FY 2010 Industry Assessment

ENERGY INDUSTRIES

A. Background on the Industry

The energy industry is defined, in general, as all the industries involved in the production and sale of energy, including fuel extraction, manufacturing, fuel and electricity transport, refining and distribution. In particular, the energy industry comprises:

- companies that explore for and produce oil and gas (upstream);
- companies that transport fuels and electricity (midstream);
- refineries (downstream);
- oil and gas field equipment manufacturers;
- coal companies;
- clean coal technology equipment manufacturers;
- nuclear energy equipment and service suppliers;
- renewable energy equipment manufacturers (solar, wind, bio-mass, geothermal, hydro, ocean and tidal);
- companies working on alternative fuels and emerging energy technologies;
- energy efficiency technology purveyors;
- electric power generation, transmission and distribution equipment manufacturers;
- smart grid manufacturers, notably information and communication technology (ICT) companies; and,
- energy services companies

The North American Industry Classification System (NAICS) codes for the energy industries are included in Attachment 1. Note that Energy Service and Oil and Gas Field Services are covered by the DAS for Services/MAS. Note also that the renewable energy is also covered in the Environmental Industries Industry Assessment.

B. Industry Overview and Global Competitiveness

The United States is the world's largest energy consumer and is a leader in the production and supply of energy. U.S. energy companies produce oil, natural gas, coal, nuclear, alternative and renewable energy, and electricity transmission/distribution equipment, as well as supply energy technology to almost every country in the world. U.S.-made energy equipment (except for renewable energy equipment) dominates the U.S. market and commands strong market share in most countries. The United States operates the most nuclear reactors in the world, has the largest installed nuclear power capacity, and generates the most nuclear power in the world.

Different types of companies predominate in different energy subsectors. Companies within the United States that are engaged in oil/gas exploration and production and electric power production are a mix of small, medium, and large companies; those that operate abroad tend to be large. As for the manufacture of energy equipment, large companies dominate in the oil and gas field equipment manufacturing sector, while small- and medium-sized companies dominate

the renewable energy equipment sector. The nuclear sector is a combination of large companies supported by small and medium sized companies. The top five U.S. coal mining companies have consistently accounted for approximately 53 percent of all U.S. coal production. U.S. companies engaged in international coal-fired power production equipment and services are small, medium, and large companies.

The renewable energy industry includes both established and emerging technologies that generate power from sources that are naturally replenished in a short amount of time. These include:

- *Solar Energy*: concentrated solar power (CSP), photovoltaic (PV) solar cells, solar hot water systems – both active or passive
- *Wind Energy*: wind turbines including the nacelle, hub, tower, blades, and down tower assembly – both onshore and offshore
- *Hydroelectric Power*: conventional hydropower dams, pump storage plants, ocean energy technologies, tidal energy, and wave energy technologies
- *Geothermal Energy*: geothermal turbines, geothermal drilling equipment, heat pumps, enhanced geothermal systems, and low-temperature cogeneration systems;
- *Biomass*: both closed and open loop biomass systems from a wide variety of feedstocks

The U.S. transmission and distribution equipment industry comprises companies that manufacture transformers, transmission towers, utility substations, and switchgear/switchboard instrumentation. Though the traditional U.S. grid is 99.7% reliable, intermittent power interruptions cost U.S. industry nearly $100 billion annually. Consequently, the Obama Administration has committed approximately $11 billion of the ARRA funds to upgrade the current grid system by incorporating smart grid technologies, namely an information and communication technology (ICT) overlay, into the existing grid system. The United States, considered as the international leader in smart grid technologies and policies, is taking an all-encompassing approach to a fully-integrated smart grid system, including power generation, electric meter, electricity end-user, and plug-in appliances/vehicles.

C. U.S. Energy Supply and Demand

Fossil Energy and Related Equipment (Oil, Gas, Coal and Field Machinery)

Oil and Gas

Although U.S. companies are leaders in the world oil industry, U.S. domestic oil production has been declining or flat for many years, after peaking in the 1970s. Even so, the United States remains the third largest oil producer in the world behind Saudi Arabia and Russia (see Table 1). In 2008, average U.S. crude oil production was 4.9 million barrels per day (mbpd). Imports of crude oil and oil products averaged 12.8 mbpd, most coming from the Western Hemisphere (see Table 2). Through October 2009, U.S. crude oil production averaged 5.2 mbpd, and imports of crude oil and oil products averaged 11.9 mbpd. Increased offshore Gulf of Mexico production and higher output from North Dakota's Bakken shale contributed greatly to the rise in domestic production. The Energy Information Administration (EIA) of the U.S. Department of Energy estimates that crude oil prices will continue to rise in 2010 as the global economy improves, beginning the year around $73 per barrel and ending the year at about $82 per barrel.

Table 1. Top Oil and Gas Producers, 2008

Country	Oil production (million bpd)*	Country	Gas production (billion cubic meters)
Saudi Arabia	10.8	Russia	601.7
Russia	9.8	USA	582.2
USA	6.7	Canada	175.2
Iran	4.3	Iran	116.3
China	3.7	Norway	99.2
Canada	3.2	Algeria	86.5
Mexico	3.1	Saudi Arabia	78.1
UAE	2.9	China	76.1

*Includes crude oil, shale oil, oil sands, natural gas liquids
Source: BP Statistical Review of World Energy 2009

Table 2. Top Total Crude Oil and Products Suppliers to the United States (million bpd)

Country	Year – 2008	Year – January to October 2009
Canada	2.493	2.439
Saudi Arabia	1.529	1.041
Mexico	1.302	1.253
Venezuela	1.189	1.119
Nigeria	.988	.762

Source: Energy Information Administration

The United States continues to meet most of its natural gas demand through domestic production. U.S. production increased approximately 5 percent from 2007 to 2008 due to the development of unconventional reserves (primarily shale gas). U.S. natural gas consumption was 23.2 trillion cubic feet (tcf) in 2008. From January to October 2008, consumption was 19.16 tcf, and for the same period in 2009, dropped to 18.55 tcf. Lack of industrial demand for natural gas was a major factor for this decline.

2008 natural gas imports totaled 3.9 tcf, or 17 percent of total U.S. natural gas consumption. 3.8 trillion cubic feet of these imports, or 97 percent, entered the United States via pipeline, primarily from Canada. 351 billion cubic feet (bcf) entered as liquefied natural gas (LNG), primarily from Trinidad & Tobago, Egypt, Nigeria, Norway, and Qatar. U.S. LNG imports dropped more than 54 percent from 2007 to 2008 due to an increase in overall U.S. natural gas production led by shale gas, a mild U.S. winter, and cargo diversions to countries willing to pay more for LNG than the United States. 2009 LNG imports averaged 38 bcf per month from January to October, a 31 percent increase compared to the same time period in 2008. Contractual agreements and saturated Asian and European LNG markets played roles in the increase.

U.S. oil and gas companies face serious challenges internationally, as more oil and natural gas resources in other countries have been made unavailable to foreign investors. According to a

study by the Baker Institute, about 77 percent of proven global oil reserves are controlled by national oil companies that do not allow foreign equity participation in their development projects. In addition, a significant proportion of the world's gas reserves are controlled by national oil companies.[1] Most of the major oil producing countries own state-controlled oil companies. U.S. companies have responded by investing more in domestic and Canadian unconventional oil and natural gas resources, such as the Canadian oil sands, North Dakota Bakken shale oil, and shale and tight sands gas.

Oil and Gas Equipment Manufacturing Services

The U.S. oil and gas equipment manufacturing and services industry's performance declined from 2008 to 2009. The decline can in part be attributed to tightened credit markets and reduced capital expenditure budgets. According to the U.S. International Trade Commission (NAICS code 333132), exports of U.S. oil and gas field machinery declined from $10.1 billion in 2008 to $8.1 billion in 2009 for the period January to October. In 2008, imports of oil and gas equipment reached an estimated $2.1 billion, comparable to imports during 2007. 2009 imports for the period January to October were $1.1 billion, down 31 percent from the same time period in 2008.

The U.S. oil and gas field equipment and services suppliers face strong competition from manufacturers in Western Europe, Canada, Japan, Korea, Russia, China, Brazil, Argentina, and Australia. European oil and gas field machinery manufacturers have favorable market shares in their regions for manufactured offshore platforms, hydraulics, moorings, and subsea components. European manufacturers have an advantage in the North Sea market, while the United States leads in the Western Hemisphere.

