Key Investments in Greenhouse Gas Mitigation Technologies by Energy Firms, Other Industry and the Federal Government: An Update

Thomas Tanton
President, T^2 and Associates

With Support from
Michelle Michot Foss
(Chief Energy Economist and Head)
Dmitry Volkov
(Energy Analyst)

Center for Energy Economics,
Bureau of Economic Geology,
The University of Texas
www.beg.utexas.edu/energyecon

June 2009

T^2 & Associates
Energy Innovations Everywhere

Table of Contents

Undertaken for API

T² & Associates
Energy Innovations Everywhere

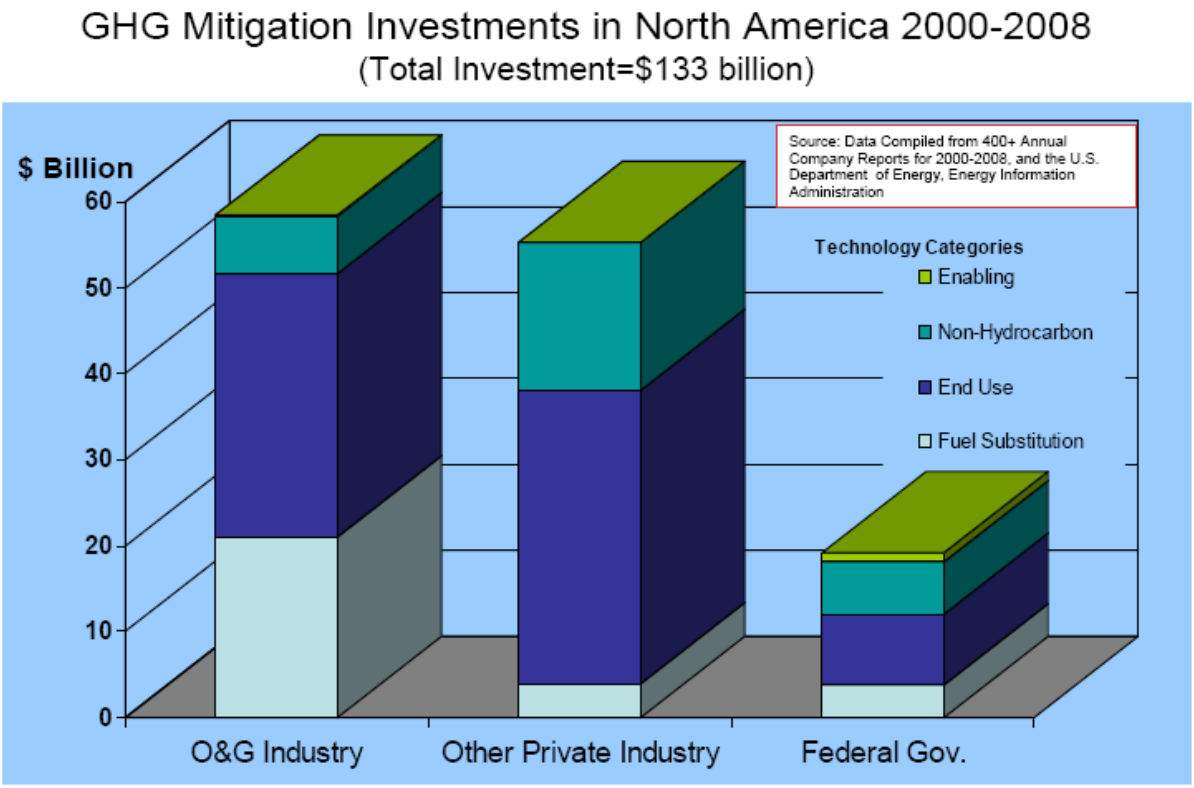
Bureau of Economic Geology, Jackson School of Geosciences
The University of Texas at Austin

Summary Results

Total North American investments in GHG mitigating technologies are estimated to have totaled $132.9 billion dollars between 2000 and 2008.[1] These investments were made by the U.S. based oil and gas industry, other U.S. based private sector industries and the Federal government. For each sector, Figure ES-1 summarizes these greenhouse gas mitigation investments by investor type and by technology category, over the 2000 to 2008 period.

- ***The U.S. based oil and gas industry invested an estimated $58.4 billion***
- ***Other U.S. based private industries invested an estimated $55.3 billion***
- ***The Federal Government invested an estimated $19.2 billion***

Figure ES-1



Fuel substitution technologies include liquefied natural gas (LNG), nuclear, and landfill gas.
End-use technologies include efficiency improvements, such as cogeneration (CHP), improved lighting, and carbon capture and storage (CCS).
Non-hydrocarbon technologies include any energy form that is not a hydrocarbon energy source, such as wind and solar.
Enabling technologies include various consortia that are researching and developing a wide variety of technologies, and include several university programs.

[1] "North American market" is used herein to include Canada and the U.S. Percentages may not add to 100% due to rounding.

Preface

Glossary of Terms

Alternative Fuel Vehicles and Advanced Technology Vehicles use both petroleum and nonpetroleum based fuels (or mixtures) or fuel-cell technologies.

Biomass uses plant materials, animal fats and wastes, or woody construction debris to produce energy.

Biorefineries produce a broad slate of products from plant materials and/or animal fats. *Biodiesel* is an increasingly important sub-group of this technology. Biodiesel is produced by chemically altering plant oils (e.g., soybean oil) and/or animal fats into diesel fuel substitutes. The term generally refers ONLY to diesel substitutes produced from vegetable oils and/or animal fats. However, we do include other bio-derivatives including those produced as refinery products, such as certain higher alcohols and alkanes.

Carbon Capture and Storage (CCS) is the capture and long term storage of carbon dioxide emissions from combustion processes.

Cogeneration, or combined heat and power (CHP), is the simultaneous production of both electricity and thermal energy (steam, hot water, hot air).

Ethanol is currently produced by the fermentation of various sugars, primarily from corn and sugar cane. Sugar cane is not a significant source in the North American market. Technologies to produce ethanol from cellulose are in the development stage.

Gasification is a thermal process for converting solid materials (e.g. biomass, coal or petroleum coke) into a synthetic gas. The gas may be used directly, or converted to hydrogen or liquid fuels.

Gas Flaring occurs when crude oil is extracted from the earth and natural gas associated with the oil is produced to the surface as well. In areas of the world lacking infrastructure and markets, this associated gas is usually flared (burned) or sometimes vented (emitted as un-burnt gas).

Liquefied natural gas (LNG) is natural gas that has been super-cooled to a liquid for transport. This dramatically reduces the volume for cost-effective transport over longer distances.

Landfill gas (LFG) is methane that is produced anaerobically in landfills from the decomposition of waste material.

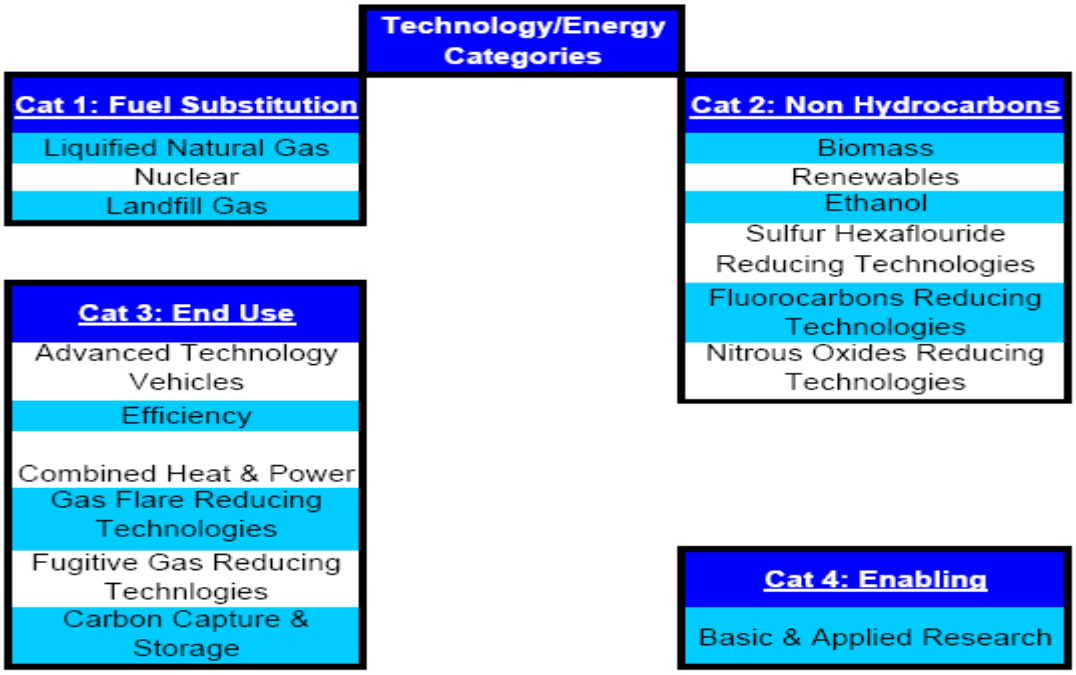
SF6 is sulfur hexafluoride. It is used in the electrical industry as a dielectric and within the magnesium production industry. It is a potent greenhouse gas.

Fluorocarbons are various chemicals used as either refrigerants or industrial cleaning agents. Several of them are potent greenhouse gasses, while others can deplete ozone. Industry continues to develop substitutes for those fluorocarbons.

Nitrous Oxides (N_2O) are produced by both biogenic and anthropogenic sources. Primary anthropogenic sources of N_2O are agricultural practices related to the use of fertilizer. Nitrous oxide is also produced naturally from a wide variety of biological sources in soil and water, particularly microbial action in wet tropical forests. In agriculture, it can be reduced through improved farming practices, such as low-tillage.

A *Disruptive Technology* is a new technological innovation, product, or service that overturns the existing dominant technology in the market, despite the fact that the disruptive technology is radically different from the leading technology and requires fundamental infrastructure and support changes.

Categorization of GHG Mitigating Technologies



Global Warming Potential of Greenhouse Gases

Each greenhouse gas has a different impact or "global warming potential" that is measured relative to carbon dioxide (CO_2). The gasses that are included within this analysis have the following global warming potentials[2]:

- Carbon Dioxide (CO2) 1
- Methane (CH_4) 21
- Nitrous Oxide (N_2O) 320
- Halogenated Fluorocarbons 1,700*
- Fluorocarbons 8,500*
- Sulfur Hexafluoride (SF_6) 23,900

Actual value depends on specific chemical within a class

Note to Readers: Throughout this report, investments are given in rounded dollar amounts and in rounded percentages. Using one of the presented numbers to derive the other, for a given investment, will not necessarily provide the same precise figure.

[2] U.S. Environmental Protection Agency, *Inventory Of U.S. Greenhouse Gas Emissions And Sinks: 1990 – 2000*, EPA 430-R-02-003 APRIL 2002; http://www.epa.gov/climatechange/emissions/downloads06/02CR.pdf

Introduction

This report documents the investments made in GHG mitigation technologies in North America during the period 2000 through 2008.[3] Investments are reported for the private sector and the Federal government and by technology/energy category. The data were compiled from a review of over 420 company annual reports, federal budget documents, and other public sources.[4] It should be noted that most of the investments have benefits in addition to any ability to reduce greenhouse gas emissions, and were made for multiple reasons including to increase and/or diversify energy supplies, or to improve efficiency.

Climate change has garnered the ever increasing attention of scientists, government officials, the media and public over the last decade. As climate policy in the U.S. continues to develop, it is important to understand how current and emerging greenhouse gas (GHG) mitigation technologies are being employed today by major stakeholders to reduce GHG emissions.

Greenhouse gas emissions can be reduced by a variety of measures, such as improving energy efficiency and developing alternative energy sources, like wind and solar power. Another way to reduce atmospheric emissions is to capture the CO_2 that is released from, say, fossil fuel-fired power plants and store it underground, referred to as carbon capture and storage (CCS). This is the focus of significant and increased attention, as power generation accounts for about one-third of CO_2 emissions from fossil fuel use. As well, oil and gas companies are reducing natural gas flaring and fugitive emissions to curb releases of methane, a potent greenhouse gas, while at the same time adding to energy supplies through various substitute fuels. The GHG mitigating technologies examined in this report were placed into four categories: fuel substitution, nonhydrocarbon, end-use and enabling technologies as laid out in the organizational chart on page iii.

