiency programs that seek to reduce greenhouse gas emissions in developing countries; and P.L. 109-103 (H.R. 2419) makes appropriations for the DOE renewable energy programs.[104]

P.L. 109-59 (H.R. 3)

Transportation Equity Act: A Legacy for Users (SAFETEA-LU). Section 1113 has a volumetric excise tax credit for alternative fuels. Section 1121 on High-Occupancy Vehicle (HOV) Lanes includes provisions for alternative-fueled vehicles. Section 1208 on High-Occupancy Vehicle (HOV) Lanes includes provisions for alternative-fueled vehicles and energy-efficient vehicles. Section 3010 on Clean Fuels Formula Grant Program includes provisions for biodiesel, alcohol fuels, and fuel cells. Section 3044 supports clean fuels, and Section 6015 supports clean fuel school buses. Conference reported (H.Rept. 109-203) July 28. Signed into law August 10.

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Tables showing DOE Renewable Energy R&D Funding trends back to FY1978 (current and constant) are available from the author of this report.

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Table 3. DOE Renewable Energy Budget for FY2005-FY2007

(selected programs, $ millions)

OFFICE OF ENERGY EFFICIENCY AND RENEWABLE ENERGY (EERE)	FY2005 Appn.	FY2006 Appn.	FY2007 Request	FY2007 House	FY2007 Senate Cmte.	Senate-House Percent Change
HYDROGEN TECHNOLOGY	166.8	155.6	195.8	195.8	189.9	-3.0%
Fuel Cell Technology	81.9	67.8	96.6	96.6	85.4	-11.6%
BIOMASS & BIOREFINERY	87.5	90.7	149.7	149.7	213.0	42.3%
Biochemical Platform (Cellulose)	11.1	10.4	32.8	32.8	—	—
SOLAR ENERGY	84.3	83.1	148.4	148.4	148.4	0.0%
Photovoltaics	65.8	60.0	139.5	134.5	125.5	-6.7%
Concentrating Solar	5.9	7.4	8.9	8.9	17.9	101.1%
Solar Heating & Lighting	2.4	1.5	0.0	5.0	5.0	0.0%
WIND	40.6	38.9	43.8	43.8	39.4	-10.0%
GEOTHERMAL	25.3	23.1	0.0	5.0	22.5	350.0%
SMALL HYDRO	4.9	0.5	0.0	0.0	4.0	400.0%
VEHICLE TECHNOLOGIES	161.3	182.1	166.0	172.5	180.0	4.4%
BUILDING TECHNOLOGIES	65.2	69.3	77.3	80.0	95.3	19.1%
INDUSTRIAL TECHNOLOGIES	73.4	56.9	45.6	51.6	47.6	-7.8%
DISTRIBUTED ENERGY*	59.1	0.0	—	—	—	—
FEDERAL ENERGY MGMT	19.9	19.2	16.9	18.9	16.9	-10.6%
FACILITIES & INFRASTRUC. (National Renewable Energy Lab)	11.4	26.1	5.9	15.9	5.9	-63.0%
WEATHERIZATION	325.5	316.9	225.6	335.4	266.4	-20.6%
International Renewables	6.4	3.9	2.5	4.5	2.5	-44.7%
Tribal Energy	5.5	4.0	4.0	4.0	5.0	25.3%
Renew. En. Production Incentive	5.0	5.0	4.9	4.9	4.9	0.0%
PROGRAM MANAGEMENT	115.1	111.9	102.0	102.0	101.9	0.0%
RENEWABLES, SUBTOTAL[a]	270.3	275.2	359.2	376.2	445.6	18.4%
Renewables R&D Subtotal	242.5	236.2	341.9	346.9	427.3	23.2%
RENEWABLES, EARMARKS	52.0	82.6	0.0	54.9	54.3	-1.2%
Prior Year Balances (EERE)	-5.3	—	—	—	—	—
EERE, TOTAL	1,234.3	1,173.8	1,176.4	1,319.4	1385.5	5.0%
Office of Electricity Delivery & Energy Reliability (OE)[b]	117.9	161.9	124.9	144.0	135.0	-6.3%

Source: DOE FY2007 Budget Request, v. 3; February 2006; H.Rept. 109-474; S. Rept 109-274.

a. R&D includes Biomass, Solar, Wind, Geothermal, Hydro. Other includes Facilities, International, Tribal, REPI.
b. Funding for Distributed Energy was moved to OE.