TOPIC PAPER #3

Demand Data Evaluation

On July 18, 2007, The National Petroleum Council (NPC) in approving its report, *Facing the Hard Truths about Energy,* also approved the making available of certain materials used in the study process, including detailed, specific subject matter papers prepared or used by the Task Groups and their Subgroups. These Topic Papers were working documents that were part of the analyses that led to development of the summary results presented in the report's Executive Summary and Chapters.

These Topic Papers represent the views and conclusions of the authors. The National Petroleum Council has not endorsed or approved the statements and conclusions contained in these documents but approved the publication of these materials as part of the study process.

The NPC believes that these papers will be of interest to the readers of the report and will help them better understand the results. These materials are being made available in the interest of transparency.

The attached Topic Paper is one of 38 such working document used in the study analyses. Also included is a roster of the Subgroup that developed or submitted this paper. Appendix E of the final NPC report provides a complete list of the 38 Topic Papers and an abstract for each. The printed final report volume contains a CD that includes pdf files of all papers. These papers also can be viewed and downloaded from the report section of the NPC website (www.npc.org).

NATIONAL PETROLEUM COUNCIL

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Demand Data Evaluation Subgroup
Report

Executive Summary

This report contains the findings of the Demand Data Evaluation Subgroup of the NPC Global Oil & Gas Study Demand Task Group that reviewed, analyzed, and compared projection data collected in the NPC data warehouse through surveys for both public and proprietary projections of world energy demand. Publicly available demand data from the U.S. Department of Energy, Energy Information Administration (EIA) and the International Energy Agency (IEA) was the main focus of the analysis. The proprietary data covering 29 separate projections from international oil companies, consulting companies and non-governmental organizations was used primarily to establish whether the public projections provided a reasonable range of projection results.

The three major input assumptions behind both the EIA and the IEA projections are economic growth, population, and effect of associated energy policies. In general, the economic growth projections for the world exceed past growth except for that used in the EIA Low Economic Growth Case. By region and country, the pattern is somewhat different. Economically developed regions (North America and OECD Europe), and both developing and economically emerging Asia are projected to grow more slowly than in the past. Countries in Africa, Central and South America, the Middle East, and Non OECD Europe and Eurasia are projected to growth more rapidly than historically. The faster global economic growth is driven by the rapidly growing emerging Asia becoming a larger share of the global economy.

World population growth in all cases is essentially the same, drawn from U.N. or Census projections of population growth. Population growth rates are projected to be generally lower then historic growth rates.

The EIA, generally, only included those energy policies that are currently in effect and allows most policies to expire as currently enacted at their sunset date. The IEA Reference Case however, assumes the likely extension of public policies. The IEA Alternative Policy Case provides a significantly different energy policy approach, assuming not only existing energy policy and their logical extension, but other policies that are under consideration around the world. IEA used the same economic projections in their Reference and Alternative Policy Cases. The implication is that the additional policies used in the Alternative Policy Case have no impact on economic growth.

Worldwide energy demand is projected to grow 1.5 to 2.5 percent per year, versus the historic growth rate of 1.7 percent per year. The projected U.S. energy demand growth of 0.5 to 1.3 percent per year was generally less than the historic rate of growth of 1.2 percent per year.

World demand for petroleum liquids is projected to grow at 1.0 to 1.9 percent per year versus the historical growth rate of 0.9 percent per year. In 2030, petroleum demand is projected to range from 103 to 138 million barrels per day, up from 76 million barrels per day in 2000. Despite this growth, petroleum as a share of total energy declines in all cases. U.S. petroleum demand is projected to grow 0.5 to 1.6 percent per year versus 0.6 percent per year historically. In 2030, U.S. petroleum liquids demand is projected to range from 22 to 30 million

barrels per day, compared to 19 million barrels per day in 2000. The IEA Alternative Policy Case is the only public case where growth in U.S. petroleum liquids demand is slower than in the past. This indicates that the policies assumed in this case could have a significant impact on the growth in petroleum liquids demand relative to the policies in place today. According to the EIA projection for the U.S., two-thirds of the volume and most of the projected growth in petroleum liquids demand is for transportation services led by increased demand by Light Duty Vehicle (60 percent). The key drivers of light duty vehicle growth are increased vehicle penetration and annual miles traveled per vehicle, which more than offset improvement in vehicle efficiency (MPG). .

World natural gas demand is projected to grow 1.6 to 2.9 percent per year versus 2.6 percent per year historically. Despite the slowing of gas demand growth rates, gas is still projected to gain market share versus other energy sources in all cases. Natural gas demand grows in all regions. Gas demand ranges from 152 to 225 trillion cubic feet in 2030, compared with world natural gas demand of 94 trillion cubic feet in 2000. In all cases, the projected rate of growth in U.S. natural gas demand is lower than the historic rate of growth. U.S. natural gas demand ranges from 25 to 30 trillion cubic feet in 2030, compared with 21 trillion cubic feet in 2000.

Worldwide coal demand growth is projected to be faster in the future than in the past in all outlooks except for the Alternative Policy Case where the growth is slightly less than in the past. More than two thirds of the projected growth in coal demand from 2000 to 2030 is in China and India, where the economies are growing rapidly and coal is very competitive with other fuels. The indication is that share of total world energy consumption met by coal is projected to increase in all cases except where policies are enacted that place a limit on the use of coal.

Worldwide nuclear consumption growth is projected to be slower in the future than it has been in the past in all outlooks. The nuclear share of total worldwide energy demand declines in all projections except for the Alternative Policy Case where it increases very slightly. While the specific numbers are different in the U.S. projections, the trends are the same. The nuclear share of U.S. energy consumption is projected to slowly decline in the U.S. through 2030. The projections suggest that a major shift in nuclear policy will be required to increase the nuclear share of energy use. The share of total worldwide energy consumption accounted for by other energy sources (hydro, biofuels, wind, solar, etc.) is projected to be higher in 2030 than in 2000.

Worldwide carbon dioxide emissions grow in all of the projections. Carbon dioxide emissions are projected to range from 34 billion metric tons in 2030 in the IEA Alternative Policy Case to 51 billion metric tons in the EIA High Economic Growth Case, compared with 24 billion metric tons in 2000. In all cases, carbon dioxide emissions increase at about the same rate as energy demand. Carbon dioxide emissions in the U.S. are also expected to grow in all projections, although not as fast as for the world. In 2030, carbon dioxide emissions in the U.S. range from 6.3 billion metrics tons in the IEA Alternative Policy Case to 9 billion metric tons in EIA High Economic Growth Case (5.8 billion metrics tons in 2000).

The regional shares of energy use are projected to change over time. The share of total worldwide energy consumed in the North America, OECD Europe, and Non-OECD Europe & Eurasia is projected to fall in all of the cases, while the share in Asia/Oceania grows. China is a major contributor to the substantial growth in Asia/Oceania share. In general, the change in

the oil share of total worldwide oil consumed by region parallels the change in the share of total energy consumption, with industrialized regions losing share and the Asia/Oceania oil share increasing significantly.

Energy consumption per unit of GDP (energy intensity) is projected to decline in all regions. The Middle East, while not exhibiting the highest energy intensity in 2000, is projected to have the highest energy intensity in 2030 in all cases. North America, the region exhibiting the highest energy use per person in 2000, is still projected to have the highest energy use per person in 2030, but it declines in the IEA cases. Energy consumption per person in all other regions is projected to higher or equal to 2000 levels in 2030.