Note that this report does not attempt to document or assess so-called "disruptive" energy technologies that have the potential for significantly altering energy production, distribution and use in the U.S. and worldwide. Disruptive technologies include nanotechnology and advanced materials that have the potential to be used for superconducting "smart grids" to vastly improve electricity transmission; for reducing weight while maintaining or increasing vehicle safety; or for reducing friction and improving energy efficiency for both air and ground modes of transportation.[5]

---

[3] No claim is made to have captured 100% of investments in each technology or for each GHG, but the authors believe that further refinements to the database would change the relative distributions only at the margin.

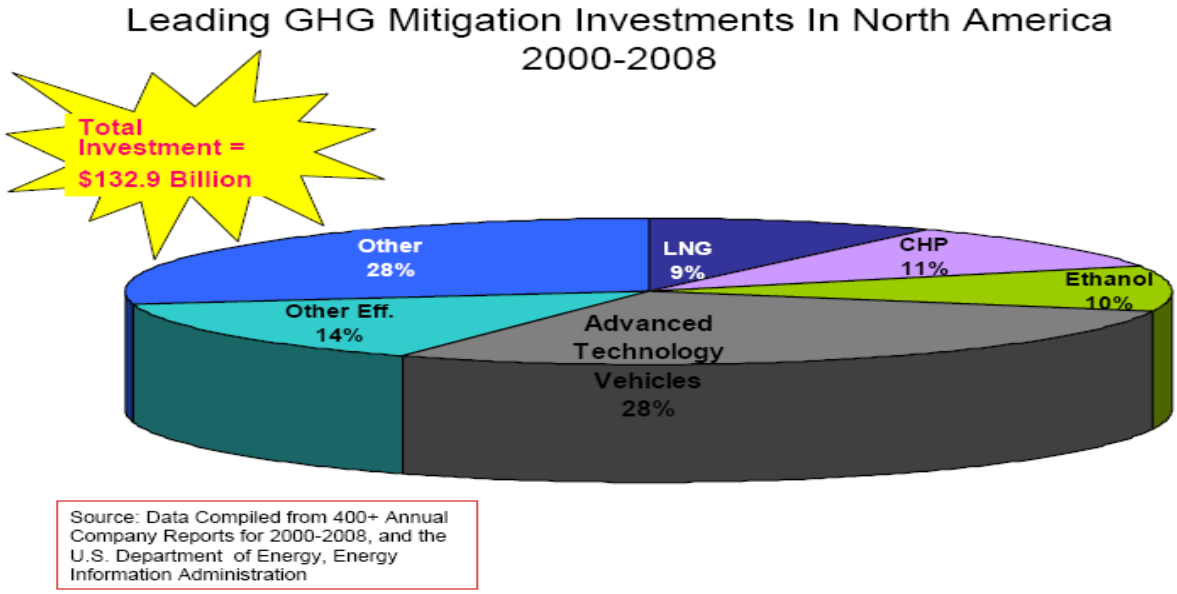
[4] See bibliography for a list of data sources used in this study. Not all company reports reviewed provided data for the analysis undertaken in this report.

[5] This report also does not include investments made by individual consumers (e.g. for more efficient appliances or hybrid and flexible fuel vehicles), tax shift and tax policies by the government intended to encourage specific technologies, nor monies paid in various legal settlements. Finally, many of the project investments were made by partnerships and/or joint ventures. While all reasonable efforts were made to allocate those project

Five Leading Technology Investments

The five leading emission mitigation technologies for private and public sector investment (***Figure 1***), as measured by expenditure share, are: advanced technology vehicles 28 percent ($37.2 billion); other efficiency 14 percent ($18.6 billion)[6]; combined heat and power (CHP) 11 percent ($14.6 billion); ethanol 10 percent ($13.3 billion), and liquefied natural gas (LNG) 9 percent ($12.0 billion).[7] These top five technologies commanded 72 percent of the estimated total investments, or $95.7 billion over the 2000 – 2008 period in the North American market. All other technologies combined comprised 28 percent of the estimated total investments.[8]

Figure 1



The investments included in this analysis mitigate greenhouse gas emissions in a variety of ways.

- Improving efficiency lowers energy use thereby decreasing GHG emissions.
- CHP – also called cogeneration or combined heat and power – saves energy through the simultaneous production of both electricity and thermal energy (steam, hot water, or hot air). According to the *EPA*[9], CHP improves energy efficiency by as much as 55 percent.

---

expenditures to the entities involved, this was not always possible. In those instances, project level expenditures were assigned to the lead sponsor and the corresponding sector.

[6] "Efficiency" comprises all 'other' efficiency technologies except for combined heat and power (CHP) and vehicle efficiency, such as improved lighting, heating ventilation and air conditioning, etc.

[7] Includes investments in North American LNG regasification facilities only and does not cover investments outside of North America in liquefaction facilities or ships. Some of the investments in LNG regasification previously identified in the May 2008 report were committed to previously but were actually spent in 2007 or 2008. We did not change the amounts allocated to different time periods for purposes of this table to avoid confusion with the prior report.

[8] Percentages may not add to 100% due to rounding.

[9] http://www.epa.gov/CHP/basic/efficiency.html

- LNG – liquefied natural gas – increases the availability of natural gas. The combustion of natural gas emits almost 45 percent less carbon dioxide than coal.
- Many renewables, such as solar and geothermal, provide electricity with no or significantly less greenhouse gas emissions than through the combustion of hydrocarbon fuels.
- Reduced fugitive gas emissions – covering mainly methane emissions from oil and gas production, and emissions associated with pipeline transmission and local distribution to customers. These reductions not only reduce methane emissions into the atmosphere but also increase the supply of lower-carbon natural gas.
- Nuclear energy provides electricity with no greenhouse gas emissions during the generation process.

All major forecasts of U.S. and global energy supply, including outlooks developed for the United States by the U.S. Department of Energy's Energy Information Administration (EIA) and for the world by both the EIA and the International Energy Agency (Organization for Economic Co-Operation and Development), continue to place carbon-based fuels in the forefront for supplying the world's energy needs at least over the next several decades. Emerging technologies, such as carbon capture and storage, to mitigate emissions from future fossil fuel use, combined with increased use of commercially viable nonhydrocarbon and GHG mitigating end-use technologies will be crucial to addressing the climate issue going forward.

The EIA has recently reported that U.S. carbon dioxide emissions from fossil fuels use decreased by 2.8% in 2008, from 5.967 million metric tons (MMT) of carbon dioxide in 2007 to 5.802 MMT in 2008. Growth in GDP in 2008 was 1.1% while energy demand declined by 2.2% indicating that the energy intensity of the economy (energy use per unit of GDP) fell by 3.3% in 2008. Carbon dioxide intensity (carbon dioxide emissions per unit of GDP) improved by roughly 3.8% in 2008.[10]

Major factors that likely contributed to the emissions decrease in 2008 included the decline in economic activity and high energy prices in 2008. A share of the GHG mitigation investments catalogued in this report likely delivered greenhouse gas mitigation benefits as well.

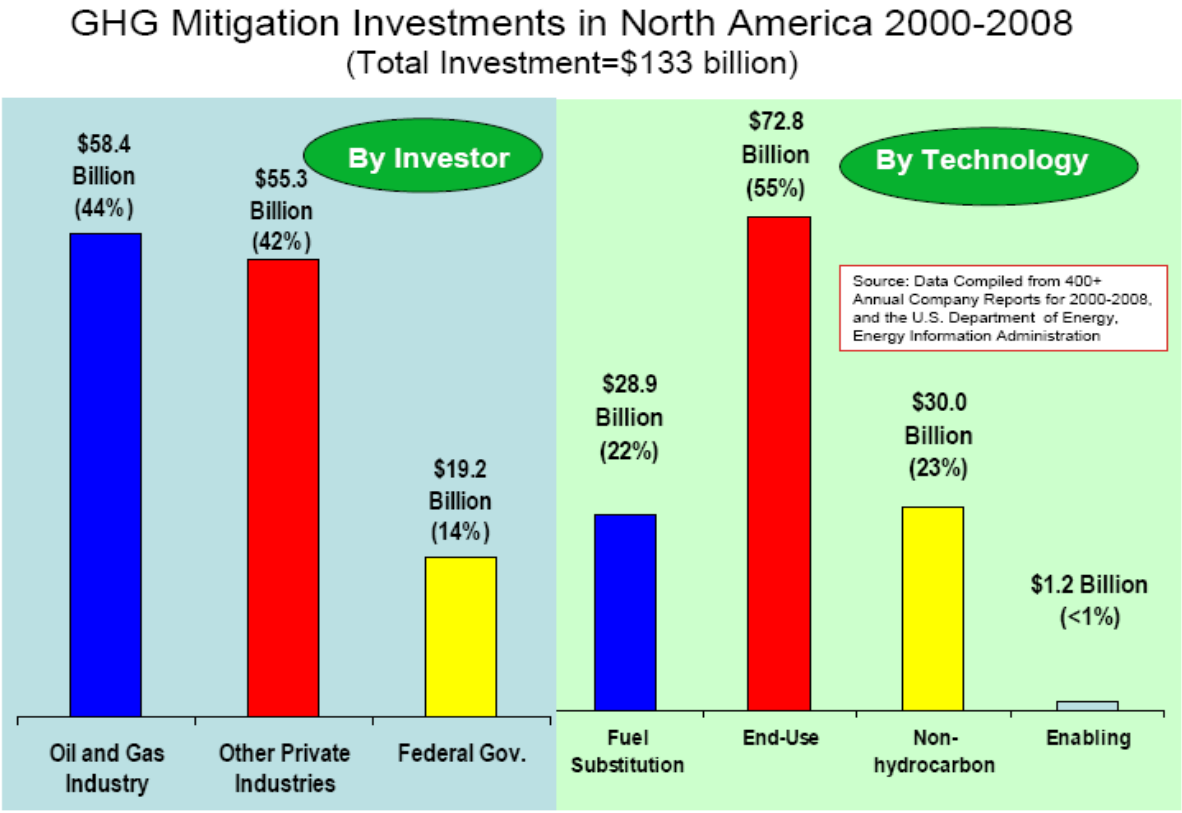
Greenhouse Gas Mitigation Technology Investments

U.S. based companies[11] and the Federal government invested approximately $132.9 billion from 2000 to 2008 on greenhouse gas mitigating technologies in the North American market. The U.S. based oil and gas industry invested $58.4 billion, 44 percent of the $132.9 billion total, in end-use, fuel substitution, non-hydrocarbon technologies, and enabling technologies. Other private industries

[10] http://www.eia.doe.gov/oiaf/1605/flash/flash.html .
[11] U.S. based companies include both U.S. companies and foreign-owned companies operating in the U.S.

invested an estimated $55.3 billion or 42 percent of the total, predominantly in end-use and non-hydrocarbon technologies. During the same eight-year period, the Federal government invested in a wide array of greenhouse gas mitigation technologies, with expenditures of approximately $19.2 billion, or 14 percent of the total North American investment ***(Figure 2)***.[12]