Coal

Compared with all other fossil fuels, coal is the most abundant and widely distributed resource worldwide. Based on the world's total recoverable coal reserves and production rates, the world has approximately 164 years of available coal resources. Coal is the most abundant energy resource in the United States, making up 94 percent of fossil energy reserves measured by British thermal units (BTU). At current production rates, the United States has approximately 240 years of domestic coal reserves. Coal provides for approximately 41 percent of the world's electricity and 50 percent of U.S. electricity, making coal the most significant international and domestic contributor to electricity production. 2008 was a record year for coal production in the United States, as production increased by 24.9 million short tons, or a 2.2 percent gain from the previous year. Wyoming, West Virginia, Kentucky, Pennsylvania, and Montana were the top five coal producing states. In 2008, U.S. coal exports totaled approximately 82 million tons, an increase of approximately 38 percent from 2007.

Over 97 percent of U.S. coal production continues to go toward electricity generation. In 2008, approximately 5 percent of new power capacity additions were coal-based, representing 1,131 megawatts of new power capacity. A total of 28 coal plants representing 16,319 megawatts of capacity are currently under construction and are due to come on line by 2012. Domestic and international coal-fired power generation facilities have widely applied readily-available clean coal technologies (CCT) which reduce sulfur dioxide, nitrogen oxide, mercury, and particulate

[1] See Attachment 2: Table 'Top 50 Oil and Gas Companies'. Out of the top 50 oil and gas companies, 30 companies are either wholly or partially state-owned.

emissions. The increased efficiency of coal-fired power plants has reduced carbon dioxide emissions in recent years, though the development, deployment, and commercialization of carbon capture and storage (CCS) technologies remain a key issue for large-scale carbon dioxide reduction strategies. Refer to Attachment 2 for data pertaining to coal production, imports, exports, and electricity generation.

Nuclear Energy

The United States generates about 20 percent of its electricity from nuclear energy, produced at 104 nuclear reactors in 31 states. Currently, 59 commercial reactors in the United States have received 20-year license extensions from the Nuclear Regulatory Commission (NRC), giving them up to a total of 60 years of operation. There is growing public and political support for nuclear energy as a base-load source of domestic, emission-free energy and as a means to reduce foreign dependence on fossil fuel. A March 2009 Gallup poll found that American public support for nuclear energy had reached a new high of 59%, with 27% strongly favoring nuclear energy. In order to maintain nuclear energy's current 20 percent nuclear share of overall U.S. electricity generation, 34,000 megawatt electrical (MWe) of new nuclear generation would be required by 2030, which equates to roughly 25 new reactors. The United States has not commissioned a new nuclear power plant in 30 years. This situation now appears to be changing with 17 companies and consortia submitting construction and operating license applications (COLAs) to the NRC to build 26 new nuclear reactors in the United States. The first new plants are expected to come on line in 2015. The new plants will have capacities ranging from 1,175 MWe for the Westinghouse AP1000 to 1,500 MWe for GE's economic simplified boiling water reactor (ESBWR) and to 1,600 MWe for Areva's evolutionary power reactor (EPR).

While much of the domestic nuclear infrastructure has atrophied over 30 years of inactivity, U.S. nuclear reactor vendors and associated companies have participated in the international market for commercial nuclear power (often as minority partner), invested in research and development for the next generation of nuclear reactors, and upgraded the domestic fleet's efficiency significantly, with increased output equivalent to almost six new 1,000 MWe power plants.

Renewable Energy and Energy Efficiency (Solar, Wind, Bio-Mass, Geothermal, Hydro, Ocean Tidal, Biofuels, and Energy Efficient Technologies)

Renewable Energy

In 2008, U.S. renewable energy accounted for 119 gigawatt (GW) of energy capacity, nearly 11% of total U.S. energy capacity. The solar and wind power sectors continue to lead the renewable industry's growth, increasing 44% and 51% respectively in 2008. Yet, hydropower and biomass remain the largest sources of renewable energy production.

In 2008, renewable energy, including hydropower, accounted for 18% of all global electricity generation; without hydropower, renewable energy accounts for 2.5% of global generation.[2] As the United States becomes the global leader in wind installation, Germany continues to lead in cumulative installed capacity of solar PV. The United States is also the leader in geothermal,

[2] REN 21, Global Status Report, 2008

biomass and concentrated-solar-power installed capacity. China has the largest installment of solar hot water heating and hydropower (mainly small hydro facilities).

Globally, in 2008, wind generating capacity reached 121 GW, small hydropower reached 85 GW, biomass power reached 52 GW, geothermal power reached 10 GW, and grid-connected solar PV now accounts for 13 GW.

In 2008, for the first time ever, the United States surpassed Germany as the global leader in wind installed capacity. However, it is anticipated that China will surpass the United States both in terms of installations in 2009, which increased by 92.3% from 2008, but also in cumulative terms. China increased its grid-connected wind capacity in 2009 by 8.97GW, accounting for 10% of the total increased power generating capacity, according to a report released by the government-owned China Electricity Council.[3]

Global investment in renewable energy reached $120 billion in 2008 including new capacity, assets, and projects. Renewable energy investment in 2008 included approximately $51.8 billion for new wind capacity, $33.5 billion in solar PV, $6 billion for small hydropower, $40-45 billion for large hydropower, and $7.2 billion each for biomass and geothermal.[4]

At time of writing (January 2010), investment and installation trends for 2009 are still incomplete. However, an initial *New Energy Finance* report indicates that for the first time Asia's new clean energy investment valued at $37.3 billion exceeded the $32 billion invested in the Americas. The wind sector accounted for the majority of clean energy investment in Asia.[5]

While the global recession reduced the amount of private sector financing in 2009, governments around the world invested an additional $180 billion in stimulus dollars to promote the industry. However, helping to offset the effect of the recession on the sector, governments' research, development and demonstration and small-scale projects increased in 2009.[6]

Liquid Biofuels

Liquid biofuels, primarily fuel ethanol and biodiesel, continue to play an important role in the U.S. energy mix as transportation fuels. The current generation of commercially available biofuels is derived from sugar, starch, vegetable oil, and animal fat sources. Research on future non-food crop produced biofuels and drop-in fuels with molecular compositions similar to petroleum derived fuels is ongoing in the public and private sectors.

In 2008, fuel ethanol production in the United States was approximately 9 billion gallons, up from 6.5 billion gallons in 2007. 2009 production figures from January to October show a 15.9 percent increase over the same time period in 2008. The United States remains the largest global fuel ethanol producer, followed by Brazil, the European Union, China, and Canada. U.S. biodiesel production is much smaller, coming in at 490 million gallons in 2009, a decrease from the 691 million gallons produced in 2008. Lower production can be attributed to high feedstock

[3] Ibid.
[4] Renewable Energy Policy Framework for the 21st Century (REN21), "Global Status Report 2009
[5] New Energy Finance, NewsWatch, January 8, 2010.
[6] Ibid.

costs, tight credit, lower diesel prices, and uncertainty over the extension of renewal of federal tax incentives.

Ethanol imports trended upward from 2000 to 2006, but have experienced marked declines since that time (see Attachment 2). The period January to October 2009 shows a marked decrease in imports from the same time period in 2008, from 489 million gallons to 181.3 million gallons (EIA figures. Note: USITC figures are higher). Increased U.S. domestic production and lower domestic ethanol prices have depressed demand for imports. Most ethanol imported by the United States originates in Brazil and enters the United States duty-free via Caribbean nations under the Caribbean Basin Initiative and CAFTA.

Table 1: Top U.S. Ethanol Producers, by Capacity December 2009

Company	Current Capacity (mgy)
Poet Energy	1356
Archer Daniels Midland	1070
Valero Renewable Fuels	780
Hawkeye Renewables	440
Green Plains Renewable Energy	440

mgy=millions of gallons/year

Source: Renewable Fuels Association

Table 2: Top U.S. Biodiesel Producers, by Capacity January 2010

Company	Current Capacity (mgy)
GreenHunter BioFuels, Inc.	105
Imperium Grays Harbor	100
Green Earth Fuels of Houston, LLC	90
ADM	85
Louis Dreyfus Agricultural Industries, LLC	80
Delta Biofuels, Inc.	80

mgy=millions of gallons/year

Source: National Biodiesel Board

Table 3: Top Fuel Ethanol-Producing Countries (Millions of Gallons)

Country	2008
USA	9000.0
Brazil	6472.2
European Union	733.6
China	501.9
Canada	237.7

Source: Renewable Fuels Association

The rapid expansion of the biofuels industry in the past several years has been driven by: (1) the federal Renewable Fuel Standard (RFS) that mandates the blending of an increasing amount of renewable fuels, including ethanol and biodiesel, into the gasoline supply (from 9 billion gallons in 2008 to 36 billion gallons by 2022); (2) state mandates for the replacement of methyl tertiary-butyl ether (MTBE) as a fuel oxygenate; and (3) federal tax incentives for biofuels production.

Industrial Energy Efficiency

Within industrial energy efficiency, the term "industrial" refers to the activities within facilities that manufacture products and "energy efficiency" is the use of technologies that require less energy to perform the same function. Energy efficiency is perhaps better defined as energy intensity—the energy consumed per unit of output. The market for industrial energy efficiency encompasses two primary groups—manufacturers interested in improving their own energy efficiency (customers) and manufacturers of energy efficiency technologies (providers). Description of the market and its barriers may apply unevenly to both.