Public Cases - Major Findings
Projections for Cases Driven by Existing Policies and Extensions

- Assumed future world economic growth is essentially equal to or greater than historic economic growth
- Assumed future US economic growth is essentially equal to or less than historic economic growth
- Even with decreases in energy intensity projected world energy growth rates in some cases are higher than in the past and in some cases lower than in the past
- In the US energy intensity decreases and energy growth rates are lower than in the past
- Most of the world and US projected energy demand will continue to be satisfied by fossil fuels
- In all cases projected global and US carbon dioxide emissions increase at about the same rate as projected energy demand
- In all cases projected world oil demand increases albeit at a slower rates than projected world energy demand
- US projected petroleum demand growth rate is faster than projected US energy demand growth rate
- Projected world gas demand grows slower than in the past (except in the projected high economic growth environment), but is gaining share
- Projected US gas demand is growing slower than in the past and is losing share of total energy
- World and US coal use increases faster than historical and gains share of total energy
- Over 80 percent of projected world coal demand growth is in China, India, and the US
- Nuclear share declines both in the world and US due to assumed closure of existing plants at existing permitted life
- In both the world and US transportation uses of petroleum are the major influence in the projected growth of petroleum demand
- Projected electric generation growth is the major driver supporting gas and coal demand growth
- Asia is projected to be the most significant contributor to world energy growth with China the major driver
- Projected energy use per capita grows in all regions with North America continuing to have the highest energy use per capita

Public Cases - Major Findings

IEA Alternative Policies Projection

- Added policy options are assumed to have no impact on economic growth relative to the IEA existing policies projection
- Projected world and US energy demand growth is slower than in the past
- Most of the world and US projected energy demand will continue to be satisfied by fossil fuels
- Projected global carbon dioxide emissions increase at a slightly slower rate than projected energy demand while the reverse is true for the US
- World and US projected petroleum demand grows faster than energy demand
- Projected gas use gains share of energy use in the world, but loses share in the US
- Nuclear use is projected to gain share in both the world and the US
- As in the existing policies case Asia is projected to be the most significant contributor to world energy growth with China the major driver
- Projected energy use per capita grows on average in the world even with North America having declining energy use per capita

Proprietary Cases - Major Findings

- The aggregation of proprietary data provided demand data all off which fell within the range of the public Energy Administration and International Energy Agency
- Additional findings were not derived from the aggregated proprietary data

Organization and Approach

The Demand Data Evaluation Subgroup is an integral part of the National Petroleum Council Global Oil & Gas Study Demand Task Group and includes participants from an international oil company, a consulting company, a non government organization, and the Energy Information Administration. The subgroup met at regular intervals to review and analyze projection comparisons.

The group approached the comparison of both public and proprietary projections of world energy demand through the use of data and information collected in the National Petroleum Council's data warehouse. In addition projections that were available in the broader media were reviewed in order to evaluate issues that were not found in the base material. The data and information that was used in the comparison effort divide the world into seven regions (North America, South and Central America, OECD Europe, Non OECD Europe and Eurasia, Middle East, Asia/Oceania, and Africa). Data was also reported for three specific countries (India, China, and the United States). There was no attempt to develop a demand projection or select a most likely future from the projections that were studied.

Scope and Data

The scope of the activity was defined by developing a series of framing issues that addressed the demand issues set forth in the Secretary of Energy's letter to the National Petroleum Council requesting the Global Oil & Gas Study. The general structure of the effort was to obtain as much information as possible from the projections that would be useful in evaluating future policy options. The following are the major framing issues that guided the demand comparison effort.

- Define survey outlooks' regional, demographic, economic, and energy trends
- Compare survey projections with historic trends
- Understand survey projections demand driver inputs as they relate to energy projections
- Compare differences in outlook economic, demographic, policy, and energy trends
- Provide a demand envelop within which to evaluate projected energy supply, technology advances, and policy options

Publicly available demand data input was provided by the US Department of Energy, Energy Information Administration (EIA) and the International Energy Agency (IEA). The EIA provided three cases; a Reference Case, a High Economic Growth Case, and a Low Economic Growth Case. The IEA provided two cases; a Reference Case and an Alternative Policy Case.

There are no universal consistency standards for collecting energy data, reporting energy data, or preparing energy projections. Consequently, it was necessary to work with the two organizations to assure that the data input to the study was on a reasonably consistent basis. There are still some differences in the data that was input to the study. Some organizations report data on a gross energy BTU (British thermal unit) basis which includes the energy contained in a physical unit before the energy required to evaporate the water produced in combustion is removed. Other organizations provide energy information on a net BTU basis which is the gross energy contained in a unit less the energy required to evaporate the water produced in combustion. When energy sources such as biomass are used to produce more commercially usable energy such as liquids, some organizations report the energy as biomass while others report the derived liquids as petroleum. There are also differences in the way in which input energy is represented for non fossil fuels such as hydroelectric, solar, and nuclear with some organizations reporting input on an equivalent input basis and others on an output basis. In other instances non commercial fuels such as wood are counted and some instances are not counted. This is particularly true in less developed areas. These accounting differences make direct numerical comparisons questionable, but have less effect on growth rate comparisons.

Historic data (1980 through 2000) was derived from EIA sources. As would be expected this data series meshed well with the EIA projections which were reported beginning in 2000. For reasons stated above the 2000 IEA data projection input did not match precisely with the 2000 history year. While absolute numbers were used to produce charts for this report, most comparisons are reflected upon in the growth rate or share sense.

Input Economy, Population, and Policies

The major input assumption behind both the EIA and the IEA projections is economic growth. As seen on the chart below (Chart 1) all the economic growth projections for the world exceed the past growth rate except for that used as input for the EIA Low Economic Growth Case. The reverse is true for the economic growth rates assumed for the various US cases. All future projections are less than the historical rate of economic growth except for the EIA High Economic Growth Case.

While the overall world economic growth patterns into the future appear different from the past, looking at economic growth by region and country provides a different perspective (Table 1). Economically developed regions such as North America and OECD Europe and

developed countries such as the US (Chart 2) as well as the economically emerging Asia containing the large countries of China and India indicate projected slower future economic growth when compared to the past. The impetus for projected future world economic growth is supplied by rapidly growing emerging Asia becoming a larger share of the global economy and the expected rapid future growth in Africa, Central and South America, the Middle East, and Non OECD Europe and Eurasia. Non OECD Europe and Eurasia presents a special condition in that over the 1980 to 2000 period the region experience an economic decline.

One exception to this is the EIA High Economic Growth Case. For this case, in addition to the trends mentioned above the large developed economies of North America and OECD Europe are also assumed to grow faster than historical growth rates.

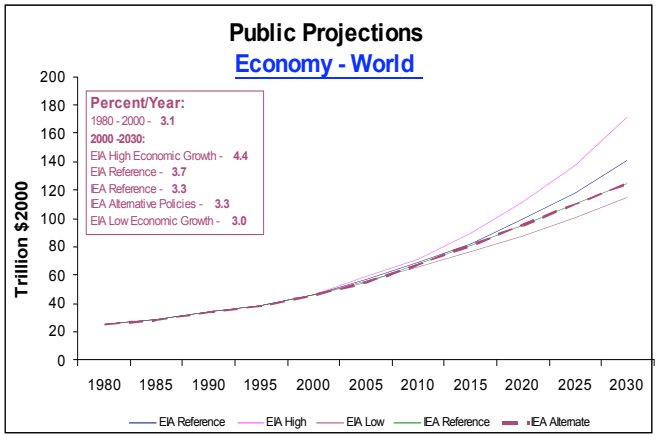

Chart 1

Regional Economic Growth Data (%/Yr):		2030/2000----------				
	2000/1980	EIA Ref	IEA Ref	IEA Alt	EIA Hi	EIA Lo
World	3.08	3.69	3.37	3.37	4.36	3.02
North America	3.13	2.88	2.36	2.36	3.32	2.07
Central and South America	2.19	3.41	3.01	3.01	4.21	2.60
OECD Europe	2.45	2.10	1.99	1.99	2.50	1.69
Non OECD Europe & Eurasia	-1.37	4.49	3.88	3.88	5.51	3.47
Middle East	2.28	4.07	3.94	3.94	4.87	3.26
Asia/Oceania	5.37	4.70	4.51	4.51	5.44	3.95
Africa	2.46	4.31	3.86	3.86	5.11	3.51
United States	3.21	2.85	2.31	2.31	3.31	2.33
China	9.25	6.02	5.87	5.87	6.81	5.23
India	5.49	5.30	5.16	5.16	6.09	4.51

Table 1

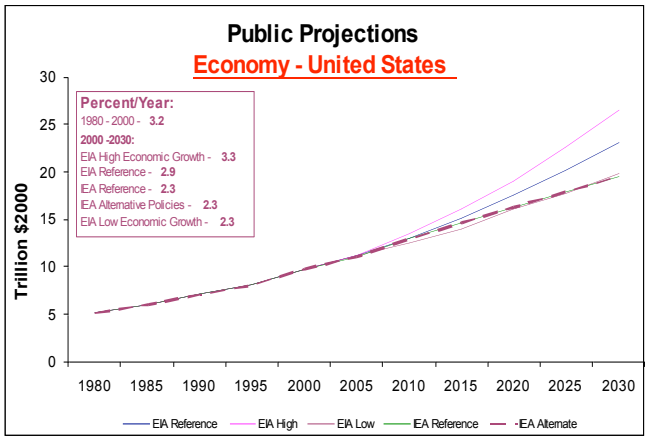

Chart 2

Population is also a major input to the energy demand projection process. As indicated on Chart 3 the world population projection used in all cases is essentially the same. As indicated on Chart 4 there are modest differences in US projected population estimates for the various cases. Population growth rate projections are generally lower than historic population growth rates.