Figure 2



Oil and Gas Industry Investments from 2000 to 2008

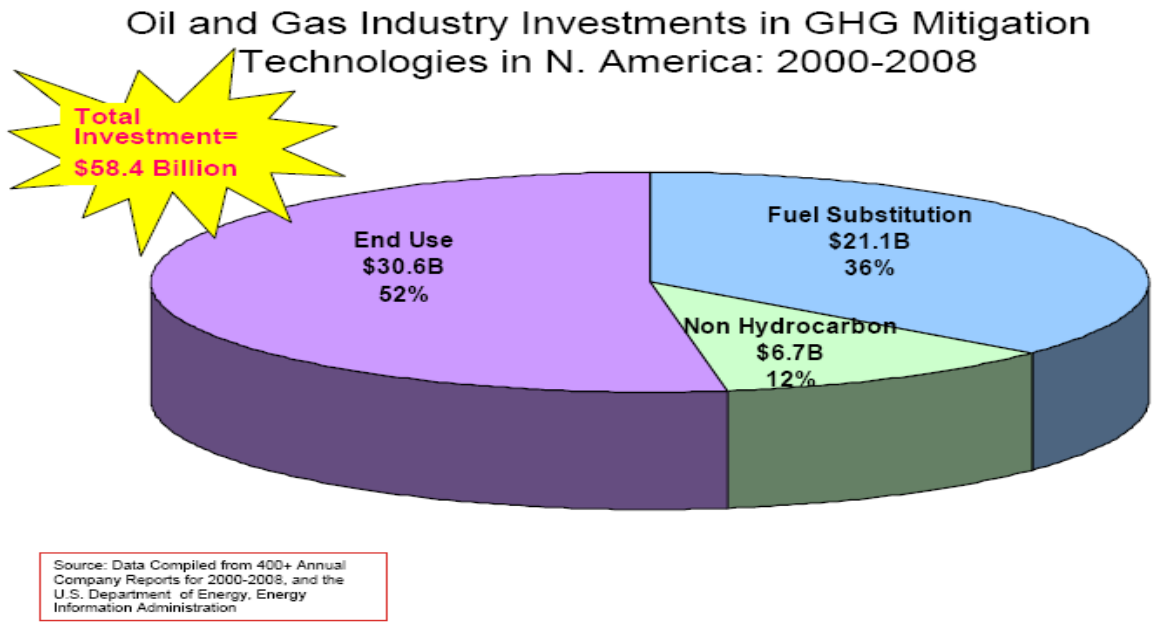
It is estimated that U.S. based oil and gas companies invested $58.4 billion from 2000 through 2008 in GHG mitigating technologies in the North American market.[13] (***Figure 3***) This expenditure represents 44 percent of the estimated total of $132.9 billion spent by U.S. companies and the Federal government. The oil and gas industry invested $30.6 billion (or 52 percent of its $58.4 billion sector total) for advanced end-use technologies, mostly for efficiency improvements through combined heat and power (cogeneration), carbon capture and storage[14] and for advanced technology for vehicles. Significantly, this $30.6 billion investment in end-use technologies represents 42 percent of the estimated total amount ($72.8 billion) spent by all U.S. companies and the Federal government in this technology category ***(Figure 6)***.

[12] State and local alternative-energy investment would add approximately $2 billion to this total on the public-sector side. http://www.dsireusa.org/
[13] "North American market" is used herein to include Canada and the U.S.
[14] Carbon Capture and Storage has been moved from "enabling" in the May 2008 Report to "end-use" here.

The second largest investment share made by the oil and gas industry, roughly 36 percent or $21.1 billion, was to develop substitute (and less carbon intensive) fuels, e.g., LNG, and to reduce methane fugitive emissions. This $21.1 billion investment in fuel substitution technologies represents 73 percent of the estimated $28.9 billion invested in total in this technology class ***(Figure 6)***. Fuel substitution can have significant impacts on greenhouse gas emission levels. For example, substituting natural gas for coal can reduce carbon dioxide emissions 45 percent per unit of energy delivered (and the mitigation improves even further when methane is captured and used, rather than released to the atmosphere). [15]

Publicly announced nonhydrocarbon investment by the U.S. based oil and gas industry in the North American market is estimated at just more than $6.7 billion over the 2000 – 2008 period, or about 12 percent of its industry total. Significantly, this represents 22 percent of the total industry and Federal government investments of approximately $30 billion in this technology class ***(Figure 6)***. The oil and gas industry's top investments are in wind and biofuels; expenditures were also made in solar, geothermal, and landfill digester gas.

Figure 3



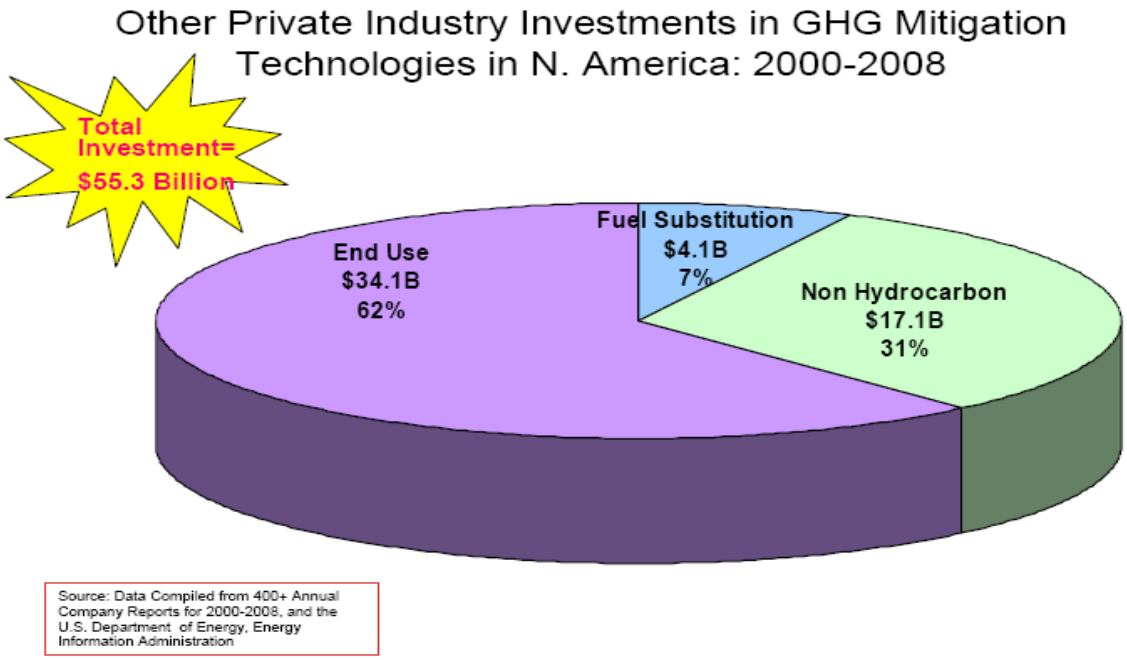
Other Private Industries and Federal Government Investments from 2000 to 2008

In addition to the oil and gas industry, other significant technology investments were made by the motor-vehicle industry, agricultural industry, electric utilities, and the renewable-fuels industry. These

[15] This investment in natural gas arguably should have included investments in unconventional gas, such as tight sands, but did not do so. As such, it is an underestimate.

other private industries are estimated to have invested $55.3 billion (or 42 percent of the $132.9 billion total) from 2000 to 2008 (***Figure 4***). Other private industries made significant investments in (1) the *end-use* market (mostly automotive companies investing in advanced-technology vehicles), and (2) the *non-hydrocarbon* market (mostly agricultural firms in the ethanol market, independent power producers in the electricity market, and manufacturing firms in the wind and solar markets).

Figure 4



Of the $55.3 billion sector total, $34.1 billion (62 percent) is associated with end-use technologies, $17.1 billion (31 percent) with non-hydrocarbons and $4.1 billion (7 percent) with fuel substitution technologies. (***Figure 4***). End-use technologies include advanced technology vehicles, efficiency improvements and combined heat and power. Non-hydrocarbons include industrial gas replacements (e.g. for SF_6), and renewables such as wind, and ethanol. Fuel substitution technologies included a significant proportion in landfill gas recovery. By technology class, other private industries' investment share was 47 percent of the end-use category, 58 percent of the non-hydrocarbon investment and 14 percent of the fuel substitution category (***Figure 6***).

The *Federal government* (***Figure 5***) has been the most diversified investor, supporting all sixteen technologies considered in this report. Total estimated expenditure in the years 2000-2008 of $19.2 billion has been spread between fuel substitution, non-hydrocarbons (primarily ethanol, wind, and solar) and end-use (primarily cogeneration and lighting technologies). Federal support for the "enabling" category, especially basic research, is significant.

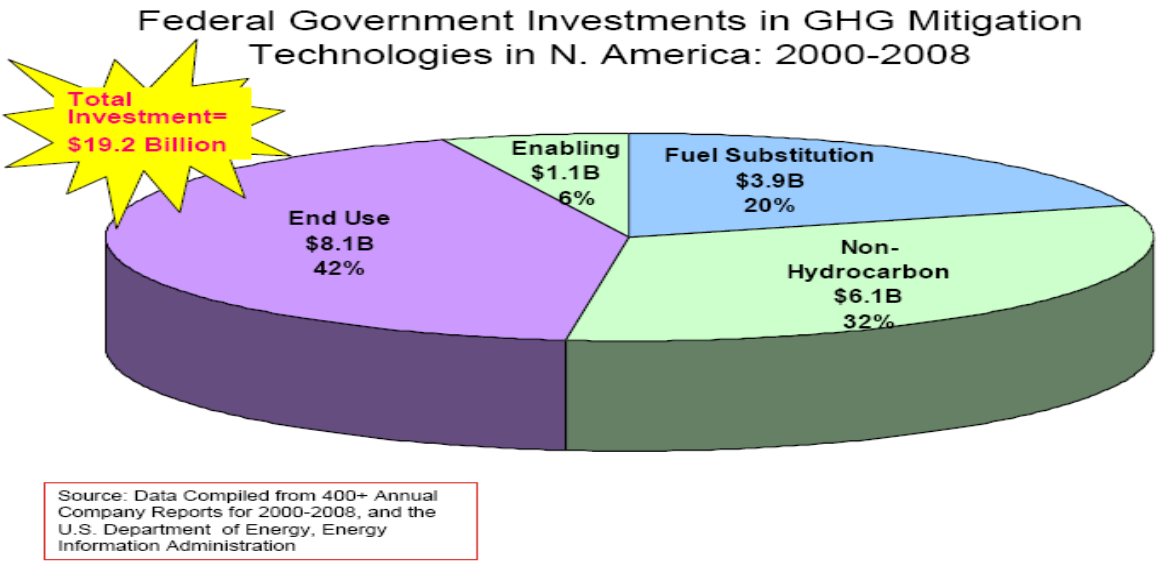
Forty-two percent of the Federal government investment is estimated to be in end-use technology, including more energy efficient lighting, combined heat and power and similar efficiency

improvements as seen in Figure 5. Thirty-two percent of the Federal government investment is in the nonhydrocarbon class (including ethanol and biodiesel), 20 percent in the fuel substitution class (such as landfill gas), and 6 percent fell into the enabling technology class.

While the level of investment is less than that of the private sector, early-stage development investments, particularly at the basic research stage, can leverage billions of dollars of later private investment. Federal investments are more evenly spread amongst the technology categories than for the industry sectors.

Federal tax transfers in the form of credits and similar techniques and international assistance were not included. A significant re-emphasis occurred in 2006/07 in Federal expenditures related to greenhouse gas mitigating technologies, with an increased Federal focus on cellulosic ethanol, solid state lighting and hydrogen storage.