While difficult to quantify, the market for energy efficiency (EE) is large and growing. According to the American Council for an Energy-Efficient Economy (ACEEE), $300 billion was invested in EE technologies and infrastructure in 2004 in the United States alone. Investments in the industrial sector represent only one quarter, $75 billion, of total EE investments—efficiency premium investments[7] are $11.1 billion. The study assessed the market size across all sectors (commercial/residential building, industry, and transportation) at roughly $43 billion, or, for the industrial sector, $13.2 billion (25 percent of the total).[8]

Industry accounts for one third (33.6 percent) of all energy consumption in the United States and contributes 35.8 percent of green house gas emissions. Since 1993, overall energy intensity in the United States has declined, but most believe this is primarily a result of structural changes[9] within the manufacturing sector and secondarily attributed to energy efficiency improvements. Recent EIA data indicates since 2002, manufacturing fuel consumption has declined 3.2 percent, but that only 60 percent of fuel purchased is used for work—the other 40 percent is lost in transmission, emitted as heat during production, or is not properly captured during manufacturing. This represents a significant opportunity as energy demand is expected to nearly double by 2020.[10] Furthermore, a 2009 study by McKinsey asserts that the potential for U.S. energy efficiency across sectors is a 23 percent reduction in energy intensity by 2020; of that, industry could account for as much as 40 percent.[11]

The Department of Energy's Industrial Technologies Program (DOE-ITP) identified the top energy consuming industries—oil refining, aluminum, metal casting, forest products, glass, steel, mining, and chemicals—which collectively supply 90 percent of the materials vital to our economy.[12] Efforts to reduce the energy intensity of these industries will reduce energy demand

[7] According to the ACEEE study (see footnote 2), an *efficiency premium investment* is the difference in the investment costs associated with efficient versus inefficient goods and services.
[8] ACEEE, "The Size of the Energy Efficiency Market: Generating a More Complete Picture," 2008.
[9] *Structural changes* are economy-wide changes that may impact energy consumption, such as a general move away from heavy manufacturing toward less energy consuming industries.
[10] EIA, 2009
[11] McKinsey, "Unlocking Energy Efficiency in the U.S. Economy," 2009
[12] See: http://www1.eere.energy.gov/industry/

and greenhouse gas emissions, improve the cost-effectiveness of manufactured products, and increase the competitiveness of the U.S. manufacturing sector.

Power Transmission and Distribution and Smart Grid

The electric power network is an integrated system consisting of generating plants, high voltage transmission lines, local distribution facilities, communication, and additional facilities that operate as a synchronized network in real-time to provide stable and reliable electricity to consumers. The U.S. bulk power system has evolved into three major interconnected transmission and distribution systems, within which regional transmission organizations (RTOs) and independent system operators (ISOs) in geographic regions operate and manage transmission systems. They also manage organized competitive markets for the purchase and sale of wholesale electricity. These major networks consist of extra-high-voltage connections between utilities designed to transfer electricity from one part of the network to another. These transfers are restricted occasionally because of a lack of contractual arrangements or because of limited transmission capability. The three T&D networks within the continental United States are:

- The Eastern Interconnected System,
- The Western Interconnected System, and
- The Texas Interconnected System.

The Texas Interconnected System is not interconnected with the other two networks (except by certain direct current lines). The other two networks have limited interconnections to each other. Both the Western and the Texas Interconnect are linked with different parts of Mexico. The Eastern and Western Interconnects are completely integrated with most of Canada or have links to the Quebec Province power grid. Virtually all U.S. utilities are interconnected with at least one other utility by these three major grids, with the exception of Alaska and Hawaii. This bulk electricity system makes it possible for utilities to engage in wholesale electricity trade. Wholesale trade has historically played an important role, allowing utilities to reduce power costs, increase power supply options, and improve reliability. In the past, most wholesale trade was between interconnected utilities within the continental United States. However, with deregulation of wholesale markets, cross-border trade has become more prominent in meeting domestic electricity requirements. U.S. international electricity trade consists mostly of imports. Most imports are from Canada, with a small portion coming from Mexico.

The term smart grid refers to a digital upgrade of distribution and transmission grids to both optimize current operations, as well as open up new markets for alternative energy production. In its most basic sense, a smart grid network is an information and communication technology (ICT) overlay onto the existing transmission and distribution system. The smart grid system reaches beyond the power generation, transmission, and distribution system as it links into smart machines and appliances (including vehicles) within industrial, commercial, and residential facilities. By enabling decentralized and inter-coordination of electricity usage, the smart grid system contributes to the optimization of electricity use. This optimization has economic (cost reduction) and environmental (reduced fuel use and emissions) implications. Moreover, dynamic pricing (or ‘time-of-use pricing’) encourages consumers to shift electricity consumption

away from expensive peak hours, thereby leading to a reduced need for new power plant construction. Smart grid features will expand energy efficiency beyond the grid and into the industrial sector and homes. Smart grid systems also can track the production of power from large numbers of small power producers such as owners of rooftop solar panels, an arrangement that would otherwise prove problematic for power operators at local utilities.

DOE has calculated that the modernization of U.S. grids with the addition of smart grid/ICT capabilities will save between $46 and $117 billion over the next 20 years, and KEMA has highlighted that over 280,000 new smart grid jobs could be created over the next four years.

D. Domestic Environment

1. Regulations

Fossil Energy and Related Equipment

Oil and Gas

Oil and gas companies must comply with numerous regulations that can delay operations and increase costs. The principal regulations that affect the oil and natural gas industry include environmental regulations under the Clean Water and Clean Air Acts, Forest Service restrictions, the Endangered Species Act, and the Coastal Zone Management Act.

Regulations that increase operation costs are of particular concern to producers with marginal oil and natural gas wells. There are over 400,000 marginal oil wells and 250,000 marginal natural gas wells (defined as producing less than 15 bpd of oil or 75 thousand cubic feet of gas per day) in the United States. According to the National Petroleum Council, marginal oil and gas wells account for about 17 percent of domestic oil production and 9 percent of domestic gas production. Since average production from a marginal oil well is only 2.2 bpd, any increase in regulatory compliance costs can force the operator to cease production.

Oil and Gas Equipment

U.S. oil and gas equipment manufacturers exist in the same regulatory environment established for other U.S. manufacturers. They also must provide equipment and services that are in compliance with laws affecting drilling, production and disposal operations by upstream oil and gas companies. The Clean Air Act, Clean Water Act, various environmental regulations enforced by EPA and state agencies, the Family and Medical Leave Act, Sarbanes-Oxley Act, and workplace safety regulations enforced by OSHA and state agencies all impact in various ways on oil and gas equipment manufacturers. Further, many U.S. oil- and gas-producing states have their own extensive environmental regulations for pollution emission and for waste disposal.

Coal

With respect to the coal industry, the 2005 Clean Air Interstate Rule (CAIR) prompted the reduction of sulfur dioxide (SO2) and nitrogen oxide (NOx) throughout the United States. As both SO2 and Nox result from coal combustion, the coal-fired power industry has incorporated clean coal technologies and emissions abatement equipment throughout U.S. coal fired power

plants. Examples of SO2 and Nox reduction equipment include flue gas desulfurization units ('scrubbers') and selective catalytic/non-catalytic reduction units. Likewise, the 2005 Clean Air Mercury Rule (CAMR) has prompted the coal power generation industry to incorporate mercury control systems within power plants. Pre-combustion coal cleaning and sorbent injection systems are examples of mercury reduction technologies.

As carbon dioxide (CO2) emissions are currently unregulated, coal-fired power plants are not mandated to reduce CO2 output. However, the coal-fired power industry is advancing on the construction of additional integrated gasification combined cycle (IGCC) power plants which utilize coal while increasing plant efficiency and reducing CO2 output. Carbon capture and storage (CCS) technology, currently in the pilot/demonstration phase, will significantly reduce CO2 emissions output. However, until CO2 emissions are regulated (through a carbon tax and/or cap-and trade system) and CCS technology is commercialized, the coal-fired power sector has taken its own initiative to incrementally reduce C02 output through advanced coal preparation equipment and increased plant efficiency (burning less coal while increasing electricity output).

The coal industry has indicated that the enactment of federally-mandated CO2 and GHG regulations will serve as a clear and concrete mechanism to advance the commercialization of CO2 and GHG emissions reduction technologies, notably CCS technology.