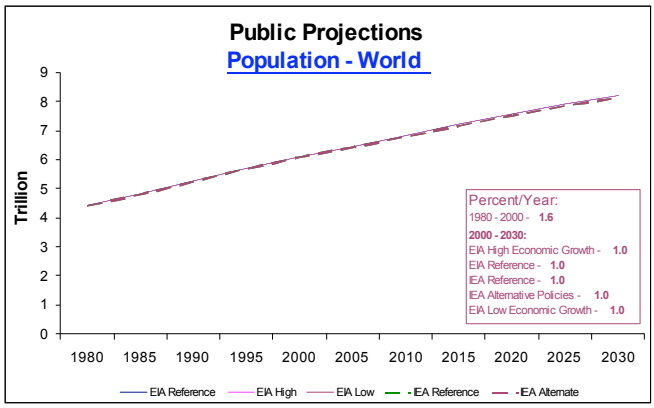

Chart 3

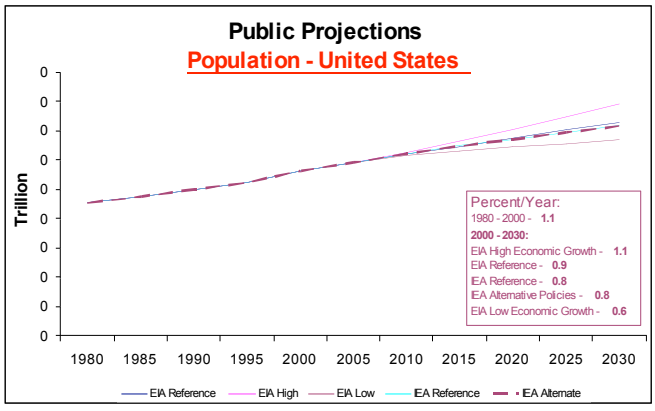

Chart 4

The third important set of input assumptions are those associated with energy policies. The policy assumptions vary between outlooks. The EIA used a constant set of policy assumptions for the three projections that were submitted to the study. This set of policy assumptions assumes that only energy policies that are now in effect will be active in the future.

The IEA used two sets of assumptions for its two cases. The IEA Reference Case is based on a policy premise similar to that of the EIA. There is one modest exception in that the IEA outlook extends policies where likely. The result is a likely slowing of energy growth relative to the EIA and potentially a modest shift in fuel use.

The IEA Alternative Policy Case, however, assumes a significantly different policy landscape in that not only are existing policies and their logical extensions used, but other policies that are under consideration around the world are incorporated. In all, the IEA Alternative Policy Case considers some 1400 energy related policies. These policies foster a range of regulations related to such programs as energy security, environmental concerns, and energy conservation.

The IEA used the same economic and population projections in their Reference and Alternative Policy scenarios. The implication is that the additional policies used in making the Alternative Policy projection are economically neutral. In the documentation for this analysis the IEA states, “Although there may be some feedback from the new policies to economic performance in practice, this factor was considered too complex and uncertain to model.”

Energy

On a world basis (Chart 5), the projected energy demand growth rates are spread around the historic energy demand growth rate of 1.7 percent per year. The IEA Alternative Policies Scenario results in a 10 percent lower energy use when compared with the EIA Reference Scenario. For the US projections (Chart 6), however, the projection growth rates were generally less than the historic rate of growth of 1.2 percent per year.

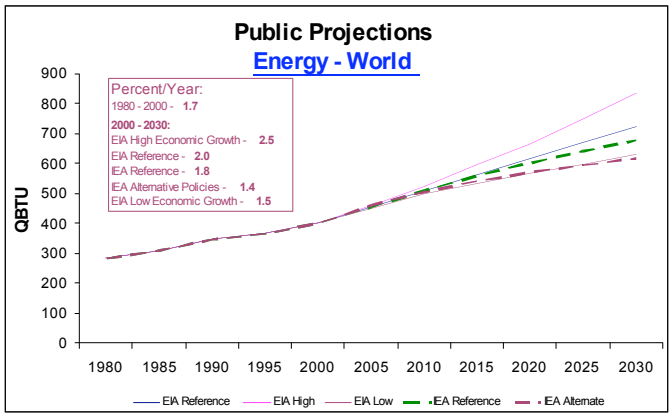

Chart 5

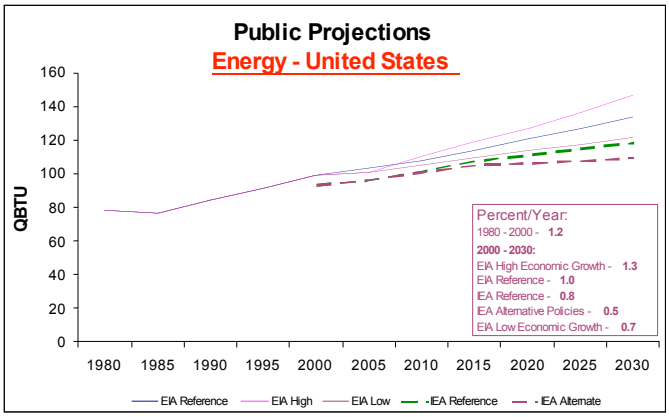

Chart 6

Liquid Petroleum Demand

World demand for petroleum (Chart 7) is projected to continue to grow throughout the projection period. During the historical period of 1980 to 2000 there was substantial switching from oil to natural gas for power generation which reduced the overal growth in oil demand. In all of the cases provided, future petroleum demand is projected to grow faster than in the past. However, the IEA Alternative Policy projected petroleum demand growth rate is only marginally higher than in the past. In 2000 the world demand for oil was about 76 million barrels per day (MBD) on the EIA accounting basis (gross BTU content). The projections for 2030 when adjusted to an EIA BTU conversion basis range from 103 to 138 MBD.

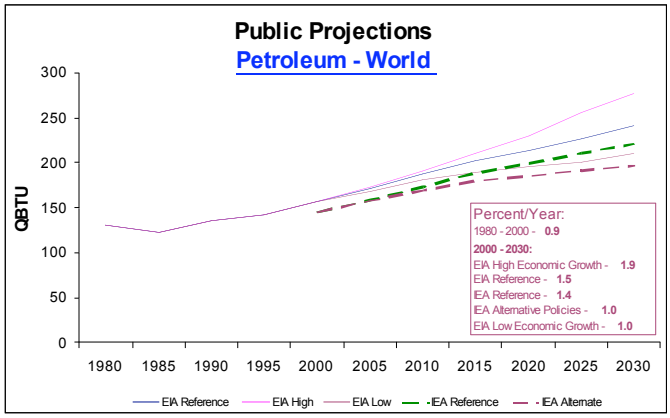

Chart 7

As is the situation for the world petroleum demand growth projections, US petroleum demand (Chart 8) is projected to grow faster in the future than in the past. The one exception is for the IEA Alternative Policy Case where growth in US oil demand is slower than in the past. This indicates that the policies assumed in this case in the US are projected to have a significant impact in slowing oil demand growth relative to the policies in place today. In 2000 the US demand for oil was about 19 MBD on the EIA accounting basis. The projections for 2030 when adjusted to an EIA BTU conversion basis range from 22 to 30 MBD.

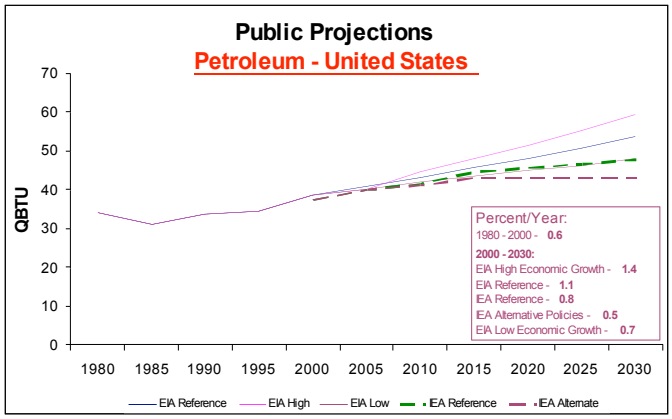

Chart 8

The EIA's US Outlook provides a greater level of detail than most other outlooks. A breakdown of the oil demand by sector for the EIA Reference Case for the US is provided in Chart 8A. Two-thirds of the volume and most of the projected growth in oil demand is for Transportation. Within Transportation about 60% of oil demand is for Light Duty Vehicles (cars, SUVs and light trucks) and another 20% is for Heavy Duty Road Transportation. Most of the growth in oil demand is in these two areas.