Figure 5



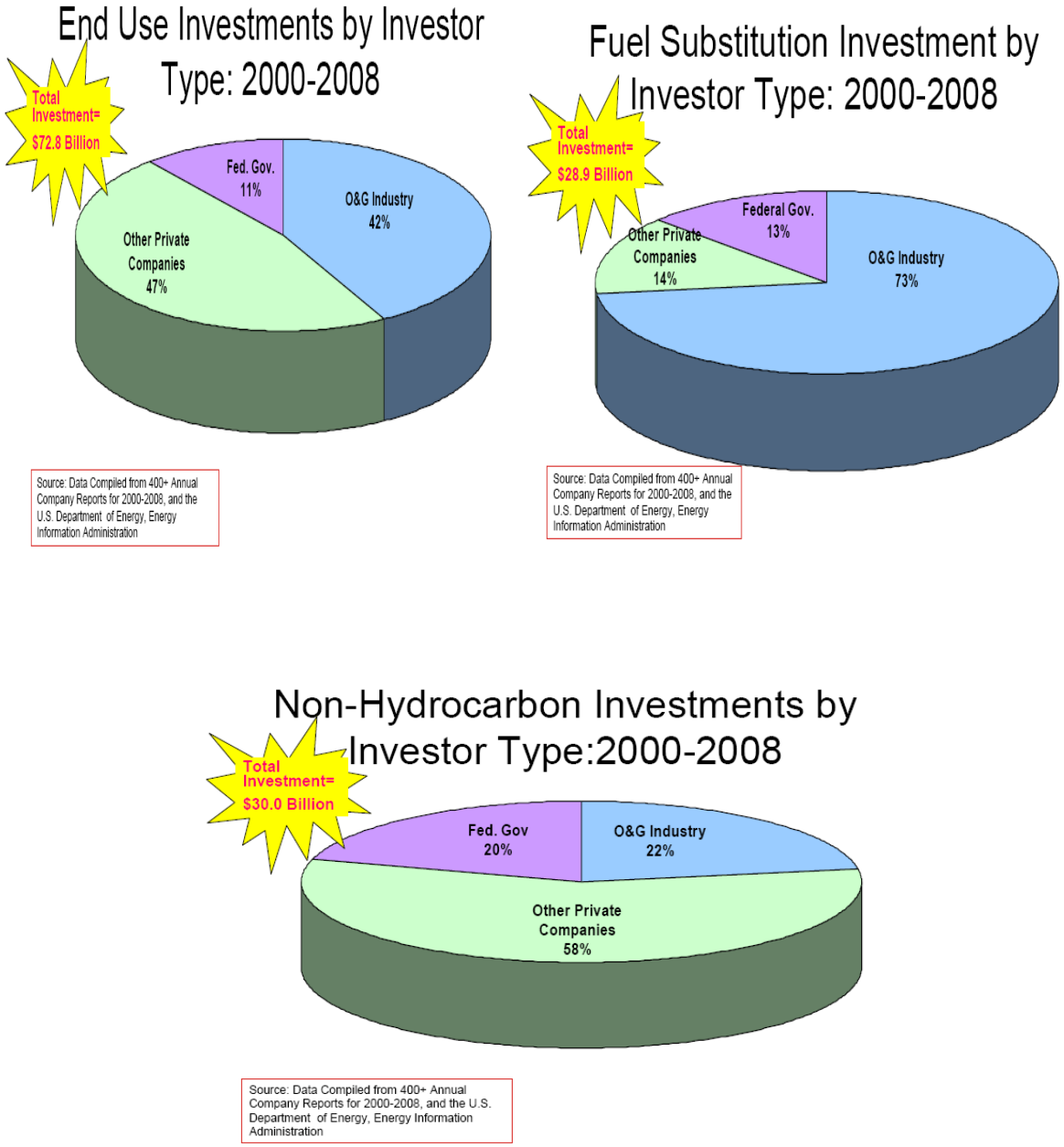
Finally, it is important to recognize that aggregate investment levels for each technology are, and should be, consistent with the development status of that technology. More mature technologies will naturally see higher levels of investment than technologies earlier in the development cycle. The technologies included here are at different stages in their development cycle as indicated in part by relative expenditures. The distribution of investments can be expected to shift as different technologies mature or market conditions change.

Technology Investments by Investor Types

Figure 6 shows for each technology category the investment shares by investor type. Within the end use category, other U.S. based industries invested an estimated 47 percent of the technology category. This includes significant investments by automotive companies investing in advanced-technology

vehicles, and coal companies investments in carbon capture and storage (CCS). U.S. based oil and gas industry invested approximately 42 percent of the $72.8 billion total investment in this technology category, principally in cogeneration, carbon capture and storage and advanced technology vehicles. Advanced batteries are an example of the advanced technology vehicle investments made by the U.S. based oil and gas industry. The Federal government invested approximately 11 percent in the end-use category, including investments in lighting technologies and advanced technology vehicles ***(Figure 6)***.

Figure 6



Other U.S. based private industry invested roughly 58 percent of the $30 billion non-hydrocarbon category total from 2000 to 2008. This includes independent power producers investing in renewables like wind and solar, and agricultural interests investing in ethanol production. The U.S. based oil and gas industry invested approximately 22 percent of the category total, including investments in renewables like wind and solar, as well as ethanol. The Federal government invested approximately 20 percent, spread among the renewables, ethanol and other technologies.

The U.S. based oil and gas industry invested approximately 73 percent of the fuel substitution category, with significant investments in liquefied natural gas (LNG). Other private companies accounted for roughly 14 percent, with a significant proportion in landfill gas recovery. The Federal government about 13 percent of this category, including investments in nuclear and landfill gas recovery.

Major Changes Since Last Report

Oil and gas companies, other private sector companies, and the Federal government continue to invest in greenhouse gas mitigating technologies in the North American market. Since the last report that covered investment from 2000-06[16], total investment in these technologies has increased by approximately $38.3 billion in 2007-08, or approximately 41 percent, from $94.5 billion to $132.9 billion. Significant growth has occurred in wind, biodiesel, nuclear and carbon capture and storage though investment in other technologies increased as well. Table 1 lists, by technology category[17], the investments made over the two time periods, and then gives the percentage increase in investments in the later period as a percent of the 2000-2006 period for the technology category.

Table 1
Comparison of 2000-2006 and 2007-2008 Investment Levels
All Investor Groups, $millions

Technology Category	2000-2006 Investment	2007-2008 Investment	Total 2000-2008 Investment	Percent growth in 2007-08 over 2000-06
Fuel Substitution	$13,818	$15,074	$28,892	109%
Non-Hydrocarbon	$18,623	$11,394	$30,017	61%
End Use	$61,506	$11,312	$72,818	18%
Enabling	$600	$562	$1,162	94%
Total	**$94,547**	**$38,342**	**$132,889**	41%

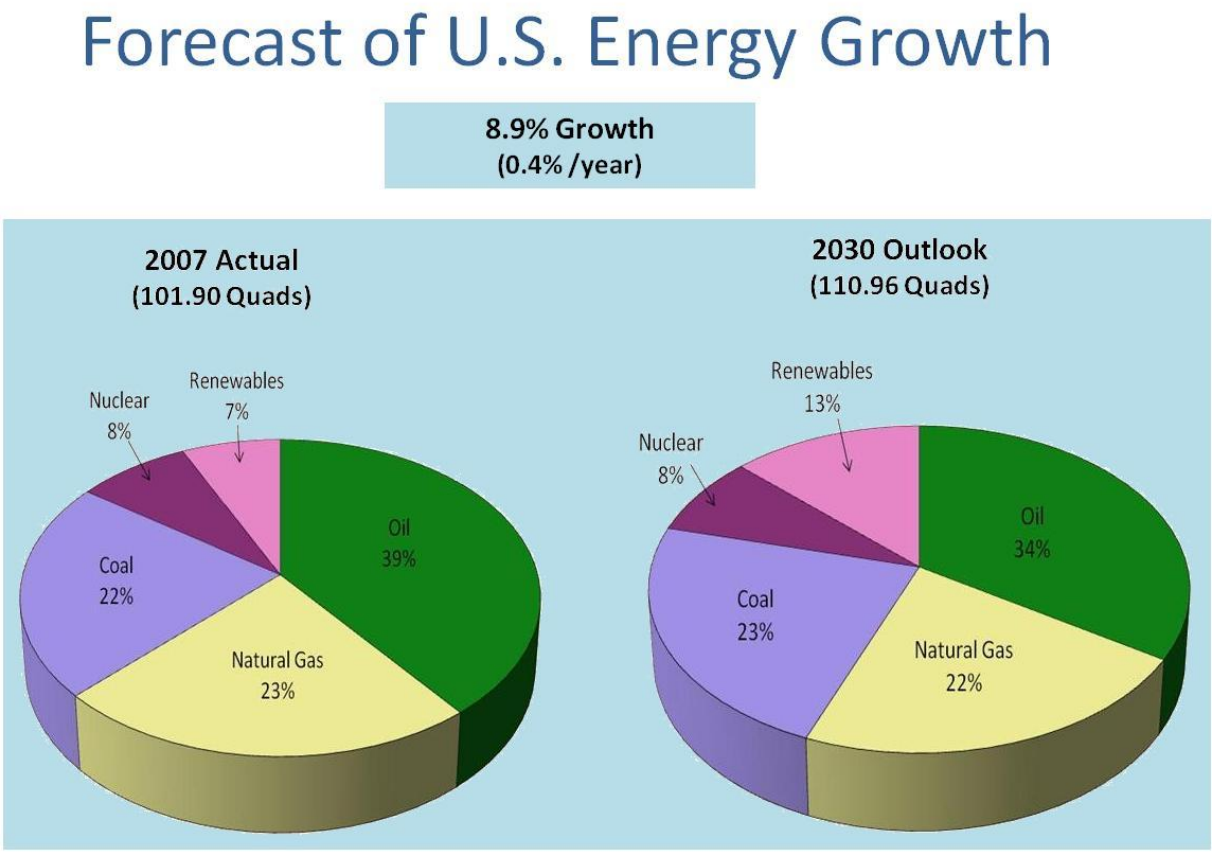
[16] Thomas Tanton, Foss, M., Volkov, D. *Key Investments in Greenhouse Gas Mitigation Technologies by Energy Firms, Other Industry and the Federal Government*, May 2008.
[17] See *Categorization of GHG Mitigating Technologies*, page iii, for individual technologies listed by category.

The Challenge of Emission Reductions in a World of Growing Energy Demand

Energy consumption in the United States is forecast by the Energy Information Administration (EIA), an agency of the U.S. Department of Energy, to increase approximately 9 percent over the 2007 to 2030 period, or about 0.4 percent annually. (***Figure 7***) This increase is projected *after* accounting for a predicted improvement in energy intensity (energy usage per real dollar of GDP).[18]

To meet the increased demand for energy, the EIA projects that hydrocarbons (crude oil and natural gas and their derivatives) will remain the mainstay of the U.S. energy sector at least over the next several decades. The market share of oil, natural gas, and coal is projected to be approximately 79 percent in 2030, moderately changed from 84 percent in 2007.[19]

Figure 7

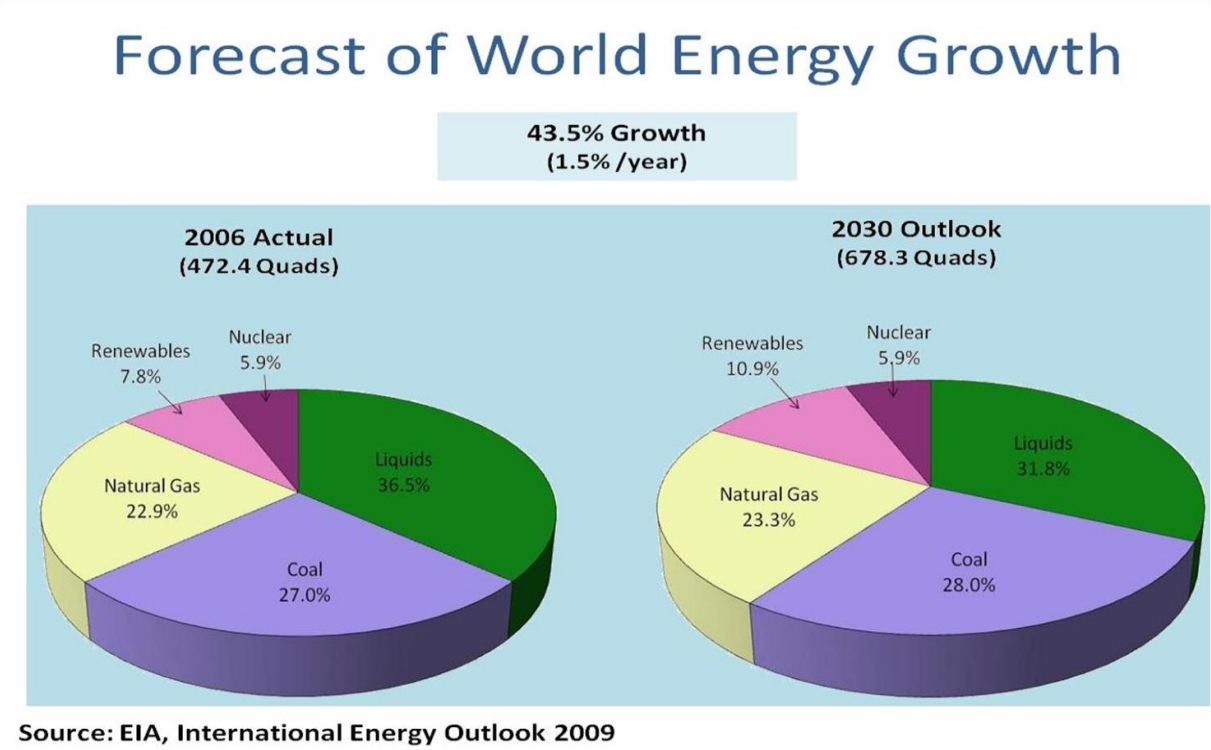


Source: EIA, An Updated Annual Energy Outlook 2009

[18] U.S. DOE, Energy Information Administration, *An Updated Annual Energy Outlook 2009 Reference*, SR/OIAF/2009-03, April 2009.
[19] Ibid.