Nuclear

The U.S. nuclear industry is the most regulated industry within the energy sector. Previously, the NRC's licensing process was unpredictable and inefficient. Sequential process reviews overlapped and led to the NRC often demanding last minute design changes due to safety or other issues that were typically not identified until after substantial investment was already made and the plant was almost completed. The NRC's regulatory regime now has implemented a new licensing process that eliminates this uncertainty. Under the new regime, the site and design of the plant are completed before the issuance of the combined COLA. The NRC and industry are optimistic about the new process. The regulations for handling spent fuel from nuclear power plants, however, remain a challenge, primarily because the U.S. government has not yet finalized a plan for the long-term storage or disposal of spent fuel. Additionally, some industry representatives are concerned that the NRC does not have the resources to review license applications for new, innovative reactor designs, such as the small modular reactors proposed by certain U.S. companies.

Further, the Energy Policy Act of 2005 has provided strong new incentives for the expansion of nuclear power, which directly affects the industry's competitiveness. The legislation promotes nuclear power through the following:

- provides incentives to encourage construction of new nuclear plants, including production tax credits, loan guarantees, and risk protection/standby support for companies pursuing the first new reactors ($500 million for the first two plants; $250 million for next four plants). The Department of Energy will choose from a short list of reactors proposed by four energy firms – Southern, Scana Corp., NRG Energy, and Constellation Energy;

- reauthorizes, for 20 years, the Price-Anderson Act, an insurance framework for protecting the public in the case of a nuclear incident; and
- funds nuclear energy R&D.

Renewable Energy and Industrial Energy Efficiency

Renewable Energy

Despite the increased importance of energy security and climate change to U.S. policy-makers, the U.S. renewable energy industry continues to operate at a disadvantage to competitors in the European Union, which generally have stronger government incentives for renewable energy technologies, and to those in China, which has strengthened domestic incentives and produces lower quality, but lower cost, renewable energy technologies. General Electric (GE) remains the only U.S. firm among the world's ten largest wind energy companies. First Solar is the only U.S. company represented in the top world's ten solar companies. The United States does dominate the geothermal sector and has produced several leading companies in the biomass sector.

According to the Solar Energy Industry Association, solar PV installations in the United States nearly doubled in 2008, bringing the industry's total capacity to around 1,000 MW.[13] U.S. wind installations also nearly doubled in 2008, bringing the wind industry's total capacity to about 27,000 MW. The United States is the largest producer of geothermal energy in the world with 2,937 MW of grid-connected capacity in 2007.[14] Stationary biomass power capacity also had a banner year in 2007, contributing 11,738 MW of power in the U.S. market.[15] Solar panel prices collapsed by nearly 50 percent in 2009; analysts predict prices could drop another 20 percent in 2010, helping the industry become cost-competitive with other energy resources but squeezing some companies out of business.

The structure of the industry differs according to specific technologies. The U.S. wind industry is dominated by a few large firms. GE Wind continues to be the leading manufacturer of wind turbines in the United States. In 2008, GE captured 43% of the global wind market (compared to 45% in 2007).[16] Foreign competitors including Vestas (Denmark), Siemens (Germany), and Suzlon (India), also had significant market share, followed by Suzlon (India), Gamesa (Spain), Mitsubishi (Japan).[17]

U.S. manufacturing in the wind sector has experienced substantial growth in recent years with foreign firms adding new manufacturing plants in Minnesota (Suzlon/India), Pennsylvania (Gamesa/Spain), and Colorado (Vestas/Denmark). GE also continues to maintain a substantial U.S. manufacturing base.

Despite this positive trend, growth prospects for 2010 have dimmed considerably as the global recession slowed project development and reduced the near-term demand for turbines. As a result, some manufacturers have delayed their plans to expand into the United States, while

[13] Solar Energy Industry Association
[14] U.S. Department of Energy, "EERE Renewable Energy Data Book (July 2009)
[15] Ibid.
[16] Ibid.
[17] DOE 2008 Wind Technologies Market Report.

others have had to scale back their efforts and lay off workers. In December 2009, Vestas announced that it would idle a blade plant it had opened in Colorado in 2008, putting 500 workers on leave until orders pick up again, which estimated would be at least the second quarter of 2010.

Domestic manufacturing capacity for solar has also grown considerably, led by First Solar, SolarWorld, United Solar, BP Solar and GE Energy. First Solar has the largest market share in the United States (31%) and a growing player internationally. In 2008, China surpassed Japan and Germany to become the world's largest exporter of solar cells. China's dominance exists primarily in mono- and poly-crystalline-based solar cells. The economic downturn and falling power demand in the United States and Europe have contributed to the price collapse in solar cells. The major cost driver has been the fluctuating supply of polysilicon, the primary raw material used the majority of solar cells. Polysilicon has gone from a major shortage to massive oversupply, and analysts have projected an oversupply of polysilicon until 2012. This provides an opening for thin film solar panels, a technology in which U.S. companies are leaders.

The geothermal industry is led by U.S. firms, both domestically and internationally. Chevron is the largest producer of geothermal energy, but the industry includes a fairly defined supply chain consisting of project developers, drilling firms, manufacturers, and plant operators. Geothermex, Power Engineers, U.S. Geothermal, Geothermal Development Associates and GE are the leading U.S. firms. Ormat (Israel), Ansaldo (Italy), Fuji Electric (Japan), and Mannvit (Iceland) are the largest international competitors.

Domestically, 13 states now have active geothermal projects under development – the most of any time in history. The Geothermal Energy Association expects that by 2012 over 25 countries will produce geothermal power. Yet the industry faces significant barriers, including a notoriously difficult financing structure (with most of the risk up-front), long lead times, and resource-dependent siting.

The biomass industry has grown 7% annually since 2005 around the world. The industry now provides 1.1% of global capacity. Priority markets for the sector include the United States, Brazil, Philippines, Germany, and Sweden. Domestically, biomass now produces enough electricity to power 8.5 million American homes. Today, over 100 biomass power plants are connected to the nation's electricity grid; many more operate as stand-alone, off-grid cogeneration facilities, particularly in conjunction within the pulp and paper industry.

The traditional hydropower industry in the United States has withered in recent years. Only American Hydro Corporation, specializing in runners, remains as a U.S. manufacturer of hydropower equipment. They compete with Voith Siemens (Germany) and other international firms to build new plants and refurbish old facilities. Newer hydropower technologies include tidal, ocean, and wave energy systems that have emerged as a potential growth industry for the sector. Greentech Media expects investment in these new hydro sectors to reach over $500 million globally by 2015.

Biofuels

With respect to biofuels, state and federal regulations, particularly blending requirements, have significantly expanded demand. The Energy Independence and Security Act of 2007 requires fuel blenders to use at least 36 billion gallons of renewable fuels by 2022. Additionally, the law mandates fuel producers and blenders to increase the use of cellulosic ethanol and other second generation biofuels, ensuring a market for those products still in development. As U.S. ethanol production exceeds the maximum amount of ethanol that can be blended into the fuel supply, industry is seeking new regulations which allow for higher blend percentages. Industry argues that cars can use such blends without requiring engine modification.

Industrial Energy Efficiency

For industrial energy users, two federal regulatory obstacles for energy efficiency technologies include the EPA's permitting process for fuel-switching, which may discourage companies from installing more efficient boilers that use different fuels, and the New Source Review (NSR) process, mandated by the Clean Air Act, which requires stationary sources of air pollution to get permits before they start construction on a major modification or installation of new equipment. Often these processes are complex and time-consuming, making efficiency upgrades costlier and less likely.

On the other hand, if comprehensive climate change legislation is enacted, either in the form of an emissions cap-and-trade system or a carbon tax, industry will face strong cost pressures to pursue energy efficiency.[18]

A primary regulatory obstacle to the industrial energy efficiency industry is an absence of international energy management standardization. Especially relevant for small- and medium-sized enterprises, having such codes would provide needed direction to SME managers who rarely have time to gain the expertise or familiarize themselves with the resources required to assess their energy needs and design effective energy management programs. Lawrence Berkeley National Labs (LBNL), DOE, and the United Nations Industrial Organization for Standardization, have supported the International Standards Organization (ISO) to develop a body of energy management standards entitled ISO-50001. Now in final development, ISO-50001 will be released in late 2010 and is expected to impact nearly 60 percent of the world's commercial and industrial energy demand.[19]

Standards on efficiency equipment are also lacking. There is little to distinguish energy-efficient technologies from those with greater energy demands. EPA's Energy Star Program seeks to address equipment standards, but more remains to be done.

Another market failure is the principal-agent barrier,[20] like the disincentive built into utility price structures. Many state utility commissions regulate rates in such a way that utility revenues are

[18] Cap and trade system, also referred to as emissions trading, is an administrative approach used to control pollution by providing economic incentives for achieving reductions in the emissions of pollutants. A carbon tax is an environmental tax on emissions of carbon dioxide and other greenhouse gases. It is an example of a pollution tax.