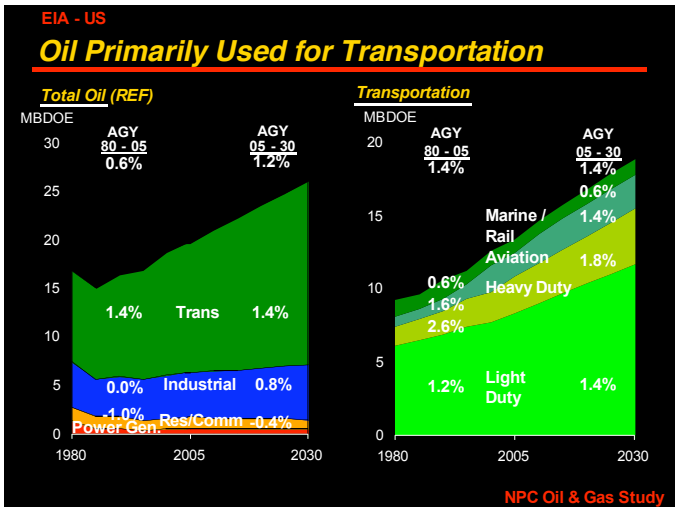

Chart 8A

The key drivers of Light Duty Vehicle oil demand are shown in Chart 8B for the three EIA Cases. These are vehicle penetration shown as vehicles per 1000 people, annual miles traveled per vehicle (VMT), and vehicle efficiency shown in miles per gallon (MPG). For vehicle penetration the assumptions for all cases are that after remaining relatively flat at ~750 cars per thousand for the past ten years, the penetration will increase to 900 cars per thousand by 2030. Average VMT per vehicle, which have declined slightly in the past five years to 11,800 miles per year are expected to increase to 12,800 miles per year by 2030. Average new vehicle miles per gallon are expected to improve 0.6% a year through 2030, higher than the increase over the past 25 years. During 1980 to 2005 new vehicle technical efficiency has improved by ~1.5% per year while on the road efficiency has grown more slowly due to the increasing weight and power of SUV's and pickup trucks that are a growing percentage of the

light duty vehicle fleet. The EIA cases assume that average vehicle weights continue to grow, but not quite as quickly as the last twenty-five years.

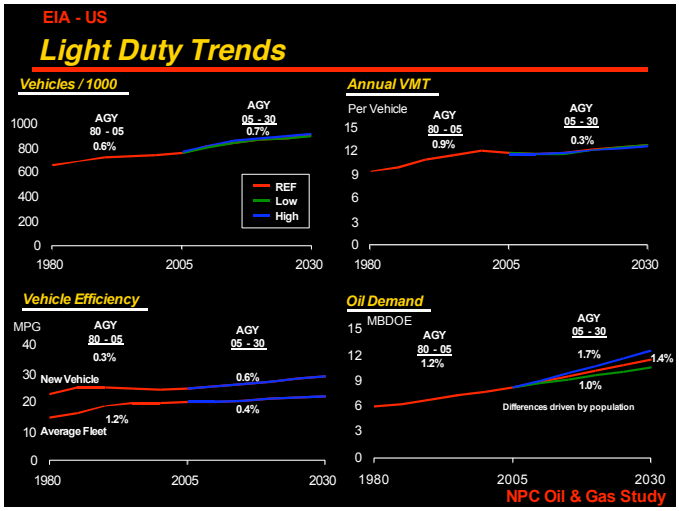

CHART 8B

US oil demand for the EIA Cases for Light Duty Vehicles is projected to increase 1.0 to 1.7 % per year through 2030. While the vehicles per 1000 people, VMT and average mpg assumptions are similar for the cases, the assumed US population in 2030 varies between the cases from 335 to 395 million as shown in Chart 4. When multiplied by cars per 1000 people, this results in a range in total Light Duty Vehicles and drives the range in oil demand between the cases.

There is potential that the US car market is close to saturation with cars per thousand relatively flat the since 1995. If car penetration remains flat at ~750 cars per 1000 people the US oil demand for Light Duty Vehicles would be ~2 MBD lower in 2030 for each case. Likewise, if MPG improves at the historical technical efficiency improvement rate of 1.5% per year (average vehicle weight remaining constant) US oil demand would be ~2.5 MBD lower in 2030 for each case.

Gas Demand

World gas demand projected (Chart 9) growth rates are generally lower than the historic growth rate. The one exception is for the EIA High Economic Growth projection. Despite this general slowing of gas demand growth rates, gas is still projected to gain share versus other energies in all cases. The growth in gas demand occurs in all regions.

As mentioned earlier the EIA shows most energy on a gross basis while the IEA shows energy on a net basis. The largest impact is for gas where this makes about a ten percent differnce in the measurement of demand. After adjusting for similar energy equivalency (gross BTU content), estimated 2000 world natural gas demand was 94 trillion cubic feet per year (TCF). The outlooks show a 2030 range of 152 to 225 TCF.

US projected natural gas demand growth rate (Chart 10) is lower than historic growth rate. After adjusting for similar energy equivalency, estimated 2000 US gas demand was 21 TCF. The outlooks show a 2030 range of 25 to 30 TCF.

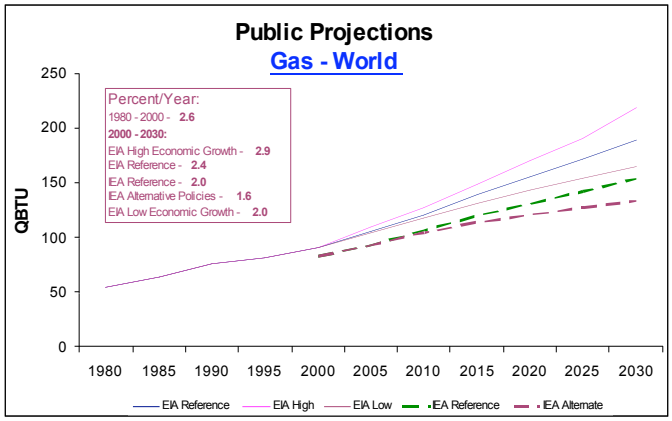

Chart 9

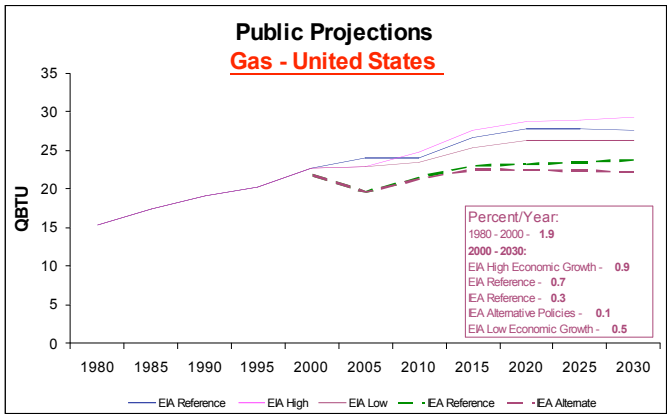

Chart 10

A breakdown of the US gas demand by sector for the EIA Reference Case is provided in Chart 10A. Unlike oil, gas demand is spread more evenly across the sectors. Gas is roughly maintaining share in the Industrial sector and slowly gaining share in the Residential and Commercial Sector where it competes primarily with oil.

Projected gas demand has the most uncertainty in the power demand sector where gas competes for share primarily with coal and nuclear. The share of power demand met by gas will be driven primarily by the relative costs of gas versus coal, the relative capital cost for building different types of power plants, the actual and expected future direct costs for CO2 emissions, and the public acceptance of various types of new power plants. The EIA outlook assumes no direct costs associated with CO2 emissions.