Global energy consumption is projected to rise by approximately 44 percent over the 2006 to 2030 period, a roughly 1.5 percent annual increase led by developing countries, many of which are expected to significantly increase energy consumption due to rising per capita incomes and population growth.[20] Similar to the forecast for the U.S., fossil fuels are estimated to fill roughly 83 percent of the projected global primary energy demand in 2030.

Figure 8



Source: EIA, International Energy Outlook 2009

These projections of energy demand highlight the importance of continued economically viable investments leading to more efficient, and lower-GHG emitting technologies, as well as the development of efficient technology transfer programs to developing countries.

There has been significant progress in mitigation of U.S. GHG emissions although significant challenges remain going forward. U.S. carbon dioxide emissions from fossil fuels decreased by 2.8 percent in 2008, from 5,967 million metric tons of carbon dioxide (MMTCO2) in 2007 to 5,802 MMTCO2 in 2008, according to preliminary estimates released by the Energy Information Administration (EIA). This is the largest annual decline in energy-related carbon dioxide emissions since EIA began annual reporting on greenhouse gas emissions.[21]

[20] Energy Information Administration / International Energy Outlook 2009, Table A2.
[21] http://www.eia.doe.gov/neic/press/press318.html .

The decrease in U.S. anthropogenic carbon dioxide emissions in 2008 resulted primarily from two factors: record-high oil prices in the first half of 2008 and a decline in economic activity. A share of the GHG mitigation investments catalogued in this report likely delivered greenhouse gas mitigation benefits as well. Oil-related emissions declined by 6 percent, accounting for the bulk of overall reduction in energy related carbon dioxide emissions.

U.S. emissions of high-global warming potential gases, which totaled 176.9 $MMTCO_2e$ in 2007 (the latest year of data), were 5.6 $MMTCO_2e$ above the 2006 total. The increase resulted mainly from higher emissions levels for hydrofluorocarbons (HFCs, up by 4.1 $MMTCO_2e$) and perfluorocarbons (PFCs, up by 2.0 $MMTCO_2e$). Emissions of sulfur hexafluoride (SF_6) were down by 0.5 $MMTCO_2e$.

From 1990 to 2008, the carbon dioxide intensity of the U.S. economy—measured as metric tons carbon dioxide equivalent ($MTCO_2e$) emitted per million dollars of gross domestic product (GDP) — improved by 29.3 percent or 1.9 percent per year. From 1990 to 2007 (the latest year of data for all greenhouse gases), carbon dioxide intensity had fallen by 26.4 percent and emissions of total greenhouse gases per dollar of GDP had fallen by 28.0 percent.[22]

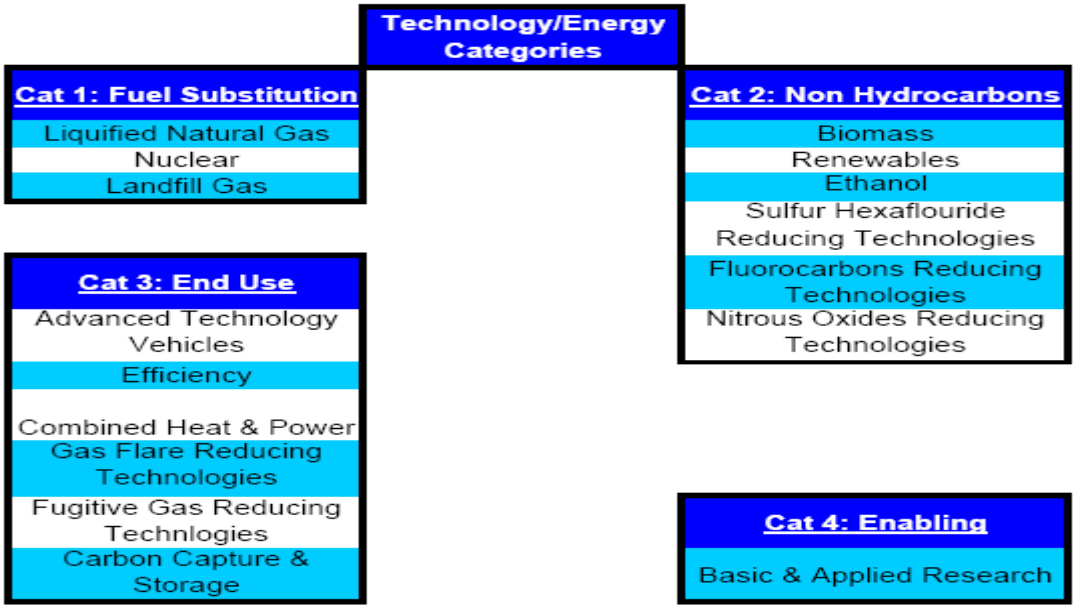
U.S. energy-related carbon dioxide emissions are projected to increase from 5,907 MMT CO2 in 2006 to 6,414 MMT CO2 in 2030, or at an average annual rate of 0.3 percent from 2006 to 2030.[23] Emissions from the non-OECD economies are projected to increase from 15,434 MMT CO2 in 2006 to 25,797 MMT CO2 by 2030, or at an average annual rate of 2.2 percent over the 2006 to 2030 period. As a result, the U.S. share of world carbon dioxide emissions is projected to fall from 20.3 percent in 2006 to 15.9 percent in 2030.[24]

[22] http://www.eia.doe.gov/neic/press/press318.html .
[23] Energy Information Administration / International Energy Outlook 2009, Table A10.
[24] Energy Information Administration / International Energy Outlook 2009, Table A10.

Greenhouse Gas Emission Mitigation Technologies

As stated above, a principal objective of this report is to identify key technologies and their associated investments that mitigate GHG emissions, or that have the potential to do so in the future. Sixteen major energy technologies have been identified in this study as actual or emerging/potential mitigation technologies. These technologies have been grouped into four categories (***Figure 9***): *fuel substitution*, (three technologies), *nonhydrocarbon* (six technologies), *end-use*[25] *(*six technologies*)*, and *enabling*. Biomass, within the non-hydrocarbon category, is further delineated into electricity and transportation applications, and ethanol is separated into corn and cellulosic ethanol. Sugar cane is not included here as it is not a major source in the North American market.

Figure 9
Categorization of GHG Mitigating Technologies



Category 1. "*Fuel substitution*" technologies include liquefied natural gas (LNG), nuclear, and landfill gas.

> *Liquefied natural gas* (LNG) is natural gas that has been super-cooled to a liquid. This dramatically reduces the volume for cost-effective transport in ships (where transport via conventional natural gas pipelines is cost prohibitive or not feasible). LNG as a transport mode opens up natural gas to become a much more broadly traded international commodity and increases the supply available to the U.S. [26] As a greenhouse gas emission reduction technology, LNG imports increase the supply of natural gas to the North American market that may substitute for coal, and to a lessor extent for petroleum fuels. The potential for greenhouse gas mitigation is determined, however, by the amount of gas-on-gas substitution versus gas-on-coal. Other incremental supplies of natural gas, such as from tight sands, arguably should have

[25] Carbon Capture and Storage has been moved from "enabling" in the May 2008 Report to "end-use" here.
[26] For more information on LNG, refer to the briefing papers and knowledge base incorporated in the CEE's online *Guide to LNG in North America*, www.beg.utexas.edu/lng.

been included in this analysis. Their exclusion leads the investment levels estimated here to be understated.

Nuclear is limited to the production of electricity and reduces the amount of coal or natural gas consumption for that purpose, and consequently the associated greenhouse gas emissions.

LFG is landfill gas (methane) produced by the anaerobic digestion of waste material. Historically, that methane was emitted into the atmosphere, but more recently has been collected and used to produce electricity or in transportation applications. There are 240 projects in the U.S. generating over 510 megawatts using captured landfill gas. LFG acts to reduce greenhouse gas emissions first by reducing the amount of methane released to the atmosphere, and secondarily by substituting for higher-carbon content fossil fuels such as coal and petroleum.

Category 2. "Non-hydrocarbon" technologies include any energy form that is not a hydrocarbon energy source. This category includes: wind energy conversion, solar to electric, geothermal (electric and direct use for industrial application), biomass and biorefinery, biodiesel, and ethanol production. Ethanol and biodiesel production were included in this category rather than in the fuel substitution category where they could have also arguably been placed. This category also includes technologies that facilitate reductions in Halogenated FluoroCarbons (HFC), Perflurocarbons and sulfur hexafluoride (SF_6).

Ethanol is currently produced by the fermentation of various sugars, primarily from corn and sugar cane. Significant fossil fuel use is involved in corn-based ethanol production both for growing the corn and in producing the ethanol. Most ethanol for fuel is produced in Brazil or the United States. Technological advances may allow ethanol production from cellulosic materials in the longer term. Greenhouse gas emissions benefits associated with corn based ethanol are likely to be marginal at best, and there is significant uncertainty surrounding greenhouse gas emissions benefits associated with cellulosic ethanol.

In particular, several recent scientific studies provide evidence challenging the conclusions of earlier studies regarding the net impact on greenhouse gases associated with biofuels, in particular, ethanol from sugar and starch. Fuel cycle analyses reported by various scientists[27] indicate that ethanol production leads to increases, not mitigation, of greenhouse gases. Fuel cycle analysis of biofuels is an area that needs further work to reduce the uncertainty surrounding the estimates.

Biomass projects also use plant or animal waste materials to produce energy either from direct combustion, through thermal gasification, or biologic treatment. Biomass gasification is included in biomass/biorefining, as a precursor to ultimate use, within the nonhydrocarbon group.

Bio-refineries produce a broad slate of products from plant materials, including energy and fuels, plastics, pharmaceuticals and animal feeds. Biodiesel is an increasingly important sub-group of this technology. Biodiesel is produced by chemically altering oils (e.g., soybean oil) into diesel fuel substitutes. Also included are other bio-derivatives including those produced as refinery products, such as certain alcohols and alkanes. Another sub-category of biologically derived petroleum substitutes are called biobased products (or bioproducts).

[27] Searchinger, T. et.al., *Use of U.S. Croplands for Biofuels Increases Greenhouse Gases Through Emissions from Land Use Change*, www.sciencexpress.org / 7 February 2008 / Page 1 and Crutzen, P. J., *N_2O Release From Agro-Biofuel Production Negates Global Warming Reduction By Replacing Fossil Fuels*, Atmos. Chem. Phys. Discuss., 7, 11191-11205, 2007.

Solar, wind and geothermal are electricity generation technologies that substitute for fossil-based generation technologies. Intermittent technologies like wind and solar may or may not reduce GHG emissions on net. Because wind and solar can be intermittent in their output, they often require other power plants on a grid to operate in less efficient modes of operation—termed ramping—which can result in reduced or no reductions in fuel use and GHG emissions.

Sulfur hexafluoride (SF_6) and Halogenated Fluorocarbons/Perflurocarbons are gases used in industrial applications and refrigeration. Various substitute gases have recently been developed to reduce those applications' greenhouse gas emissions, or their global warming potential. These gases substitute for other industrial and commercial gases, but are not "fuels" and not considered as fuel substitutes.

Nitrous Oxides (N_2O) are produced by both natural and human sources. Primary human-related sources of N_2O are agricultural soil management, animal manure management, sewage treatment, adipic acid production, and nitric acid production. Nitrous oxide is also produced naturally from a wide variety of biological sources in soil and water, particularly microbial action in wet tropical forests. Control mechanisms for human sources include improved tillage practices and fertilization techniques, and improved efficiency in manufacture of adipic acid and combustion.