[19] See: http://industrial-energy.lbl.gov/

[20] This type of market barrier is one in which the incentive does not translate from the principal to the agent in such a way as to encourage energy efficient decisions. Agents may not be in the position to make determinations about their energy usage or the kinds of technologies they purchase. Homebuyers are one such example. Buyers rarely

directly related to the amount of electricity sold; thus, investments in energy efficiency by a utility can reduce revenue. "De-coupling" this relationship could remove the disincentive. Beyond the utility example, however, incentives within the industry are misaligned such that there is little motivation for manufacturers to invest in making EE improvements, particularly if it would mean decreasing profit margins in the short-term or raising prices and potentially losing market share.

Power Transmission and Distribution and Smart Grid

The electric power industry is evolving from a monopolistic industry characterized by vertically integrated electric utilities providing generation, transmission and distribution service to consumers at cost-based rates to an industry where ownership and/or operation of generation, transmission and distribution facilities have been increasingly separated functionally or by divestiture of generating assets. Increasingly wholesale and retail electricity prices are determined by competitive market forces, subject to a regulatory framework that is based on rules that monitor market participants' behavior to ensure workable competition. Monopoly transmission and distribution service providers generally operate under a traditional cost-based regulatory framework. However, FERC and certain states are implementing ratemaking methods that provide regulated utilities greater financial incentives to operate, maintain and expand their transmission and distribution systems on an efficient, reliable and cost-effective basis.

According to the most recent data provided by the Energy Information Administration, the average retail price of electricity, per kilowatt-hour (kWh), is 9.13 cents in the United States. The three states with the highest average price of electricity in 2007 were Hawaii (21.29 cents per kWh), Connecticut (16.45 cents per kWh), and New York (15.22 cents per kWh). The three states with the lowest average price for electricity in 2007 were Idaho, Wyoming, and West Virginia, at 5.07, 5.29, and 5.34 cents per kWh, respectively. Electricity price data from all fifty states is noted in Attachment 2.

2. Non-Regulatory Issues

Fossil Energy and Related Equipment

Oil and Gas

The most significant, ongoing, domestic non-regulatory issue for the oil and natural gas industries is access to resources. In October 2008, the Congressional moratorium on oil and natural gas exploration and production in certain Outer Continental Shelf (OCS) areas expired. According to the Minerals Management Service, the OCS areas affected hold undiscovered, technically available resources of up to 18.9 billion barrels of oil and 85.79 tcf of gas. Additionally, according to the National Petroleum Council, restrictions on the development of many onshore federal lands means that undiscovered, technically available resources of up to 20 billion barrels of oil and 161 tcf of gas are off limits to oil and gas companies.
By comparison, the United States currently has proved crude oil reserves of 19.12 billion barrels and approximately 238 trillion cubic feet of natural gas according to EIA.

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determine how energy is transmitted to their homes or kinds of technology used. Once faced with replacing an appliance, they regain some decision-making capacity but are still bound by the building's design.

Continual development of state-of-the-art technology allows the U.S. oil and natural gas industry to produce more oil and natural gas from more remote places - some previously unreachable - with significantly less adverse effect on the environment. With advanced technologies, the oil and gas industry can pinpoint resources accurately, extract them efficiently and with less surface disturbance, minimize associated wastes, and, ultimately, restore sites to original or better condition.

A major issue for U.S. oil and gas producers is a looming deficit of petroleum engineers and geologists. According to a 2006 Schlumberger study, in the United States, a large proportion of these professionals will reach retirement age by 2016, and there are not enough "mid-career" professionals (ages 30-45) to replace them. This problem could be resolved if companies are able to recruit professionals from Asia or Latin America, where there is projected to be a surplus of such talent over the next decade.

Oil and Gas Equipment

With respect to U.S. oil and gas equipment manufacturers, a number of non-regulatory issues potentially impede their competitiveness. The industry's cost structures – particularly for steel and other metals that are used for fabricating end-products – continues to make financial planning difficult. Transportation constraints, both within the United States and to overseas markets, also exist because of inadequate infrastructure. Other challenges as noted above include access to technology and skilled labor.

Coal

Emphasis on technology advancement also applies to the coal industry. The industry is currently working with DOE and Congress to move forward on the FutureGen project, an advanced 250-MW clean coal technology system which incorporates integrated gasification combined cycle (IGCC) technology with carbon capture and storage (CCS) and hydrogen production to create the world's cleanest coal-based power plant. Launched in 2005, the status of the FutureGen program, a public-private partnership, was questioned in late 2008 when estimated financial projections doubled the cost of the program from $1 billion to $2 billion. In January 2009, DOE revived government support for FutureGen and is continuing its partnership with the FutureGen Industrial Alliance for the construction of the facility. Similar clean coal technology systems have been launched worldwide, notably the ZeroGen program in Australia, the HypoGen program in the EU, and the GreenGen program in China. Of all the programs, China's GreenGen program is the most advanced, as it is currently being constructed near Tianjin. St. Louis-based Peabody Energy is the sole U.S. interest in the GreenGen program and was an original FutureGen Industrial Alliance partner. China's Huaneng Group, the largest stakeholder in China's GreenGen program, is the sole Chinese entity which has partnered on the U.S. FutureGen program.

As is the case with most energy sectors, the need for specialized and skilled workers is of major concern for the U.S. coal mining and power production sectors. Approximately 48 percent of coal miners are in the 45-50 age range. The combination of several mining industry workforce growth initiatives, high wages, and good benefits are enticing a new generation of coal miners and power generation specialists to enter the workforce.

Nuclear Energy

The U.S. nuclear power industry faces major challenges to restore its place as the global leader in the nuclear power field. Namely, it needs to demonstrate it can successfully and profitably build new plants domestically. Serious competitiveness issues affecting domestic firms include a weak domestic nuclear infrastructure because of the lack of new reactor construction in the last several decades. Specifically, there is a lack of nuclear engineers and high-skilled manufacturers, including steel welders and forgers. Storing and disposal of spent fuel remains a fundamental issue for the viability and growth of the industry as well. Financing plants is an obstacle due to a lack of investor confidence given the poor record of the last plants built (resulting from delays in the previous licensing and regulatory process). Additionally, U.S. firms face formidable competition abroad because most of the foreign competition has more capital and political support from their governments compared to U.S. companies. Ensuring adequate liability insurance, i.e., the entry into force of the United Nations Convention on Supplementary Compensation (CSC), is necessary for U.S. companies to develop nuclear power projects abroad. The U.S. government does not provide liability insurance in the case of a nuclear accident to U.S. firms for their business abroad. Most of the competition has some sort of liability insurance from their government, which thereby disadvantages U.S. firms. CSC would provide international coverage and level the playing field.

Renewable Energy and Energy Efficiency

Renewable Energy

The renewable energy sector hailed President Obama's call to double alternative energy installations within three years and to spend $150 billion on renewable energy research over ten years. In addition, the passage of the American Recovery and Reinvestment Act provided $80 billion for the U.S. clean energy sector.

Despite these achievements, renewable energy companies across the technology continuum continue to cite the short-term nature of the production tax credit and investment tax credits, the lack of a national renewable portfolio standard (RPS), and the failure to enact a pricing mechanism for carbon as reasons why the U.S. renewable industry continues to fall behind competitor nations.

Renewable portfolio standards, which mandate percentages of power generation from renewable sources, are key drivers of the renewable energy industry in states where they exist. As of February 2009, only 29 U.S. states and the District of Columbia had a renewable portfolio standard. Without specific technology mandates or "cutouts," a general RPS tends to favor more mature renewable energy technologies, such as wind, over other emerging forms of renewable energy like solar, enhanced geothermal or tidal power.

The lack of uniform national standards and mandates makes projecting industry growth rates difficult. One good example involves varying state interconnection standards. Manufacturers often must make different products for each state since each state's utility commission mandates differently how distributed energy sources connect to the electricity grid. A national

interconnection standard, such as exists in the telephone industry, would remove this barrier and improve the economies-of-scale manufacturers seek to develop.

Parity among sectors would likely spur additional investment in these sectors. Currently, not all renewable energy technologies benefit equally from the investment tax credit and production tax credit, the two most important federal financial incentives. Both hydropower technologies and some biomass technologies receive only half the credit that wind and solar technologies do.

Biofuels

U.S. biofuels producers say without the 51 cents per gallon federal tax credit for ethanol, the $1 per gallon credit for agri-biodiesel, and the 54 cents per gallon tariff on imported fuel ethanol – all in effect through 2010 – foreign competition, from Brazil in particular, could significantly impact domestic production. Industry argues that the U.S. market is currently oversupplied, so cheaper foreign imports would drive out U.S. producers and would negatively impact the work being done by U.S. firms on next-generation biofuels.

Energy Efficiency

Several government policies are designed to encourage the growth of the energy efficiency industry. The Energy Policy Act 2005 extended DOE's Federal Energy Management Program's authority to implement Energy Savings Performance Contracting (ESPCs) to 2016. In addition, state policy is also an important driver of energy efficiency incentives for industrial, commercial, and residential sectors. Examples of successful efficiency programs include: air quality standards and enforcement; alternative fuels for vehicles and power generation; and, green building codes. Public Benefits organizations, such as the Northwest Energy Efficiency Alliance, have also formed regional public-private partnerships to target geographically localized EE needs.

Federal agencies, state governments, gas and electric utilities, energy consumers, energy service providers, and environmental/energy efficiency organizations also are collaborating in a public-private partnership called the National Action Plan on Energy Efficiency (NAPEE), which is working to identify barriers and best practices to facilitate the deployment of energy efficiency technologies.

A 2008 Peer Review of DOE-ITP noted that the R&D pipeline for new EE technologies is largely empty. This presents a bleak future for industry since new innovations require an estimated seven years before becoming commercially available. Access to capital prevents many from seizing upon currently available technologies. This is particularly so for small- and medium-sized companies where potential energy efficiency gains may not be sufficient to outweigh short-term costs of financing improvements. Lack of awareness about assessment options, technical expertise, and workforce training are also barriers.

Power Transmission and Distribution and Smart Grid

Under the 2009 ARRA, the Department of Energy was allocated $36.7 billion to advance clean energy technology and commercialization. As part of this funding, $4.5 billion has been awarded to U.S. industry on a cost-share basis under the Smart Grid Investment Grant and Smart

Grid Demonstration Grant program. Utility companies, power producers, ICT companies, and appliance manufacturers are among the recipients of these smart grid awards. In addition, USDA-Rural Utility Service and DOC-National Telecommunications and Information Administration are managing $7 billion of ARRA funds to expand broadband coverage throughout the United States, notably in rural communities. This broadband program will ensure that smart grid and ICT technologies reach all regions, industries, and households within the United States.

E. Trading Environment

Fossil Energy and Related Equipment

Oil and Gas

As the United States is a net importer of both oil and gas, the industry does not face any export-related issues. However, because conventional oil and gas resources in the United States have been declining for many years (and other resources are off-limits, as referenced earlier), U.S. large and medium-sized oil and gas companies invest heavily in other resource-rich countries in order to stay in the upstream oil and gas business. Access to resources in other countries is therefore a key issue for them.

Oil and Gas Equipment

U.S. oil and gas equipment has a strong market position in all oil- and natural gas- producing countries in the world where U.S. companies are allowed to operate. In most of these countries, U.S. equipment is at least a third of the market and sometimes over 50 percent. The only major oil-producing country where the United States does not have a significant market share of the oil and gas equipment industry is Iran, which is the fourth largest oil producer.

In the first 10 months of 2009, the top five leading export markets for U.S. oil and gas equipment manufacturers were Singapore, Brazil, Korea, the United Arab Emirates, and the United Kingdom. During this period, these countries accounted for about 35.5 percent of U.S. oil and gas equipment manufacturers' U.S. domestic exports based on FAS value.

Although U.S. oil and gas equipment is in wide demand and competitive in every market, there are still a number of non-tariff barriers with which exporting companies must contend. These include domestic content requirements, standards and certifications, and non-transparent procurement and other practices.

Coal

The United States remains the second largest coal-producing and coal-consuming country in the world, with China as the world's top coal producer and consumer. However, only one percent of U.S. coal is exported abroad, as the majority is used domestically for power generation and steel production. The United States is still recognized internationally for its market leadership in clean coal technology and emissions abatement equipment. Specifically, U.S. clean coal technology companies are internationally recognized for their coal preparation equipment (crushers, screeners, cleaners), low NOx boilers, emissions abatement equipment, and air pollution control equipment. Such technologies can reduce greenhouse gas emissions in

countries where coal is used as a primary energy source, most notably South Africa, China, India, Australia, Russia, and Poland.

In 2007, China witnessed two significant coal-related events: for the first time ever, China imported coal, as domestic supply did not meet domestic demand, and China emerged as the world's top greenhouse-gas emitting country, surpassing the United States by mid-2007. Both U.S. clean coal technology companies as well as competing international clean coal technology companies have voiced concern over IPR and technology transfer issues in China. Though China currently provides the greatest opportunity for U.S. and international clean coal technology firms, many companies are concerned that their technological knowledge and patents will be misappropriated should they commence operations in China.

Nuclear Energy

Currently, there are approximately 50 nuclear plants currently under construction worldwide in 13 countries, the bulk of them being in China, South Korea, Japan, and Russia. The International Atomic Energy Agency (IAEA) projects 7300 MW in net new capacity by 2020, and between 18,400-48,000 MW of net new capacity by 2030. The global nuclear industry is developing at a definitively strong pace. The best prospect markets include: China, India, Russia, Europe (Finland, France, Baltics, UK), United States, Japan, and South Korea.

The major obstacles to international trade include mitigating nuclear liability risk, managing the onerous legal and regulatory requirements, meeting the local content requirements and price demands from foreign customers, and competing with state-owned companies abroad. Additionally, the complex export licensing process, which involves approvals from the National Nuclear Security Administration at DOE, the NRC, the State Department, and Commerce's Bureau of Industry and Security, represents a serious hurdle for companies interested in exporting civil nuclear technology and services.

Renewable Energy and Energy Efficiency

Renewable Energy

In 2007, the United States and the European Union initiated a drive to reduce or eliminate WTO tariffs on clean energy technologies. Progress on this initiative depends in part on the outcome of the Doha Round of negotiations.

Numerous nontariff barriers to trade exist within European and Asian markets that effectively restrict U.S. exports and prevent meaningful U.S. industry market penetration.

China and other countries consider the establishment of a renewable energy manufacturing base to be a national priority and can be expected to maintain a variety of non-tariff trade barriers and investment restrictions to protect their domestic producers. In numerous consultations with energy industry companies, the Office of Energy and Environmental Industries identified many barriers to U.S. companies doing business overseas. Among them are:

- Intellectual property protection,

- Preferential procurement,
- Lengthy or non-transparent project approval process,
- Central versus provincial government authority issues,
- Legal framework issues,
- Regulatory framework issues,
- Lack of financing,
- Limits on foreign equity ownership,
- Lack of adequate energy infrastructure, and
- Incompatible standards.

Biofuels

Biofuels are not currently traded on fully open international markets. To encourage domestic growth, many governments provide incentives for domestic production while imposing duties on imports. As such, U.S. biofuels producers have minimal exports, finding domestic production more profitable. The future competitiveness of U.S. biofuels in the domestic and global fuels market depends on a number of factors, most importantly the market price of oil. Additional factors include: availability of low-cost feedstocks; continued U.S. government support for biofuels; expansion of fueling infrastructure and flexible fuel vehicles; technology breakthroughs in second-generation biofuels; and, the competitive strength of unconventional fossil fuels (e.g., oil sands, coal-to-liquids).

The United States is engaged in significant bilateral and multilateral cooperation on biofuels. The U.S. focus at the G-8 mandated Global Bioenergy Partnership (GBEP) is the development of voluntary global criteria and indicators for the sustainable development of biofuels. The International Biofuels Forum (IBF), which includes Brazil, the United States, the European Commission, China, India, and South Africa, is working to achieve greater compatibility of biofuels standards and codes in order to expand the global biofuels marketplace. The United States also signed Memorandums of Understanding (MOUs) on biofuels cooperation with the European Union, Brazil, and China, and is working to provide technical assistance to several Caribbean nations on biofuels production.

Energy Efficiency

According to the EIA, the world's consumption of energy is projected to increase 50 percent from 2005 to 2030. Coupled with the reality of climate change, this increase will no doubt fuel the market for energy efficient services and technologies. Two subsectors are highlighted below as examples of the challenges and opportunities abroad.

1. *Energy Service Companies (ESCOs)*

While exports of energy services have been minimal, the potential for U.S. ESCOs in markets with rising energy demand and electricity reliability issues could be substantial. China and India, for instance, have been identified as prime candidates for the deployment of ESCOs. Financing, conceptual unfamiliarity, intellectual property concerns and other barriers, however, discourage ESCOs from widely entering these markets.

2. *District Energy*

District energy involves connecting multiple heating and cooling energy users through a piping network to centralized energy sources, such as combined heat and power (CHP), or renewable energy sources like biomass or geothermal. The primary export potential for district energy is in China, the Middle East, and India. According to the International District Energy Association, total capital investment in China in district heating and cooling over the next 10 years is estimated at over $360 billion. U.S. industry estimates U.S. companies could capture at least $8.2 billion in sales. District cooling opportunities in the Middle East, primarily the United Arab Emirates, Saudi Arabia, Qatar, Bahrain, and Egypt over the next 10 years are estimated at $7 billion, with a 20-year potential of almost $15 billion. Annual U.S. district cooling sales are projected to grow from $42 million in 2005 to nearly $200 million by 2015.

Obstacles to U.S. companies in these foreign markets include lack of protection for intellectual property, particularly in India and China, and demands for unconditional guarantees on letters of credit – and, in some cases, no cap on economic losses in contract guarantees. Additionally, for many smaller district energy equipment and service providers, unfamiliarity with foreign markets and exporting in general prevent these companies from taking advantage of opportunities abroad.

China and India present significant opportunities for trade, particularly as they are experiencing rapid growth of their manufacturing sector and energy infrastructures. EU pressure on member countries to reduce energy intensity and greenhouse gas emissions represents additional market opportunities for U.S. energy efficiency technologies manufacturers.

Although several U.S. energy service companies, such as Rockwell Automation, Honeywell, and Johnson Controls, have established footholds in these markets, they are often impaired by an abundance of cheap domestically manufactured options despite those products performing far below more expensive offerings by these U.S. firms. A distinction in the HS codes for exports of energy efficiency products would facilitate trade negotiation requests for reductions in import tariffs that may assist in mitigating this dilemma. Intellectual property rights protections, domestic content requirements, and demands for unconditional guarantees on letters of credit are also barriers to trade. Development of the ISO 50001 energy management standards and efforts by the DOE-ITP's and Commerce's MEP programs to introduce industrial energy assessments into these markets, are ways of overcoming insufficient awareness that may lead to increased demand for energy efficiency technologies.

Power Transmission and Distribution and Smart Grid

Currently, the U.S. transmission system is an interconnected network with more than 150,000 miles of high-voltage transmission lines. The goal of the Obama Administration is to use a combination of existing and emerging technology as well as policy to incorporate an information and communication technology (ICT) overlay into the existing grid. The Administration aims to expand smart grid pilot projects and commercialization under the ARRA Smart Grid Investment Program and Smart Grid Demonstration Program, which will modernize the electricity grid, making it more efficient, secure, and reliable. Many of the smart grid technologies already have been developed, as the majority of smart grid components are sourced from the ICT sector. However, the standardization of these technologies is of key importance to ensure that the various components of the smart grid system are interoperable. The standardization of these

technologies will further advance U.S. international industrial competitiveness and trade of smart grid technologies. As a component of the ARRA smart grid program, NIST has collaborated with industry to develop a framework for smart grid standards. Under the Market Development Cooperator Program, ITA is supporting the National Electrical Manufacturers Association (NEMA) as it embarks on the "Development of a North American Smart Grid," which aims to ensure that smart grid development among the NAFTA countries proceeds in a structured and compatible manner.

ATTACHMENT 1

ENERGY INDUSTRY NAICS CODE

Product/Service Name	**NAICS Codes**
Petroleum and Natural Gas Extraction	211111
Natural Gas Liquid Extraction (pt)	211112
Bituminous Coal & Lignite Surface Mining	212111
Bituminous Coal Underground Mining	212112
Anthracite Mining	212113
Support Activities for Coal Mining	213113
Drilling Oil and Gas Wells	213111
Oil and Gas Distribution Systems	221210
Manufacturing Industrial Organic & Inorganic Gases	225120
Other Renewable Power Drilling, Tapping, & Capping	235810
Hydroelectric Plant Development & Construction	234990
Refining Petroleum (fractionation, distillation or cracking)	324110
Petroleum Lubricating Oil and Grease Manufacturing	324191
All Other Petroleum and Coal Product Manufacturing (pt)	324199
Mining and Oil & Gas Field Machinery Manufacturing	333131
Oil & Gas Field Machinery and Equipment Manufacturing	333132
Solar Power Chip Manufacturing	334413
Solar Power Heating Equipment	334140
Solar Power Wholesaling Plumbing Equipment	421720
Solar Power Wholesaling Roofing	421330
Solar Power Wholesaling Electronic Parts & Equip.	421690
Nuclear fuels, inorganic, manufacturing	325188
Nuclear Reactor Containment Structure	234930
Nuclear Reactor Steam Supply System Manufacturing	332410
Nuclear Reactor Manufacturing	332410
Nuclear Instrument Modules Manufacturing	334519
Combustion Engineering Contractors	541330
Geophysical Surveying & Mapping Services	541360
Combustors, Non-hazardous Solid Waste	562213
Fuel Cells (technology requires revised NAIC code)	
Distribution of electric power	221122
Electric light and power plant (except hydroelectric) construction	237130
Electric power control	221121
Electric power control panel and outlet installation	238210
Electric power distribution systems	221122
Electric power generation, (except fossil fuel, hydroelectric, nuclear)	221119
Electric power generation, fossil fuel (e.g., coal, oil, gas)	221112
Electric power generation, hydroelectric	221111
Electric power generation, nuclear	221113
Electric power generation (solar, tidal, wind)	221119

Electric power transmission line and tower construction	237130
Electric power transmission systems	221121
Electrical power measuring equipment manufacturing	334515
Panelboards, electric power distribution, merchant wholesalers	423610
Power generation, electric (except fossil fuel, hydroelectric, nonhazardous solid waste, nuclear)	221119
Power generation, fossil fuel (e.g., coal, gas, oil), electric	221112
Power generation, nonhazardous solid waste combustor or incinerator electric	562213
Power measuring equipment, electrical, manufacturing	334515
Power transformers, electric, manufacturing	335311
Power transmission equipment, electrical, merchant wholesalers	423610
Substation transformers, electric power distribution, manufacturing	335311
Transformer station and substation, electric power, construction	237130
Transformers, electric power, manufacturing	335311
Transmission of electric power	221121
Utility line (i.e., communication, electric power), construction	237130
Voltage regulating transformers, electric power, manufacturing	335311
Wind generated electrical power regulation	926130
Windmills, electric power, generation-type, manufacturing	333611

Renewable Energy NAIC Codes

Wind

Fabricated Structural Metal Manufacturing	332312
All Other Plastics Product Manufacturing	326199
Speed Changer, Industrial	333612
Electronic Equipment and Components, NEC	335999
Power Transmission Equipment	333613
Iron Foundries	331511
Measuring and Controlling Devices	334519
Motors and Generators	335312
Industrial and Commercial fans and blowers	333412
Printed circuits and electronics assemblies	334418

Solar

Electronic Equipment and Components, NEC	335999
Current-Carrying Wiring Device Manufacturing	335931
Plastics Material and Resin Manufacturing	325211
Unlaminated Plastics Film and Sheet (Except Packaging)	326113
Instrument Manufacturing for Measuring and Testing	334515
Sheet Metal Work Manufacturing	332322
Switchgear and Switchboard Apparatus Manufacturing	335313

Geothermal

Industrial and Commercial fans and blowers	333412
Iron and Steel Pipe and Tube Manufacturing	331210
Power Boiler and Heat Exchanger Manufacturing	332410
Overhead Traveling Crane, Hoist, and Monorail System	333923
Air-Conditioning and Warm Air Heating Equipment	333415
Pump and Pumping Equipment Manufacturing	333911
Air and Gas Compressor Manufacturing	333912
Metal Tank (Heavy Gauge) Manufacturing	332420

Biomass

Air Purification Equipment Manufacturing	333411
Power Boiler and Heat Exchanger Manufacturing	332410
Iron and Steel Pipe and Tube Manufacturing	331210
Conveyor and Conveying Equipment Manufacturing	333922
Industrial and Commercial fans and blowers	333412
Electronic Equipment and Components, NEC	335999
All Other Miscellaneous General Purpose Machinery	333999
Air-Conditioning and Warm Air Heating Equipment	333415
Switchgear and Switchboard Apparatus Manufacturing	335313
Metal Tank (Heavy Gauge) Manufacturing	332420
Instruments and Related Products Manufacturing	334513
Pump and Pumping Equipment Manufacturing	333911
Overhead Traveling Crane, Hoist, and Monorail System	333923
Scale and Balance (except Laboratory) Manufacturing	333997
Construction Machinery Manufacturing	333120
Fluid Power Cylinder and Actuator Manufacturing	333995
Air and Gas Compressor Manufacturing	333912
Power, Distribution, and Specialty Transformer Manufacturing	335311

ATTACHMENT 2
SUPPLEMENTAL TABLES

Fossil Fuels and Related Equipment Tables

Top 50 Oil and Gas Companies
PIW's Top 50: How The Firms Stack Up

2008 Rank	2007 Rank	PIW Index	Company	Country	State Ownership (%)*
1	1	29	Saudi Aramco	Saudi Arabia	100
2	2	33	NIOC	Iran	100
3	3	37	Exxon Mobil	US	
4	4	49	PDV	Venezuela	100
5	5	53	CNPC	China	100
6	6	55	BP	UK	
7	7	65	Royal Dutch Shell	UK/Netherlands	
8	8	87	ConocoPhillips	US	
9	9	90	Chevron	US	
9	10	90	Total	France	
11	11	92	Pemex	Mexico	100
12	14	101	KPC	Kuwait	100
13	12	103	Sonatrach	Algeria	100
14	13	109	Gazprom	Russia	50.0023
15	15	113	Petrobras	Brazil	32.2
16	16	123	Rosneft	Russia	75.16
17	18	127	Lukoil	Russia	
18	17	129	Petronas	Malaysia	100
19	18	135	Adnoc	UAE	100
20	21	141	Eni	Italy	30
21	20	152	NNPC	Nigeria	100
22	22	161	QP	Qatar	100
23	24	162	INOC†	Iraq	100
24	23	168	Libya NOC	Libya	100
25	25	173	Sinopec	China	75.84
26	27	175	EGPC	Egypt	100
27	26	184	StatoilHydro	Norway	65
28	28	188	Repsol YPF	Spain	
29	29	192	Surgutneftegas	Russia	
30	30	222	Pertamina	Indonesia	100
31	31	228	ONGC	India	74.14
32	32	236	Marathon	US	
33	32	258	PDO	Oman	60
34	34	265	EnCana	Canada	
35	34	266	Uzbekneftegas	Uzbekistan	100
36	36	269	Socar	Azerbaijan	100
37	43	279	TNK-BP‡	Russia	
38	39	295	Apache	US	
38	39	295	CNR	Canada	
40	37	297	SPC	Syria	100
41	50	300	Kazmunaigas	Kazakhstan	100
42	42	301	Devon Energy	US	

42	45	301	Hess	US	
44	41	302	Anadarko	US	
44	46	302	Occidental	US	
44	44	302	OMV	Austria	31.5
47	47	306	BG	UK	
48	48	314	CNOOC	China	66.41
49	52	317	Novatek	Russia	
50	38	325	Ecopetrol	Colombia	89.9

Source: Petroleum Intelligence Weekly, December 2009

Proven Crude Oil and Gas Reserves – Top Countries Ranked by Oil

Country	Oil reserves (billion barrels)	Gas reserves (trillion cubic feet)
Saudi Arabia*	266.71	258.47
Canada*	178.09	57.9
Iran	136.15	991.6
Iraq	115	111.94
Kuwait	104	63.36
Venezuela*	99.37	170.92
UAE	97.8	214.4
Russia	60	1,680
Libya	43.66	54.38
Nigeria*	36.22	184.16

Source: EIA World Proven Crude Oil and Natural Gas Reserves, January 2009
Oil and Gas Journal, January 2009
Note: (*) Denotes a top five supplier of crude oil to the United States
Note: Canada reserves include oil sands.

Leading Markets for U.S. Exports of Oil and Gas Equipment, January-October 2009
(NAICS 333132 – U.S. Domestic Exports, FAS Value)

Country	Exports (Thousand dollars)
Singapore	851,438
Brazil	715,436
Korea	493,191
UAE	488,863
United Kingdom	363,094
Mexico	336,600
Angola	321,902
China	310,561
Saudi Arabia	282,851

Russia	264,498
India	224,127
Nigeria	210,886
Venezuela	180,996
Colombia	175,958
Norway	164,166
Trinidad & Tobago	156,759
Egypt	151,063
Iraq	134,626
Canada	122,895
Algeria	117,202
Peru	112,457
All others	2,054,486
Total	**8,194,095**

Source: USITC Dataweb

Key Prospective Countries for Oil and Gas

Country	Oil reserves (billion barrels)	Gas reserves (trillion cubic feet)
Iraq	115.0	111.94
Russia	60	1,680
Libya	41.5	50
Kazakhstan	30	100
Nigeria	36.2	183.9
Brazil	12.18	-
Angola	9.0	-
Equatorial Guinea	1.1	-
Turkmenistan	.6	100

Source: EIA World Proved Crude Oil and Natural Gas Reserves, January 2008

Largest Coal Producing Countries, (in metric tons)

China	2761	Indonesia	246
USA	1007	South Africa	236
India	490	Kazakhstan	104
Australia	325	Poland	84
Russia	247	Colombia	79

Source: World Coal Institute, 2008 data

Percentage of Coal Use for Electricity Generation

South Africa	94%		India	68%
Poland	93%		Czech Republic	62%
China	81%		Morocco	57%
Australia	76%		USA	49%
Israel	71%		Germany	49%
Kazakhstan	70%			

Source: World Coal Institute, 2007 data

Top Coal Exporters (in metric tons)

Australia	252		USA	74
Indonesia	203		South Africa	62
Russia	101		China	47
Colombia	74			

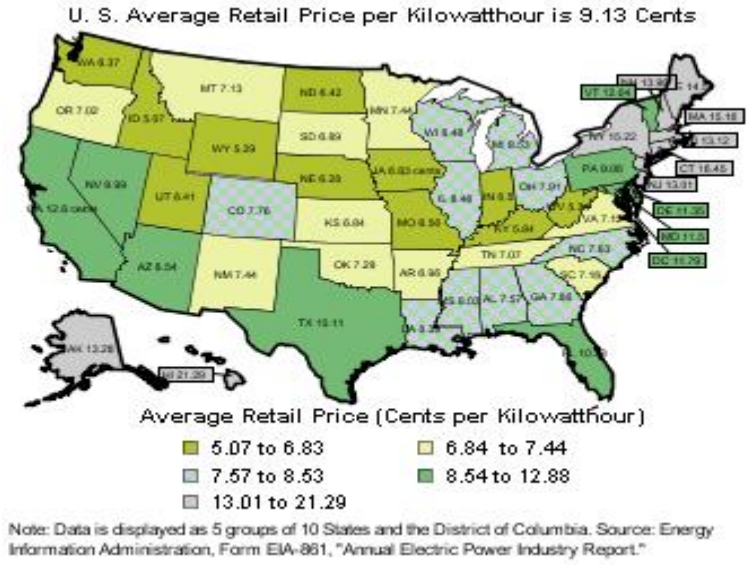
Source: World Coal Institute, 2008 data

Top Coal Importers (in metric tons)

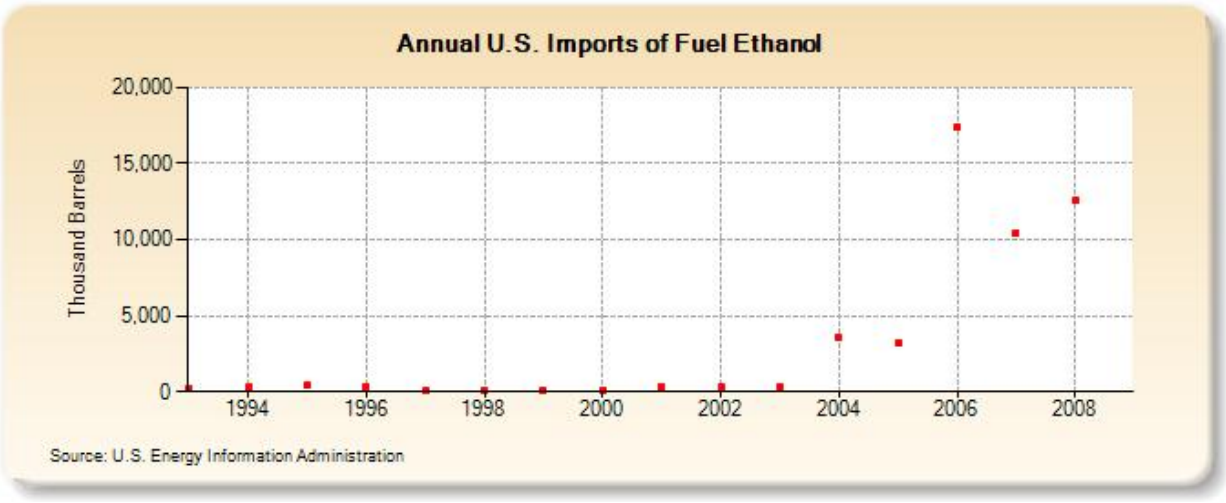
Japan	186		Germany	46
Korea	100		China	46
Taiwan	66		UK	44
India	60			

Source: World Coal Institute, 2008 data

U.S. Electricity Prices (2007)
Source: DOE-EIA



Fuel Ethanol



The five largest markets for each renewable energy technologies are listed below:

Largest Markets for Renewable Energy Technologies, 2008					
Rank	**Wind**	**Solar**	**Biomass**	**Geothermal**	**Small Hydro**

1	United States	Germany	United States	United States	China
2	Germany	Spain	Brazil	Philippines	Japan
3	Spain	Japan	Philippines	Indonesia	United States
4	China	United States	Germany	Mexico	Italy
5	India	South Korea	Sweden	Italy	Brazil
Source: U.S. Department of Energy, “Renewable Energy Data Book 2009”					