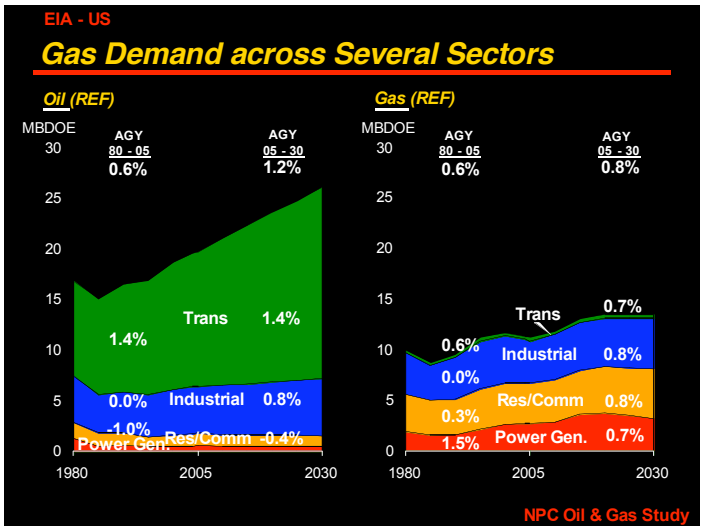

CHART 10A

In addition to gas share, the gas demand for power generation is driven by the overall demand for electricity. In the US, electricity demand per unit of GDP has been declining over time as shown in the upper left of chart 10B. For the EIA Cases this results in a projected slowing of electricity demand growth to 1.1 to 1.9% per year on average through 2030 versus 2.3% over the past 25 years as shown on the upper right of the chart.

Gas share of power generation fuel is projected to increase from 14% in 2005 to about 16% in 2015. It is then projected to decline through 2030 as new gas supplies become more costly and gas becomes less competitive with coal if there is no direct cost for CO2 emissions. This results in projected average gas demand growth of 0.5 to 0.9% per year through 2030 versus 1.5% per year from 1980 to 2005.

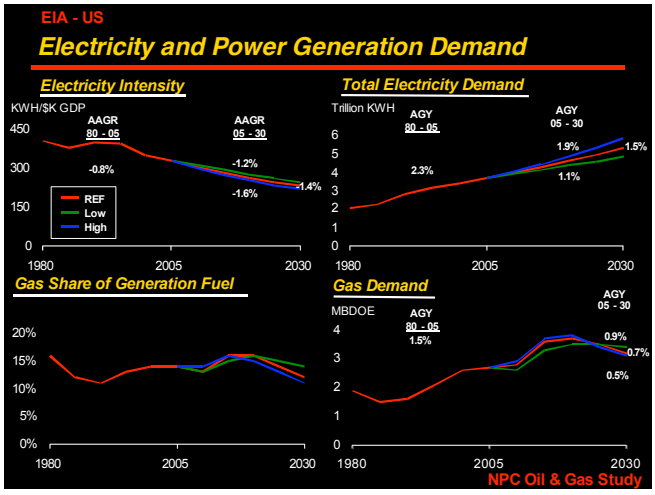

CHART 10B

Coal and Nuclear Demand

The projected growth of coal in the world (Chart 11) is faster in the future than in the past in all outlooks except for the Alternative Policy projection where the growth is slightly less than in the past. About two thirds of the growth in coal demand from 2000 to 2030 is in China and India where the economies are growing rapidly and coal is a very economic fuel. Compared with projected world energy growth rates, coal grows faster than energy except for the Alternative Policy projection where coal energy grows at about the same rate. The indication is that coal is expected to gain share of the energy market except when policies are broadly implemented putting a direct cost on CO2 emissions.. Using a conversion factor of 21 million BTUs per short ton, the estimated world use of coal in 2000 is 4.5 billion short tons. The outlooks range from 7.3 to 11.6 billion short tons of demand in 2030.

The IEA projections of future US coal use (Chart 12) growth rates are equal to or less than the historic rate of growth while the EIA projected growth rates are equal to or greater than the historic rate of growth. When compared with projected energy growth rates, the EIA projections indicated an increase in projected US coal use relative to energy use. The IEA projections, however, indicate an increase in share in the Reference case and a decline in share in the Alternative Policy projection. Using a conversion factor of 21 million BTUs per short ton, the estimated US use of coal in 2000 is 1.14 billion tons. The outlooks range from 1.19 to 1.94 short tons of demand in 2030.

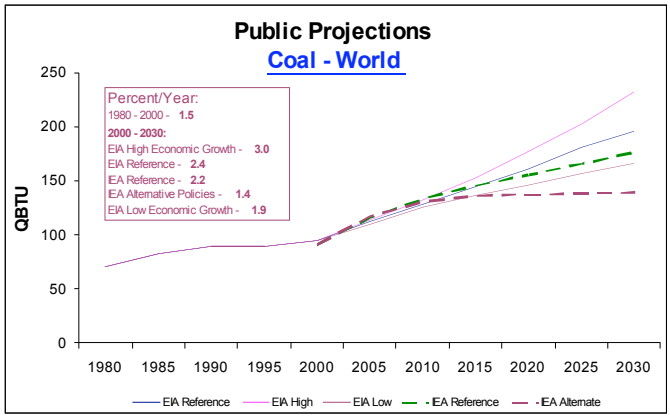

Chart 11

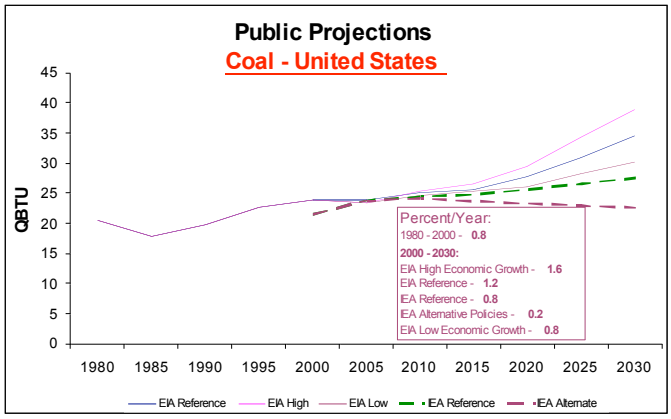

Chart 12

Coal demand in the US is primarily for power generation. For the three EIA cases the projected increase in coal share for power generation fuel can be seen on the upper right of Chart 12A This is the result of favorable economics for new coal versus gas fueled power plants long-term assuming no direct costs for CO_2 emissions.

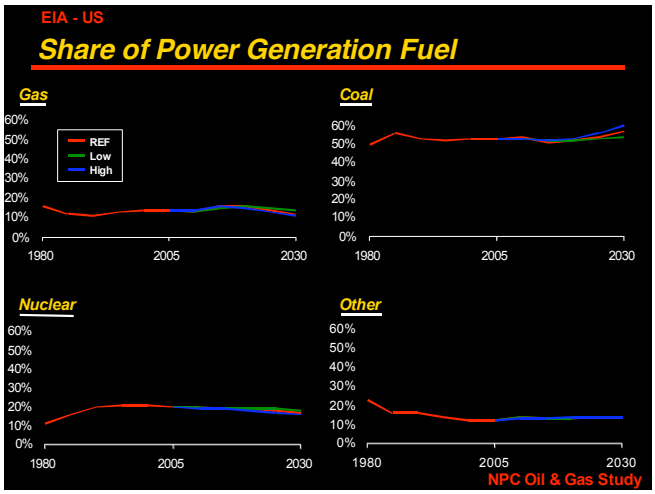

CHART 12A

Projections of the growth in use of nuclear fuels are less in the future than past growth in all of the outlooks (Chart 13). One of the limits on future growth in nuclear in the cases other than the Alternative Policy case appears to be the assumed closing of nuclear plants when their permitted life is reached. Even in the Alternative Policy case where nuclear initiatives are included, the growth in nuclear fuel use is at a slower rate than in the past. However, the nuclear fuel use growth in the Alternative Policy case is slightly greater than total the energy growth rate for that case indicating a slight increase in share of total world energy supplied by nuclear in 2030.

While the specific numbers, both absolute and growth rate for the US projections (Chart 14) are different from the world outlook, the implications are the same. While the electricity produced by nuclear in the US is projected to increase through 2030, a continued slow

decrease in share is expected as shown on the bottom left of Chart 12A. It appears that a major shift in the nuclear policy initiatives will be required to result in the share of nuclear energy use increasing.