Category 3. "*End-use*" technologies include stationary fuel-cell applications[28], transportation applications (fuel cell, electric hybrid, and flex-fuel vehicles, high efficiency gasoline and diesel engines), and cogeneration—regardless of fuel source. The extent of greenhouse gas mitigation from flexible fuel vehicles depends on the consumers' actual use of different fuels, and may be negligible. This category also includes investments made to improve thermodynamic efficiency. It further includes other efficiency measures such as reducing flaring and reducing fugitive emissions of methane.

Advanced-Technology Vehicles use both petroleum and non-petroleum based fuels (or mixtures), advanced batteries for hybrid vehicles or fuel-cell technologies. Automakers, engine manufacturers, and oil and gas companies are actively developing vehicle technologies and the advanced fuels of the future that will power them.

Cogeneration, or *combined heat and power* (CHP) is the simultaneous production of both electricity and thermal energy (steam, hot water, hot air). CHP is an important efficiency improvement compared to separate production of electricity and heat. These facilities range from very small units in commercial buildings to large units at petroleum refineries, and are captured separately from other efficiency improvements.

Efficiency measures include a whole range of technologies, from improved combustion burners, to advanced lighting, and improved process efficiencies, but does not include, for purposes of this report, combined heat and power.

Gas Flaring can occur when methane associated with crude oil production is combusted. In areas of the world lacking infrastructure and markets, this associated gas is usually flared (burned) or sometimes vented (emitted as un-burnt gas). Reducing this flared gas reduces greenhouse gas emissions of either CO_2 if the gas is burned, or of methane if the gas is vented.

Fugitive Gas Emissions can occur when methane, a potent greenhouse gas, is collected and transported, and certain amounts leak out to the atmosphere. Investments made to reduce

[28] Note that fuel cells as a technology are not separately listed, as they depend on a variety of fuels and can be used in a variety of applications, including transportation and combined heat and power. They are subsumed in the various categories where applicable.

fugitive emissions directly and indirectly reduce greenhouse gas emissions. Emissions may indirectly be reduced as lower carbon natural gas is added to the fuel supply.

Carbon Capture and Storage is the capture and long-term storage of carbon dioxide emissions from combustion processes.

Category 4. "Enabling Technologies" includes various consortia that are researching and developing a wide variety of technologies that were not delineated by specific technology due to lack of data availability. This includes the university programs supported by the private sector companies and federal government.

Methodology

This analysis was carried out in several steps. The first was an identification of major categories of emerging energy sources, and the associated technologies. Second, a database of investments was constructed by GHG mitigation technology category and by investor type. The database was compiled from a review of over 400 company annual reports, federal budget documents, and other public sources, beginning with the database constructed for the 2008 report, *Key Investments in Greenhouse Gas Mitigation Technologies by Energy Firms, Other Industry and the Federal Government*, May 2008 . If an investment amount for a relevant technology was specified in a source document it was included in the database. All investments were tabulated in nominal dollars. Third, each investment was reviewed to determine if it should remain in the database, be prorated, or otherwise adjusted from a global level to the North American market. For example, we identified three major types of investments for LNG: liquefaction, regasification facilities, and ships. We have only included investments in North American LNG regasification facilities. The global LNG market also includes investments in ships, and liquefaction facilities in foreign locations. Investments in ships and liquefaction facilities were not included in the data base as they, to a large extent, fall outside the area of the North American market.

Appendix A

Bibliography

(note: Some corporate names have changed during the period 2000-2007 due to mergers and/or acquisitions; current names are used below)

Amerada Hess Corporation; *Annual Report to Shareholders*; 2000
Amerada Hess Corporation; *Annual Report to Shareholders*; 2001
Amerada Hess Corporation; *Annual Report to Shareholders*; 2002
Amerada Hess Corporation; *Annual Report to Shareholders*; 2003
Amerada Hess Corporation; *Annual Report to Shareholders*; 2004
Amerada Hess Corporation; *Annual Report to Shareholders*; 2005
American Wind Energy Association*; http://www.awea.org/projects/*
Anadarko Petroleum, Inc. *Annual Report to Shareholders*; 2000
Anadarko Petroleum, Inc. *Annual Report to Shareholders*; 2001
Anadarko Petroleum, Inc. *Annual Report to Shareholders*; 2002
Anadarko Petroleum, Inc. *Annual Report to Shareholders*; 2002
Anadarko Petroleum, Inc. *Annual Report to Shareholders*; 2004
Anadarko Petroleum, Inc. *Annual Report to Shareholders*; 2005
Anadarko Petroleum, Inc. *Annual Report to Shareholders*; 2006
Anadarko Petroleum, Inc. *Annual Report to Shareholders*; 2007
Apache Corporation; *Annual Report to Shareholders*; 2000
Apache Corporation; *Annual Report to Shareholders*; 2001
Apache Corporation; *Annual Report to Shareholders*; 2002
Apache Corporation; *Annual Report to Shareholders*; 2003
Apache Corporation; *Annual Report to Shareholders*; 2004
BP America, Inc.; *Annual Report to Shareholders;* 2000
BP America, Inc.; *Annual Report to Shareholders;* 2001
BP America, Inc.; *Annual Report to Shareholders;* 2002
BP America, Inc.; *Annual Report to Shareholders;* 2003
BP America, Inc.; *Annual Report to Shareholders;* 2004
BP America, Inc.; *Annual Report to Shareholders;* 2005
BP America, Inc.; *Annual Report to Shareholders;* 2006
BP America, Inc.; *Annual Report to Shareholders;* 2007
BP America, Inc.; *Annual Report to Shareholders;* 2008
Burlington Resources Inc. *Annual Report to Shareholders;* 2000
Burlington Resources Inc. *Annual Report to Shareholders;* 2001
Burlington Resources Inc. *Annual Report to Shareholders;* 2002
Burlington Resources Inc. *Annual Report to Shareholders;* 2003
Burlington Resources Inc. *Annual Report to Shareholders;* 2004
Burlington Resources Inc. *Annual Report to Shareholders;* 2005
Canadian Association of Petroleum Producers;
http://www.capp.ca/raw.asp?x=1&dt=NTV&e=PDF&dn=34093
Chesapeake Energy Corporation; *Report to Shareholders;* 2000
Chesapeake Energy Corporation; *Report to Shareholders;* 2001
Chesapeake Energy Corporation; *Report to Shareholders;* 2002
Chesapeake Energy Corporation; *Report to Shareholders;* 2003
Chesapeake Energy Corporation; *Report to Shareholders;* 2004
Chevron Corporation; *Annual Report to Shareholders; 2000*
Chevron Corporation; *Annual Report to Shareholders; 2001*
Chevron Corporation; *Annual Report to Shareholders; 2002*

Chevron Corporation; *Annual Report to Shareholders; 2003*
Chevron Corporation; *Annual Report to Shareholders; 2004*
Chevron Corporation; *Annual Report to Shareholders; 2005*
Chevron Corporation; *Annual Report to Shareholders; 2006*
Chevron Corporation; *Annual Report to Shareholders; 2007*
Chevron Corporation; *Annual Report to Shareholders; 2008*
CITGO Petroleum Corporation *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2000*
CITGO Petroleum Corporation *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2001*
CITGO Petroleum Corporation *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2002*
CITGO Petroleum Corporation *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2003*
CITGO Petroleum Corporation *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2004*
CITGO Petroleum Corporation *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2005*
CITGO Petroleum Corporation *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2006*
CITGO Petroleum Corporation *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2007*
CITGO Petroleum Corporation *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2008*
ConocoPhillips Petroleum Company *Annual Report to Shareholders, 2000*
ConocoPhillips Petroleum Company *Annual Report to Shareholders, 2001*
ConocoPhillips Petroleum Company *Annual Report to Shareholders, 2002*
ConocoPhillips Petroleum Company *Annual Report to Shareholders, 2003*
ConocoPhillips Petroleum Company *Annual Report to Shareholders, 2004*
ConocoPhillips Petroleum Company *Annual Report to Shareholders, 2005*
ConocoPhillips Petroleum Company *Annual Report to Shareholders, 2006*
ConocoPhillips Petroleum Company *Annual Report to Shareholders, 2007*
ConocoPhillips Petroleum Company *Annual Report to Shareholders, 2008*
ConocoPhillips Petroleum Company; *Sustainable Development Report – Baseline;* 2004
ConocoPhillips Petroleum Company; *Sustainable Development Report – 2006*
DaimlerChrysler Group; *Annual Report to Shareholders*; 2000
DaimlerChrysler Group; *Annual Report to Shareholders*; 2001
DaimlerChrysler Group; *Annual Report to Shareholders*; 2002
DaimlerChrysler Group; *Annual Report to Shareholders*; 2003
DaimlerChrysler Group; *Annual Report to Shareholders*; 2004
DaimlerChrysler Group; *Annual Report to Shareholders*; 2005
DaimlerChrysler Group; *Annual Report to Shareholders*; 2006
DaimlerChrysler Group; *Annual Report to Shareholders*; 2007
DaimlerChrysler Group; *Annual Report to Shareholders*; 2008
Devon Energy Corporation *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2000*
Devon Energy Corporation *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2001*
Devon Energy Corporation *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2002*
Devon Energy Corporation *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2003*
Devon Energy Corporation *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2004*
Devon Energy Corporation *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2005*
Devon Energy Corporation *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2006*
Devon Energy Corporation *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2007*

Devon Energy Corporation *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2008*
Dominion Resources, Inc. *Annual Report to Shareholders;* 2003
El Paso Corporation *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2000*
El Paso Corporation *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2001*
El Paso Corporation *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2002*
El Paso Corporation *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2003*
El Paso Corporation *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2004*
Energy Information Administration / Annual Energy Outlook 2008
Energy Information Administration, Form EIA-886, "Annual Survey of Alternative Fueled Vehicles"
EOG Resources, Inc. *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2000*
EOG Resources, Inc. *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2001*
EOG Resources, Inc. *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2002*
EOG Resources, Inc. *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2003*
Equitable Resources, Inc. *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For The Fiscal Year Ended December 31, 2000*
Equitable Resources, Inc. *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For The Fiscal Year Ended December 31, 2001*
Equitable Resources, Inc. *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For The Fiscal Year Ended December 31, 2002*
Equitable Resources, Inc. *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For The Fiscal Year Ended December 31, 2003*
Equitable Resources, Inc. *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For The Fiscal Year Ended December 31, 2004*
Equitable Resources, Inc. *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For The Fiscal Year Ended December 31, 2005*
Exxon Mobil Corporation *Annual Report to Shareholders; 2000*
Exxon Mobil Corporation *Annual Report to Shareholders; 2001*
Exxon Mobil Corporation *Annual Report to Shareholders; 2002*
Exxon Mobil Corporation *Annual Report to Shareholders; 2003*
Exxon Mobil Corporation *Annual Report to Shareholders; 2004*
Exxon Mobil Corporation *Annual Report to Shareholders; 2005*
Exxon Mobil Corporation *Annual Report to Shareholders; 2006*
Exxon Mobil Corporation *Annual Report to Shareholders; 2007*
Exxon Mobil Corporation *Annual Report to Shareholders; 2008*
Ford Motor Company; Annual Report; 2000
Ford Motor Company; Annual Report; 2001
Ford Motor Company; Annual Report; 2002
Ford Motor Company; Annual Report; 2003
Ford Motor Company; Annual Report; 2004
Ford Motor Company; Annual Report; 2005
Ford Motor Company; Annual Report; 2006
Ford Motor Company; Annual Report; 2007
Ford Motor Company; Annual Report; 2008
Frazier, Barnes and Associates; http://www.agecon.uga.edu/~caed/biodieselrpt.pdf; 2003
General Motors Corp.; *Annual Shareholders Report*; 2000
General Motors Corp.; *Annual Shareholders Report*; 2001
General Motors Corp.; *Annual Shareholders Report*; 2002
General Motors Corp.; *Annual Shareholders Report*; 2003
General Motors Corp.; *Annual Shareholders Report*; 2004
General Motors Corp.; *Annual Shareholders Report*; 2005

General Motors Corp.; *Annual Shareholders Report*; 2006
General Motors Corp.; *Annual Shareholders Report*; 2007
General Motors Corp.; *Annual Shareholders Report*; 2008
Hess Corporation; *Annual Report to Shareholders*; 2006
Hess Corporation; *Annual Report to Shareholders*; 2007
Hess Corporation; *Annual Report to Shareholders*; 2008
Honda Corporation, North America; *North American Environmental Report*, 2005
Honda Corporation, North America; *North American Environmental Report*, 2006
Honda Corporation, North America; *North American Environmental Report*, 2007
Honda Corporation, North America; *North American Environmental Report*, 2008
http://209.85.165.104/search?q=cache:8_EmYPfUutYJ:sec.edgar-online.com/2006/02/23/0000950129-06-001722/Section5.asp+elk+hills+shale+percent24+million+capex&hl=en&ct=clnk&cd=6&gl=us
http://209.85.165.104/search?q=cache:8_EmYPfUutYJ:sec.edgar-online.com/2006/02/23/0000950129-06-001722/Section5.asp+elk+hills+shale+percent24+million+capex&hl=en&ct=clnk&cd=6&gl=us
http://209.85.165.104/search?q=cache:8_EmYPfUutYJ:sec.edgar-online.com/2006/02/23/0000950129-06-001722/Section5.asp+elk+hills+shale+%24+million+capex&hl=en&ct=clnk&cd=6&gl=us
http://209.85.165.104/search?q=cache:8_EmYPfUutYJ:sec.edgar-online.com/2006/02/23/0000950129-06-001722/Section5.asp+elk+hills+shale+%24+million+capex&hl=en&ct=clnk&cd=6&gl=us
http://209.85.215.104/search?q=cache:uB3-1gBvOJ0J:www.secinfo.com/d19YC9.u3Fe.htm+Coshoctan+Ethanol+percent24+million&hl=en&ct=clnk&cd=11&gl=us
http://blog.syracuse.com/news/2007/09/spitzer_visits_northeast_biofu.html
http://downloads.pennnet.com/pnet/surveys/lng/0710lng_construction.pdf
http://findarticles.com/p/articles/mi_m0EIN/is_2006_Nov_9/ai_n27047072
http://findarticles.com/p/articles/mi_m0EIN/is_2006_Nov_9/ai_n27047072
http://findarticles.com/p/articles/mi_m0EIN/is_2007_Oct_11/ai_n27404255
http://findarticles.com/p/articles/mi_m0EIN/is_2007_Oct_11/ai_n27404255
http://fossil.energy.gov/news/techlines/2006/06050-DOE_Awards_EOR_Project.html
http://fossil.energy.gov/news/techlines/2006/06050-DOE_Awards_EOR_Project.html
http://gcep.standford.edu/about/facts.html
http://gcep.standford.edu/about/facts.html
http://goliath.ecnext.com/coms2/gi_0199-45692/NLNG-Awards-Train-6-Contract.html
http://goliath.ecnext.com/coms2/gi_0199-5534450/Exceeding-expectations-Alpine-expansion-and.html
http://goliath.ecnext.com/coms2/gi_0199-5534450/Exceeding-expectations-Alpine-expansion-and.html
http://goliath.ecnext.com/coms2/summary_0199-6188227_ITM
http://goliath.ecnext.com/coms2/summary_0199-6188227_ITM
http://governor.nd.gov/media/news-releases/2007/08/070814.html
http://investor.chevron.com/phoenix.zhtml?c=130102&p=irol-newsArticle&ID=693376&highlight=
http://investor.chevron.com/phoenix.zhtml?c=130102&p=irol-newsArticle&ID=693376&highlight=
http://library.corporate-ir.net/library/19/196/196066/items/287687/SandRidge_2007_Annual_10K.pdf
http://library.corporate-ir.net/library/19/196/196066/items/287687/SandRidge_2007_Annual_10K.pdf
http://mpua.org/Communications/April2002advantageForPDF.pdf
http://nei.org/resourcesandstats/documentlibrary/newplants/graphicsandcharts/newnuclearplantstatus/
http://nei.org/resourcesandstats/documentlibrary/reliableandaffordableenergy/graphicsandcharts/usnuclearplantsales/
http://petroleum.berkeley.edu/patzek/Harmful/Materials/nyt_12_21_2006.htm
http://phx.corporate-ir.net/phoenix.zhtml?c=196219&p=irol-sec
http://phx.corporate-ir.net/phoenix.zhtml?c=196219&p=irol-sec
http://phx.corporate-ir.net/phoenix.zhtml?c=196219&p=irol-sec
http://sec.edgar-online.com/2008/01/04/0000950129-08-000077/Section3.asp
http://sec.edgar-online.com/2008/01/04/0000950129-08-000077/Section3.asp
http://stlouis.bizjournals.com/stlouis/gen/company.html?gcode=1C432B8B168B4CCAB4D2FAB4DAAA1211
http://webstar.postbulletin.com/agrinews/144923469760839.bsp
http://westernplainsenergy.biz/wpe.html
http://whiting.bp.com/go/doc/1550/165362/

http://wichita.bizjournals.com/wichita/stories/2006/02/13/daily3.html
http://wistechnology.com/articles/3811/
http://www.aberdeenenergy.com/press_2-10-06.htm
http://www.accessmylibrary.com/coms2/summary_0286-15674368_ITM
http://www.accessmylibrary.com/coms2/summary_0286-15782189_ITM
http://www.accessmylibrary.com/coms2/summary_0286-15782189_ITM
http://www.accessmylibrary.com/coms2/summary_0286-16667386_ITM
http://www.accessmylibrary.com/coms2/summary_0286-32474146_ITM
http://www.allbusiness.com/operations/shipping/161168-1.html
http://www.ameren.com/EnvReport/ADC_FullEnvReport.pdf
http://www.ameren.com/EnvReport/ADC_FullEnvReport.pdf
http://www.asalliances.com/ethanol.htm
http://www.asalliances.com/ethanol.htm
http://www.asalliances.com/ethanol.htm
http://www.aventinerei.com/facilities.htm
http://www.aventinerei.com/facilities.htm
http://www.aventinerei.com/facilities.htm
http://www.aventinerei.com/facilities.htm
http://www.babcockbrown.com/media/187092/bnb percent20investor percent20presentations.pdf
http://www.berr.gov.uk/files/file45788.pdf
http://www.bfenergy.com/news/nebraska_construction.html
http://www.bioenergyllc.com/projects.htm
http://www.biofuelsjournal.com/info/bf_articles.html?type=ar&ID=29034
http://www.bp.com/genericarticle.do?categoryId=2012968&contentId=7038865
http://www.canopetro.com/files/companyprofile/Cano2007AnnualReport.pdf
http://www.canopetro.com/files/companyprofile/Cano2007AnnualReport.pdf
http://www.cardinalethanol.com/Upload/Documents/Annual_Meeting_Powerpoint2.pdf
http://www.centralvalleybusinesstimes.com/stories/001/?ID=6491
http://www.chadbourne.com/newsevents/NewsDetail.aspx?news=682
http://www.chemie.de/news/e/53973/
http://www.cheniere.com/LNG_terminals/freeport_lng.shtml
http://www.cheniere.com/LNG_terminals/freeport_lng.shtml
http://www.chevron.com/documents/pdf/Chevron2007AnnualReportSupplement.pdf
http://www.chevron.com/documents/pdf/Chevron2007AnnualReportSupplement.pdf
http://www.chevron.com/news/press/Release/?id=2006-10-26
http://www.chevron.com/products/sitelets/pascagoula/refineryprofile/
http://www.chron.com/disp/story.mpl/ap/business/5875017.html
http://www.conocophillips.com/newsroom/news_releases/2007news/12-07-2007.htm
http://www.conocophillips.com/newsroom/news_releases/2007news/12-07-2007.htm
http://www.contractorsunlimited.co.uk/news/050112-BG-Group.shtml
http://www.denverpost.com/ci_4530946
http://www.dom.com/investors/annual.jsp
http://www.dom.com/investors/annual.jsp
http://www.dom.com/investors/annual.jsp
http://www.dom.com/investors/annual.jsp
http://www.dot.state.oh.us/OHIORAIL/Project percent20Briefings/July percent202007/greater percent20ohio percent20ethanol.pdf
http://www.downstreamtoday.com/News/Articles/200806/Chile_LNG_Project_Secures_Financing_11508.aspx?AspxAutoDetectCookieSupport=1
http://www.edaofstclaircounty.com/docs/pdf/PressRelease/Marysville percent20Ethanol percent202 percent20Press percent20Release.pdf
http://www.eenergyadams.com/investor_proxy.htm
http://www.eia.doe.gov/oiaf/servicerpt/subsidy2/pdf/execsum.pdf
http://www.eia.doe.gov/oiaf/servicerpt/subsidy2/pdf/execsum.pdf
http://www.eia.doe.gov/oiaf/servicerpt/subsidy2/pdf/execsum.pdf
http://www.eia.doe.gov/oiaf/servicerpt/subsidy2/pdf/execsum.pdf
http://www.ekaellc.com/history.html
http://www.energyme.com/energy/2005/en_05_0246.htm
http://www.enhancedoilres.com/financials/MD&A_Annual.pdf
http://www.enhancedoilres.com/financials/MD&A_Annual.pdf

http://www.enhancedoilres.com/news/EOR-nr-Jan312008.pdf
http://www.enhancedoilres.com/shareholders/ShareholderUpdate-EOR-Aug-07.pdf
http://www.enhancedoilres.com/news/EOR-nr-Jan312008.pdf
http://www.enhancedoilres.com/shareholders/ShareholderUpdate-EOR-Aug-07.pdf
http://www.entergy.com/content/investor_relations/pdfs/2007_Annual_rpt.pdf
http://www.entergy.com/content/investor_relations/pdfs/2007_Annual_rpt.pdf
http://www.entergy.com/content/investor_relations/pdfs/2007_Annual_rpt.pdf
http://www.epa.gov/gasstar/documents/ll_dimcompstat.pdf
http://www.epa.gov/gasstar/documents/ll_pipeline.pdf
http://www.epa.gov/lmop/proj/index.htm#1
http://www.evolutionpetroleum.com/assets_enhanced.html
http://www.evolutionpetroleum.com/assets_enhanced.html
http://www.forbes.com/markets/feeds/afx/2007/08/08/afx3999270.html
http://www.forbes.com/markets/feeds/afx/2007/08/08/afx3999270.html
http://www.fossil.energy.gov/programs/reserves/npr/Secure_Fuels_from_Domestic_Resources_-_P.pdf
http://www.fplgroup.com/reports/pdf/2007_annual.pdf
http://www.fplgroup.com/reports/pdf/2007_annual.pdf
http://www.gastool.methanetomarkets.org/m2mtool/files/docs/eliminateunnecessaryequipmentandorsystems.pdf
http://www.gastool.methanetomarkets.org/m2mtool/files/docs/ReducingEmissionsfromCompressorSeals.ppt
http://www.ghgworks.com/4b-bluelake.html
http://www.ghgworks.com/4b-bluelake.html
http://www.grainnet.com/info/articles.html?type=bn&ID=32674
http://www.granitefallsenergy.com/
http://www.greatplainsethanol.com/
http://www.greencarcongress.com/2007/10/aep-to-sell-cap.html
http://www.greencarcongress.com/2007/10/aep-to-sell-cap.html
http://www.highbeam.com/doc/1G1-142338612.html
http://www.hks.harvard.edu/hepg/Papers/Fertel_Handout.pdf
http://www.hks.harvard.edu/hepg/Papers/Fertel_Handout.pdf
http://www.iadg.com/Hawkeye-Renewables.aspx
http://www.ibecethanol.com/
http://www.ilcorn.org/news/html/11-19-04.html
http://www.imperialoil.ca/Canada-English/Files/Kearl_May06.pdf
http://www.indusbusinessjournal.com/ME2/dirmod.asp?sid=&nm=&type=Publishing&mod=Publications percent3A percent3AArticle&mid=8F3A7027421841978F18BE895F87F791&tier=4&id=EB1470A942E745B796BD2E8EB26DA1AD
http://www.insideindianabusiness.com/newsitem.asp?ID=19189
http://www.kindermorgan.com/investor/kmp_2007_annual_report_overview.pdf
http://www.kindermorgan.com/investor/kmp_2007_annual_report_overview.pdf
http://www.kindermorgan.com/investor/presentations/2007_Analysts_Conf_03_CO2.pdf
http://www.kindermorgan.com/investor/presentations/2007_Analysts_Conf_03_CO2.pdf
http://www.klprocess.com/Press percent20Releases/RCJ_010608.html
http://www.littlesiouxcornprocessors.com/
http://www.littlesiouxcornprocessors.com/
http://www.mairetecnimont.it/business-unit/oil-gas/oil-gasprojects/fos-cavaou-lng-project
http://www.marathon.com/content/includes/2007ar/page3.asp
http://www.marathon.com/Search/?search2=heavy+oil+investment
http://www.marketwatch.com/news/story/10-q-nedak-ethanol-llc/story.aspx?guid= percent7B9FEF4E86-BB4A-41D1-A4F2-2F0464AF5E89 percent7D
http://www.marketwire.com/press-release/Industrial-Info-Resources-872128.html
http://www.marketwire.com/press-release/King-and-Spalding-820291.html
http://www.marketwire.com/press-release/King-and-Spalding-820291.html
http://www.marubeni.com/news/2007/070525e.html
http://www.megawestenergy.com/projects/deerfield.html
http://www.megawestenergy.com/projects/montana.html
http://www.megawestenergy.com/projects/trinity.html
http://www.mitsui.co.jp/en/release/2004/1174939_1205.html
http://www.mocorn.org/news/2003/MediaAdvisory09-26-03.htm

http://www.mywire.com/pubs/PRNewswire/2007/12/11/5157879?extID=10051
http://www.mywire.com/pubs/PRNewswire/2007/12/11/5157879?extID=10051
http://www.nationalgrid.com/uk/GrainLNG/Expansion/
http://www.ne.doe.gov/np2010/neScorecard/pdfFiles/scorecard_suppl_2008_03_03.pdf
http://www.netl.doe.gov/publications/factsheets/project/Proj441.pdf
http://www.netl.doe.gov/technologies/carbon_seq/core_rd/RegionalPartnership/42588.html
http://www.netl.doe.gov/publications/factsheets/project/Proj441.pdf
http://www.netl.doe.gov/technologies/carbon_seq/core_rd/RegionalPartnership/42588.html
http://www.netl.doe.gov/technologies/carbon_seq/core_rd/RegionalPartnership/42587.html
http://www.netl.doe.gov/technologies/carbon_seq/core_rd/RegionalPartnership/42589.html
http://www.netl.doe.gov/technologies/carbon_seq/core_rd/RegionalPartnership/42587.html
http://www.netl.doe.gov/technologies/carbon_seq/core_rd/RegionalPartnership/42589.html
http://www.netl.doe.gov/technologies/carbon_seq/core_rd/RegionalPartnership/42592.html
http://www.netl.doe.gov/technologies/carbon_seq/core_rd/RegionalPartnership/42590.html
http://www.netl.doe.gov/technologies/carbon_seq/core_rd/RegionalPartnership/42591.html
http://www.netl.doe.gov/technologies/carbon_seq/core_rd/RegionalPartnership/42593.html
http://www.news-banner.com/index/news-app/story.3955/menu./sec./home.
http://www.northernlightsethanol.com/smac.asp
http://www.nrc.gov/reading-rm/doc-collections/commission/secys/2007/secy2007-0081/enclosure3.pdf
http://www.oregontrailethanol.com/
http://www.ottertailethanol.com/documents/Jan_31_2006_Press_Release.pdf
http://www.pearleandp.com/s/SanMiguel.asp?ReportID=143129
http://www.pennwest.com/operations/crude_pembina.html
http://www.pennwest.com/operations/crude_pembina.html
http://www.projectdubai.com/ta_news.php?news_id=2199&section=real
http://www.ptac.org/co2/dl/co2f0602p03.pdf http://www.arcresources.com/en-ca/news/
http://www.ptac.org/co2/dl/co2f0602p03.pdf http://www.arcresources.com/en-ca/news/
http://www.qp.com.qa/qp.nsf/8c264276b952633c432571290026c60e/c8a5483e9a32793b432571440021a4d4?OpenDocument
http://www.akersolutions.com/Internet/MediaCentre/PressReleases/Group/2005/AKPressRelease_992834.htm
http://www.reuters.com/article/pressRelease/idUS111767+14-Apr-2008+BW20080414
http://www.reuters.com/article/pressRelease/idUS111767+14-Apr-2008+BW20080414
http://www.rigzone.com/news/article.asp?a_id=47926
http://www.rigzone.com/news/article.asp?a_id=47926
http://www.riotechnical.com/files/LHCE.pdf
http://www.rockymountainnews.com/drmn/energy/article/0,2777,DRMN_23914_5726152,00.html
http://www.rockymountainnews.com/drmn/energy/article/0,2777,DRMN_23914_5726152,00.html
http://www.rockymountainnews.com/drmn/energy/article/0,2777,DRMN_23914_5726152,00.html
http://www.rrc.state.tx.us/commissioners/carrillo/mexico/2007/presentations/CREIngSalazar.pdf
http://www.scandoil.com/moxie-bm2/gas/lng_gas/bp-migas-announces-tanggu.shtml
http://www.sec.gov/Archives/edgar/data/1287900/000114420407053675/v089753_10k-a.htm
http://www.sec.gov/Archives/edgar/data/1287900/000114420407053675/v089753_10k-a.htm
http://www.sempralng.com/Files/pdf/CameronBrochure_May06.pdf
http://www.sempralng.com/Files/pdf/CameronBrochure_May06.pdf
http://www.shell.ca/home/content/ca-en/about_shell/what_we_do/oil_sands/aosp/sustainable_dev/hssd_resources.html
http://www.shell.ca/home/content/ca-en/news_and_library/press_releases/2006/unindex/april21_new_engine_oil.html?LN=/news_and_library/press_releases/2006
http://www.shell.com/static//ca-en/downloads/about_shell/what_we_do/aosp_sd_report.pdf
http://www.shipbuildinghistory.com/world/highvalueships/lngactivefleet.htm
http://www.stpns.net/view_article.html?articleId=31849783182153932
http://www.syncrude.ca/users/folder.asp?FolderID=5726
http://www.syncrude.ca/users/folder.asp?FolderID=5726
http://www.syncrude.ca/users/folder.asp?FolderID=5726
http://www.tallcornethanol.com/
http://www.uwgp.com/
http://www.washingtonpost.com/wp-dyn/content/article/2006/03/25/AR2006032500033.html
http://www.washingtonpost.com/wp-dyn/content/article/2006/03/25/AR2006032500033.html
http://www.windaction.org/news/8571

http://www.woodside.com.au/NR/rdonlyres/1B6BA1C2-9028-4639-9EE4-802D28FBB839/0/Plutofactsheetapril2008lores.pdf
http://www.zwire.com/site/news.cfm?dept_id=474107&newsid=18776169
http://www.zwire.com/site/news.cfm?dept_id=474107&newsid=18776169
http://www.zwire.com/site/news.cfm?newsid=18175190&BRD=2020&PAG=461&dept_id=231738&rfi=6
https://portal.perulng.com/irj/go/km/docs/documents/PLNG%20Website/index.htm
Kerr-McGee Corporation *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2000*
Kerr-McGee Corporation *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2001*
Kerr-McGee Corporation *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2002*
Kerr-McGee Corporation *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2003*
Lyondell-CITGO Refining, L.P. *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2001*
Lyondell-CITGO Refining, L.P. *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2002*
Lyondell-CITGO Refining, L.P. *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2003*
Lyondell-CITGO Refining, L.P. *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2004*
Marathon Oil Corporation *Annual Report to Shareholders; 2000*
Marathon Oil Corporation *Annual Report to Shareholders; 2001*
Marathon Oil Corporation *Annual Report to Shareholders; 2002*
Marathon Oil Corporation *Annual Report to Shareholders; 2003*
Motiva Enterprises, L.L.C. *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2000*
Motiva Enterprises, L.L.C. *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2001*
Motiva Enterprises, L.L.C. *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2002*
Motiva Enterprises, L.L.C. *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2003*
Motiva Enterprises, L.L.C. *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2004*
Motiva Enterprises, L.L.C. *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2005*
National Biodiesel Board; http://www.biodiesel.org/
National Science Foundation; *2001 Survey of Industrial Research and Development*; 2003
Occidental Petroleum Corporation *Annual Report to Shareholders; 2000*
Occidental Petroleum Corporation *Annual Report to Shareholders; 2001*
Occidental Petroleum Corporation *Annual Report to Shareholders; 2002*
Occidental Petroleum Corporation *Annual Report to Shareholders; 2003*
Occidental Petroleum Corporation *Annual Report to Shareholders; 2004*
Premcor, Inc. *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2000*
Premcor, Inc. *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2001*
Premcor, Inc. *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2002*
Premcor, Inc. *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2003*
Premcor, Inc. *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2004*
Premcor, Inc. *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2005*
REN21 Renewable Energy Policy Network. 2005. *Renewables 2005 Global Status Report*. Washington, DC: Worldwatch Institute.

Shell Oil Company *Annual Report to Shareholders;* 2000
Shell Oil Company *Annual Report to Shareholders;* 2001
Shell Oil Company *Annual Report to Shareholders;* 2002
Shell Oil Company *Annual Report to Shareholders;* 2003
Shell Oil Company *Annual Report to Shareholders;* 2004
Shell Oil Company *Annual Report to Shareholders;* 2005
Shell Oil Company *Annual Report to Shareholders;* 2006
Shell Oil Company *Annual Report to Shareholders;* 2007
Shell Oil Company *Annual Report to Shareholders;* 2008
Shell Oil Company; http://eng.volkswagen-media-services.com/medias_publish/m...lose_ethanol_in_germany.standard.gid-oeffentlichkeit.html
Shell Oil Company; Shell Sustainability Report 2006
Shell Oil Company; Shell Sustainability Report 2007
Shell Oil Company; Shell Sustainability Report 2008
sites.nppd.com/IO/spring06.pdf
Sunoco, Inc. *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2000*
Sunoco, Inc. *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2001*
Sunoco, Inc. *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2002*
Sunoco, Inc. *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2003*
Sunoco, Inc. *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2004*
Tesoro Petroleum Corporation *Annual Report to Shareholders,* 2004
The Williams Companies, Inc. *Annual Report to Shareholders,* 2003
Total Fina Elf Holdings USA, Inc. *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2000*
Total Fina Elf Holdings USA, Inc. *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2001*
Total Fina Elf Holdings USA, Inc. *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2002*
Total Fina Elf Holdings USA, Inc. *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2003*
Total Fina Elf Holdings USA, Inc. *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2004*
Total Fina Elf Holdings USA, Inc. *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2005*
Total Fina Elf Holdings USA, Inc. *Annual Report Pursuant To Section 13 Or 15(D) Of The Securities Exchange Act Of 1934; (10-K) For the Fiscal Year Ended December 31, 2007*
U.S Department of Energy, General Services Administration; *Federal Automotive Statistical Tool*
U.S. Department of Energy, Energy Information Administration,; Form EIA-860, *Annual Electric Generator Report.*
U.S. Department of Energy, Energy Information Administration; Form EIA-886, "Annual Survey of Alternative Fuel Vehicles Suppliers and Users"
U.S. Department of Energy, Energy Information Administration; http://www.iea.org/Textbase/stats/rd.asp
U.S. Department of Energy*; s:/xlsfiles/history tables/BA history by approp 98-06 energy programs*
Unocal Corporation *Annual Report to Shareholders;* 2000
Unocal Corporation *Annual Report to Shareholders;* 2001
Unocal Corporation *Annual Report to Shareholders;* 2002
Unocal Corporation *Annual Report to Shareholders;* 2003
Unocal Corporation *Annual Report to Shareholders;* 2004
Unocal Corporation *Annual Report to Shareholders;* 2005
Valero Energy Corporation *Annual Report to Shareholders*
www.secinfo.com/d14Bmp.z34.htm
XTO Energy, Inc. *Annual Report*; 2000
XTO Energy, Inc. *Annual Report*; 2001
XTO Energy, Inc. *Annual Report*; 2002

XTO Energy, Inc. *Annual Report*; 2003
XTO Energy, Inc. *Annual Report*; 2004
XTO Energy, Inc. *Annual Report*; 2005
XTO Energy, Inc. *Annual Report*; 2006
XTO Energy, Inc. *Annual Report*; 2007
XTO Energy, Inc. *Annual Report*; 2008