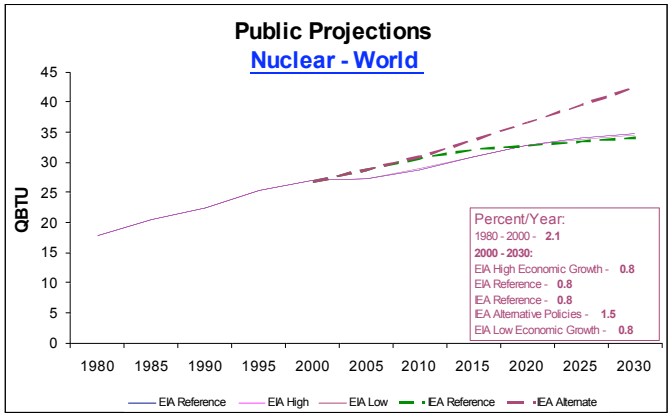

Chart 13

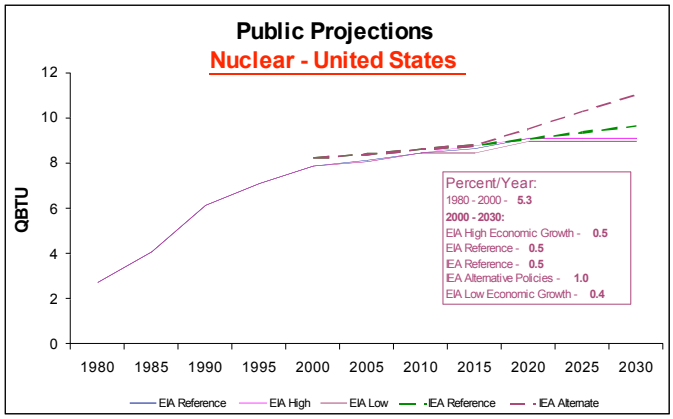

Chart 14

Demand Fuel Share

From a fuel share perspective, world projected share (Chart 15) of total energy demand for oil is lower in all cases while gas and coal share is generally higher in 2030 relative to 2000. Nuclear as a share of total energy is lower in all projections except for the Alternative policy case where it essentially maintains its 2000 share. Other energy sources (hydro, biofuels, wind, solar, etc.) are higher in share in 2030 than in 2000.

In the US, oil's projected share of demand (Chart 16) ranges from slightly above its share in 2000 to slightly below the 2000 share. Gas share is essentially the same as 2000 in the EIA cases and is less in the IEA cases. The projected share of coal in the 2030 energy mix is equal to or less than its 2000 share in all outlooks. Nuclear energy's share of total energy is essentially unchanged between 2000 and 2030 except in the Alternative policy case where it is higher as a result of policy initiatives.

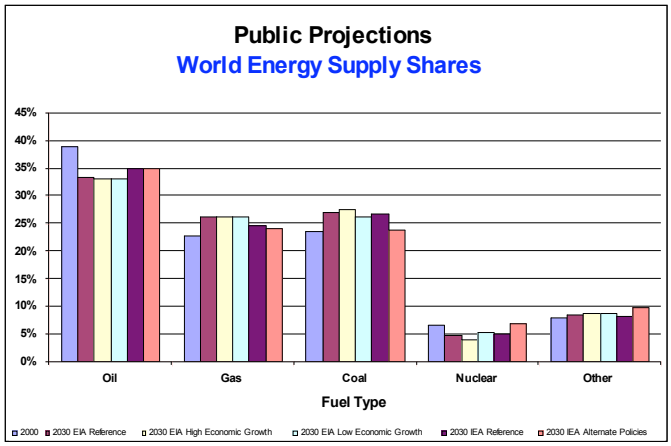

Chart 15

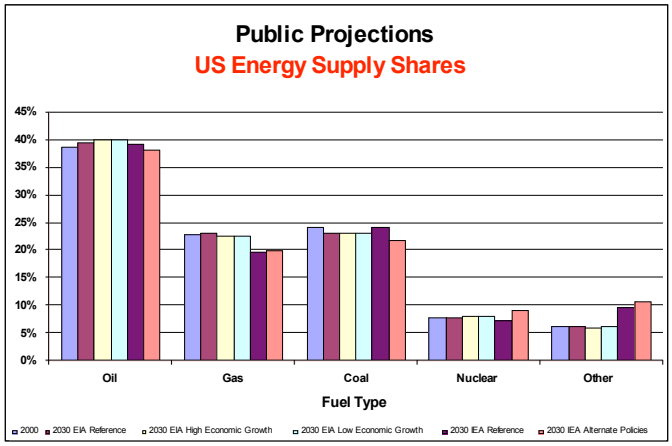

Chart 16

The EIA Reference Case for the US provides a more detailed breakdown of energy demand than most of the other cases. US demand broken by oil, gas, coal, and other is shown on the left of Chart 16A. Other is broken down further and the scale of the graph is expanded on the right. Hydro is projected to grow about 0.5% per year through 2030 restrained by the limited availability of new sites. Wind, Solar and Biomass combined are projected to have the fastest growth rate at 2.5% per year through 2030 growing from ~3% to ~5% of total energy. Biomass for energy in the US is primarily from the municipal solid waste used for electricity generation and wood waste used for energy in the Industrial sector.

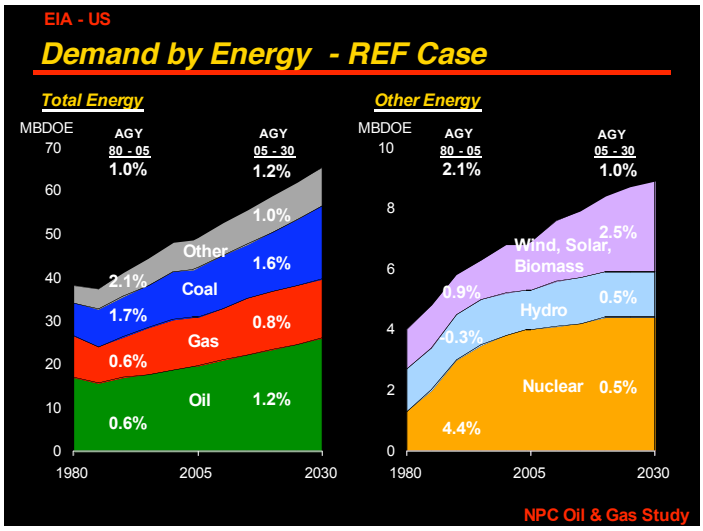

CHART 16A

Carbon Dioxide Emissions

Carbon dioxide emissions are projected to grow worldwide (Chart 17) in all of the outlook projections. In 2000 the EIA reported worldwide carbon dioxide emissions from energy consumption activities at 24 billion metric tonnes. The 2030 projected carbon dioxide emissions range from a low of 34 billion metric tons in the EIA Alternative Policies case to a high of 51 billion metric tons in the EIA High Economic Growth case.

US carbon dioxide emissions (Chart 18) are also predicted to grow in all projections although not at as fast a rate as the world. In 2000 the US carbon dioxide emissions as reported by the EIA were about 5.8 billion metric tons. The IEA Alternative Policies projection of carbon dioxide emissions is the lowest in 2030 at 6.3 billion metric tons while the EIA High Economic Growth case projection is for 9.0 billion metric tons of carbon dioxide emissions.

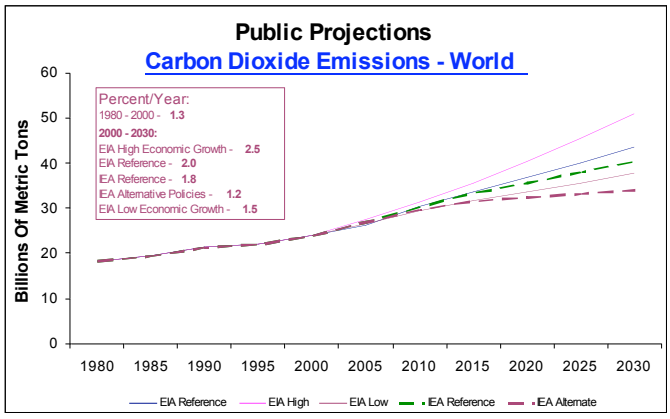

Chart 17

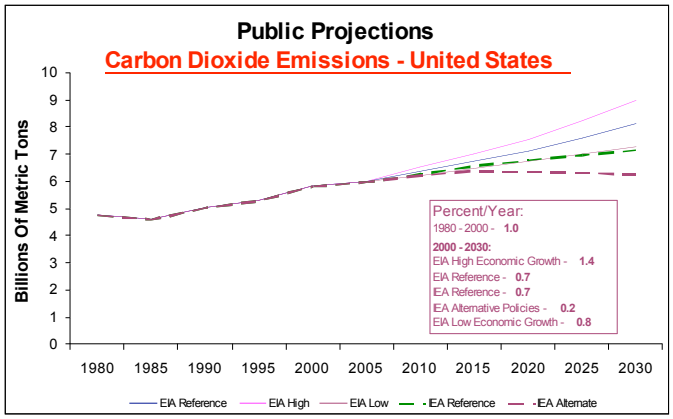

Chart 18

Energy Intensity and Energy Use Per Capita

Table 2 shows the regional shift in energy use contained in the IEA public outlook projections. EIA regional shares are similar to those indicated in the IEA projections. The 2030 column provides the range of outcomes for each region. North America and OECD Europe are projected to lose share while Asia/Oceania exhibits the largest share growth of all the regions. China is the major contributor to the large growth in Asia/Oceania share. Non OECD Europe and Eurasia's share of total world energy is essentially unchanged to modestly declining over the period while other regions generally show small projected growth in world energy share.

Regional Energy Shares (%):

	2000 IEA	2030 IEA Ref	2030 IEA Alt. Pol.
North America	27%	21%	22%
Central and South America	5%	5%	5%
OECD Europe	18%	13%	13%
Non OECD Europe & Eurasia	10%	8%	8%
Middle East	4%	6%	6%
Asia/Oceania	31%	41%	40%
Africa	5%	6%	6%

Table 2

Table 3 shows the projected shift in the regional shares of oil use by region. In general the expected shift in oil share use by region parallels that of energy with industrialized regions losing shares of oil use in the projected future while Asia/Oceania use of oil is expected to increase significantly.

Regional Oil Shares (%):

	2000 IEA	2030 IEA Ref	2030 IEA Alt. Pol.
North America	31%	27%	27%
Central and South America	6%	6%	6%
OECD Europe	20%	14%	14%
Non OECD Europe & Eurasia	6%	6%	5%
Middle East	6%	9%	9%
Asia/Oceania	28%	35%	35%
Africa	3%	4%	4%

Table 3

Energy Intensity

Table 4 depicts energy intensity (energy consumption per economy unit) changes anticipated in the various projections. All regions show a projected decrease in energy intensity. The Middle East, while not exhibiting the highest energy intensity in 2000, is projected to be at the highest energy intensity level in 2030 in all projections.

Regional Energy Intensity (1000 BTUs/2000$ GDP) :

	2000 IEA	2030 IEA Ref	2030 IEA Alt. Pol.
North America	9.51	6.18	5.68
Central and South America	6.53	4.88	4.30
OECD Europe	6.49	4.35	4.06
Non OECD Europe & Eurasia	21.27	9.40	8.51
Middle East	15.23	12.04	10.15
Asia/Oceania	8.04	4.64	4.14
Africa	12.00	7.07	6.41

Table 4

Energy Use Per Capita

The following table, Table 6, is a measure of energy use per unit of population by region. North America was the region exhibiting the highest energy use per person in 2000. That is still the case at the end of the projection period. All other regions are projected to exhibit an increase in energy consumption per person by the end of the projection period under Reference Scenario conditions. The EIA Reference Scenario situation is similar to that of the IEA. Growth in energy use per capita is less in the EIA Alternative Policies Scenario with North America and Africa exhibiting a decline.

Regional Energy Per Capita (Million BTUs/Person) :

	2000 IEA	2030 IEA Ref	2030 IEA Alt. Pol.
North America	265.97	273.22	250.94
Central and South America	44.02	58.27	51.30
OECD Europe	136.86	154.86	144.46
Non OECD Europe & Eurasia	116.67	178.53	161.57
Middle East	95.85	143.86	121.29
Asia/Oceania	36.62	62.59	55.81
Africa	25.46	26.59	24.12

Table 6

Aggregated Proprietary Data and Other Outlook Analyses

Part of the study effort involved collecting energy demand projections from organizations other than the EIA or the IEA. These projections were proprietary and, therefore, were collected by a third party with data made available to study participants on an aggregated basis. Twenty one organizations submitted 29 projections. The projections were averaged on and international oil company (IOC) basis, a consulting company basis (Cons), and a total submission basis.

The results of the aggregated proprietary data collection effort confirmed that the use of the EIA and IEA projections was reasonable. As can be seen on Chart 19, the aggregated proprietary projections for all three levels of the total submissions output (average of the two highest submissions, average of the two lowest submissions, and the average of all submissions) fall generally in the range of the EIA and IEA projections for total energy. The same is true for all the major energy types.

For the US situation there were an insufficient number of submissions to provide a high and low average. Chart 20 shows that the average for the proprietary data is in the range of the EIA and IEA projections for total energy. Similar observations hold for major energy types.

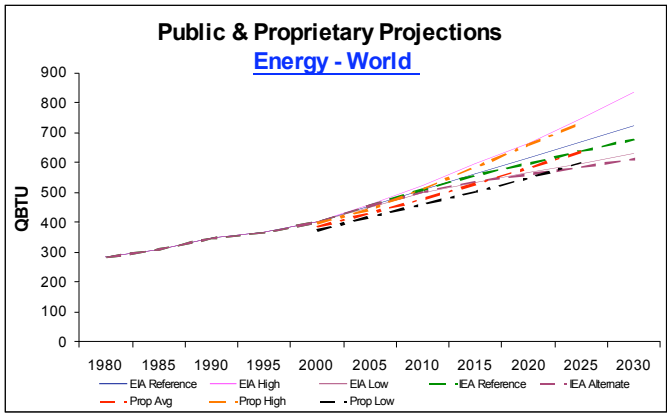

Chart 19

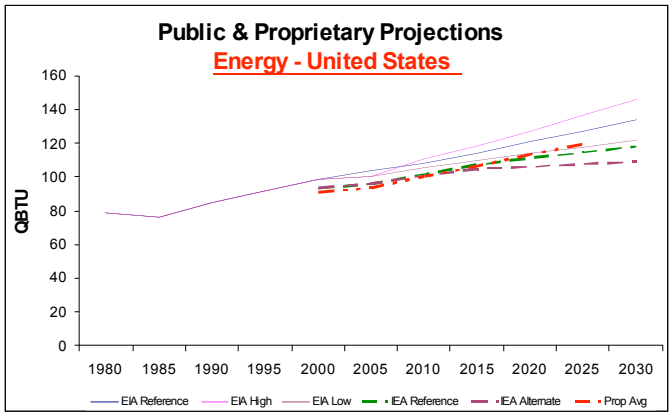

Chart 20

Other studies were provided to the study effort as public projections. Generally the information in these studies was in less detail than provided in the EIA and IEA studies. There were other organizations that had sufficient data available to provide partially complete data input templates. The other studies support the finding that the EIA and IEA projections provide a reasonable range of results for assessing energy issues. With the exception of the IEA Alternate Policies Case, policy assumptions underpinning the projections are extensions of polices in place today. It is interesting to note that projections with lower energy demand growth rates are based on lower economic growth rates. As an example of the congruence of study results, the energy and carbon dioxide growth rates are shown in Table D-III-3. There were other projections that were submitted or captured in other efforts with insufficient definition of underlying bases or detail.

Table D-III-3. Comparison of Growth Rates from 2004 to 2030

Outside Studies Comparison				
	World	World	World	World
Growth rate 2030/2004 - percent per year	Economy	Population	Energy	CO_2
Energy Information Administration - reference	3.7%	1.0%	1.9%	2.0%
Energy Information Administration - low economic	2.9%	1.0%	1.4%	1.4%
Energy Information Administration - high economic	4.5%	1.0%	2.5%	2.6%
International Energy Agency - reference	3.7%	1.0%	1.6%	1.7%
International Energy Agency - alternative policy	3.4%	1.0%	1.2%	1.0%
European Commission	3.1%	0.9%	1.7%	1.6%
Institute of Energy Economics, Japan	3.1%	1.0%	1.7%	1.8%
Greenpeace & European Renewable Energy Council	3.1%	0.9%	1.4%	1.5%
U.S. Climate Change Science Program - MERGE	2.6%	0.8%	1.0%	1.2%
U.S. Climate Change Science Program - MINICAM	2.3%	0.9%	1.7%	1.5%
U.S. Climate Change Science Program - IGSM	3.1%	1.0%	1.9%	2.1%

The Petroleum Federation of India (PFI) provided a series of outlooks for India. These projections offer perspective on the expected Indian energy situation. The data are limited, but there is sufficient information to look at the 2020 energy mix. The PFI total energy projection has an indicated 2004 to 2020 energy demand growth rate of 3.3 percent per year for the Business as Usual scenario. This growth rate is slightly higher than the 3.0 and 2.8 percent per growth rates developed in the EIA and IEA Reference cases, respectively. One of the differences between the projections is in petroleum demand where the PFI projection has an indicated 2004 to 2020 growth rate of 4.7 percent per year while the other two projections have indicated growth rates of 2.6 to 3.2 percent per year. Offsetting this difference, to some extent, is the lower growth in coal use expected by PFI relative to the other projections.

McKinsey Global Institute conducted a study in November 2006 that approached the issue of the potential for energy savings (*Productivity of growing global-energy demand: A microeconomic perspective*). The study provides an assessment of potential savings without regard for time frame necessary to achieve the estimated savings or the practicality of achieving the possible savings. The McKinsey study used 2020 as its horizon year. As indicated in Table D-III-4, the McKinsey study suggests that essentially all of the U.S. energy growth and about 75 percent of the world energy growth between 2003 and 2020 could be recovered by efficiency/conservation measures assuming they could be instituted within the time period. The McKinsey study adds support to the NPC study recommendations that efficiency/conservation measures are an important piece of providing a balanced U.S. energy program.

Table D-III-4. Comparison of Data from McKinsey Global Institute and EIA

McKinsey Global Institute - Productivity of growing global-energy demand: A microeconomic perspective				
	McKinsey		EIA	
	US	World	US	World
Energy consumption:				
2003 - quadrillion BTUs	92	422	101	433
2020 - quadrillion BTUs	113	615	121	613
Growth - percent per year	1.2%	2.2%	1.0%	2.1%
2020-2003 - quadrillion BTUs	21	193	19	181
McKinsey potential 2020 reduction				
Low estimate - quadrillion BTUs	19	117	19	117
High estimate - quadrillion BTUs	27	173	27	173
Percent of 2003 to 2020 growth				
Low - percent	90%	61%	99%	65%
High - percent	129%	90%	140%	96%

The EIA in preparing the International Energy Outlook (IEO) uses the Annual Energy Outlook as a major source of U.S. data. The EIA released an updated version of its Annual Energy Outlook during the first quarter of 2007. Table D-III-5 contains a 2004 to 2030 growth rate comparison between the 2006 and 2007 Annual Energy Outlooks. There are only minor differences between the two projections, which suggests that the overall analysis which uses the 2006 International Energy Outlook is basically unchanged as a result of the recently released EIA U.S. outlook. Data availability issues have lead to some of the analyses that support various components of the demand effort being based on the 2007 Annual Energy Outlook, which should not present any difficulties.

Table D-III-5. Comparison of 2006 and 2007 EIA Annual Energy Reference Case Outlooks' (U.S.) 2004 to 2030 Growth Rates (Percent per Year)

	AEO 2006	AEO 2007
Primary Energy		
Petroleum Products	1.1%	1.0%
Natural Gas	0.7%	0.6%
Coal	1.7%	1.6%
Nuclear	0.4%	0.5%
Other	1.7%	1.6%
Total (calc)	1.1%	1.1%
Total (report)	1.1%	1.1%
Sectors		
Residential	0.8%	0.7%
Commercial	1.6%	1.6%
Industrial	0.9%	0.7%
Transportation	1.4%	1.3%
Electric Generation	1.3%	1.2%
Subtotal	1.2%	1.1%
Electricity	1.6%	1.4%
Total	1.1%	1.1%
Gross Domestic Product	3.0%	2.9%

The EIA released the 2007 version of the International Energy Outlook (IEO 2007) on May 21, 2007. IEO 2007 suggests no changes in the overall demand related conclusions of the National Petroleum Council Global Oil and Gas Study. However, there are some interesting differences between IEO 2006 and IEO 2007 that should be noted. A comparison between the two Reference Case outlooks is shown in Table EF.

World economic growth is higher in IOE 2007. From a regional perspective, the major differences are in Asia/Oceania where faster economic growth is projected and in North America where slower economic growth is projected. All other regions show a greater growth in economy than in IOE 2006 with the Non OECD Europe and Eurasia region projected difference slightly greater than in other regions.

While the economic growth projections used as a basis for IEO 2007 are generally greater than in IEO 2006, energy growth projections are equal or less than they were in IEO 2006. This suggests that the energy efficiency/conservation assumptions underpinning IEO 2007 are greater than in IEO 2006. Energy intensities (energy use per unit of economic activity) calculated from the two outlooks show that in all regions except North America energy intensity is lower in IEO 2007.supporting the idea that there is more energy efficiency/conservation incorporated in IEO 2007 than in IEO 2006.

The projected regional energy consumption pattern in IEO 2007 is little different than in IEO 2006. The biggest difference is in Asia/Oceania where projected 2030 share energy use share increased from 37.6 percent to 39.2 percent.

From an energy consumption type perspective, the most significant difference appears to be a lower projection of world natural gas use. Both nuclear and coal use are projected to be higher. There was an accounting convention change between the two outlooks in the way in which renewable liquids were handled. In IEO 2007 liquids from renewables are shown as petroleum liquids instead of as other. This change accounts for most of the reduction in other energy use, but suggests that petroleum liquids from more traditional sources is somewhat lower in IEO 2007 than in IEO 2006.

An output from both projections is an estimate of carbon dioxide emissions. In 2030 the estimate for Reference Case carbon dioxide emissions was 43,676 million metric tons. The IEO 2007 carbon dioxide emissions estimate for 2030 is 42,880 million metric tons.

Table EF: IEO 2007 and IEO 2006 Reference Case Comparison

EIA International Energy Outlook 2006 versus 2007
(Reference Case)

	2003 – 2030		2030	2030	Difference 2007-2006	2030	2030
	%/Yr IEO 2006	%/Yr IEO 2007	Share % IEO 2006	Share % IEO 2007	QBTU	Intensity IEO 2006	Intensity IEO 2007
Primary Energy							
Petroleum Products	1.4%	1.4%	33.1%	34.1%	-0.2		
Natural Gas	2.4%	2.0%	26.3%	24.3%	-19.5		
Coal	2.5%	2.6%	27.1%	28.4%	3.6		
Nuclear	1.0%	1.5%	4.8%	5.7%	5.0		
Other	2.4%	1.8%	8.6%	7.6%	-8.9		
Total	2.0%	1.9%	100.0%	100.0%	-20.0		
Regions (Energy)							
North America	1.3%	1.2%	23.0%	23.0%	-4.6	5.99	6.01
OECD Europe	0.7%	0.5%	13.1%	12.7%	-5.3	4.87	4.48
Central and South America	2.8%	2.4%	6.3%	5.9%	-4.3	5.49	4.67
Middle East	2.5%	2.5%	5.2%	5.4%	0.5	9.23	9.03
Non OECD Europe and Eurasia	1.8%	1.4%	10.9%	10.2%	-7.5	8.60	7.24
Africa	2.6%	2.3%	3.7%	3.5%	-1.9	3.85	3.36
Asia/Oceania	3.1%	3.1%	37.6%	39.2%	3.2	4.20	3.56
Total	2.0%	1.9%	100.0%	100.0%	-19.9	5.14	4.55
Gross Domestic Product - billion $2000					B $2000		
North America	3.1%	2.9%	19.8%	17.4%	-849		
OECD Europe	2.2%	2.3%	13.8%	12.9%	519		
Central and South America	3.8%	4.0%	5.9%	5.7%	541		
Middle East	4.2%	4.3%	2.9%	2.7%	145		
Non OECD Europe and Eurasia	4.4%	4.7%	6.5%	6.4%	691		
Africa	4.4%	4.6%	5.0%	4.8%	438		
Asia/Oceania	4.8%	5.5%	46.1%	50.0%	12498		
Total	3.8%	4.2%	100.0%	100.0%	13983		

Potential Policy Options

Review of the information developed as part of this analysis suggested several potential policy options which are listed below.

- Energy data collection efforts around the world should be expanded to provide data in a consistent fashion via the IEA
- EIA should use the IEA as its source for historical energy demand data outside the US
- The IEA should be encouraged to provide its outlook in greater detail than the summary tables provided at the back of the WEO book

- Both the EIA and IEA should be encouraged to better document the assumptions underlying their demand projections
- Development and use of economic activity feedback projection techniques should be encouraged to aid in evaluation of critical policies such as a carbon tax or constraint
- The rapid growth of energy demand in India and China presents a significant challenge to future world energy markets. Support outreach programs to encourage and assist these countries in reducing uncertainties in their energy data reporting
- Policies promoting safe nuclear plant license renewal and new construction should be evaluated

- Energy data collected by EIA and IEA could be expanded to provide additional sources of consumption data for inclusion in annually prepared public domain energy outlooks
- The duplication of energy modeling across many parts of the US Government should be evaluated to determine if consolidation can reduce costs while improving the quality and consistency of the modeling activity.

End: