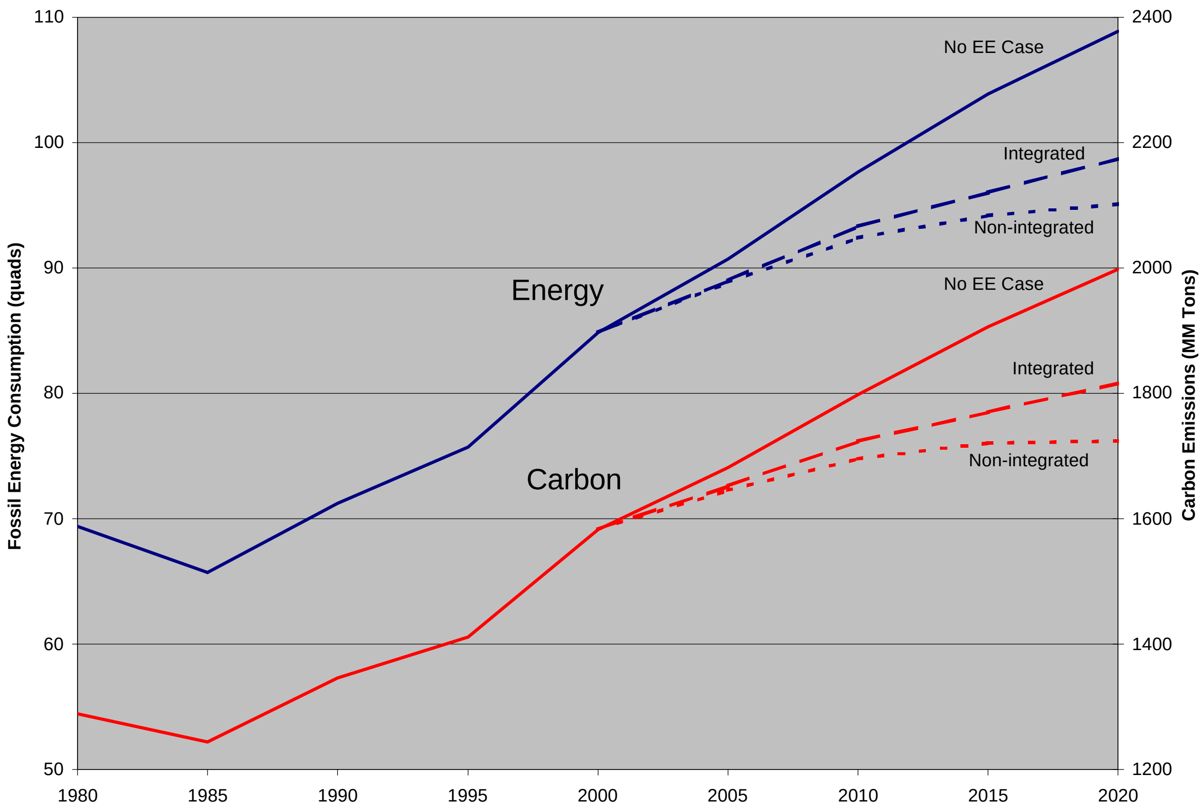
Projected Benefits of Federal Energy Efficiency and Renewable Energy Programs

FY 2001 – FY 2020



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Office of Energy Efficiency and Renewable Energy

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Contents

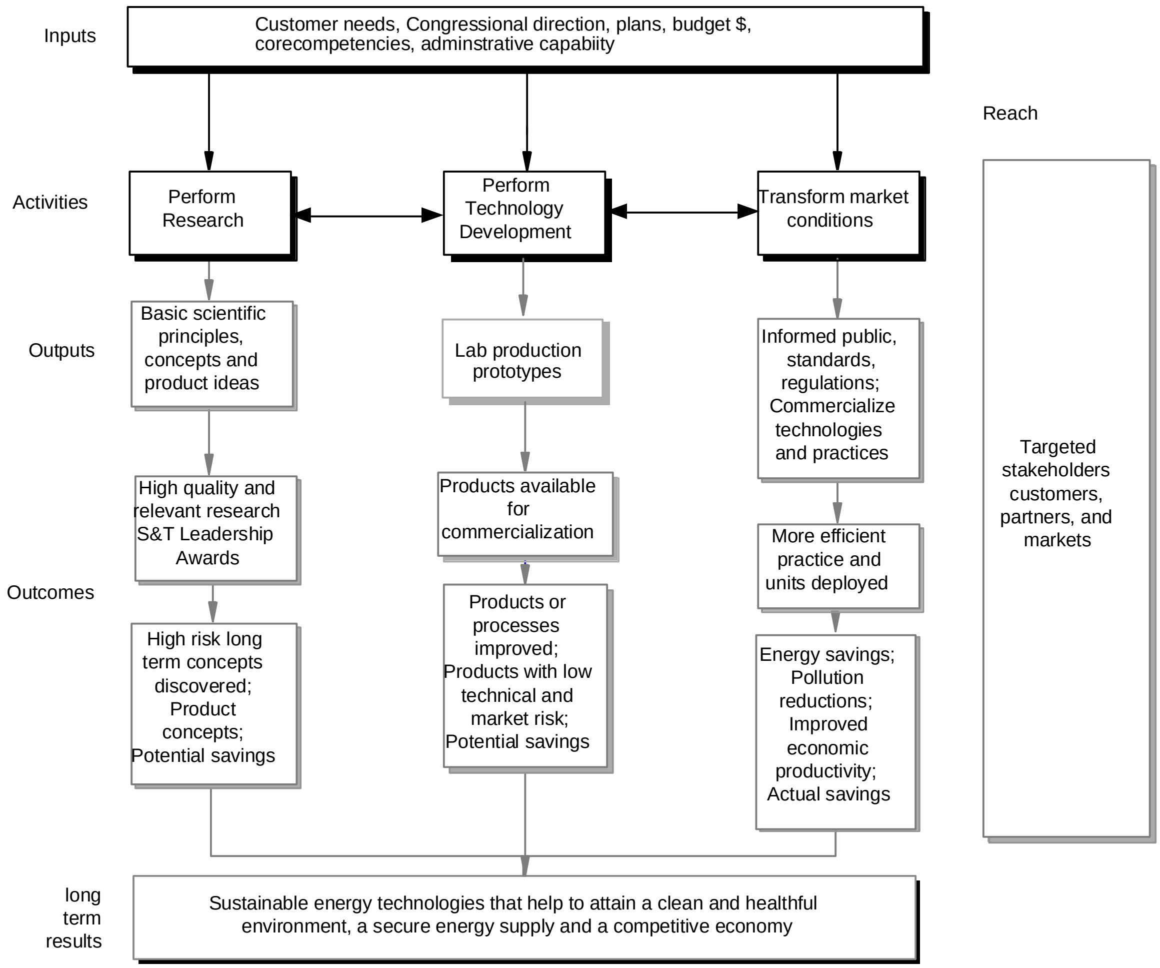
Introduction

This report summarizes the results of the Office of Energy Efficiency and Renewable Energy's (EERE) annual GPRA data call for Fiscal Year 2001. The Government Performance and Results Act of 1993 (GPRA), part of a world-wide performance measurement movement, is the U.S. federal government's response to concerns over limited federal resources and lack of agency accountability. GPRA requires federal agencies to develop a strategic plan, an annual performance plan, and an annual performance report. EERE's role in meeting these requirements is to provide information for the Department of Energy's strategic plan, performance plan, and performance report. The GPRA data call provides key information for these and other documents that communicate the benefits of EERE's programs as well as for internal management needs.

The current data collection effort has its roots EERE’s 1993 Managing for Results activity. The purpose of Managing for Results was to collect benefit and cost information on EERE’s programs to assist in funding decisions. In 1994 Managing for Results was renamed Quality Metrics. In 1995 near term (five year) performance measures (PM) were added to the FY1997 data collection to support the long term quality metrics and the process renamed the Quality Metrics/Performance Measures (QM/PM) data call. In 1997 the FY1999 data call attempted to improve the links between near-term performance measures and long-term quality metrics by requesting the technology and market penetration assumptions used in calculating long-term benefit estimates. The FY1999 data call was also the first used to meet GPRA requirements and was therefore renamed the GPRA Data Call. The FY2001 data call was streamlined by requesting that performance measurement information be placed directly in the budget. This included the development of "trended" performance measures, that is, performance measures that are quantitative, consistent from year to year, and could be displayed graphically.

Understanding EERE’s data collection process first requires a general familiarity with EERE. The logic behind how EERE turns resources into benefits is presented in Figure 1. EERE collaborates with scientists, consumers, suppliers, industry officials, and other government organizations to perform research, develop new and improved products and processes, and provide policy, standards, technical tools and information that will accelerate and expand the adoption of energy efficient and renewable energy technologies. The adoption of these technologies will result in energy savings, increased use of alternative energy sources such as wind and solar, which means a cleaner, healthier environment, and less dependence on imported oil. The office is structured around the end-use sectors for which its technologies are developed: buildings, industry, and transportation, as well as the power sector and the federal government.

Figure 1: Sample EE Logic Chart



Data Collection, Review and Analysis Process

The annual process for obtaining projected benefits and performance measures occurs over approximately a nine month period, starting in April and ending in January. In April EERE's Office of Planning, Budget and Management (OPBM) begins development of a data call or survey instrument. A draft instrument is distributed to EERE's five sectors for review, with comments incorporated into a final instrument that is distributed in June.[1] Sectors have about three months to submit their initial response to OPBM. After initial responses are received, about one quarter of the planning unit responses are reviewed by external experts from October through December.[2] Planning unit responses are also used in an integrated analysis that accounts for the interaction effects across sector programs. The integrated analysis is completed in early December. Final projected benefits and performance measures are then placed in the EERE budget request and help form EERE's portion of the Department's Performance Plan and Performance Agreement with the President[3]. The survey instrument, sector non-integrated analyses, external review, and integrated analysis for FY2001 are described below.

Survey Instrument

The survey instrument developed for Fiscal Year 2001 requested the following information:

- Inputs: projected resources
- Outcomes: projected energy, environmental and financial impacts
- Assumptions: technology characteristic, market penetration, and other

Near-term milestones, collected in previous data calls, were not requested in the FY2001 data call but were collected as part of the FY2001 budget process. Trended performance measures and accomplishments were also collected as part of the FY2001 budget process.

Projected Resources

Resources significantly impact the ability of planning units to achieve their goals. Therefore, information was requested on the level of resources used in estimating the planning unit's and impacts. This included funding estimates for FY2001 through FY2005, the percentage of funding allotted to research, development, and deployment, the level of partner investment in the planning unit (both financial and non-financial), and the number of partners with whom the planning unit is projected to collaborate.

Projected energy, environmental and financial impacts

The energy, environmental and financial impacts of planning unit activities are captured by a variety of metrics, as shown in Table 1 below. The metric "total primary energy displaced" represents energy savings for efficiency programs and energy produced for renewable programs.

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[1] See Appendix A for a copy of the FY 2001 survey instrument.
[2] See Appendix C for a copy of ADL's review report.
[3] See Appendix B for a copy of planning unit responses and sector totals (reflecting changes made after ADL review)

The environmental and financial impacts are largely derived from the amount of primary energy displaced.

Table 1: Energy, environmental and financial metrics

Energy	Environmental	Financial
Total Primary Energy Displaced	Carbon Equivalent Emissions Displaced	Energy Costs or Savings
Direct Electricity Displaced	CO Displaced	Non-Energy Costs or Savings
Direct Natural Gas Displaced	Other Greenhouse Emissions Displaced	
Direct Petroleum Displaced	SO2 Displaced	
Direct Coal Displaced	NOx Displaced	
	Particulates Displaced	
	PM10 Displaced	
	VOCs Displaced	
	HCs Displaced	
	Other Environmental Benefits	

Assumptions

Assumptions used in calculating energy, environmental and financial impacts were also requested. Although no set format was requested, planning unit assumptions generally included market penetration estimates, technology performance levels, and technology cost. The Energy Information Administration's Annual Energy Outlook 1999 served as a baseline scenario for: a) energy prices; b) residential, commercial, industrial, transportation, and utility sector technology projections; and c) energy consumption by industry. To ensure uniformity across programs, projections were provided for electricity heat rates and electricity carbon emission factors. These were derived by running a side case in the National Energy Modeling System (NEMS), which identified the changing electricity fuel mix given a reduction in electricity demand. Non-electricity heat rates and carbon emission factors were also provided.

Sector Non-integrated Analyses

The survey instrument was distributed in June 1999 to EERE's five sectors – Office of Building, State and Community Programs (BTS), Office of Industrial Technologies (OIT), Office of Power Technologies (OPT), Office of Transportation Technologies (OTT), and the Federal Energy Management Program (FEMP). Responses were received from 42 planning units across the five sectors. Each sector analyzed the impacts of its programs in a slightly different manner. A brief description of each analysis is provided below.

BTS developed characterizations for each of its programs. These include information on target market, market introduction, market penetration goal, consumer cost of conventional and BTS technology, and non-energy cost of conventional and BTS technology. These characterizations were used to develop inputs into the Building Energy Savings Estimation Tool (BESET) and the National Energy Modeling System (NEMS). Benefit estimates were generated using BESET (for non-equipment programs and equipment programs not easily characterized in NEMS) and NEMS (for equipment programs and technologies). For more information on BTS' methodology see *BTS Program Characterization Summaries - FY 2001 GPRA Metrics Effort* prepared by Donna Hostick (PNNL), September 10, 1999.

For its R&D programs, OIT used an experience-based market penetration model designed to estimate the national energy, economic and environmental impacts of innovative industrial technologies. For each R&D project a market penetration curve was selected from a handful of market penetration curves derived from historical analyses. Model runs for individual R&D projects were aggregated to obtain impact estimates for each planning unit. Typically, the projects analyzed represented 45 to 90 percent of the FY 2001 budget for the various planning units. Impacts of the technical and financial assistance planning units were assessed based on retrospective analysis of performance data accumulated over a period of years. Impact estimates assumed that continuation of the programs will result in beneficial impacts proportional to documented experience at historical budget levels. For more information on OIT's methodology see *GPRA 2001 Quality Metrics Methodology and Results: Office of Industrial Technologies* prepared by Energetics Incorporated for the Office of Industrial Technologies, April 20, 2000.

The OTT analysis included assumptions about the future costs and characteristics of alternative vehicles and fuels. Computer models that take into account the value that vehicle buyers place on various vehicle characteristics were used to estimate the market penetration of new vehicle technologies. Energy, environmental and financial impacts were derived from these market penetration estimates. Five analytical tools were used to calculate the various projected OTT program benefits: the Vehicle Size/Consumer Choice (VSCC) Model, the Integrated Market Penetration and Anticipated Cost of Transportation Technologies (IMPACTT) Model, the Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) Model, the Heavy Vehicle Market Penetration (HVMP) Model, and the Employment Spreadsheet Model (ESM). Outputs from some of these models become inputs to some of the others. For more information on OTT's methodology see *Program Analysis Methodology: Office of Transportation Technologies Quality Metrics 2001 Final Report* prepared by the OTT Analytic Team, February 23, 2000 available at http://www.ott.doe.gov/facts/program_impact.htm.

OPT used several different approaches for its two broad research areas, renewable energy technologies and electricity delivery. For the renewable technologies, the National Energy Modeling System (NEMS) was used to estimate future generating technology for the bulk power market. Changes were made to assumptions within NEMS, including the use of technology data from the EPRI/DOE *Renewable Energy Technology Characteristics*. A variety of technology-specific changes were also made, resulting in increased penetration of wind and geothermal technologies as compared to the AEO99 projections. The Green Power Market model was used to project the green power market size and allocate the various OPT technologies using an algorithm similar to that which is used by NEMS. The model performs the allocation using a logit function which uses the various competing technologies' cost of energy to determine which will be chosen by the green power suppliers in a particular region. Customer-sited power projections were also performed for photovoltaics and biomass cogeneration. Different approaches were used for each of the electricity delivery programs (Renewable Energy Production Incentive, Solar Program Support (Competitive Solicitation), Hydrogen, Transmission Reliability, High Temperature Superconductivity, and Energy Storage). For more information on OPT's methodology see *Documentation for FY 2001 GPRA Metrics: Office of Power Technologies* prepared by Princeton Energy Resources International, February 2000.

The FEMP impacts assumed that Federal energy reduction goals (30% reduction by 2005 and 35% reduction by 2010) were going to be met.

External Review

For the past five years EERE has had external experts review a portion of the planning unit responses. Fourteen planning units were selected for the FY2001 review, based on whether they had large expected energy savings, had not been previously reviewed, were impacted by significant changes from last year's analysis (e.g., new initiatives), and had high visibility[4]. The fourteen planning units reviewed for FY2001 include:

Office of Building Technology and State/Community Programs (BTS)
- Community Energy Program
- Technology Roadmaps and Competitive R&D
- Weatherization Assistance Program

Office of Industrial Technologies (OIT)
- Industrial Assessment Centers
- Inventions & Innovations
- Steel Vision

Office of Power Technologies (OPT)
- Energy Storage
- Hydrogen
- Solar Buildings
- Transmission Reliability

Office of Transportation Technology (OTT)
- Materials Technologies
- Technology Deployment
- Vehicle Technologies - Heavy Vehicle Systems

ADL experts worked with DOE staff to review the estimates and assumptions for each of the planning units. The external review is an interactive, iterative process between the individual planning unit managers and ADL experts, in each case leading to a consensus regarding the final submissions. The ADL review concentrated on three areas:

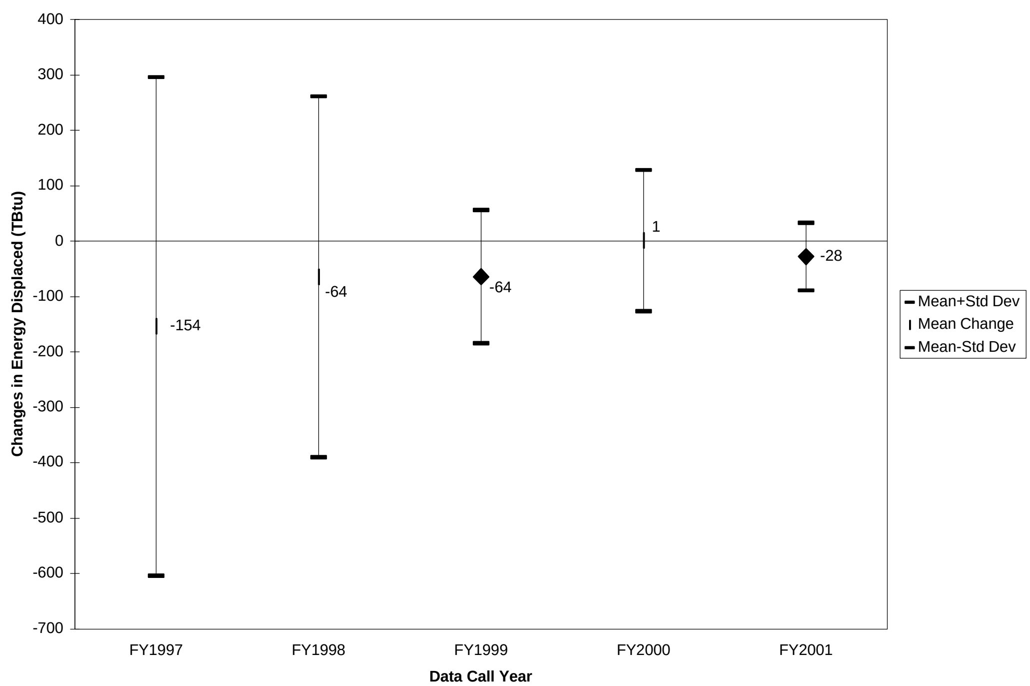
- The energy and emission savings of each technology projected for the years 2005 through 2030, which depend on estimates of market penetration, cost, and performance assumptions for each technology.

[4] See the Arthur D. Little report contained in Appendix B.

- The performance measurements of each planning unit, as contained in the FY2001 budget request. This included milestones and trended performance measures designed to achieve the market penetration, cost, and performance objectives underlying the energy savings metrics.
- Sector accomplishments in terms of energy savings, energy cost savings, and carbon emission reductions.

The discussions between ADL and the sectors resulted in eleven of the fourteen planning units revising their impact estimates. A comparison of these revisions against those made in the previous four years shows that revisions are generally becoming smaller, likely indicating an improvement in EERE's estimates. Figure 2 shows that the average change to planning unit energy displacement figures after the external reviews have declined from -154 TBtu in FY 1997 (i.e., the estimates were reduced by an average of 154 TBtu) to -64 TBtu in FY 1998 and 1999, to -28 TBtu in FY 2001. At the same time, the standard deviation of changes has narrowed from 450 TBtu in FY 1997 to 61 TBtu in FY 2001, reflecting a smaller range of changes across planning units.

Figure 2: Changes in Energy Displacement After External Reviews FY1997-2001



Integrated Analysis[5]

Once initial impact estimates were submitted by each sector, an "integrated set" of impact estimates were developed. The purpose of this assessment is to analyze EE's programs in a consistent economic framework and to account for the interactive effects among the various programs. Sector estimates of the savings for their programs cannot be simply summed to create a value for all of EE. There will be feedback and interactive effects resulting from (1) changes in energy prices resulting from lower energy consumption and (2) the interaction between programs affecting the mix of generation sources and those affecting the demand for electricity.

The National Energy Modeling System (NEMS) was used as the integrated model. The Annual Energy Outlook 1999 (AEO99) version was used as the starting point. Several changes were then made to the model to enhance its ability to represent the EE programs. The most significant changes were the addition of an endogenous building shell efficiency component and the inclusion of the Energy Information Administration's (EIA's) preliminary distributed generation and biomass cofiring structures. Significant parametric changes were made in some sectors, for example the behavioral assumptions for modeling alternative technology vehicles and various parameters affecting the expansion of renewable capacity in the electricity sector. The modified version of the model is referred to as NEMS-GPRA01.

The No EE Case. The baseline forecast, called the No EE Case, is a projection meant to represent the future U.S. energy system without the effect of continued EE programs. The idea is to remove any effects of EE programs that are already included in the AEO99 Reference Case in order to avoid double counting energy consumption reductions. As recommended by the various EE sector offices, the following modifications were made for the No EE Case. For the transportation sector, it was assumed that no advanced gasoline vehicles and no alternative fuel vehicles would be purchased except those mandated in California. Similarly, in the utility sector, it was assumed that there would be no new renewable capacity constructed except as part of state set-asides as represented in the AEO99. The No EE Case includes the modified shell efficiency structure and assumes that part of the shell efficiency improvement in the Residential sector in the AEO99 is attributable to EE programs. No changes were made to the industrial sector for the No EE Case. See the Integrated Modeling for GPRA 2001 report in Appendix D for the No EE Case projected energy consumption by sector and fuel.

Representation of EE Programs. After the No EE Case was established, the EE programs were represented in the various NEMS-GPRA01 modules. Each sector was treated separately to derive estimated energy savings without the interaction of the other sectors' programs[6]. Inputs for the programs were received from the sector offices and their contractors. To the maximum extent possible, the programs were represented through their impacts on technology characteristics, allowing NEMS-GPRA01 to project the market penetration and savings resulting from their development. In some cases, where the model had insufficient technology representation or the programs were of a market deployment rather than R&D nature, projections were based on the program office penetration estimates and NEMS-GPRA01 was used as an accounting tool. A major exception is the treatment of the industrial sector. The OIT programs

[5] The Integrated Analysis description draws heavily from OnLocation's Integrated Analysis report, which is contained in Appendix D.
[6] The modeling of the individual demand models was done using PC stand-alone versions of the module that speed the run time and facilitate data changes.

and technologies are very specialized and beyond the capability of the model to represent. For this sector energy savings were simply input.

Energy savings were estimated at the planning unit level for each sector, except for industry. In this step, the primary savings for electricity were computed using the marginal heat rates supplied in the GPRA Data Call. The use of these heat rates makes the savings directly comparable to the sectors' estimates. The integration with electricity is kept separate and is introduced as part of the integration effect. Preliminary comparison tables were shared with EE, and minor modeling adjustments were made based on their comments. The revised tables are shown in the sector descriptions below.

The full NEMS-GPRA01 model was then run for each of the sector office programs individually. In these scenarios the energy savings include the effect that a single sector's programs have on fuel consumption in the other sectors. For example, reductions in energy usage generally lead to lower energy prices, which may stimulate additional demand, both in the sector that is being analyzed and in all other sectors. The primary energy associated with reduced electricity generation is calculated endogenously within the electricity module. In addition, reductions in oil and gas use affect the energy required for oil and gas production, petroleum refining, and pipeline gas consumption.

Lastly, the full integrated model was run with all programs in all sectors to derive the Full EE Case. The total primary energy savings (fossil and nuclear savings because renewables are not included), carbon savings, and energy expenditures were then allocated to the individual sectors. Because the total savings were not equal to the sum of the individual sectors, they were allocated to the sectors based on the single-sector integrated savings estimates.

Projected Resources FY2001-2005

Each planning unit was asked to project resources for FY2001-2005 including DOE funding, percentage of funding targeted for research, development or deployment (R,D&D), the number of partners, partner financial investment, and partner non-financial investment. Planning unit responses and sector totals are provided in Appendix B. A sector breakdown of DOE funding is provided in Figure 3. This information is taken from EERE's FY 2001 budget request because incomplete budget information was provided in data call responses. (Resource information was not provided by OTT and OPT.) The distribution of FY2001 budget dollars across R,D&D categories is provided in Figure 4 for the three sectors submitting resource data. Definitions for research, development and deployment are contained in the data call provided in Appendix A. The breakdown provided in Figure 4 is estimated to remain relatively stable through 2005.

Figure 3[7]

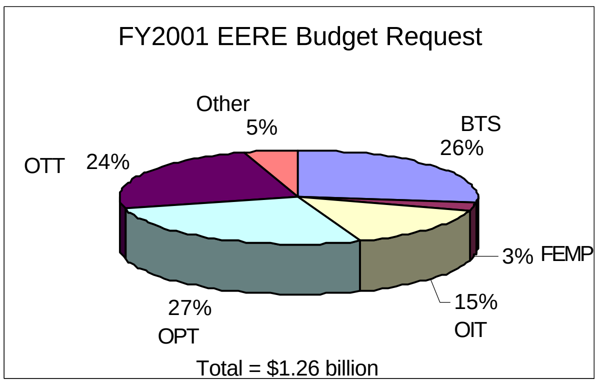
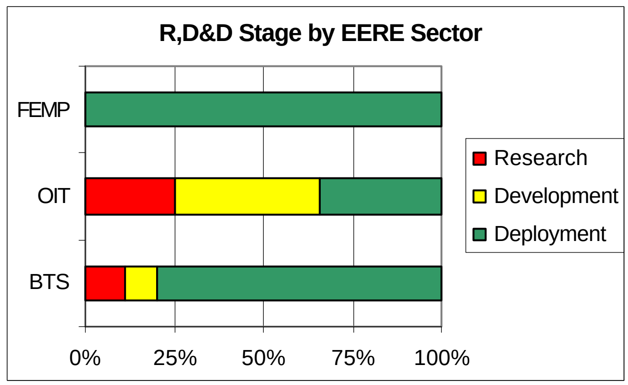
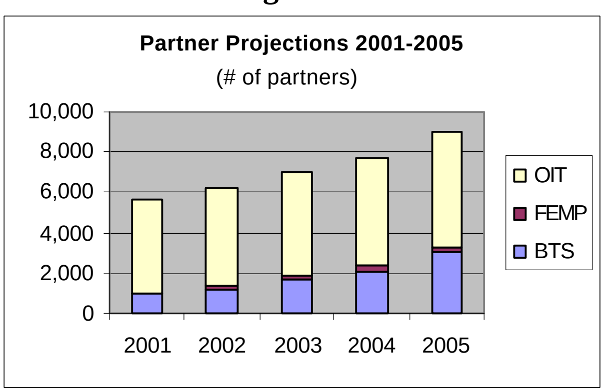


Figure 4



EERE works with numerous partners as it pursues its mission. Partners are a measure of the relevance of EERE's work to outside organizations. While this measure is far from perfect (e.g., the extent of partner involvement is not captured), EERE sees it as an important component of its larger suite of measures. It is estimated that EERE will work with over 5600 partners in FY 2001 – a figure that is expected to grow to over 8900 in 2005 (see Figure 5). No estimates were provided for OPT and OTT. Industrial Assessment Center partners are also not included, but are estimated to be about 13,000 in FY2001.

Figure 5



Another measure of the private sector's interest in EERE's programs is the amount of money partners are willing to invest in their partnerships with EERE. This second measure is important because in some areas EERE is working with a handful of partners, but the partners are making large investments. Partners typically contribute financial and/or non-financial resources. Financial resources represent the amount of money partners are contributing to co-fund or co-deliver an EERE product or service, including related planning activities. Non-financial resources represent the dollar equivalent of equipment, staff, or facilities devoted to the partnership. It is estimated that EERE partners will contribute over $528 million in financial resources and $53 million in non-financial resources in FY 2001 (this excludes financial resources from OPT and OTT partners, which were not estimated). These figures are expected to grow to $1,000 million and $120 million, respectively, in 2005. (See Figures 6 and 7) Given the variation in financial and non-financial estimates across EERE's sectors, it is believed that programs may be measuring these items differently. A closer examination of, and improvement in, these measures is expected for next year.

Figure 6

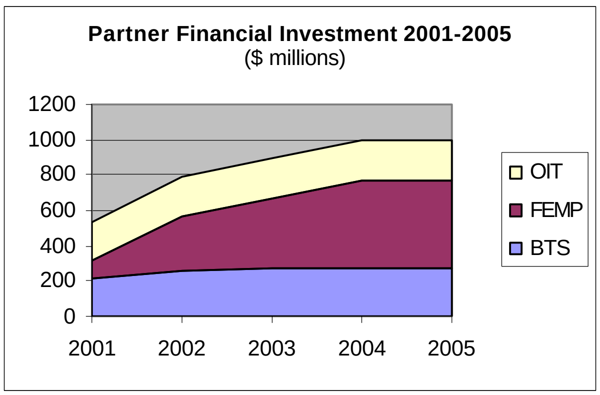
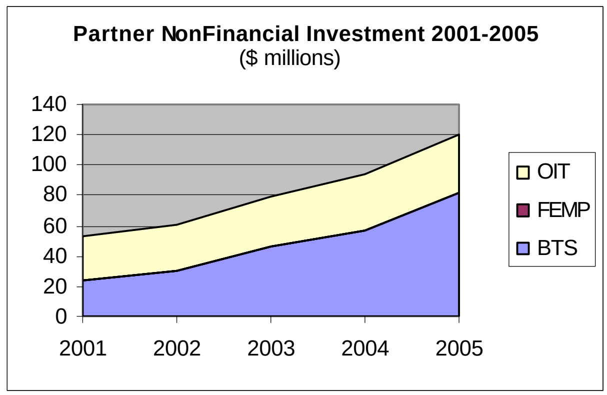


Figure 7



[7] Sector percentages are based on data in EERE's FY 2001 budget request.

Projected Benefits 2005-2020

Planning units were asked to identify the impacts of their programs for the years 2001-2005, 2010, 2015, 2020, 2025, 2030. Estimates through 2020 are described below. Program impact metrics were divided into three areas reflecting the energy, environmental, and financial benefits of EERE programs. A list of the metrics associated with each area is contained in Table 1. Definitions for each may be found in the data call instrument provided in Appendix A.

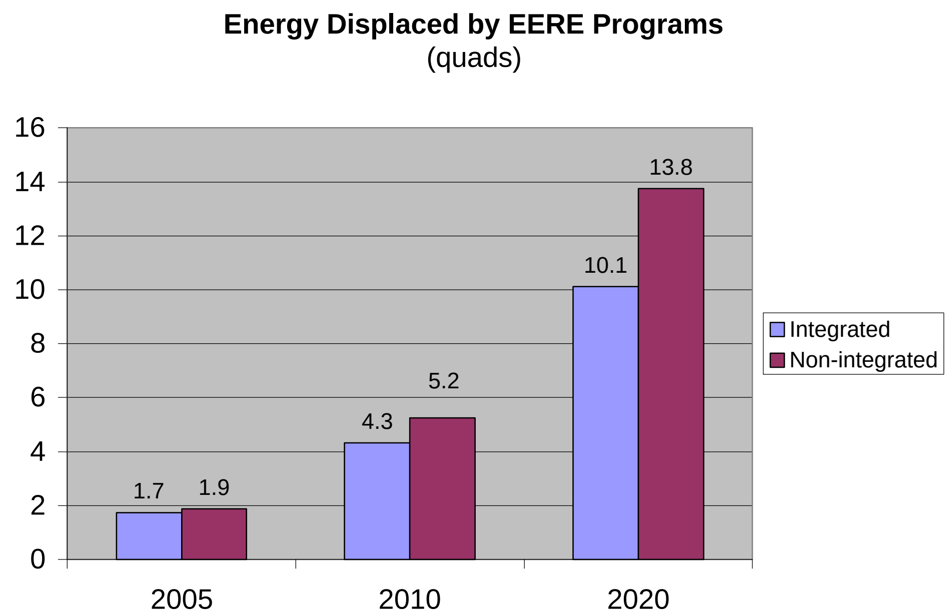
All planning units provided impact data, reports of which are contained in Appendix B. Sector and EERE level impact data are derived from the planning unit data and presented as ranges. Upper ranges are usually the non-integrated aggregations of planning unit analyses while lower ranges are derived from the integrated analysis described earlier. Program benefits are typically lower in the integrated analysis than the non-integrated analyses because inter- and intra-sector double-counting is eliminated, energy efficiency gains reduce the demand for electricity generation, and different models are used. Integrated and non-integrated totals placed in the FY 2001 Budget (Interior) are provided in Table 3. Figures 8-13 depict the integrated and non-integrated estimates for 2005, 2010 and 2020. Table 3 provides a planning unit breakdown of the non-integrated numbers. Figure 14 shows the impact the programs will have relative to projections under a "No EE" case – where the effects of EERE's programs are removed from AEO99 projections.

Three items need to be kept in mind when reviewing the impact estimates. First, estimates assume all program goals are met. Second, estimates represent annual benefits, not cumulative ones. Third, estimates are designed to capture the benefits of current and future EERE programs, not past ones. Program activities before FY 2001 resulting in energy, emission, or financial benefits in or after FY 2001 are excluded.[8] As a result, benefit estimates within the FY 2001 data call increase with time as technologies creating the benefits are diffused throughout the market. This is apparent in Figures 10-16. In future data calls estimates for the same year (e.g., 2010) will likely decrease because of the shorter time frame in which a technology has to diffuse.

[8] The indirect benefits of earlier programs may be included however. For instance, R&D programs that build upon past R&D or deployment programs that learn from past deployment efforts.

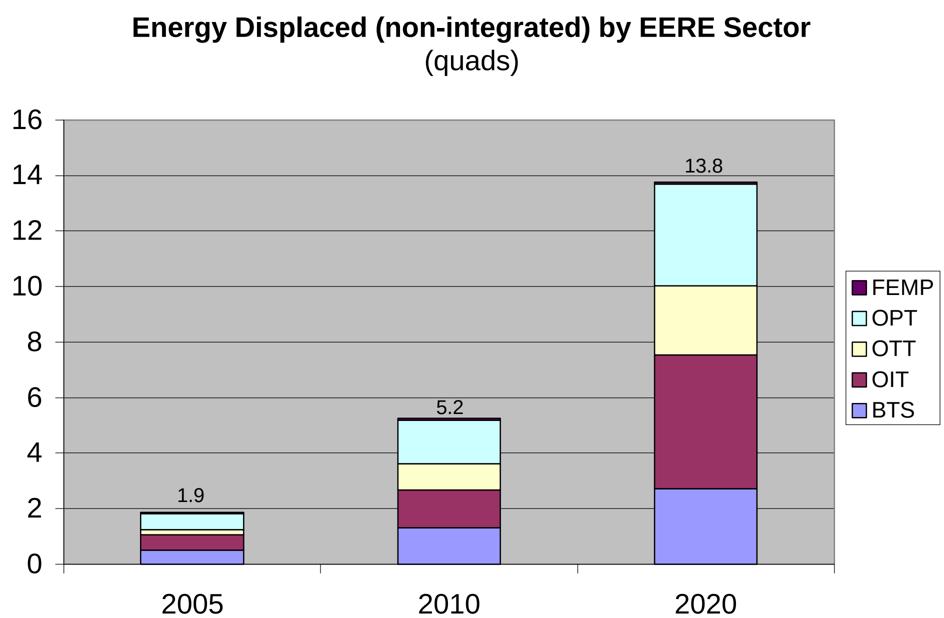
Energy Displaced. It is estimated that EERE programs will result in the displacement of 1.7-1.9 quads of primary energy in 2005, 4.3-5.2 quads in 2010, and 10.1-13.8 quads in 2020 (Figure 8).

Figure 8



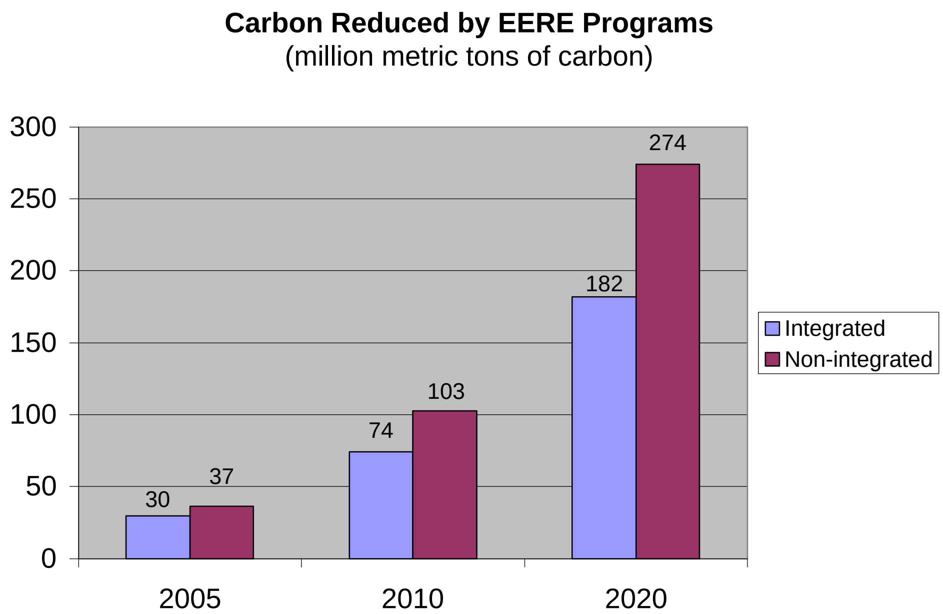
The distribution of energy savings across EERE's five sector offices is shown in Figure 9 below for the non-integrated estimates.

Figure 9



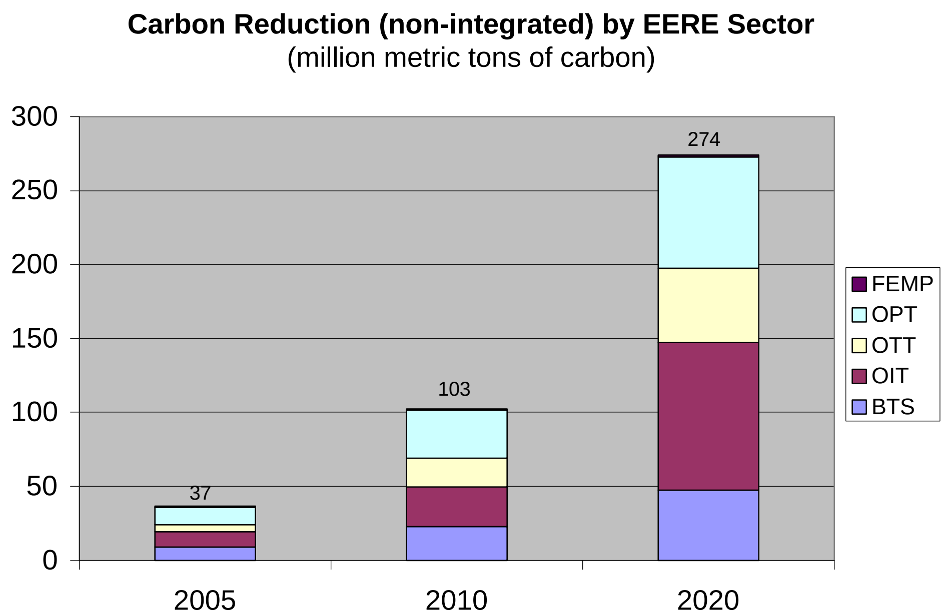
Carbon Reduction. The displacement of energy is estimated to result in the reduction of 30-37 million metric tons of carbon equivalent (MMTCE) in 2005, 74-103 MMTCE in 2010, and 182-274 MMTCE in 2020 (Figure 10).

Figure 10



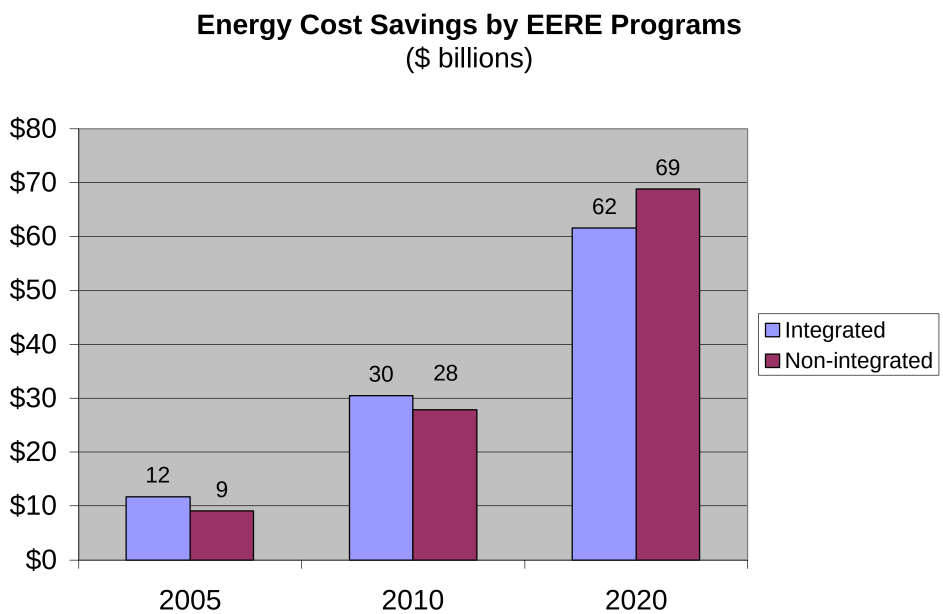
The distribution of carbon reduction across EERE's five sector offices is shown in Figure 11 below for the non-integrated estimates.

Figure 11



Energy Cost Savings. The displacement of energy will also result in energy savings of $9-12 billion in 2005, $28-30 billion in 2010, and $62-69 billion in 2020 (Figure 12).

Figure 12



The distribution of energy cost savings across EERE's five sector offices is shown in Figure 13 below for the non-integrated estimates.

Figure 13

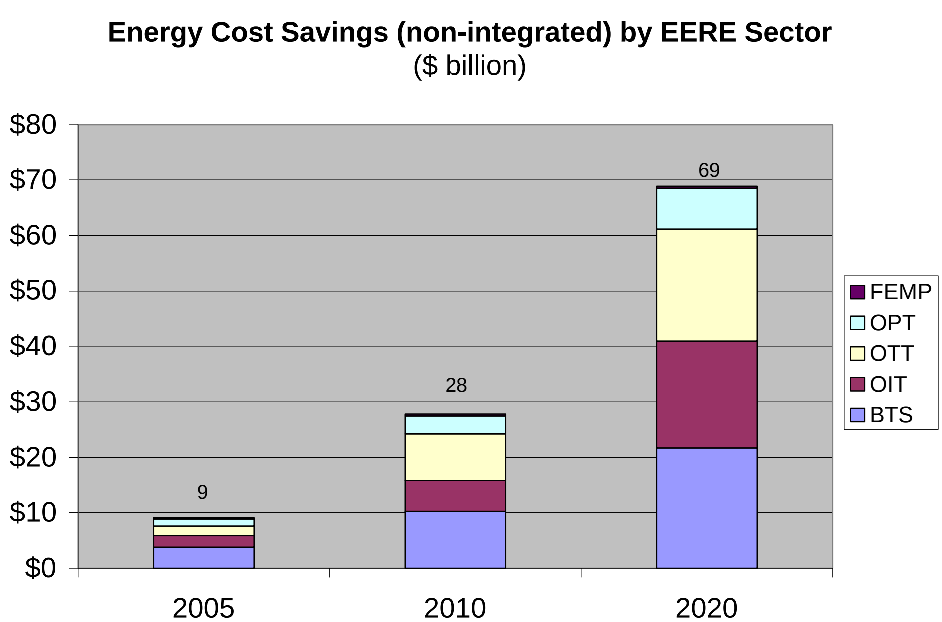


Figure 14 shows the impacts of EERE programs relative to the "No-EE" case, where the effects of EERE's programs are removed from AEO99 projections. By 2020, EERE's programs could reduce total fossil energy consumption by 9-13% and reduce total carbon emissions by 9-14% compared to the "No-EE" case. Projected growth in fossil energy consumption could be reduced by 42-57% by 2020. Projected growth in carbon emissions could be reduced by 41-66% by 2020.

Figure 14

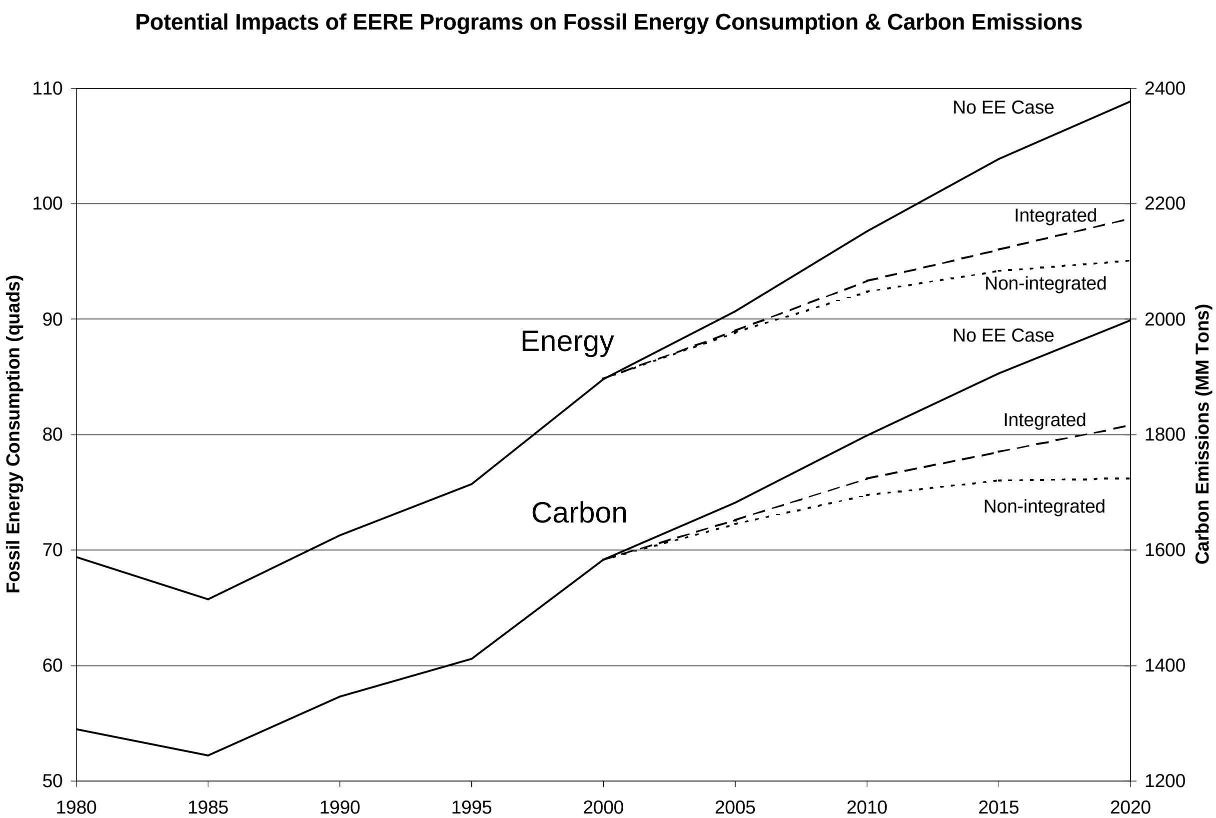


Table 2

Office of Energy Efficiency and Renewable Energy Energy Efficiency Programs Projected Benefits by Sector through the Year 2020									
	Total Primary Energy Displaced (Quadrillion BTUs)			Energy Cost Savings* ($ billions)			Carbon Reductions (million metric tons)		
	2005	2010	2020	2005	2010	2020	2005	2010	2020
Transportation Sector *(oil savings in quads)*	0.2-0.3 (*0.5-0.6*)	0.9-1.0 (*1.4-1.5*)	2.5-2.5 (*2.8-3.2*)	1.7-3.3	8.4-9.9	20.1-22.6	3.8-4.6	17.9-19.5	46.0-50.1
Industry Sector	0.6	1.4-1.5	3.8-4.8	2.1-2.2	5.5-6.8	17.3-19.3	10.3-11.9	26.0-26.7	65.3-99.8
Building Technology, State & Community Sector	0.5-0.6	1.0-1.3	1.9-2.7	3.8	8.4-10.3	15.0-21.7	9.2-11.2	17.1-23.0	34.4-47.4
Federal Energy Management Program	.05	.07	.07	0.3	0.4	0.3	1.0	1.2	1.2

Note: The program benefit ranges are developed through an impact analysis process undertaken annually by the Office of Energy Efficiency and Renewable Energy (EERE). EERE's sectors analyze the impacts their programs will have on energy savings, cost savings, and carbon reductions if all program goals are met. These estimates are externally reviewed by Arthur D. Little. An integrated analysis model run by an external contractor controls for interaction effects. The integrated analysis model accounts for inter- and intra-sector double-counting as well as market trends, including reductions in new electricity generation created by reduced demand. Totals for Transportation include impacts from the Biofuels program funded under Energy and Water.

Table 3 - Final GPRA2001 Benefit Estimates

06/06/2000

Sector	Planning Unit	Primary Energy Displaced (Tbtu) 2005	2010	2020	Energy Cost Savings ($ billion) 2005	2010	2020	Carbon Reduction (MMTCE) 2005	2010	2020
BTS	Commercial Buildings Integration	8	42	159	$0.06	$0.32	$1.22	0.15	0.75	2.81
	Community Energy Program	113	293	575	$0.80	$2.21	$4.54	2.02	5.05	9.86
	Energy Star Program	92	219	279	$0.77	$1.93	$2.39	1.78	3.99	4.90
	Equipment, Materials & Tools	177	532	1,236	$1.33	$4.20	$10.16	3.28	9.43	22.07
	Residential Buildings Integration	3	20	110	$0.02	$0.15	$0.81	0.05	0.33	1.78
	State Energy Program	27	51	97	$0.19	$0.37	$0.70	0.48	0.88	1.64
	Technology Roadmaps and Competitive R&D	47	88	162	$0.36	$0.69	$1.28	0.87	1.56	2.82
	Weatherization Assistance Program	32	63	92	$0.23	$0.44	$0.63	0.54	1.03	1.50
	BTS TOTAL (non-integrated)	498	1,307	2,709	$3.76	$10.31	$21.74	9.17	23.02	47.38
	BTS TOTAL (integrated)	570	1,020	1,870	$3.80	$8.40	$15.00	11.20	17.10	34.40
OIT	Agriculture Vision	1	4	45	$0.00	$0.01	$0.06	0.00	0.03	0.30
	Advanced Industrial Materials (AIM)	7	22	86	$0.01	$0.04	$0.19	0.06	0.20	0.89
	Aluminum Vision	16	40	148	$0.08	$0.21	$0.73	0.41	1.13	4.47
	Best Practices	79	163	336	$0.28	$0.63	$1.26	1.26	2.50	5.26
	CFCCs/Engineered Ceramics	21	58	153	$0.06	$0.18	$0.43	0.33	0.93	2.56
	Chemicals Vision	81	196	876	$0.18	$0.48	$2.35	1.08	2.49	9.95
	Distributed Generation	86	163	541	$0.49	$1.14	$3.17	2.48	6.41	21.44
	Forest & Paper Products Vision	111	259	1,510	$0.52	$1.29	$7.37	2.17	5.97	37.20
	Glass Vision	24	43	77	$0.08	$0.15	$0.27	0.36	0.66	1.20
	Industrial Assessment Centers (IAC)	20	39	54	$0.11	$0.20	$0.28	0.34	0.61	0.88
	Inventions & Innovations	3	43	108	$0.01	$0.18	$0.47	0.05	0.78	1.92
	Metal Casting Vision	10	25	96	$0.03	$0.08	$0.32	0.20	0.55	2.15
	Mining Vision	3	9	39	$0.01	$0.04	$0.16	0.07	0.20	0.92
	NICE-3	1	16	98	$0.00	$0.06	$0.38	0.02	0.25	1.55
	Petroleum Refining Vision	74	206	417	$0.20	$0.59	$1.20	1.00	2.80	5.59
	Sensors and Controls	2	2	5	$0.01	$0.01	$0.02	0.04	0.05	0.09
	Steel Vision	27	79	238	$0.07	$0.21	$0.61	0.39	1.19	3.42
	OIT TOTAL (non-integrated)	568	1,367	4,827	$2.15	$5.50	$19.27	10.26	26.74	99.79
	OIT TOTAL (integrated)	600	1,490	3,760	$2.20	$6.80	$17.30	11.90	26.00	65.30
OTT	Biofuels	23	182	683	-$0.01	$0.01	$0.13	0.44	3.43	12.86
	Fuel Utilization (1)	0	0	0	$0.00	$0.00	$0.00	0.00	0.00	0.00
	Materials Technologies	1	9	43	$0.02	$0.11	$0.49	0.03	0.18	0.85
	Technology Deployment (2)	0	0	0	$0.39	$0.78	$0.96	1.20	1.83	2.25
	Vehicle Technologies	154	742	1,768	$1.30	$7.52	$18.56	2.91	14.09	34.18
	OTT TOTAL (non-integrated)	179	933	2,495	$1.70	$8.42	$20.14	4.58	19.53	50.14
	OTT TOTAL (integrated)	280	1,010	2,490	$3.30	$9.90	$22.60	3.80	17.90	46.00
OPT	Biomass Power R&D	186	503	826	$0.08	$0.18	$0.32	4.42	11.70	17.43
	Competitive Solicitation	3	3	3	$0.00	$0.00	$0.01	0.06	0.06	0.05
	Concentrating Solar Power	3	12	43	$0.01	$0.04	$0.14	0.06	0.22	0.77
	Energy Storage	0	1	4	$0.00	$0.00	$0.01	0.01	0.02	0.07
	Geothermal Energy R&D	23	94	307	$0.05	$0.24	$0.70	0.45	1.73	5.54
	High Temperature Superconductivity	5	85	343	$0.01	$0.21	$0.78	0.10	1.58	6.20
	Hydrogen	1	43	303	$0.00	$0.00	$0.00	0.02	1.87	13.45
	Photovoltaic Systems R&D	6	21	98	$0.01	$0.05	$0.22	0.12	0.40	1.76
	Solar Buildings	34	64	164	$0.22	$0.39	$1.00	0.50	0.93	2.46
	Transmission Reliability	65	164	339	$0.30	$0.65	$1.43	1.07	2.78	5.50
	Transmission Reliability	*24*	*74*	*132*	*$0.00*	*$0.00*	*$0.00*	*0.52*	*1.62*	*2.82*
	Distributed Power	*41*	*89*	*207*	*$0.30*	*$0.65*	*$1.43*	*0.55*	*1.17*	*2.68*
	Wind Energy R&D	246	585	1,231	$0.55	$1.47	$2.80	4.81	10.79	22.24
	OPT TOTAL (non-integrated)	573	1,576	3,662	$1.23	$3.24	$7.41	11.63	32.08	75.48
	OPT TOTAL (integrated)	220	740	1,930	$2.20	$5.00	$6.40	2.00	12.10	35.00
FEMP	**FEMP**	52	67	66	$0.27	$0.37	$0.30	0.99	1.22	1.20
	FEMP TOTAL	52	67	66	$0.27	$0.37	$0.30	0.99	1.22	1.20
EERE	TOTAL (non-integrated)	1,870	5,250	13,758	$9.10	$27.84	$68.85	36.63	102.59	273.99
	TOTAL (integrated + FEMP)	1,722	4,327	10,116	$11.77	$30.47	$61.60	29.89	74.32	181.90

Bold = ADL Reviewed Planning Unit

(1) Benefits for Fuels Utilization are included in the benefits for Vehicle Technologies

(2) There is no net energy displaced for OTT Technology Deployment because petroleum based fuels are being replaced by alternative fuels. However, since the alternative fuels are less costly and produce less carbon, there are energy cost savings and carbon reduction.

Appendix A

EERE

GPRA Data Call

Fiscal Year 2001

U.S. Department of Energy
Office of Energy Efficiency and Renewable Energy

GPRA Data Call

Fiscal Year 2001

June 15, 1999

Form available at http://bowens2.nrel.gov/gpra

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INTRODUCTION

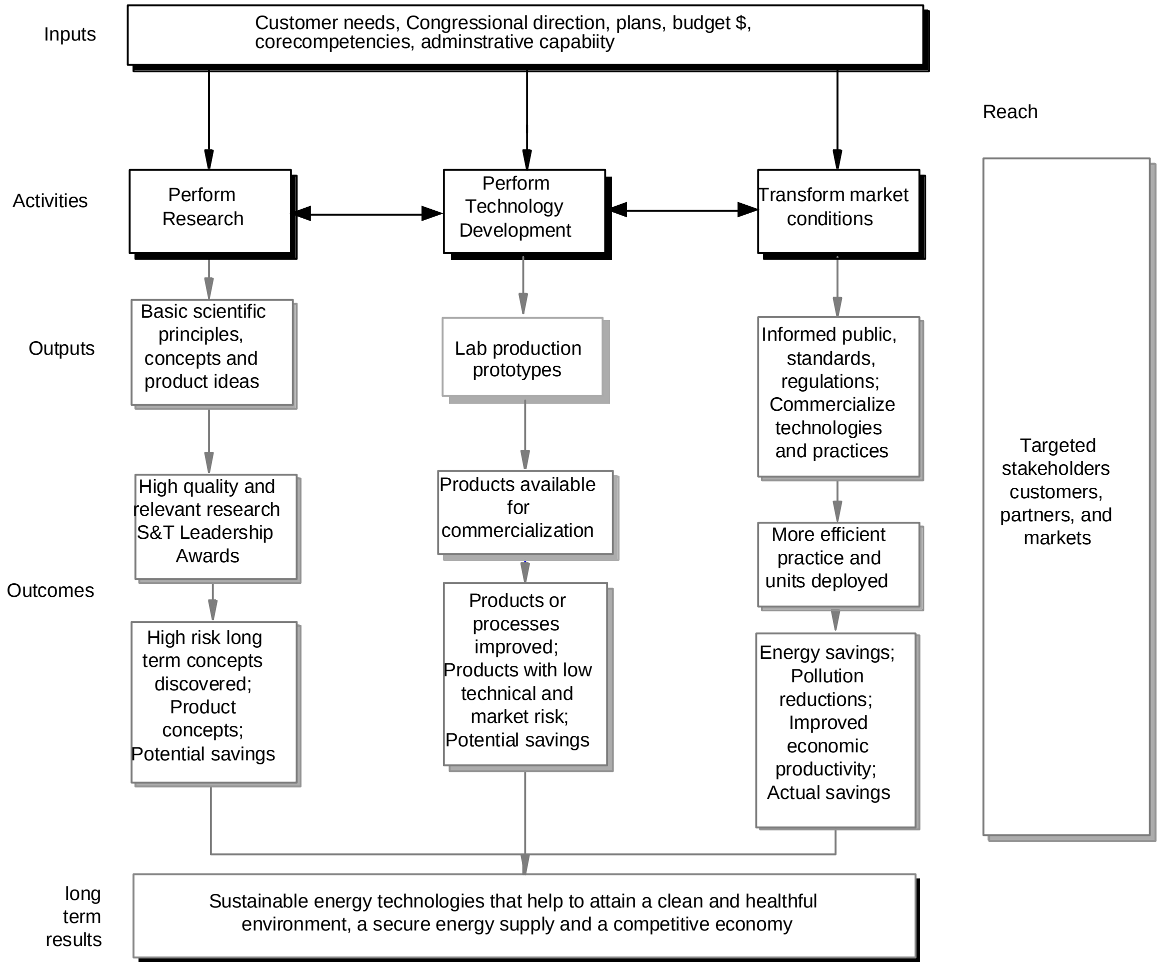
Background

The objective of the GPRA 2001 Data Call is to collect information that will meet the growing strategic management requirements of the White House, Congress, the Department of Energy (DOE) and DOE's Office of Energy Efficiency and Renewable Energy (EERE). The Department's approach to strategic management integrates planning, budget formulation, budget execution and evaluation. There are both legal and informal requirements for collecting the information necessary to support strategic management.

Legal requirements of strategic management include the Government Performance and Results Act of 1993 (GPRA), the National Performance Review's Performance Agreements with the President, and Executive Order 12862 on setting Customer Service Standards. Of particular importance is GPRA, which took effect in Fiscal Year 1999. GPRA requires that each agency develop a strategic plan and annual performance plans that link to the strategic plan. EERE will provide input into DOE's FY2001 Performance Plan, which identifies the Department's major goals for FY2001, measures that will indicate whether those goals have been met, the current level of performance, and the resources required to meet the goals. This information may be summarized in a logic chart, which captures an organizations inputs, activities, outputs, outcomes, and longer-term results. A sample logic chart for EERE is presented below in Figure 1. This year's data call is structured to capture the type of information in the logic chart. Although not required, each planning unit is strongly encouraged to develop its own logic chart.

Throughout the year, the DOE Secretary, the EERE Assistant Secretary, Deputy Assistant Secretaries, and program staffs respond to numerous informal, but equally important, external requests for information at varying levels of detail on program budget, activities, accomplishments, progress, and benefits. Information is also required for internal budget allocation decisions and financial management. In addition, all of us experience the need to be proactive about presenting this information to others, both internal to EERE for budget and promotion decisions and external to our potential customers and investors.

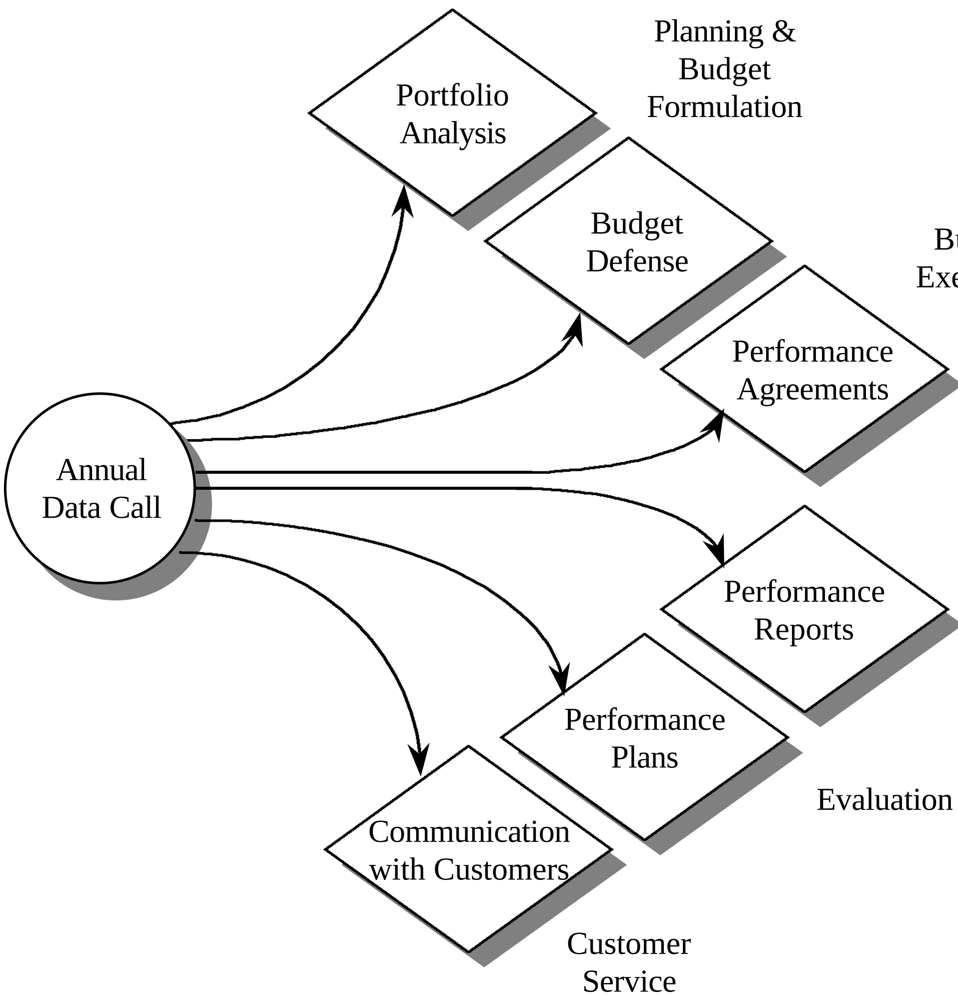
Figure 1: Sample EERE Logic Chart



How Collected Data Will Meet Requirements

Information collected in current and past data calls helps EERE and its programs meet the legal and informal needs and requirements identified above. Figure 2 indicates specific ways the data are used during the strategic management cycle which in turn meets GPRA and other legal requirements. During the planning and budget formulation phases the data are used in portfolio analysis and defense of budget allocations. Performance agreements are finalized once budget allocation is known, and progress relative to these targets measured during the budget execution phase. A performance plan will be developed that states expected outcomes during FY2001 for the taxpayer's investment in the EERE programs.

Figure 2: Uses of Data Collected in FY2001 Data Call



Changes From Last Year's Data Call

Data Call Section	GPRA2000	GPRA2001
5 Year Goal Statement	Included in data call.	Not collected. To be included in FY2001 budget narrative
Accomplishments	Included resources, milestones, market information, and impact metrics for FY1997 & FY1998.	Not collected. Three metrics – energy displaced, energy cost savings, and carbon emissions reduced – and supporting assumptions and calculations are being collected as part of the FY2001 budget call.
Resource Metrics	Timeframe 1997-2004.	Timeframe 2001-2005.
Milestones	Milestone & milestone cost by strategy and milestone type (technology characteristic, market penetration, other).	Not collected. To be included in FY2001 budget narrative.
Assumptions	Format determined by sector. Should include technology characteristics and market penetration estimates.	No changes. To be submitted with remainder of the data call.
Energy, Financial and Environmental Metrics	Timeframe 1999-2005, 2010, 2015, 2020.	Timeframe changed to 2001-2005, 2010, 2015, 2020, 2025, 2030.
Calculation Methodologies & Assumptions	Marginal fossil fuel generation mix, heat rates, and emission factors provided. Assumptions from AEO98.	Updated marginal fuel mix, heat rates and emission factors. Fuel mix & heat rates based on side case in AEO99. Carbon emission factor adjusted for less than full combustion. Particulate emission factors updated based on latest EPA data. Assumptions from AEO99.

Resource Metrics

Resources significantly impact the ability of planning units to achieve their goals. We are therefore requesting information about the level of resources used in estimating your planning unit's impacts. The table that follows requests information about the planning unit's funding estimates for FY2001 through FY2005, the percentage of funding allotted to research, development, and deployment, the level of partner investment in the planning unit (both financial and non-financial), and the number of partners with whom you are working. Estimates only need to be provided for FY2001 through FY2005 (i.e., fields for 2010-2030 may be left blank). Funding level estimates should be consistent with the "Program Outyear Funding Table" developed for EERE's FY2001 budget request (table attached).

Resource metrics may be entered into the table that follows or directly into the GPRA database located on the world-wide web at http://bowens2.nrel.gov/gpra (a secure site).

GPRA2001 Data Submission

Metric	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030

Resource Metrics

DOE Funding Level (Millions of $'s)										
Research (%)										
Development (%)										
Deployment (%)										
Partner Financial Investment (Millions of $'s)										
Partner Non-Financial Investment (Millions of $'s)										
Partners (Number)										

Program Outyear Funding Table
FY 2001 to FY 2005
(Dollars in thousands)

Program	FY 2001 Target	FY 2002 Target	FY 2003 Target	FY 2004 Target	FY 2005 Target
Solar and Renewable					
Solar Building Technology Research	5,500	6,600	7,150	7,700	7,700
Photovoltaic Energy Systems	87,000	86,860	99,000	102,300	105,380
Concentrating Solar Energy	15,000	18,700	19,800	19,800	19,800
Biopower	37,000	40,700	44,000	44,000	44,000
Biofuels	52,441	67,980	70,019	72,120	74,284
Wind	50,000	59,950	63,800	66,000	66,000
Renewable Energy Production Incentive Program	4,000	4,400	4,400	4,400	4,400
Solar Program Support	11,000	12,650	12,650	12,100	12,100
International Solar Energy Program	6,000	7,700	7,700	7,700	7,700
National Renewable Energy Laboratory	4,100				
Geothermal	28,500	33,000	34,100	37,400	38,500
Hydrogen Research	27,000	30,800	33,000	34,100	34,100
Hydropower Development	5,500	7,700	7,700	7,700	7,700
Renewable Indian Energy Resources	0	0	0	0	0
Electric Energy Systems and Storage	44,500	51,700	55,000	57,200	55,000
Climate Challenge	500	550	550	275	275
Federal Buildings/Remote Power Initiative	0	0	0	0	0
Program Direction	19,171	22,687	6,668	6,708	16,949
Departmental Energy Management	5,000				
Federal Renewable Projects Funding	500				
OPT and OTT EWD Programs	**402,712**	**451,977**	**465,537**	**479,503**	**493,888**

Program Outyear Funding Table (cont.)

Program	FY 2001 Target	FY 2002 Target	FY 2003 Target	FY 2004 Target	FY 2005 Target
Energy Conservation R&D					
Transportation Sector					
Vehicle Technology R&D	165,100	166,000	166,000	134,000	98,000
Hybrid Systems R&D	41,800	48,000	45,000	25,000	10,000
Fuel Cell R&D	41,380	42,000	43,000	45,000	45,000
Advanced Combustion Engine	59,920	60,000	60,000	47,000	29,000
CARAT	7,000	8,000	10,000	10,000	7,000
Electric Vehicle R&D	10,000	3,000	3,000	2,000	2,000
Heavy Vehicle Systems R&D	5,000	5,000	5,000	5,000	5,000
Fuels Utilization R&D	24,000	28,000	28,000	28,000	28,000
Advanced Petroleum Based Fuels	12,000	15,000	15,000	10,000	7,000
Alternative Fuels	12,000	13,000	13,000	18,000	21,000
Materials Technologies	33,000	35,000	35,000	35,000	35,000
Propulsion Materials Technology	10,000	10,000	10,000	10,000	10,000
Lightweight Materials Technology	17,000	18,000	18,000	17,000	17,000
High Temperature Materials Lab	6,000	7,000	7,000	8,000	8,000
Technology Deployment	19,000	22,000	25,000	28,000	28,000
Clean Cities	11,500	14,000	14,000	14,500	16,500
Testing and Evaluation	4,000	4,000	6,000	8,000	8,000
EPACT Replacement Fuels Program	2,500	3,000	4,000	4,000	2,000
Advanced Vehicle Competitions	1,000	1,000	1,000	1,500	1,500
Management and Planning	10,000	11,000	12,000	12,000	12,000
Technology Assessment and Analysis	2,500	2,500	2,500	2,500	2,500
Program Direction	7,500	8,500	9,500	9,500	9,500
OTT Interior Programs	**251,100**	**262,000**	**266,000**	**237,000**	**201,000**
Federal Energy Management Program					
Project Financing	10,364	15,198	15,654	16,123	16,607
Technical Guidance & Assistance	10,204	11,742	12,094	12,457	12,831
Planning, Reporting & Evaluation	5,400	5,562	5,729	5,901	6,078
Program Direction	3,500	3,605	3,713	3,825	3,939
DOE Departmental Energy Man.	0	0	0	0	0
Federal Renewable Projects	0	0	0	0	0
FEMP	**29,468**	**36,107**	**37,190**	**38,305**	**39,454**

Program Outyear Funding Table (cont.)

Program	FY 2001 Target	FY 2002 Target	FY 2003 Target	FY 2004 Target	FY 2005 Target
Industry Sector					
Industries of the Future (specific)	86,100	110,606	113,848	121,107	123,446
Forest and Paper Products	28,400	36,600	35,600	35,600	29,600
Steel	10,900	14,600	16,600	21,600	26,600
Aluminum	11,000	11,536	11,882	12,239	12,606
Metal Casting	5,800	7,210	7,426	7,649	7,879
Glass	4,800	6,180	6,365	6,556	6,753
Chemicals	12,200	14,420	14,853	15,298	15,757
Mining	4,000	6,000	6,000	6,000	7,000
Agriculture	5,000	8,000	8,000	8,000	8,000
Petroleum	2,000	4,000	5,000	6,000	7,000
Supporting Industries	2,000	2,060	2,122	2,165	2,251
Industries of the Future (crosscutting)	71,600	73,160	74,155	75,180	76,235
Enabling Technologies	22,000	20,000	18,000	18,000	18,000
Distributed Generation	16,800	20,000	22,000	22,000	22,000
Financial Assistance	12,000	12,360	12,731	13,113	13,506
Technical Assistance	20,800	20,800	21,424	22,067	22,729
Management and Planning	11,300	11,500	11,900	12,300	12,800
Evaluation and Planning	1,400	1,200	1,200	1,200	1,200
Program Direction	9,900	10,300	10,700	11,100	11,600
OIT Programs	**169,000**	**195,266**	**199,903**	**208,587**	**212,481**
Building Technology, State and Community Programs					
Building Research and Standards	86,810	98,165	101,972	104,550	106,491
Technology Roadmaps & Comp.	7,455	7,500	7,500	7,500	7,500
Residential Buildings Integration	13,850	16,805	18,418	18,971	19,350
Commercial Buildings Integration	6,280	7,480	8,012	8,253	8,418
Equipment, Materials & Tools	59,225	66,380	68,042	69,826	71,223
Building Technology Access	231,412	264,595	269,640	277,729	285,755
State Energy Program	37,135	42,080	42,922	44,209	45,536
Weatherization	154,205	175,349	178,800	184,164	189,689
Community Partnerships	34,108	39,642	39,642	40,831	41,153
Energy Star	5,964	7,524	8,276	8,525	9,377
Management and Planning	15,659	17,793	20,358	21,451	23,596
Evaluation and Planning	7,065	7,859	9,430	9,431	10,374
Program Direction	8,594	9,934	10,928	12,020	13,222
BTS Programs	**333,881**	**380,553**	**391,970**	**403,730**	**415,842**

Assumptions

This section of the data call collects information about the assumptions used in calculating energy, financial, and environmental impacts. Each sector is free to develop its own format for reporting assumptions. At a minimum, the assumptions should show how impact estimates were calculated and be consistent with milestones contained in the FY2001 budget. The list of assumptions on the following page has been developed as a result of the Arthur D. Little reviews performed over the last few years. Sectors should submit these or similar assumptions for each planning unit.

Assumptions may be emailed to: john_mortensen@nrel.gov

Assumptions

OPT
- Installed System Price ($/kW)
- O&M Costs ($/kWh)
- Performance Characteristics (efficiency, unit size, etc.)
- Current Installed Capacity
  - Cumulative installations to date (MW)
  - Annual installations (MW/yr)
- Average Lifetime (yrs)
- Market Penetration Assumptions (e.g. annual wind installations would represent x percent of conventional central station market)

OTT
- Vehicle Cost (e.g. ratio to conventional car)
- Annual Maintenance Cost (e.g. ratio to conventional car)
- Performance Characteristics (e.g. fuel economy, driving range, trunk space, acceleration, top speed)
- Year of Introduction
- Annual Sales of Vehicles (Fleet Stock)

OBT
- Installed System Price of Advanced Technology relative to Standard Technology
- Manufacturer Cost and Installed Cost
- Performance Characteristics (efficiency, life/reliability)
- Non-energy Related Benefits
- Projected Rate of Market Penetration (provide description of the target market being displaced, the number of units sold per year, etc.)
- A Clear List of the Technologies Assumed for the Program

OIT
- Installed Price/Unit
- Operating Costs/Unit
- Energy Improvements in BTU/tons
- Performance Characteristics (e.g. throughput/unit; lifetime, emissions/unit)
- Industry Growth Rates
- Technologies Assumed for the Program
- Non-energy Costs/Unit
- Market Penetration Rates
- Market Introduction Date
- R&D Spending/Milestones

Energy, Financial, and Environmental Impact Metrics

This section requests information on planning unit impacts in three areas: energy, financial, and environmental. The information being requested is the same as last year's data call, except that the timeframe begins in 2001 and extends to 2030.

When providing information in this section, it is important that you clearly understand what data are being requested. To assist in this effort, a definition of all key terms appears in Appendix A. We encourage you to review these definitions if there is uncertainty regarding the meaning of a term.

In addition, please refer to Appendix B (*Calculations Methodology and Assumptions*) if you have questions about the assumptions that are common to the costs and benefits calculations of all the sectors, as well as if you have questions about how to calculate certain metrics.

Energy, Financial and Environmental metrics may be entered into the tables that follow or directly into the GPRA database located on the world-wide web at http://bowens2.nrel.gov/gpra (a secure site).

GPRA2001 Data Submission

Metric	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030

Energy Metrics

Total Primary Energy Displaced (Trillion Btu)										
Direct Electricity Displaced (Billion Kilowatthours)										
Direct Natural Gas Displaced (Billion Cubic Feet)										
Direct Petroleum Displaced (Million Barrels)										
Direct Coal Displaced (Million Short Tons)										

Financial Metrics

Energy Costs or Savings (Billions of $'s)										
Non-Energy Savings or Costs (Billions of $'s)										

Environmental Metrics

CO Displaced (MMTons)										
Carbon Equivalent Emissions Displaced (MMTCe)										
Other Greenhouse Emissions Displaced (MMTCe)										
SO2 Displaced (MMTons)										
NOX Displaced (MMTons)										
Particulates Displaced (MMTons)										
VOCs Displaced (MMTons)										
HCs Displaced (MMTons)										
Other Environmental Benefits (MMTons)										
PM10 Displaced (MMTons)										

APPENDIX A

Definitions

Carbon Emissions - estimate of the amount of the carbon equivalent emissions displaced due to fuel switching or the energy displaced from the EE technologies comprising the planning unit. (S*ee Appendix B for more details on calculating this metric*).

CO Displaced - estimate of the amount of carbon monoxide displaced annually due to fuel switching or the energy displaced from the EE technologies comprising the planning unit.

Deployment - percentage of program funding directed toward efforts to foster the penetration of EE-related products in commercial markets.

Development - percentage of program funding directed toward the systematic use of the knowledge or understanding gained from research that is directed toward the production of useful materials, devices, systems, or methods.

Direct Coal Displaced - total direct coal that would have been consumed by conventional technologies had not the EE technologies comprising the planning unit entered the market, minus the direct coal consumed by the EE technologies. Definition of coal includes metallurgical coal, steam coal, and net coal coke imports.

Direct Electricity Displaced – total direct electricity that would have been consumed by conventional technologies had not the EE technologies comprising the planning unit entered the market, minus the direct electricity consumed by the EE technologies.

Direct Natural Gas Displaced - total direct natural gas that would have been consumed by conventional technologies had not the EE technologies comprising the planning unit entered the market, minus the direct natural gas consumed by the EE technologies. Definition of natural gas includes pipeline fuel natural gas and compressed natural gas.

Direct Petroleum Displaced – total direct petroleum that would have been consumed by conventional technologies had not the EE technologies comprising the planning unit entered the market, minus the direct petroleum consumed by the EE technologies. Definition of petroleum includes distillate fuel, jet fuel, motor gasoline, residual fuel, liquid petroleum gasoline, and other petroleum.

DOE Funding Level - anticipated annual DOE financial investment in the planning unit. Figures should be consistent with the Program Outyear Funding Table provided in the Resource Metrics section.

Energy Costs or Savings - estimate of annual dollar savings resulting from fuel related cost reductions that are due to planning unit actions. (S*ee Appendix B for more details on calculating this metric.*)

Energy Saved or Displaced by Fuel - amount of conventional, fossil, or electric energy being directly displaced by the planning unit on an annual basis.

HC Displaced - estimate of the amount of hydro-carbons displaced annually due to fuel switching or the energy displaced from the EE technologies comprising the planning unit.

Non-Energy Savings or Costs - dollar savings or costs related to non-fuel related operations that are due to planning unit actions. This should include items such as: operation and maintenance costs that result from the introduction of a new technology (e.g., the new equipment is considered to be more reliable and needs less maintenance and has less downtime, capital cost savings if the new technology is cheaper than the alternative, direct pollution abatement cost savings, etc.). If the technology results in cost savings, please submit the numbers as a negative. If the technology results in additional O&M costs, please submit the numbers as a positive.

NO_X Displaced - estimate of the amount of NO_X displaced annually due to fuel switching or the energy displaced from the EE technologies comprising the planning unit.

Other Environmental Benefits - estimate of the amount non-emission pollutants displaced annually due to fuel switching or the energy displaced from the EE technologies comprising the planning unit.

Other Greenhouse Emissions Displaced - estimate of the amount of greenhouse emissions other than SO_2, NOx, CO, C, particulates, VOCs displaced annually due to fuel switching or the energy displaced from the EE technologies comprising the planning unit.

Particulates Displaced - estimate of the amount of particulates displaced annually due to fuel switching or the energy displaced from the EE technologies comprising the planning unit.

Partners - number of distinct organizations or individuals, outside of DOE, who co-fund or co-deliver an EE product or service, including related planning activities in a given year. Partners may contribute money, expertise, or participate in planning and decision making and implementation. Partners are generally distinguished from customers who make use of services, although sometimes a partner may also be a customer, or vice-versa. Partners may include industry and trade associations, federal, state and local governments, utilities, universities and non-governmental organizations.

Partners Financial Investment – total annual monetary contributions from partners to co-fund or co-deliver an EE product or service, including related planning activities in a given year.

Partners Non-Financial Investment - total annual non-monetary investment partners are contributing to EE programs comprising the planning unit (e.g., equipment, staff, or facilities devoted to R&D).

Research - percentage of program funding directed toward efforts to develop new scientific knowledge without immediate commercial objectives in mind or to advance scientific knowledge to meet a specific, recognized need.

SO_2 Displaced - estimate of the amount of SO_2 displaced annually due to fuel switching or the energy displaced from the EE technologies comprising the planning unit.

Total Primary Energy Displaced - the amount of conventional, fossil, or electric energy being directly displaced by the planning unit on an annual basis (e.g., improved refrigerators displacing electricity; PV for peak load displacing natural gas or oil generation for peak load electricity; electric vehicles displace oil but use electricity; improved process heating displaces the industry fuel mix; etc.). If the planning unit causes fuel switching from one energy source to another (e.g., natural gas vehicles displacing petroleum fueled vehicles), record the increase in energy source consumption as a negative figure (i.e., if the planning unit increases natural gas consumption by 60,7000 cubic feet, while displacing 500 gallons of automobile gasoline, place a negative sign in front of the 60,700 cubic feet of natural gas). (S*ee Appendix B for more details on calculating this metric*).

VOCs Displaced - estimate of the amount of VOCs displaced annually due to fuel switching or the energy displaced from the EE technologies comprising the planning unit.

APPENDIX B

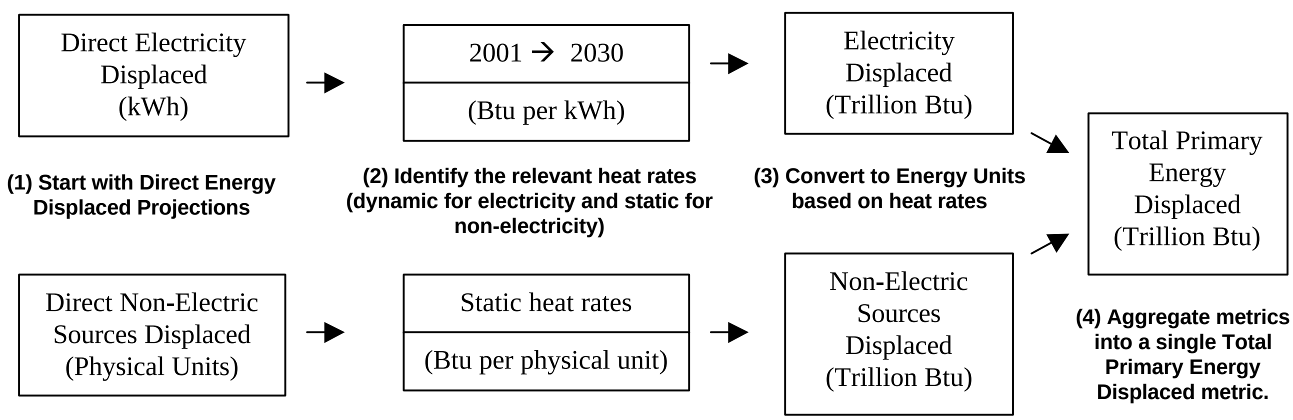
Calculation Methodologies and EIA/AEO99 Baseline Assumptions

There are a variety of methods and assumptions that may be used to calculate the benefits of EERE programs. However, certain methodologies and assumptions may be applied to all of EERE's programs. This appendix provides methodologies and baseline assumptions for calculating energy, financial and environmental metrics requested in the GPRA2001 Data Call. Baseline assumptions are drawn from the Energy Information Administration's Annual Energy Outlook 1999 (AEO99) and its supporting documentation.

Calculation Methodologies

Converting from Direct to Primary Energy Displaced

The process for converting projections of direct energy displaced into a single total primary energy displaced metric involves four steps. These steps are displayed in the diagram below.



(1) The first step in the conversion process is to identify the electric and non-electric displaced energy projections. The direct electricity displaced projections will be expressed in kilowatt-hours; the direct non-electric projections will be expressed in barrels of oil, cubic feet of natural gas, and short tons of coal.

(2) The next step involves the conversion from direct units into heat content units using the heat rate of each direct fuel source.

Electricity Heat Rates

Electricity heat rates for GPRA2001 were derived by comparing the AEO99 reference case against a side case in which electricity demand was reduced. The first step was to determine the marginal fuel mix based on the differences in kWh of electricity generated. The results, shown in the table below, indicate that EERE technologies are projected to displace electricity generated from fossil fuels and, beginning in 2010, will also displace electricity generated from non-fossil (nuclear) sources.

Projected Marginal Fuel Generation Mix
(based on marginal kWh generated)

Fuel Mix	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Coal	62.5%	45.2%	47.7%	44.2%	39.4%	27.6%	32.7%	39.1%	44.1%	49.1%
Natural Gas	25.0%	43.2%	44.6%	54.7%	58.7%	71.4%	58.7%	54.1%	49.1%	44.1%
Oil	12.5%	11.6%	7.8%	1.2%	1.9%	0.4%	0.2%	0.8%	0.8%	0.8%
Non-Fossil	0.0%	0.0%	0.0%	0.0%	0.0%	0.6%	8.4%	5.9%	5.9%	5.9%

The second step was to calculate the marginal electricity heat rates for each fuel source based on a comparison of the two cases. The results are shown in the table below.

Projected Marginal Electricity Heat Rates by Fuel Source

Projected Electricity Heat Rates	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Coal (Btu per kWh)	10889	10758	11196	10943	10962	10791	9868	8755	8755	8755
Natural Gas (Btu per kWh)	11111	10317	10116	9412	8387	6908	6967	7076	7076	7076
Oil (Btu per kWh)	11111	10588	10667	15000	12000	10000	10000	9091	9091	9091
Non-Fossil (Btu per kWh)	NA	NA	NA	NA	NA	10600	10641	10779	10779	10779

To derive the dynamic GPRA2001 electricity heat rates, the percentage of the marginal mix associated with each fuel source was multiplied by the expected electricity heat rate for the same source. This yielded the intermediate apportioned heat content associated with each generation source. Then, for each forecast year, the apportioned heat contents were summed to arrive at a final GPRA2001 heat rate. For example, in the year 2020, electricity generated from coal is expected to account for 39.1 percent of the marginal mix, electricity generated from natural gas 54.1 percent, and oil 0.8 percent. The expected electricity heat rates in 2020 for coal, natural gas and oil are 8,755 and 7,076 and 9,091 Btu/kWh, respectively. Therefore, the GPRA2001 heat rate for 2020 is (39.1%)(8,755) + (54.1%)(7,076) + (0.8%)(9,091) + (5.9%)(10,779) = 7,969 Btu/kWh.

GPRA2001 Electricity Heat Rates

GPRA2001 Heat Rate	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Electricity (Btu per kWh)	10972	10548	10674	10153	9470	8016	8231	7969	8053	8137

Non-Electric Heat Rates

The heat rates used for conversion of non-electric sources are much more straightforward. The table below contains the appropriate conversion factors for these sources that are based on heat rate estimates provided in AEO99 Table H1. Simply find the matching direct energy displaced source with the appropriate heat rate from the table below.

GPRA2001 Non-Electricity Heat Rates

Coal			
	Coal Production	million Btu per short ton	21.287
	Coal Consumption	million Btu per short ton	20.856
	Coke Plants	million Btu per short ton	26.800
	Industrial	million Btu per short ton	22.105
	Residential and Commercial	million Btu per short ton	23.011
	Electric Utilities	million Btu per short ton	20.525
Oil			
	Crude Oil Production	million Btu per barrel	5.800
	Oil Products Consumption	million Btu per barrel	5.362
	Motor Gasoline	million Btu per barrel	5.206
	Jet Fuel (Kerosene)	million Btu per barrel	5.670
	Distillate Fuel Oil	million Btu per barrel	5.825
	Residual Fuel Oil	million Btu per barrel	6.287
	Liquefied Petroleum Gas	million Btu per barrel	3.625
	Kerosene	million Btu per barrel	5.670
	Petrochemical Feedstocks	million Btu per barrel	5.630
	Unfinished Oils	million Btu per barrel	5.800
Natural Gas			
	Natural Gas Production	Btu per cubic foot	1,028
	Natural Gas Consumption	Btu per cubic foot	1,028
	Natural Gas Consumption from Electric Utilities	Btu per cubic foot	1,022

(3) The third step involves multiplying the above heat rates by the direct energy displaced projections.

(4) The final step is to sum the energy displaced estimates (not expressed in heat content units) for each forecast year.

Converting from Direct to Primary Energy – An Example

To better understand the mechanics of the energy conversion process, consider the following example. The direct energy displaced projections for a hypothetical Planning Unit EE are displayed in the table below. Assume planning Unit EE is a demand-side technological development program which displaces electricity and natural gas in the Buildings sector.

Step 1 consists of simply identifying the direct energy displaced estimates for each forecast year.

Step (1)	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Direct Electricity Displaced (billion kWhs)	0.00	0.50	1.20	2.10	3.20	11.00	25.00	41.00	61.00	90.00
Direct Natural Gas Displaced (billion cubic feet)	1.00	2.00	3.50	5.50	8.20	31.00	66.00	102.00	150.00	200.00

In step 2, the relevant heat rates are identified. A static conversion factor is used for the non-electric projections while a dynamic heat rate is used for electricity.

Step (2)	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Electricity (Btu per kWh)	10972	10548	10674	10153	9470	8016	8231	7969	8053	8137
Natural Gas Consumption (Btu per cubic foot)	1028	1028	1028	1028	1028	1028	1028	1028	1028	1028

In step 3, all direct energy displaced estimates are converted from physical units to heat content units by multiplying by the appropriate heat rates.

Step (3)	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Electricity (trillion Btu)	0.00	5.27	12.81	21.32	30.30	88.17	205.77	326.73	491.24	732.33
Natural Gas (trillion Btu)	1.03	2.06	3.60	5.65	8.43	31.87	67.85	104.86	154.20	205.60

After all of the metrics have been converted to heat content units, the last step involves summing the metrics in each forecast year.

Step (4)	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Total Primary Energy Displaced (trillion Btu)	1.03	7.33	16.41	26.98	38.73	120.04	273.62	431.59	645.44	937.93

Calculating Energy Cost Savings

The methodology for calculating energy cost savings continues from the conversion of direct to primary energy displaced. Sector energy prices are applied to the projections of primary energy displaced by energy source to obtain energy cost savings by energy source. These estimates are then summed to arrive at total energy cost savings. The GPRA2001 Data Call uses energy prices in Table 20 of the Assumptions to the AEO99 (found later in Appendix B).

Calculating Energy Cost Savings – An Example

To better understand how to calculate energy cost savings, consider the following example, which continues from Step 3 of the direct to primary energy example.

Step (3)	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Electricity (trillion Btu)	0.00	5.27	12.81	21.32	30.30	88.17	205.77	326.73	491.24	732.33
Natural Gas (trillion Btu)	1.03	2.06	3.60	5.65	8.43	31.87	67.85	104.86	154.20	205.60

Instead of summing these metrics to arrive at a final total primary energy displaced metric, the appropriate energy prices are applied. (Prices from the Commercial buildings sector are used).

Step (4)	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Electricity ($ per million Btu)	20.71	20.25	20.27	20.24	20.11	19.28	18.25	17.59	16.70	15.86
Natural Gas ($ per million Btu)	5.30	5.28	5.27	5.26	5.27	5.17	5.08	5.09	4.98	4.87

The resultant energy cost savings projections for each fuel are listed in the table below.

Step (5)	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Electricity ($ billions)	0.00	0.11	0.26	0.43	0.61	1.70	3.75	5.75	8.20	11.61
Natural Gas ($ billions)	0.01	0.01	0.02	0.03	0.04	0.16	0.34	0.53	0.77	1.00

The final step is to sum these individual estimates to arrive at a final metric of energy cost savings as illustrated below (components may not sum to totals due to rounding).

Step (6)	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Total Energy Cost Savings ($ billions)	0.01	0.12	0.28	0.46	0.65	1.86	4.10	6.28	8.97	12.62

Calculating Carbon Equivalent Emissions Displaced

The methodology for calculating the level of carbon equivalent emissions displaced continues from the conversion of direct to primary energy displaced. Emission factors for carbon are applied to the projections of primary energy displaced by energy source to obtain carbon equivalent emissions displaced by energy source. These estimates are then summed to arrive at a final metric of carbon equivalent emissions displaced.

The GPRA2001 Data Call uses carbon emission factors found in Table 2 of the Assumptions to the AEO99. These emission factors are based on the carbon content of the fuel and the fraction of the fuel consumed in combustion. The emission factors are based on 1997 data.

Adjusted Carbon Emission Factors (1997)
(Million Metric Tons of Carbon per Trillion Btu)

Fuel		Emission Factor
Petroleum		
	Motor Gasoline	0.01916
	LPG	
	Used as Fuel	0.01679
	Used as Feedstock	0.00342
	Jet Fuel	0.01914
	Distillate Fuel	0.01975
	Residual Fuel	0.02128
	Asphalt and Road Oil	0.00000
	Lubricants	0.01214
	Petrochemical Feedstocks	0.00387
	Kerosene	0.01952
	Petroleum Coke	0.01393
	Petroleum Still Gas	0.01742
	Other Industrial	0.02011
Coal		
	Residential and Commercial	0.02574
	Metallurgical	0.02528
	Industrial Other	0.02538
	Electric Utility	0.02548
Natural Gas		
	Used as Fuel	0.01440
	Used as Feedstocks	0.01120

Like the electricity heat rate, the carbon emission factor for electricity changes over the forecast period with the changing projections of the marginal fuel mix.

Electricity Carbon Emission Factor
(million metric tons of carbon per trillion Btu)

Carbon Coefficient	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Electricity (MMTCE per trillion Btu)	0.02205	0.02022	0.02041	0.01978	0.01960	0.01844	0.01719	0.01806	0.01862	0.01917

Calculating Carbon Equivalent Emissions Displaced – An Example

To better understand how to calculate displacement of carbon equivalent emissions, consider the following example, which continues from Step 3 of the direct to primary energy example.

Step (3)	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Electricity (trillion Btu)	0.00	5.27	12.81	21.32	30.30	88.17	205.77	326.73	491.24	732.33
Natural Gas (trillion Btu)	1.03	2.06	3.60	5.65	8.43	31.87	67.85	104.86	154.20	205.60

Instead of summing these metrics to arrive at a final total primary energy displaced metric, the appropriate carbon emissions coefficients are applied.

Step (4)	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Electricity (MMTCE per trillion Btu)	0.02205	0.02022	0.02041	0.01978	0.01960	0.01844	0.01719	0.01806	0.01862	0.01917
Natural Gas (MMTCE per trillion Btu)	0.01440	0.01440	0.01440	0.01440	0.01440	0.01440	0.01440	0.01440	0.01440	0.01440

The resultant emissions displaced projections are listed in the table below.

Step (5)	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Electricity (MMTCE)	0.00	0.11	0.26	0.42	0.59	1.63	3.54	5.90	9.15	14.04
Natural Gas (MMTCE)	0.01	0.03	0.05	0.08	0.12	0.46	0.98	1.51	2.22	2.96

The final step is to sum these individual estimates to arrive at a final metric of carbon equivalent emissions displaced as illustrated below (components may not sum to totals due to rounding).

Step (6)	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Carbon Equivalent Emissions Displaced (MMTons)	0.01	0.14	0.31	0.50	0.72	2.08	4.51	7.41	11.37	17.00

Calculating Criteria Pollutants Displaced

Calculating the amount of criteria pollutants displaced is similar to calculating the displacement of carbon equivalent emissions. Emission factors are applied to primary energy displaced by energy source to obtain criteria pollutant displacement levels by energy source. These estimates as then summed to obtain total criteria pollutant displaced levels.

The Environmental Protection Agency catalogues emission factors for numerous technologies. For the GPRA Data Call more generic emission factors have been calculated from aggregate emission and energy consumption data provided by EPA for 1997. These are provided in the tables below. Emission factors for specific technologies may be obtained from EPA's *Compilation of Air Pollutant Emission Factors* (AP-42) available on the world wide web at http://www.epa.gov/ttn/chief/ap42etc.html

Emission Factors of Criteria Pollutants
(MMTons of emissions per trillion Btu)

Fuel	NOx	SO2	VOCs	CO	PM10
Coal	0.000254	0.000568	0.000001	0.000011	0.000012
Natural Gas	0.000106	0.000000	0.000003	0.000029	0.000000
Oil	0.000140	0.000527	0.000004	0.000013	0.000007

Like the electricity carbon emission factor, the electricity criteria pollutant emission factors are dynamic, changing over time with the changing fuel mix.

Electricity Emission Factors of Criteria Pollutants
(MMTons of emissions per trillion Btu)

Criteria Coefficients	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
NOx (MMTons per trillion Btu)	0.000202	0.000178	0.000183	0.000177	0.000175	0.000161	0.000153	0.000162	0.000169	0.000176
SO2 (MMTons per trillion Btu)	0.000419	0.000324	0.000325	0.000280	0.000272	0.000214	0.000224	0.000249	0.000278	0.000305
VOCs (MMTons per trillion Btu)	0.000002	0.000002	0.000002	0.000002	0.000002	0.000002	0.000002	0.000002	0.000002	0.000002
CO (MMTons per trillion Btu)	0.000016	0.000019	0.000019	0.000020	0.000021	0.000022	0.000019	0.000019	0.000018	0.000017
PM10 (MMTons per trillion Btu)	0.000008	0.000006	0.000007	0.000006	0.000006	0.000005	0.000005	0.000005	0.000006	0.000007

Calculating Criteria Pollutant Emissions Displaced – An Example

To better understand the calculations behind criteria pollutants displaced, consider the following example for calculating emissions of NOx displaced. Similar steps would be taken for calculating SO2, VOCs, CO and PM10. Steps 1-3 of the energy conversion process for Planning Unit EE yielded the following energy displacement estimates by fuel source.

Step (3)	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Electricity (trillion Btu)	0.00	5.27	12.81	21.32	30.30	88.17	205.77	326.73	491.24	732.33
Natural Gas (trillion Btu)	1.03	2.06	3.60	5.65	8.43	31.87	67.85	104.86	154.20	205.60

Instead of summing these metrics to arrive at a total primary energy displaced metric, the appropriate emission factors are applied.

Step (4)	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Electricity (MMTon of NOx per trillion Btu)	0.000202	0.000178	0.000183	0.000177	0.000175	0.000161	0.000153	0.000162	0.000169	0.000176
Natural Gas (MMTons of NOx per trillion Btu)	0.000106	0.000106	0.000106	0.000106	0.000106	0.000106	0.000106	0.000106	0.000106	0.000106

The resultant emissions displaced for NOx are listed in the table below. Similar calculations would be performed for SO2, VOCs, CO and PM10.

Step (5)	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Electricity (MMTons NOx)	0.000	0.001	0.002	0.004	0.005	0.014	0.031	0.053	0.083	0.129
Natural Gas (MMTons NOx)	0.000	0.000	0.000	0.001	0.001	0.003	0.007	0.011	0.016	0.022

The final step is to sum these individual estimates to arrive at a final metric of NOx emissions displaced as illustrated below.

Step (6)	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
NOx Displaced (MMTons)	0.000	0.001	0.003	0.004	0.006	0.018	0.039	0.064	0.099	0.151

Energy Information Administration
Annual Energy Outlook 1999
Baseline Assumption Tables*

Table 20. Energy Prices by Sector and Source for the United States

Table 21. Residential Sector Supplement Table

Table 22. Commercial Sector Supplement Table

Table 23. Industrial Sector Macroeconomic Indicators

Table 24. Refining Industry Energy Consumption

Table 25. Food Industry Energy Consumption

Table 26. Paper Industry Energy Consumption

Table 27. Bulk Chemical Industry Energy Consumption

Table 28. Glass Industry Energy Consumption

Table 29. Cement Industry Energy Consumption

Table 30. Iron and Steel Industries Energy Consumption

Table 31. Aluminum Industry Energy Consumption

Table 32. Other Industrial Sector Energy Consumption

Table 47. Light-Duty Vehicle MPG by Technology Type (MPG Gasoline Equivalents)

Table 72. Electric Power Projections for the United States

* Tables in the AEO99 contain projections to 2020. These projections have been extended to 2030 using the average growth rate from 1997-2020.

Please contact John Mortensen at NREL (john_mortensen@nrel.gov) if you would like copies of the above tables in spreadsheet format. All AEO99 supplemental tables may be found on the EIA website at **http://www.eia.doe.gov/oiaf/supplement/supdata.html**

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Table 20. Energy Prices by Sector and Source
(1997 Dollars per Million Btu)
United States Total

	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Residential	12.96	12.85	12.95	13.01	13.04	12.95	12.63	12.47	12.28	12.09
Primary Energy 1/	6.74	6.73	6.72	6.71	6.74	6.57	6.37	6.33	6.18	6.02
Petroleum Products 2/	8.04	8.27	8.52	8.79	9.04	9.36	9.49	9.67	9.97	10.27
Distillate Fuel	6.67	6.85	7.06	7.24	7.45	7.75	7.82	7.79	7.98	8.17
Liquefied Petroleum Gas	10.74	11.04	11.31	11.68	12.00	12.22	12.38	12.85	13.14	13.44
Natural Gas	6.46	6.38	6.32	6.24	6.24	6.00	5.78	5.74	5.54	5.34
Electricity	22.97	22.58	22.75	22.86	22.78	22.45	21.50	20.68	19.88	19.10
Commercial	12.45	12.29	12.33	12.35	12.34	12.04	11.63	11.43	11.09	10.77
Primary Energy 1/	5.18	5.19	5.21	5.22	5.26	5.21	5.14	5.16	5.09	5.01
Petroleum Products 2/	4.99	5.17	5.40	5.61	5.80	6.10	6.22	6.40	6.63	6.86
Distillate Fuel	4.44	4.61	4.83	5.02	5.21	5.49	5.61	5.69	5.87	6.05
Residual Fuel	2.43	2.51	2.70	2.81	2.86	3.13	3.18	3.39	3.38	3.36
Natural Gas 3/	5.30	5.28	5.27	5.26	5.27	5.17	5.08	5.09	4.98	4.87
Electricity	20.71	20.25	20.27	20.24	20.11	19.28	18.25	17.59	16.70	15.86
Industrial 4/	4.75	4.85	4.96	5.06	5.12	5.22	5.21	5.28	5.26	5.23
Primary Energy	3.35	3.47	3.59	3.71	3.82	4.02	4.13	4.27	4.33	4.39
Petroleum Products 2/	4.28	4.50	4.71	4.93	5.11	5.38	5.53	5.79	5.83	5.87
Distillate Fuel	4.48	4.67	4.90	5.11	5.28	5.56	5.76	5.97	6.17	6.39
Liquefied Petroleum Gas	5.45	5.74	5.98	6.30	6.60	6.67	6.85	7.33	7.12	6.91
Residual Fuel	2.01	2.14	2.29	2.42	2.42	2.72	2.73	2.89	2.88	2.88
Natural Gas 5/	2.82	2.87	2.91	2.94	2.99	3.14	3.23	3.30	3.38	3.46
Metallurgical Coal	1.68	1.66	1.65	1.64	1.63	1.57	1.50	1.45	1.38	1.32
Steam Coal	1.36	1.34	1.33	1.32	1.31	1.26	1.20	1.14	1.08	1.03
Electricity	12.89	12.79	12.86	12.78	12.54	11.89	11.09	10.68	10.14	9.63
Transportation	7.75	7.95	8.20	8.46	8.63	9.00	9.00	9.00	9.09	9.18
Primary Energy	7.74	7.93	8.18	8.44	8.61	8.98	8.97	8.97	9.06	9.15
Petroleum Products 2/	7.74	7.93	8.18	8.44	8.61	8.98	8.97	8.97	9.06	9.15
Distillate Fuel 6/	7.71	7.86	8.09	8.30	8.49	8.58	8.56	8.53	8.53	8.52
Jet Fuel 7/	4.33	4.54	4.81	5.08	5.36	5.74	5.96	6.31	6.58	6.86
Motor Gasoline 8/	8.92	9.13	9.40	9.69	9.85	10.40	10.43	10.40	10.56	10.72
Residual Fuel	1.51	1.67	1.82	2.02	2.19	2.58	2.60	2.82	2.77	2.72
Liquid Petroleum Gas 9/	11.90	12.15	12.40	12.77	13.04	13.06	12.99	13.20	13.47	13.75
Natural Gas 10/	6.48	6.50	6.56	6.62	6.72	7.17	7.31	7.36	7.64	7.94
E85 11/	15.11	15.54	16.05	16.55	16.83	17.53	17.68	17.78	18.12	18.48
M85 12/	10.62	10.95	11.34	11.66	11.91	13.02	13.10	13.22	13.22	13.21
Electricity	15.57	15.32	15.43	15.24	15.10	14.55	13.67	13.04	12.42	11.83
Average End-Use Energy	8.02	8.09	8.24	8.39	8.48	8.62	8.53	8.52	8.47	8.43
Primary Energy	7.59	7.69	7.86	8.03	8.13	8.31	8.24	8.23	8.21	8.18
Electricity	19.00	18.69	18.78	18.79	18.62	18.00	17.10	16.50	15.78	15.09
Electric Generators 13/										
Fossil Fuel Average	1.46	1.47	1.48	1.49	1.52	1.57	1.61	1.61	1.62	1.64
Petroleum Products	2.49	2.63	2.83	3.03	3.29	3.89	4.05	4.33	4.71	5.13
Distillate Fuel	4.02	4.21	4.45	4.62	4.81	5.11	5.28	5.45	5.71	5.97
Residual Fuel	2.36	2.46	2.61	2.78	2.97	3.52	3.63	3.90	4.20	4.53
Natural Gas	2.67	2.74	2.80	2.87	2.94	3.08	3.17	3.24	3.37	3.50
Steam Coal	1.18	1.17	1.16	1.15	1.14	1.06	0.99	0.93	0.87	0.81
Average Price to All Users 14/										
Petroleum Products 2/	6.79	7.01	7.28	7.55	7.75	8.11	8.16	8.24	8.36	8.49
Distillate Fuel 6/	6.91	7.08	7.31	7.52	7.71	7.88	7.91	7.94	8.03	8.13
Jet Fuel	4.33	4.54	4.81	5.08	5.36	5.74	5.96	6.31	6.58	6.86
Liquefied Petroleum Gas	6.55	6.85	7.11	7.46	7.77	7.88	8.03	8.46	8.34	8.23
Motor Gasoline 8/	8.92	9.13	9.40	9.69	9.85	10.40	10.43	10.41	10.56	10.73
Residual Fuel	2.00	2.09	2.20	2.33	2.43	2.76	2.76	2.96	2.96	2.96
Natural Gas	4.10	4.09	4.08	4.08	4.10	4.06	4.02	4.05	3.99	3.93
Coal	1.20	1.19	1.18	1.16	1.15	1.08	1.01	0.95	0.89	0.83
E85 11/	15.11	15.54	16.05	16.55	16.83	17.53	17.68	17.78	18.12	18.48
M85 12/	10.62	10.95	11.34	11.66	11.91	13.02	13.10	13.22	13.22	13.21
Electricity	19.00	18.69	18.78	18.79	18.62	18.00	17.10	16.50	15.78	15.09

Table 20. Energy Prices by Sector and Source
(1997 Dollars per Million Btu)
United States Total

	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Non-Renewable Energy Expentures by Sector (billion 1997 dollars)										
Residential	139.23	138.95	140.51	142.28	142.98	147.38	150.70	154.96	158.84	162.81
Commercial	99.66	99.42	100.71	101.77	102.66	105.54	106.71	106.97	108.58	110.21
Industrial	103.96	106.73	109.45	111.95	114.44	122.05	127.03	133.57	138.38	143.36
Transportation	208.12	217.67	229.16	240.90	250.95	285.93	301.75	317.40	348.00	381.54
Total Non-Renewable Expend	550.96	562.76	579.82	596.91	611.03	660.89	686.18	712.90	751.44	792.07
Trans. Renew. Expenditures	0.21	0.28	0.35	0.43	0.51	0.90	1.15	1.32	3.94	11.75
Total Expenditures	551.17	563.03	580.17	597.33	611.53	661.79	687.33	714.22	753.13	794.17

1/ Weighted average price includes fuels below as well as coal.
2 / This quantity is the weighted average for all petroleum products, not just those listed below.
3/ Excludes independent power producers.
4/ Includes cogenerators.
5/ Excludes uses for lease and plant fuel.
6/ Low sulfur diesel fuel. Price includes Federal and State taxes while excluding county and local taxes.
7/ Kerosene-type jet fuel. Price includes Federal and State taxes while excluding county and local taxes.
8/ Sales weighted-average price for all grades. Includes Federal and State taxes and excludes county and local taxes.
9/ Includes Federal and State taxes while excluding county and local taxes.
10/ Compressed natural gas used as a vehicle fuel. Price includes estimated motor vehicle fuel taxes.
11/ E85 is 85 percent ethanol (renewable) and 15 percent motor gasoline (nonrenewable).
12/ M85 is 85 percent methanol and 15 percent motor gasoline.
13/ Includes all electric power generators except cogenerators, which produce electricity and other useful thermal energy. Includes small power producers and exempt wholesale generators.
14/ Weighted averages of end-use fuel prices are derived from the prices shown in each sector and the corresponding sectoral consumption.
Btu = British thermal unit.
Note: 1996 and 1997 figures may differ from published data due to internal rounding.
Sources: 1996 prices for gasoline, distillate, and jet fuel are based on prices in the Energy Information Administration (EIA), Petroleum Marketing Annual 1996. Online. http:/www.eia.doe.gov/oil-gas/pmal/pmaframe.html (August 1, 1998). 1997 prices for gasoline, distillate, and jet fuel are based on prices in various issues of EIA, Petroleum Marketing Monthly, DOE/EIA-0380 (97/03-98/04) (Washington, DC, 1997-98). 1996 and 1997 prices for all other petroleum products are derived from the EIA, State Energy Price and Expenditures Report: 1995, DOE/EIA-0376(95) (Washington, DC, August, 1998). 1996 residential, commercial, and transportation natural gas delivered prices: EIA, Natural Gas Annual 1996, DOE/EIA-0131(96) (Washington, DC, September 1997). 1996 electric generators natural gas delivered prices: Form FERC-423, "Monthly Report of Cost and Quality of Fuels for Electric Plants." 1996 and 1997 industrial gas delivered prices are based on EIA, Manufacturing Energy Consumption Survey 1991. 1997 residential and commercial natural gas delivered prices: EIA, Natural Gas Monthly, DOE/EIA-0130(98/06) (Washington, DC, June 1998). Other 1997 natural gas delivered prices: EIA, AEO99 National Energy Modeling System run AEO99B.D100198A. Values for 1996 and 1997 coal prices have been estimated from EIA, State Energy Price and Expenditures Report: 1995, DOE/EIA-0376(95) (Washington, DC, August, 1998) by use of consumption quantities aggregated from EIA, State Energy Data Report 1995 , DOE/EIA-0214(95)(Washington, DC, December 1997) and the Coal Industry Annual 1997, DOE/EIA-0584(97) (Washington, DC, November 1998). 1996 residential electricity prices derived from EIA, Short-Term Energy Outlook, September 1998. Online http://www.eia.doe.gov/emeu/steo/pub/upd/sep98/contents.html (October 15, 1998). 1996 and 1997 electricity prices for commercial, industrial, and transportation: EIA, AEO99 National Energy Modeling System run AEO99B.D100198A. Projections: EIA, AEO99 National Energy Modeling System run AEO99B.D100198A.

Table 21. Residential Sector Supplement Table

	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Equipment Stock (million units)										
Main Space Heaters										
Electric Heat Pumps	9.08	9.27	9.46	9.66	9.81	10.63	11.52	12.54	13.74	15.06
Electric Other	18.55	18.71	18.88	19.07	19.17	19.82	20.56	21.22	22.01	22.83
Natural Gas Heat Pumps	0.09	0.10	0.11	0.12	0.12	0.17	0.23	0.32	0.48	0.72
Natural Gas Other	57.64	58.42	59.21	60.03	61.06	66.30	71.27	75.51	81.05	86.99
Distillate	9.77	9.72	9.66	9.61	9.55	9.27	9.00	8.68	8.43	8.18
Liquid Petroleum Gas	5.39	5.46	5.51	5.55	5.56	5.58	5.53	5.44	5.55	5.67
Kerosene	0.91	0.90	0.89	0.88	0.87	0.82	0.78	0.74	0.70	0.66
Wood Stoves	3.03	3.02	3.01	3.01	3.00	2.96	2.95	2.95	2.92	2.89
Geothermal Heat Pumps	0.48	0.51	0.55	0.58	0.61	0.74	0.96	1.49	2.05	2.80
Total	104.93	106.10	107.29	108.50	109.74	116.29	122.80	128.89	136.93	145.80
Space Cooling (million units)										
Electric Heat Pumps	9.08	9.27	9.46	9.66	9.81	10.63	11.52	12.54	13.74	15.06
Natural Gas Heat Pumps	0.09	0.10	0.11	0.12	0.12	0.17	0.23	0.32	0.48	0.72
Geothermal Heat Pumps	0.48	0.51	0.55	0.58	0.61	0.74	0.96	1.49	2.05	2.80
Central Air Conditioners	41.99	42.89	43.78	44.70	45.67	50.73	55.55	59.61	65.64	72.28
Room Air Conditioners	36.35	36.32	36.30	36.28	36.27	36.32	36.39	36.43	36.42	36.41
Total	87.99	89.09	90.20	91.33	92.49	98.59	104.65	110.39	118.32	127.27
Water Heaters (million units)										
Electric	39.80	40.20	40.62	41.06	41.37	43.05	44.94	47.23	49.44	51.77
Natural Gas	57.16	57.82	58.51	59.21	60.09	64.82	69.36	73.14	77.99	83.17
Distillate	4.57	4.58	4.58	4.58	4.57	4.53	4.48	4.45	4.42	4.40
Liquid Petroleum Gas	3.89	3.98	4.07	4.14	4.18	4.36	4.46	4.52	4.84	5.17
Solar Thermal	0.63	0.63	0.63	0.62	0.62	0.61	0.59	0.58	0.57	0.56
Total	106.05	107.21	108.40	109.60	110.84	117.36	123.84	129.91	137.26	145.06
Cooking Equipment (million units) 1/										
Electric	66.04	66.92	67.81	68.73	69.62	74.43	79.25	84.04	89.62	95.57
Natural Gas	34.36	34.59	34.83	35.09	35.41	37.10	38.76	40.10	41.71	43.40
Liquid Petroeum Gas	5.72	5.77	5.81	5.83	5.83	5.81	5.75	5.67	5.73	5.80
Total	106.13	107.28	108.45	109.64	110.87	117.34	123.77	129.80	137.07	144.77
Clothes Dryers (million units)										
Electric	63.06	64.08	65.11	66.14	67.19	72.54	77.79	82.81	89.24	96.16
Natural Gas	15.17	15.34	15.51	15.69	15.87	16.78	17.67	18.52	19.55	20.63
Total	78.23	79.42	80.62	81.83	83.06	89.32	95.46	101.34	108.79	116.79
Other Appliances(million units)										
Refrigerators	110.25	111.50	112.77	114.07	115.40	122.39	129.33	135.86	143.69	151.96
Freezers	32.20	32.05	31.90	31.77	31.65	31.65	32.27	33.32	33.45	33.57
Stock Average Equipment Efficiency										
Main Space Heaters										
Electric Heat Pumps (HSPF)	7.02	7.06	7.09	7.11	7.17	7.24	7.36	7.53	7.73	7.92
Natural Gas Heat Pumps (HSPF)	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00
Geothermal Heat Pumps (COP)	3.40	3.40	3.40	3.40	3.40	3.40	3.52	3.65	3.71	3.76
Natural Gas Furnace (AFUE)	0.77	0.78	0.78	0.79	0.79	0.82	0.83	0.84	0.86	0.88
Distillate Furnace (AFUE)	0.80	0.80	0.80	0.81	0.81	0.82	0.82	0.82	0.83	0.83
Space Cooling										
Electric Heat Pumps (SEER)	10.62	10.72	10.79	10.84	10.91	10.98	11.15	11.41	11.74	12.08
Natural Gas Heat Pumps (SEER)	15.60	15.60	15.60	15.60	15.60	15.60	15.60	15.60	15.60	15.60
Geothermal Heat Pumps (EER)	13.50	13.50	13.50	13.50	13.50	13.50	13.95	14.44	14.65	14.87
Cent. Air Conditioners (SEER)	10.21	10.28	10.34	10.37	10.54	10.80	11.05	11.32	11.68	12.05
Room Air Conditioners (EER)	8.97	9.06	9.15	9.22	9.28	9.49	9.59	9.65	9.91	10.17
Water Heaters										
Electric (EF)	0.87	0.87	0.87	0.87	0.87	0.88	0.88	0.88	0.89	0.89
Natural Gas (EF)	0.56	0.56	0.56	0.56	0.57	0.57	0.58	0.59	0.60	0.61
Distillate (EF)	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.54	0.54
Liquid Petroleum Gas (EF)	0.56	0.56	0.57	0.57	0.57	0.58	0.60	0.61	0.63	0.65

Table 21. Residential Sector Supplement Table

	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Other Appliances (kWh/yr)										
Refrigerators	849.27	809.32	776.12	746.05	719.09	615.83	559.24	538.26	472.93	415.54
Freezers	652.02	622.85	596.60	572.33	551.85	488.93	456.77	441.90	391.61	347.04
Build. Shell Eff.Index										
Space Heating										
Pre-1994 Homes	0.91	0.91	0.90	0.90	0.89	0.86	0.84	0.82	0.79	0.77
New Construction	0.79	0.78	0.77	0.77	0.76	0.71	0.66	0.61	0.57	0.54
All Homes	0.90	0.89	0.89	0.88	0.87	0.84	0.81	0.78	0.75	0.72
Space Cooling										
Pre-1994 Homes	0.93	0.93	0.92	0.92	0.91	0.89	0.87	0.84	0.82	0.80
New Construction	0.84	0.83	0.82	0.82	0.81	0.75	0.71	0.66	0.62	0.58
All Homes	0.92	0.91	0.91	0.90	0.90	0.87	0.84	0.81	0.79	0.76

1/ Does not include microwave ovens or outdoor grills.

HSPF = Heating Seasonal Performance Factor: The total heating output of a heat pump in Btu during its normal annual usage period for heating divided by total electric input in watt-hours during the same period.

COP = Coefficient of Performance: Energy efficiency rating measure determined, under specific testing conditions, by dividing the energy output by the energy input.

AFUE = Annual Fuel Utilization Efficiency: Efficiency rating based on average usage, including on and off cycling, as set out in the standardized Department of Energy test procedures.

SEER = Seasonal Energy Efficiency Ratio: The total cooling of a central unitary air conditioner or a unitary heat pump in Btu during its normal annual usage period for cooling divided by the total electric energy input in watt-hours during the same period.

EER = Energy Efficiency Ratio: A ratio calculated by dividing the cooling capacity in Btu per hour by the power input in watts at any given set of rating conditions, expressed in Btu per hour per watt.

EF = Efficiency Factor: Efficiency (measured in Btu out / Btu in) of water heaters under certain test conditions specified by the Department of Energy.

kWh/y = Kilowatt hours per year to run the appliance under certain test conditions as specified by the Department of Energy.

Btu = British thermal unit.

N/A = Not applicable.

Note: Totals may not equal sum of components due to independent rounding.

Source: EIA, AEO99 National Energy Modeling System run AEO99B.D100198A.

Table 22. Commercial Sector Supplement Table

	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Commercial Building Delivered										
Energy Consumption (quadrillion Btu) 1/										
Assembly	0.58	0.58	0.58	0.58	0.58	0.59	0.60	0.61	0.62	0.63
Education	0.71	0.71	0.72	0.72	0.73	0.76	0.78	0.79	0.82	0.84
Food Sales	0.15	0.15	0.15	0.15	0.15	0.16	0.17	0.17	0.18	0.19
Food Service	0.39	0.39	0.39	0.40	0.40	0.42	0.45	0.46	0.48	0.51
Health Care	0.52	0.53	0.54	0.54	0.55	0.59	0.63	0.65	0.69	0.74
Lodging	0.55	0.56	0.56	0.57	0.57	0.60	0.64	0.65	0.68	0.71
Office - Large	0.72	0.73	0.74	0.74	0.75	0.79	0.83	0.85	0.89	0.93
Office - Small	0.57	0.57	0.58	0.58	0.59	0.62	0.65	0.66	0.69	0.73
Mercantile/Service	1.09	1.10	1.11	1.11	1.12	1.17	1.21	1.23	1.28	1.33
Warehouse	0.49	0.50	0.51	0.51	0.52	0.55	0.58	0.59	0.63	0.66
Other	0.62	0.64	0.65	0.66	0.68	0.75	0.81	0.85	0.93	1.02
Total	6.39	6.46	6.52	6.58	6.64	7.00	7.35	7.51	7.89	8.28
Commercial Building Floorspace										
(billion square feet)										
Assembly	7.03	7.06	7.10	7.13	7.17	7.33	7.47	7.56	7.73	7.90
Education	8.47	8.59	8.71	8.84	8.96	9.53	9.94	10.09	10.62	11.18
Food Sales	0.70	0.71	0.72	0.73	0.74	0.78	0.82	0.84	0.88	0.93
Food Service	1.46	1.47	1.48	1.50	1.51	1.58	1.63	1.66	1.72	1.78
Health Care	1.81	1.84	1.86	1.89	1.91	2.01	2.08	2.13	2.24	2.35
Lodging	3.99	4.03	4.08	4.13	4.18	4.41	4.63	4.71	4.96	5.22
Office - Large	5.93	5.96	5.99	6.03	6.07	6.29	6.42	6.36	6.49	6.63
Office - Small	5.59	5.63	5.66	5.70	5.74	5.96	6.09	6.05	6.19	6.34
Mercantile/Service	13.75	13.86	13.99	14.13	14.26	14.87	15.43	15.69	16.31	16.96
Warehouse	9.42	9.53	9.64	9.74	9.83	10.31	10.68	10.79	11.28	11.80
Other	5.45	5.58	5.70	5.81	5.92	6.42	6.80	7.02	7.59	8.21
Total	63.60	64.25	64.94	65.62	66.28	69.49	72.00	72.90	76.02	79.30
Stock Avgerage Equipment Efficiency 2/										
Space Heating										
Electricity	1.08	1.08	1.09	1.09	1.09	1.10	1.11	1.11	1.12	1.13
Natural Gas	0.75	0.76	0.76	0.76	0.77	0.78	0.79	0.80	0.81	0.82
Distillate	0.75	0.76	0.76	0.76	0.76	0.77	0.77	0.77	0.78	0.79
Space Cooling										
Electricity	2.62	2.65	2.69	2.73	2.77	2.95	3.08	3.20	3.39	3.60
Natural Gas	0.89	0.90	0.91	0.93	0.94	1.02	1.07	1.11	1.19	1.27
Water Heating										
Electricity	0.95	0.95	0.95	0.95	0.96	0.97	0.98	0.99	1.00	1.01
Natural Gas	0.75	0.75	0.76	0.77	0.77	0.79	0.79	0.80	0.82	0.84
Distillate	0.75	0.75	0.75	0.76	0.76	0.77	0.77	0.77	0.78	0.79
Ventilation (cfm per Btu) 3/										
Electricity	0.41	0.41	0.41	0.42	0.42	0.43	0.45	0.46	0.48	0.50
Cooking										
Electricity	0.52	0.52	0.52	0.52	0.52	0.53	0.53	0.52	0.53	0.53
Natural Gas	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.49	0.49	0.49
Lighting Efficacy 4/										
(efficacy in lumens per watt)										
Electricity	55.31	56.04	56.80	57.52	58.10	60.56	62.00	63.54	66.15	68.87
Refrigeration										
Electricity	1.63	1.64	1.64	1.64	1.65	1.66	1.67	1.68	1.70	1.71

1/ Excludes commercial sector energy consumption (from uses such as street lights) that is not attributable to buildings.

2/ Unless noted otherwise, the efficiency measures are in the terms of Btu of energy output divided by Btu of purchased energy input.

3/ The efficiency measure for ventilation is in terms of cubic feet per minute (cfm) of ventilation air delivered divided by Btu of purchased energy input.

Table 22. Commercial Sector Supplement Table										
	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
4/ A measurement of the ratio of light produced by a light source to the electrical power used to produce that quality of										
light, expressed in lumens per watt.										
Quad. = Quadrillion.										
Btu = British thermal unit.										
Avg. = Average.										
Equip. = Equipment.										
Cfm = Cubic feet per minute.										
PC = Personal computer.										
Note: Totals may not equal sum of components due to independent rounding.										
Source: EIA, AEO99 National Energy Modeling System run AEO99B.D100198A.										

Table 23. Industrial Sector Macroeconomic Indicators

	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
GDP (billion 1992 dollars)	7995.7	8172.6	8361.6	8549.3	8769.3	9895.5	10800.5	11680.0	12948.2	14354.1
Non-Agricultural Employment (million)	128.0	129.4	130.8	132.3	134.2	143.5	149.4	154.0	162.2	170.8
Value of Gross Output										
(billion 1987 dollars)										
Nonmanufacturing Sector										
Agricultural	262.5	264.2	267.2	270.7	275.1	295.0	311.1	325.4	345.1	366.1
Mining	138.5	139.5	140.8	141.8	143.4	150.8	158.5	162.4	168.7	175.3
Construction	459.5	472.0	481.9	491.7	503.8	567.5	611.3	657.0	721.1	791.5
Manufacturing Sector										
Food and Kindred Products	417.6	421.4	426.1	431.3	437.7	470.0	497.8	522.0	554.5	589.1
Tobacco Products	24.5	23.9	23.7	23.5	23.3	22.0	20.5	18.1	16.6	15.3
Textile Mill Products	60.6	61.5	62.3	63.2	64.9	71.4	74.4	75.5	80.0	84.8
Apparel and Other Textile										
Products	89.2	90.5	91.1	92.4	95.2	106.3	113.1	112.4	118.1	124.1
Lumber and Wood Products	82.0	83.4	84.5	85.2	86.5	94.8	98.4	101.9	108.4	115.4
Furniture and Fixtures	47.7	48.5	49.7	50.1	50.7	53.1	53.9	53.3	55.0	56.7
Paper and Allied Products	132.9	134.6	135.9	137.4	139.6	149.5	156.8	162.2	171.6	181.6
Printing and Publishing	148.0	148.7	150.2	151.4	153.7	162.5	170.4	175.8	184.3	193.2
Chemical and Allied Products	296.4	302.0	305.0	309.7	316.7	350.4	379.1	403.6	438.5	476.8
Bulk Chemicals	154.5	156.8	157.2	158.4	160.7	172.4	182.6	192.5	202.7	213.4
Other Chemicals and										
Allied Products	141.8	145.2	147.8	151.3	156.0	178.0	196.5	211.1	235.8	263.3
Petroleum and Coal Products	159.5	161.8	162.5	163.6	164.9	175.4	180.9	184.2	191.4	198.9
Petroleum Refining	143.0	145.1	145.6	146.4	147.5	156.5	161.1	163.2	169.0	175.0
Other Petroleum and										
Coal Products	16.5	16.7	16.9	17.1	17.4	18.9	19.9	21.0	22.4	23.9
Rubber and Miscellaneous										
Plastic Products	143.4	147.5	151.8	156.3	162.2	188.8	219.6	251.8	292.4	339.4
Leather and Leather Products	6.6	6.8	6.6	6.7	7.0	7.6	8.1	7.5	7.5	7.6
Stone, Clay, and Glass Products	69.3	70.6	71.3	71.9	72.8	77.2	79.6	81.5	84.2	87.0
Glass and Glass Products	19.1	19.3	19.4	19.4	19.6	20.4	21.4	22.1	22.7	23.4
Cement, Hydraulic	4.6	4.7	4.7	4.8	4.8	5.1	5.2	5.3	5.4	5.6
Other Stone, Clay, and										
Glass Products	45.6	46.6	47.2	47.7	48.3	51.6	53.0	54.0	56.0	58.1
Primary Metals Industry	151.4	153.3	154.8	156.2	158.4	163.0	167.1	168.0	172.4	176.9
Blast Furnace and Basic										
Steel Products	72.0	73.1	74.4	75.1	76.4	78.4	81.2	81.4	84.2	87.2
Aluminum	28.4	28.8	29.0	29.1	29.3	29.4	29.4	28.8	28.9	28.9
Other Primary Metal Products.	51.0	51.4	51.5	51.9	52.7	55.2	56.5	57.8	59.3	60.8
Fabricated Metal Products	186.3	189.0	191.2	193.3	197.0	213.1	223.1	232.8	246.3	260.6
Industrial Machinery and										
Equipment	353.3	367.2	378.8	391.3	407.6	477.0	536.4	595.4	683.3	784.2
Electronic and Other Electric										
Equipment	404.7	425.0	447.7	477.8	515.3	703.5	849.0	1021.1	1287.0	1622.0
Transportation Equipment	433.6	438.8	449.7	458.9	471.6	516.5	545.7	571.8	615.2	661.8
Instruments & Related Products.	132.4	133.7	136.9	140.2	144.7	170.4	185.7	194.9	214.4	235.8
Miscellaneous Manufacturing										
Industries	44.1	45.0	45.3	45.7	46.8	51.2	53.0	52.5	55.0	57.8
Total Industrial Gross Output	4244.1	4328.8	4415.3	4510.1	4639.1	5237.0	5693.4	6131.0	6811.0	7601.7

GDP = Gross domestic product.

Note: Totals may not equal sum of components due to independent rounding.

Sources: 1997: Data Resources Incorporated (DRI), DRI Trend0898. Projections: Energy Information Administration, AEO99 National Energy Modeling System run AEO99B.D100198A.

Table 24. Refining Industry Energy Consumption

	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Industry Output (billion 1987 dollars)	142.96	145.05	145.58	146.44	147.47	156.52	161.07	163.22	169.01	175.00
Energy Consumption (trillion Btu)										
Residual Oil	39.6	41.1	41.7	40.0	40.2	43.5	47.2	44.5	42.3	40.2
Distillate Oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Liquefied Petroleum Gas	4.3	4.8	4.7	4.2	4.4	6.8	6.9	4.8	3.6	2.6
Petroleum Coke	581.5	564.9	565.1	562.2	563.3	539.3	514.5	497.1	482.0	467.3
Still Gas	1748.2	1807.6	1778.5	1771.1	1775.6	1872.9	1819.8	1755.8	1834.5	1916.8
Other Petroleum 2/	18.1	4.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Petroleum Subtotal	2391.7	2423.2	2390.1	2377.4	2383.5	2462.5	2388.3	2302.2	2362.4	2427.0
Natural Gas	979.3	999.0	1043.1	1064.4	1081.5	1146.7	1228.0	1283.3	1422.2	1576.2
Steam Coal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Purchased Electricity	159.8	167.2	167.5	168.4	171.0	194.8	199.4	200.4	228.5	260.5
Total	3530.9	3589.3	3600.7	3610.2	3636.1	3804.0	3815.7	3785.9	4013.0	4263.6
Energy Consumption per Unit of										
Output (thousand Btu/1987$ output)										
Residual Oil	0.28	0.28	0.29	0.27	0.27	0.28	0.29	0.27	0.25	0.23
Distillate Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Liquefied Petroleum Gas	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.03	0.02	0.02
Petroleum Coke	4.07	3.89	3.88	3.84	3.82	3.45	3.19	3.05	2.85	2.67
Still Gas	12.23	12.46	12.22	12.09	12.04	11.97	11.30	10.76	10.85	10.95
Other Petroleum 2/	0.13	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Petroleum Subtotal	16.73	16.71	16.42	16.24	16.16	15.73	14.83	14.11	13.98	13.87
Natural Gas	6.85	6.89	7.17	7.27	7.33	7.33	7.62	7.86	8.42	9.01
Steam Coal	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Purchased Electricity	1.12	1.15	1.15	1.15	1.16	1.24	1.24	1.23	1.35	1.49
Total	24.70	24.75	24.73	24.65	24.66	24.30	23.69	23.20	23.74	24.36

1/ Fuel consumption includes consumption for cogeneration.
2/ Includes lubricants and miscellaneous petroleum products.
Btu = British thermal unit.
N/A = Not applicable.
Note: Totals may not equal sum of components due to independent rounding.
Source: Energy Information Administration, AEO99 National Energy Modeling System run AEO99B.D100198A.

Table 25. Food Industry Energy Consumption

	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Industry Output (billion 1987 dollars)	417.59	421.39	426.14	431.28	437.73	470.04	497.83	522.01	554.54	589.10
Energy Consumption (trillion Btu)										
Residual Oil	24.7	24.3	23.9	23.5	23.9	23.8	25.1	25.6	26.6	27.7
Distillate Oil	18.5	18.3	18.1	17.9	17.9	17.9	18.8	19.4	20.2	21.0
Liquefied Petroleum Gas	5.9	5.8	5.8	5.6	5.5	5.8	6.1	6.2	6.6	7.0
Other Petroleum 2/	129.8	128.5	127.5	126.2	128.5	129.8	138.9	144.0	151.5	159.5
Petroleum Subtotal	178.9	176.9	175.3	173.2	175.9	177.3	188.9	195.1	204.9	215.2
Natural Gas	568.7	570.6	573.0	576.1	576.6	591.6	609.1	628.7	642.8	657.1
Steam Coal	177.3	180.2	183.3	186.1	188.7	199.6	209.7	222.3	234.7	247.8
Renewables	12.8	12.9	13.1	13.2	13.5	14.7	15.8	16.8	18.0	19.3
Purchased Electricity	210.2	211.8	213.2	215.0	217.9	229.8	242.2	253.2	265.9	279.3
Total	1147.8	1152.4	1157.9	1163.6	1172.5	1213.0	1265.6	1316.2	1366.4	1418.8
Energy Consumption per Unit of										
Output (thousand Btu/1987$ output)										
Residual Oil	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Distillate Oil	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Liquefied Petroleum Gas	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Other Petroleum 2/	0.31	0.30	0.30	0.29	0.29	0.28	0.28	0.28	0.27	0.27
Petroleum Subtotal	0.43	0.42	0.41	0.40	0.40	0.38	0.38	0.37	0.37	0.37
Natural Gas	1.36	1.35	1.34	1.34	1.32	1.26	1.22	1.20	1.16	1.12
Steam Coal	0.42	0.43	0.43	0.43	0.43	0.42	0.42	0.43	0.42	0.42
Renewables	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Purchased Electricity	0.50	0.50	0.50	0.50	0.50	0.49	0.49	0.49	0.48	0.47
Total	2.75	2.73	2.72	2.70	2.68	2.58	2.54	2.52	2.46	2.41

1/ Fuel consumption includes consumption for cogeneration.

2/ Includes petroleum coke, lubricants, and miscellaneous petroleum products.

Btu = British thermal unit.

Note: Totals may not equal sum of components due to independent rounding.

Source: Energy Information Administration, AEO99 National Energy Modeling System run AEO99B.D100198A.

Table 26. Paper Industry Energy Consumption

	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Industry Output (billion 1987 dollars)	132.85	134.61	135.90	137.41	139.64	149.47	156.84	162.23	171.62	181.56
Energy Consumption (trillion Btu)										
Residual Oil	48.2	46.9	45.5	44.1	44.6	41.6	42.3	41.6	41.4	41.3
Distillate Oil	13.8	13.7	13.5	13.4	13.3	13.0	12.9	12.8	12.6	12.4
Liquefied Petroleum Gas	13.3	13.3	13.2	13.1	13.0	13.1	13.1	13.0	13.1	13.2
Other Petroleum 2/	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1
Petroleum Subtotal	85.5	84.0	82.3	80.7	81.0	77.8	78.4	77.5	77.3	77.0
Natural Gas	304.2	302.9	302.2	300.6	297.7	284.3	276.8	274.6	266.6	258.8
Steam Coal	125.6	124.3	122.4	120.6	118.7	105.3	96.8	92.9	85.7	79.2
Renewables	1317.3	1334.2	1346.3	1360.9	1387.4	1504.7	1594.3	1660.6	1768.9	1884.2
Purchased Electricity	231.3	231.9	230.8	230.1	230.2	228.0	228.4	228.5	227.7	227.0
Total	2063.9	2077.3	2084.1	2093.0	2115.0	2200.0	2274.5	2334.1	2426.2	2526.2
Energy Consumption per Unit of Output (thousand Btu/1987$ output)										
Residual Oil	0.36	0.35	0.33	0.32	0.32	0.28	0.27	0.26	0.24	0.23
Distillate Oil	0.10	0.10	0.10	0.10	0.10	0.09	0.08	0.08	0.07	0.07
Liquefied Petroleum Gas	0.10	0.10	0.10	0.10	0.09	0.09	0.08	0.08	0.08	0.07
Other Petroleum 2/	0.08	0.08	0.07	0.07	0.07	0.07	0.06	0.06	0.06	0.06
Petroleum Subtotal	0.64	0.62	0.61	0.59	0.58	0.52	0.50	0.48	0.45	0.42
Natural Gas	2.29	2.25	2.22	2.19	2.13	1.90	1.76	1.69	1.55	1.43
Steam Coal	0.95	0.92	0.90	0.88	0.85	0.70	0.62	0.57	0.50	0.44
Renewables	9.92	9.91	9.91	9.90	9.94	10.07	10.16	10.24	10.31	10.38
Purchased Electricity	1.74	1.72	1.70	1.67	1.65	1.53	1.46	1.41	1.33	1.25
Total	15.54	15.43	15.34	15.23	15.15	14.72	14.50	14.39	14.14	13.91

1/ Fuel consumption includes consumption for cogeneration.

2/ Includes petroleum coke, lubricants, and miscellaneous petroleum products.

Btu = British thermal unit.

Note: Totals may not equal sum of components due to independent rounding.

Source: Energy Information Administration, AEO99 National Energy Modeling System run AEO99B.D100198A.

Table 27. Bulk Chemical Industry Energy Consumption

	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Industry Output (billion 1987 dollars)	154.54	156.81	157.23	158.44	160.70	172.41	182.56	192.53	202.72	213.44
Energy Consumption (trillion Btu)										
Heat and Power										
Residual Oil	36.2	35.9	34.6	33.6	34.4	33.9	36.1	36.9	38.0	39.1
Distillate Oil	6.0	6.0	5.8	5.7	5.6	5.7	5.8	5.9	6.0	6.0
Liquefied Petroleum Gas	2.4	2.4	2.3	2.2	2.2	2.3	2.4	2.5	2.6	2.8
Other Petroleum 2/	242.1	239.7	232.2	226.2	231.7	229.0	245.6	254.2	261.3	268.6
Petroleum Subtotal	286.7	283.9	274.9	267.7	273.9	270.9	289.9	299.5	307.8	316.4
Natural Gas	1828.1	1843.7	1841.2	1844.2	1843.6	1871.9	1930.2	2000.0	2033.1	2066.7
Steam Coal	134.6	138.3	139.4	141.2	143.0	154.9	167.3	183.2	194.5	206.5
Purchased Electricity	619.1	627.1	624.5	626.0	633.9	670.8	709.7	749.9	781.4	814.3
Total Heat and Power	2868.6	2893.1	2879.9	2879.1	2894.4	2968.5	3097.2	3232.5	3316.8	3403.9
Feedstock										
Liquefied Petroleum Gas	1596.6	1615.5	1616.8	1625.4	1644.1	1742.3	1827.3	1911.1	1991.2	2074.6
Petrochemical Feedstocks	1290.0	1305.3	1306.4	1313.3	1328.5	1407.8	1476.5	1544.2	1608.9	1676.3
Natural Gas	703.2	711.5	712.1	715.9	724.1	767.4	804.8	841.7	877.0	913.7
Total Feedstocks	3589.8	3632.3	3635.2	3654.6	3696.7	3917.4	4108.6	4297.1	4477.1	4664.7
Total	6458.4	6525.4	6515.1	6533.7	6591.2	6885.9	7205.8	7529.6	7793.9	8068.6
Consumption per Unit of Output										
(thousand Btu/1987$ output)										
Heat and Power										
Residual Oil	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Distillate Oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Liquefied Petroleum Gas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Petroleum	1.6	1.5	1.5	1.4	1.4	1.3	1.3	1.3	1.3	1.3
Petroleum Subtotal	1.9	1.8	1.7	1.7	1.7	1.6	1.6	1.6	1.5	1.5
Natural Gas 2/	11.8	11.8	11.7	11.6	11.5	10.9	10.6	10.4	10.0	9.7
Steam Coal	0.9	0.9	0.9	0.9	0.9	0.9	0.9	1.0	1.0	1.0
Purchased Electricity	4.0	4.0	4.0	4.0	3.9	3.9	3.9	3.9	3.9	3.8
Total Heat and Power	18.6	18.4	18.3	18.2	18.0	17.2	17.0	16.8	16.4	15.9
Feedstock										
Liquefied Petroleum Gas	10.3	10.3	10.3	10.3	10.2	10.1	10.0	9.9	9.8	9.7
Petrochemical Feedstocks	8.3	8.3	8.3	8.3	8.3	8.2	8.1	8.0	7.9	7.9
Natural Gas 2/	4.6	4.5	4.5	4.5	4.5	4.5	4.4	4.4	4.3	4.3
Total Feedstocks	23.2	23.2	23.1	23.1	23.0	22.7	22.5	22.3	22.1	21.9
Total	41.8	41.6	41.4	41.2	41.0	39.9	39.5	39.1	38.4	37.8

1/ Fuel consumption includes consumption for cogeneration.
2/ Includes petroleum coke, lubricants, and miscellaneous petroleum products.
Btu = British thermal unit.
N/A = Not applicable.
Note: Totals may not equal sum of components due to independent rounding.
Source: Energy Information Administration, AEO99 National Energy Modeling System run AEO99B.D100198A.

Table 28. Glass Industry Energy Consumption

	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Industry Output (billion 1987 dollars)	19.13	19.29	19.37	19.44	19.65	20.44	21.39	22.13	22.74	23.37
Energy Consumption (trillion Btu)										
Residual Oil	14.7	14.4	14.2	13.8	13.7	12.8	13.3	13.6	13.9	14.1
Distillate Oil	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Liquefied Petroleum Gas	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Petroleum Subtotal	16.0	15.7	15.4	14.9	14.9	14.0	14.4	14.7	15.0	15.3
Natural Gas	125.2	125.3	124.6	124.0	123.6	119.8	119.6	120.7	117.8	115.1
Purchased Electricity	27.6	27.8	27.8	27.8	28.0	28.5	29.4	30.1	30.4	30.7
Total	168.8	168.8	167.8	166.7	166.5	162.3	163.5	165.5	163.2	161.0
Energy Consumption per Unit of										
Output (thousand Btu/87$output)										
Residual Oil	0.77	0.75	0.73	0.71	0.70	0.63	0.62	0.61	0.61	0.60
Distillate Oil	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03
Liquefied Petroleum Gas	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Petroleum Subtotal	0.84	0.81	0.79	0.77	0.76	0.68	0.68	0.67	0.66	0.65
Natural Gas	6.55	6.49	6.44	6.38	6.29	5.86	5.59	5.45	5.18	4.92
Purchased Electricity	1.45	1.44	1.44	1.43	1.43	1.39	1.38	1.36	1.34	1.31
Total	8.83	8.75	8.66	8.57	8.48	7.94	7.64	7.48	7.18	6.89

1/ Fuel consumption includes consumption for cogeneration.
Btu = British thermal unit.
Note: Totals may not equal sum of components due to independent rounding.
Source: Energy Information Administration, AEO99 National Energy Modeling System run AEO99B.D100198A.

Table 29. Cement Industry Energy Consumption

	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Industry Output (billion 1987 dollars)	4.60	4.68	4.74	4.77	4.84	5.14	5.24	5.30	5.43	5.56
Energy Consumption (trillion Btu)										
Residual Oil	1.4	1.4	1.3	1.2	1.2	1.0	1.0	0.9	0.8	0.8
Distillate Oil	2.8	2.6	2.5	2.4	2.3	2.1	1.9	1.8	1.6	1.5
Other Petroleum 2/	66.3	66.6	66.7	66.4	66.5	65.8	64.8	64.4	63.2	62.1
Petroleum Subtotal	70.4	70.7	70.5	69.9	70.0	68.9	67.7	67.1	65.7	64.3
Natural Gas	21.9	21.5	21.0	20.6	20.1	18.1	16.7	15.5	14.2	12.9
Steam Coal	236.3	238.0	238.4	236.9	237.1	232.3	228.7	228.2	223.3	218.6
Purchased Electricity	40.9	41.3	41.5	41.6	42.0	43.2	43.6	43.7	43.8	44.0
Total	369.5	371.5	371.5	368.9	369.2	362.5	356.6	354.5	347.0	339.9
Energy Consumption per Unit of Output (thousand Btu/1987$ output)										
Residual Oil	0.31	0.29	0.27	0.25	0.25	0.20	0.19	0.17	0.16	0.14
Distillate Oil	0.60	0.57	0.53	0.50	0.47	0.40	0.36	0.33	0.30	0.26
Other Petroleum 2/	14.40	14.25	14.08	13.92	13.72	12.81	12.38	12.15	11.65	11.18
Petroleum Subtotal	15.31	15.10	14.88	14.67	14.44	13.41	12.93	12.65	12.10	11.58
Natural Gas	4.76	4.59	4.44	4.32	4.14	3.53	3.19	2.93	2.61	2.32
Steam Coal	51.37	50.87	50.29	49.67	48.95	45.24	43.68	43.04	41.15	39.35
Purchased Electricity	8.89	8.84	8.77	8.71	8.67	8.42	8.32	8.24	8.08	7.92
Total	80.33	79.40	78.37	77.37	76.21	70.59	68.11	66.85	63.94	61.18

1/ Fuel consumption includes consumption for cogeneration.

2/ Includes petroleum coke, lubricants, and miscellaneous petroleum products.

Btu = British thermal unit.

Note: Totals may not equal sum of components due to independent rounding.

Source: Energy Information Administration, AEO99 National Energy Modeling System run AEO99B.D100198A.

Table 30. Iron and Steel Industries Energy Consumption

	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Industry Output (billion 1987 dollars)	72.03	73.07	74.36	75.14	76.43	78.40	81.19	81.36	84.21	87.17
Energy Consumption (trillion Btu)										
Residual Oil	58.7	56.7	55.1	53.0	54.1	47.6	47.8	46.0	44.7	43.6
Other Petroleum 2/	88.7	87.7	86.9	85.5	86.2	79.5	78.9	76.8	75.0	73.2
Petroleum Subtotal	147.3	144.4	142.0	138.5	140.2	127.1	126.7	122.7	119.7	116.8
Natural Gas	433.3	436.3	440.3	442.4	443.1	441.4	454.9	471.2	477.7	484.4
Metallurgical Coal	727.2	714.4	701.1	687.9	674.9	606.1	552.3	509.6	464.4	423.2
Net Coke Imports	124.6	136.0	148.4	158.0	170.3	201.6	240.4	269.2	345.8	444.2
Steam Coal	76.4	78.1	79.8	81.0	82.0	83.7	86.8	90.2	92.9	95.7
Coal Subtotal	928.2	928.5	929.3	927.0	927.2	891.5	879.5	869.0	903.2	963.2
Purchased Electricity	158.4	161.0	163.4	164.8	167.8	169.7	176.8	178.3	183.9	189.7
Total	1667.2	1670.2	1675.0	1672.6	1678.4	1629.7	1637.9	1641.2	1684.5	1754.1
Energy Consumption per Unit of										
Output (thousand Btu/87$ output)										
Residual Oil	0.81	0.78	0.74	0.71	0.71	0.61	0.59	0.56	0.53	0.50
Other Petroleum 2/	1.23	1.20	1.17	1.14	1.13	1.01	0.97	0.94	0.89	0.84
Petroleum Subtotal	2.05	1.98	1.91	1.84	1.83	1.62	1.56	1.51	1.42	1.34
Natural Gas	6.02	5.97	5.92	5.89	5.80	5.63	5.60	5.79	5.67	5.56
Metallurgical Coal	10.10	9.78	9.43	9.15	8.83	7.73	6.80	6.26	5.51	4.86
Net Coke Imports	1.73	1.86	2.00	2.10	2.23	2.57	2.96	3.31	4.11	5.10
Steam Coal	1.06	1.07	1.07	1.08	1.07	1.07	1.07	1.11	1.10	1.10
Coal Subtotal	12.89	12.71	12.50	12.34	12.13	11.37	10.83	10.68	10.72	11.05
Purchased Electricity	2.20	2.20	2.20	2.19	2.20	2.16	2.18	2.19	2.18	2.18
Total	23.14	22.86	22.53	22.26	21.96	20.79	20.17	20.17	20.00	20.12

1/ Fuel consumption includes consumption for cogeneration.

2/ Includes petroleum coke, lubricants, and miscellaneous petroleum products.

Btu = British thermal unit.

Note: Totals may not equal sum of components due to independent rounding.

Source: Energy Information Administration, AEO99 National Energy Modeling System run AEO99B.D100198A.

Table 31. Aluminum Industry Energy Consumption

	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Industry Output (billion 1987 dollars)	28.39	28.80	28.95	29.11	29.35	29.43	29.41	28.83	28.86	28.89
Energy Consumption (trillion Btu)										
Distillate Oil	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Liquefied Petroleum Gas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Natural Gas	69.9	69.4	68.5	67.6	66.8	61.8	58.7	55.5	52.1	48.9
Purchased Electricity	187.5	191.4	192.8	194.3	196.4	196.8	198.5	196.5	198.4	200.3
Total	257.5	260.9	261.5	262.0	263.3	258.6	257.3	252.1	250.6	249.3
Energy Consumption per Unit of Output (thousand Btu/1987$ output)										
Distillate Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Liquefied Petroleum Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	2.46	2.41	2.37	2.32	2.28	2.10	1.99	1.93	1.81	1.69
Purchased Electricity	6.61	6.64	6.66	6.67	6.69	6.69	6.75	6.82	6.88	6.93
Total	9.07	9.06	9.03	9.00	8.97	8.79	8.75	8.75	8.68	8.63

1/ Fuel consumption includes consumption for cogeneration.

Btu = British thermal unit.

Note: Totals may not equal sum of components due to independent rounding.

Source: Energy Information Administration, AEO99 National Energy Modeling System run AEO99B.D100198A.

Table 32. Other Industrial Sector Energy Consumption
(Trillion Btu)

	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Agriculture										
Distillate Oil	584.4	588.5	596.4	604.5	614.7	655.7	689.8	719.8	762.8	808.3
Liquid Petroleum Gas	80.7	81.3	82.3	83.5	84.9	90.6	95.3	99.4	105.4	111.7
Motor Gasoline	95.8	96.5	97.7	99.1	100.7	107.5	113.1	118.0	125.0	132.5
Other Petroleum	17.0	17.1	17.4	17.6	17.9	19.1	20.1	20.9	22.2	23.5
Petroleum Subtotal	777.9	783.4	793.9	804.7	818.2	872.8	918.2	958.2	1015.4	1076.0
Natural Gas	58.0	58.4	59.0	59.7	60.5	63.9	66.6	69.1	72.6	76.2
Steam Coal	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Renewables	20.5	20.6	21.0	21.3	21.7	23.7	25.2	26.6	28.5	30.6
Purchased Electricity	138.0	139.0	140.8	142.8	145.2	155.0	163.1	170.3	180.5	191.4
Total	994.6	1001.6	1014.9	1028.7	1045.9	1115.5	1173.4	1224.3	1297.2	1374.4
Industry Output (billion 1987 dollars)	262.48	264.16	267.24	270.73	275.11	294.97	311.06	325.36	345.11	366.05
Energy Consumption per Unit of										
Output (thousand Btu/1987$ output)	3.79	3.79	3.80	3.80	3.80	3.78	3.77	3.76	3.76	3.75
Construction										
Residual Oil	129.3	132.3	134.7	137.1	140.0	155.6	166.2	177.3	192.3	208.6
Distillate Oil	196.4	201.0	204.6	208.2	212.7	236.4	252.4	269.3	292.2	317.0
Liquid Petroleum Gas	34.4	35.2	35.8	36.5	37.2	41.4	44.2	47.1	51.1	55.4
Motor Gasoline	120.8	123.6	125.9	128.1	130.8	145.4	155.3	165.7	179.7	195.0
Asphalt and Road Oil	1440.3	1472.9	1498.8	1524.5	1556.3	1725.9	1842.2	1964.5	2127.4	2303.8
Petroleum Subtotal	1921.1	1965.1	1999.8	2034.3	2077.0	2304.6	2460.2	2623.9	2842.7	3079.8
Natural Gas	195.9	200.5	204.1	207.7	212.1	235.8	251.8	268.7	291.5	316.2
Purchased Electricity	127.4	130.4	132.8	135.1	138.0	153.3	163.7	174.7	189.4	205.5
Total	2244.5	2296.0	2336.7	2377.1	2427.1	2693.7	2875.7	3067.2	3323.6	3601.5
Industry Output (billion 1987 dollars)	459.53	471.96	481.92	491.74	503.76	567.46	611.28	656.96	721.12	791.54
Energy Consumption per Unit of										
Output (thousand Btu/1987$ output)	4.88	4.86	4.85	4.83	4.82	4.75	4.70	4.67	4.61	4.55
Mining										
Residual Oil	25.2	25.4	25.6	25.7	25.9	26.9	27.8	28.4	29.3	30.2
Distillate Oil	173.7	175.3	176.4	177.5	179.0	185.7	192.0	196.3	202.3	208.4
Motor Gasoline	14.6	14.7	14.8	14.8	14.9	15.5	16.1	16.4	16.9	17.5
Other Petroleum	7.9	8.0	8.1	8.1	8.2	8.5	8.9	9.0	9.2	9.5
Petroleum Subtotal	221.4	223.3	224.8	226.1	228.0	236.6	244.8	250.1	257.7	265.5
Natural Gas	357.3	358.8	362.1	363.3	367.0	381.2	399.5	403.5	415.2	427.3
Lease and Plant Fuel	1380.55	1424.34	1475.40	1515.99	1546.94	1694.35	1857.03	1979.53	2176.00	2391.98
Steam Coal	69.6	70.6	71.1	72.1	73.2	76.8	78.7	80.4	82.7	85.1
Renewables	1.1	1.1	1.1	1.1	1.2	1.2	1.3	1.3	1.3	1.4
Purchased Electricity	293.4	295.9	298.1	300.3	303.6	316.3	327.6	333.3	342.9	352.8
Total	2323.5	2374.1	2432.7	2479.0	2519.9	2706.6	2909.0	3048.1	3275.9	3524.1
Industry Output (billion 1987 dollars)	138.49	139.47	140.82	141.78	143.43	150.80	158.45	162.36	168.70	175.30
Energy Consumption per Unit of										
Output (thousand Btu/1987$ output)	16.78	17.02	17.27	17.48	17.57	17.95	18.36	18.77	19.42	20.10
Metal-Based Durables Consumption										
Residual Oil	37.6	38.6	38.7	39.1	40.9	46.1	50.8	53.9	60.1	67.1
Distillate Oil	26.3	26.6	26.7	26.9	27.8	31.4	34.5	37.1	41.3	45.9
Liquid Petroleum Gas	8.9	8.9	8.9	8.9	9.0	10.3	11.1	11.5	12.6	13.8
Other Petroleum	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Petroleum Subtotal	76.3	77.7	77.8	78.4	81.2	91.2	99.8	106.0	117.5	130.3
Natural Gas	744.9	760.4	780.1	802.3	830.5	960.4	1049.4	1141.8	1269.6	1411.7
Steam Coal	115.6	118.6	122.4	126.4	131.3	152.9	167.8	183.0	203.9	227.1
Renewables	0.9	0.9	1.0	1.0	1.0	1.2	1.3	1.4	1.5	1.7
Purchased Electricity	614.1	629.6	646.0	664.9	692.3	813.1	905.6	998.1	1125.9	1270.1
Total	1551.8	1587.2	1627.3	1672.9	1736.3	2018.8	2223.9	2430.3	2718.4	3040.8
Industry Output (billion 1987 dollars)	1510.44	1553.64	1604.25	1661.43	1736.28	2080.51	2339.82	2616.06	3005.25	3452.33
Energy Consumption per Unit of										
Output (thousand Btu/1987$ output)	1.03	1.02	1.01	1.01	1.00	0.97	0.95	0.93	0.90	0.88

Table 32. Other Industrial Sector Energy Consumption
(Trillion Btu)

	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Other Manufacturing Consumption										
Residual Oil	145.6	145.1	143.3	141.7	147.3	153.4	165.9	168.8	181.9	195.9
Distillate Oil	84.3	84.6	84.6	84.3	86.1	91.3	97.6	100.8	109.3	118.4
Liquid Petroleum Gas	146.7	145.6	144.8	142.9	143.5	161.9	174.0	175.1	196.3	220.0
Petroleum Subtotal	376.6	375.4	372.8	369.0	376.8	406.6	437.5	444.7	487.4	534.3
Natural Gas	1391.5	1415.8	1437.9	1461.4	1489.7	1614.7	1703.8	1776.3	1877.6	1984.6
Steam Coal	226.5	232.5	237.8	243.5	250.2	284.9	311.4	334.1	366.1	401.0
Renewables	316.0	321.7	326.7	331.8	340.1	376.6	405.1	426.5	461.2	498.7
Purchased Electricity	764.0	777.9	787.6	798.9	819.0	900.2	967.9	1015.6	1089.3	1168.4
Total	3074.5	3123.3	3162.7	3204.7	3275.8	3582.9	3825.8	3997.3	4281.5	4587.0
Industry Output (billion 1987 dollars)	901.06	915.91	928.80	942.44	964.72	1061.44	1137.22	1192.64	1282.46	1379.05
Energy Consumption per Unit of										
Output (thousand Btu/1987$ output)	3.41	3.41	3.41	3.40	3.40	3.38	3.36	3.35	3.34	3.33

Source: Energy Information Administration, AEO99 National Energy Modeling System run AEO99B.D100198A.

Table 47. Light-Duty Vehicle MPG by Technology Type (MPG Gasoline Equivalents)

	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Automobiles 1/										
Conventional Vehicles										
Gasoline ICE Vehicles	28.37	28.71	29.05	29.33	29.58	30.92	31.30	31.27	32.05	32.85
TDI Diesel ICE	39.20	39.59	40.04	40.34	40.60	42.00	42.32	42.10	42.92	43.75
Alternative-Fuel Vehicles										
Alcohol Fuel Technology										
Methanol-Flex Fuel ICE	31.50	31.83	32.15	32.43	32.65	33.98	34.39	34.37	35.16	35.96
Methanol ICE	31.23	31.74	32.28	32.70	33.10	34.84	35.35	35.32	36.55	37.83
Ethanol-Flex Fuel ICE	31.22	31.55	31.87	32.14	32.37	33.70	34.11	34.09	34.88	35.69
Ethanol Ice	31.04	31.59	32.08	32.47	32.78	34.25	34.68	34.63	36.00	37.42
Natural Gas Technology										
CNG ICE	30.75	31.03	31.35	31.49	31.69	32.94	33.72	33.63	34.44	35.26
CNG Bi-fuel	28.97	29.25	29.58	29.76	29.96	31.18	31.81	31.67	32.37	33.09
LPG ICE	30.74	30.87	30.97	31.02	31.17	32.46	33.25	33.15	34.02	34.92
LPG Bi-fuel	29.17	29.45	29.77	29.96	30.17	31.42	32.06	31.91	32.61	33.33
Electric Technology										
Electric Vehicle	33.23	33.02	35.69	38.74	42.81	53.65	52.35	51.01	55.52	60.44
Electric-Diesel Hybrid	50.43	50.65	51.28	50.94	50.79	52.29	53.47	54.23	55.21	56.20
Fuel Cell Technology										
Fuel Cell Gasoline	0.00	0.00	0.00	0.00	43.71	43.28	43.11	42.86	42.58	42.31
Fuel Cell Methanol	0.00	0.00	0.00	0.00	46.55	46.02	45.72	45.41	45.03	44.66
Fuel Cell Hydrogen	0.00	0.00	0.00	0.00	51.12	50.36	49.82	49.31	48.72	48.14
Average New Car MPG	28.52	28.86	29.39	29.74	30.07	31.65	32.08	32.06	33.03	34.03
Light-Duty Trucks 1/										
Conventional Vehicles										
Gasoline ICE Vehicles	19.34	19.44	19.59	19.63	19.74	20.54	21.26	21.80	22.16	22.53
TDI Diesel ICE	26.60	26.68	26.86	26.83	26.94	28.17	29.03	29.55	30.09	30.63
Alternative-Fuel Vehicles										
Alcohol Fuel Technology										
Methanol-Flex Fuel ICE	19.94	20.09	20.28	20.32	20.43	21.37	22.18	22.62	23.10	23.59
Methanol ICE	20.40	20.61	20.92	21.05	21.29	22.54	23.47	24.07	25.03	26.02
Ethanol-Flex Fuel ICE	19.99	20.11	20.30	20.34	20.45	21.37	22.15	22.65	23.15	23.67
Ethanol Ice	20.24	20.60	20.98	21.21	21.47	22.65	23.56	24.10	25.26	26.49
Natural Gas Technology										
CNG ICE	20.47	20.61	20.83	20.87	21.03	21.99	22.70	23.36	24.12	24.90
CNG Bi-fuel	20.55	20.61	20.70	20.69	20.77	21.44	22.00	22.52	22.98	23.45
LPG ICE	20.11	20.25	20.42	20.42	20.56	21.49	22.18	22.80	23.55	24.33
LPG Bi-fuel	20.65	20.72	20.81	20.81	20.91	21.66	22.31	22.94	23.47	24.02
Electric Technology										
Electric Vehicle	24.31	24.12	27.16	29.81	33.19	41.78	40.57	39.60	44.03	48.95
Electric-Diesel Hybrid	33.36	33.56	33.64	33.58	33.70	35.26	36.11	36.63	37.33	38.05
Fuel Cell Technology										
Fuel Cell Gasoline	0.00	0.00	0.00	0.00	37.61	36.15	35.03	34.25	33.20	32.18
Fuel Cell Methanol	0.00	0.00	0.00	0.00	46.45	44.24	42.34	41.05	39.40	37.81
Fuel Cell Hydrogen	0.00	0.00	0.00	0.00	44.01	42.31	40.99	40.08	38.85	37.66
Average New Truck MPG	19.40	19.50	19.69	19.74	19.86	20.73	21.48	22.00	22.41	22.83
Fleet Average Stock Car MPG 2/	23.09	23.15	23.25	23.35	23.48	24.21	25.06	25.64	26.27	26.91
Fleet Average Stock Truck MPG 2/	15.96	15.89	15.83	15.75	15.72	15.78	16.21	16.67	16.74	16.82
Fleet Aver. Stock Vehicle MPG 2/	20.21	20.17	20.15	20.11	20.12	20.34	20.91	21.43	21.64	21.86

1/ Fuel efficiencies are EPA rated. Includes personal and fleet vehicles.
2/ Stock values are on road efficiencies. Includes personal vehicles, fleet vehicles, and freight light trucks.
MPG = Miles per Gallon.
ICE = Internal combustion engine.
N/A = Not applicable.

Table 47. Light-Duty Vehicle MPG by Technology Type (MPG Gasoline Equivalents)

	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030

Sources: 1997 derived using: Energy and Environmental Analysis Inc., Update to the Fuel Economy Model, prepared for Energy Information Administration (EIA) (Washington, DC, June 1998); National Highway Traffic and Safety Administration, Mid-Model Year Fuel Economy Reports from Auto Manufacturers, 1997; Federal Highway Administration, Highway Statistics 1995, (November 1997); United States Department of Commerce, Bureau of the Census, Truck Inventory and Use Survey, TC92-T-52 (Washington, DC, May 1995);and EIA, AEO99 National Energy Modeling System run AEO99B.D100198A. Projections: EIA, AEO99 National Energy Modeling System run AEO99B.D100198A.

Table 72. Electric Power Projections for the United States

	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Electricity Generating Capability 1/										
(gigawatts)										
Coal Steam	305.81	305.86	304.00	304.13	305.22	308.87	316.18	333.03	339.53	346.15
Other Fossil Steam 2/	138.30	138.16	121.19	105.34	101.65	80.18	79.53	75.69	66.35	58.17
Combined Cycle	31.24	44.01	53.60	72.85	88.67	126.02	175.94	211.46	368.77	643.09
Combustion Turbine/Diesel	102.17	107.28	124.55	132.77	141.11	151.02	174.92	186.73	225.60	272.58
Nuclear Power	94.84	94.84	91.22	88.34	87.36	74.18	56.37	48.87	41.91	35.95
Pumped Storage/Other 3/	21.52	21.52	21.52	21.52	21.52	21.52	21.52	21.52	21.98	22.44
Fuel Cells	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
Renewable 4/	90.20	90.52	90.68	90.77	91.05	92.14	93.89	96.68	98.69	100.75
Total Capability	784.08	802.19	806.77	815.74	836.59	853.94	918.36	973.99	1162.84	1479.13
Cumulative Planned Additions 5/										
Coal Steam	0.82	0.82	0.82	0.82	1.45	1.45	1.45	1.45		
Other Fossil Steam 2/	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09		
Combined Cycle	2.54	3.63	3.76	4.78	5.32	5.32	5.32	5.32		
Combustion Turbine/Diesel	7.82	11.34	13.90	16.67	18.56	18.56	18.56	18.56		
Nuclear Power	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Pumped Storage/Other 3/	1.97	1.97	1.97	1.97	1.97	1.97	1.97	1.97		
Fuel Cells	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Renewable 4/	2.00	2.27	2.34	2.38	2.46	2.76	2.76	2.76		
Total (planned)	15.26	20.13	22.88	26.72	29.85	30.15	30.15	30.15		
Cumulative Unplanned Additions 5/										
Coal Steam	0.42	0.46	0.64	1.03	1.54	5.61	13.52	30.96		
Other Fossil Steam 2/	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Combined Cycle	13.03	24.71	34.17	52.41	67.68	105.02	154.95	190.47		
Combustion Turbine/Diesel	37.88	39.51	55.11	62.21	68.81	81.08	108.16	120.16		
Nuclear Power	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Pumped Storage/Other 3/	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Fuel Cells	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Renewable 4/	0.95	1.03	1.10	1.21	1.35	2.30	4.34	7.31		
Total (unplanned)	52.28	65.72	91.03	116.86	139.38	194.02	280.97	348.89		
Cumulative Total Additions	67.54	85.85	113.91	143.58	169.23	224.17	311.12	379.04		
Cumulative Retirements	19.60	19.88	43.54	64.33	68.66	105.73	128.30	140.60		
Cogenerators 6/										
Capacity										
Coal	9.68	9.69	9.70	9.70	9.72	9.76	9.82	9.86	10.01	10.17
Petroleum	1.32	1.32	1.32	1.33	1.33	1.35	1.36	1.37	1.41	1.44
Natural Gas	34.99	34.93	35.02	35.14	35.27	36.18	37.34	37.74	38.75	39.78
Other Gaseous Fuels	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.97	1.05
Renewables	7.60	7.66	7.69	7.73	7.82	8.19	8.55	8.81	9.31	9.83
Other	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.15	0.16
Total	54.64	54.66	54.78	54.95	55.18	56.53	58.12	58.82	60.60	62.43
Electricity Demand										
(billion kilowatthours)										
Residential	1205.32	1222.78	1234.36	1246.10	1260.79	1339.37	1444.71	1551.58	1681.93	1823.22
Commercial/Other	1097.77	1116.47	1130.79	1144.84	1161.24	1246.35	1330.83	1381.92	1480.20	1585.46
Industrial	1077.93	1092.77	1100.45	1109.51	1129.08	1209.52	1279.15	1338.01	1415.83	1498.17
Transportation	17.14	17.52	21.69	25.52	29.02	42.68	53.28	63.39	85.61	115.60
Total Sales	3398.14	3449.55	3487.29	3525.97	3580.13	3837.92	4107.97	4334.91	4663.56	5022.46
Net Energy for Load (billion kwh) 7/										
Gross International Imports	57.14	55.15	56.89	56.85	54.05	52.18	49.22	48.98	50.65	52.38
Gross International Exports	15.40	15.51	20.83	20.97	21.10	21.79	21.79	21.79	25.80	30.53
Gross Interregional Elec. Imp	245.41	245.31	245.79	238.20	229.11	214.44	225.45	230.79	221.96	213.47
Gross Interregional Elec. Exp	247.13	247.04	247.57	239.84	230.67	215.78	227.02	232.47	223.62	215.11
Purchases from cogenerators 6/	178.26	178.31	178.49	178.69	178.95	180.44	182.01	182.60	182.59	182.59
Generation by Utilities	3479.69	3534.34	3575.14	3613.57	3671.78	3933.88	4207.82	4449.90	4783.30	5141.68
Total Net Energy for Load	3697.97	3750.56	3787.90	3826.50	3882.10	4143.37	4415.69	4658.01	4986.53	5338.23
Generation by Fuel Type										
(billion kilowatthours)										
Coal	1956.44	1967.55	1975.60	1976.10	1975.98	2045.85	2150.51	2298.44	2425.12	2558.79
Petroleum	98.25	78.74	60.83	46.40	36.22	27.81	25.54	24.02	18.39	14.08
Natural Gas	385.72	444.17	505.17	570.50	648.82	918.77	1212.75	1349.44	1872.51	2598.33
Nuclear	663.13	666.29	655.19	641.50	630.27	553.88	418.87	358.55	317.34	280.88
Pumped Storage/Other 3/	-1.78	-1.78	-1.78	-1.78	-1.78	-1.78	-1.78	-1.78	-1.59	-1.42
Renewable 4/	377.93	379.36	380.12	380.85	382.26	389.33	401.92	421.24	428.57	436.02
Total Generation	3479.69	3534.34	3575.14	3613.57	3671.78	3933.88	4207.82	4449.90	5060.34	5886.68

Table 72. Electric Power Projections for the United States

	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Sales to Customers	3470.08	3524.73	3565.99	3604.55	3662.76	3925.07	4199.02	4441.22	5051.85	5878.36
Generation for Own Use	9.61	9.61	9.16	9.02	9.02	8.80	8.80	8.68	8.50	8.32
Cogenerators										
Coal	57.70	57.56	57.31	57.05	56.79	55.18	54.63	54.24	53.12	52.03
Petroleum	7.52	7.50	7.48	7.48	7.34	7.34	7.34	7.33	6.88	6.45
Natural Gas	212.15	211.61	212.23	213.07	214.10	221.00	229.89	232.62	237.81	243.12
Other Gaseous Fuels	5.16	5.16	5.16	5.16	5.16	5.16	5.16	5.16	5.47	5.80
Renewable	49.27	49.95	50.44	51.03	52.10	56.81	60.41	63.06	69.38	76.33
Other	4.13	4.13	4.13	4.13	4.13	4.13	4.13	4.13	4.17	4.21
Total	335.93	335.91	336.76	337.93	339.62	349.62	361.56	366.54	376.83	387.94
Sales to Utilities	178.26	178.31	178.49	178.69	178.95	180.44	182.01	182.60	182.59	182.59
Generation for Own Use	157.67	157.60	158.27	159.24	160.67	169.18	179.55	183.94	194.23	205.34
End-Use Prices										
(1997 cents per kilowatthour)										
Residential	7.8	7.7	7.8	7.8	7.8	7.7	7.3	7.1	6.8	6.5
Commercial	7.1	6.9	6.9	6.9	6.9	6.6	6.2	6.0	5.7	5.4
Industrial	4.4	4.4	4.4	4.4	4.3	4.1	3.8	3.6	3.5	3.3
Transportation	5.3	5.2	5.3	5.2	5.2	5.0	4.7	4.4	4.2	4.0
All Sectors Average	6.5	6.4	6.4	6.4	6.4	6.1	5.8	5.6	5.4	5.1
Price Components										
(1997 cents per kilowatthour)										
Capital Component	3.3	3.2	3.2	3.3	3.2	3.0	2.8	2.6	2.5	2.3
Fuel Component	1.1	1.1	1.1	1.1	1.1	1.2	1.2	1.2	1.3	1.3
O&M Component	1.9	1.9	1.9	1.9	1.8	1.8	1.6	1.6	1.6	1.5
Wholesale Power Cost	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1
Total	6.5	6.4	6.4	6.4	6.4	6.1	5.8	5.6	5.4	5.2
Fuel Consumption (quad. Btu) 8/										
Coal	20.46	20.59	20.68	20.69	20.68	21.41	22.35	23.51	24.73	26.03
Natural Gas	3.70	4.00	4.34	4.58	5.03	6.84	8.61	9.36	11.66	14.53
Oil	1.05	0.84	0.65	0.49	0.38	0.30	0.27	0.26	0.20	0.15
Total	25.21	25.42	25.66	25.76	26.09	28.54	31.23	33.12	36.60	40.71
Emissions(million short tons) 9/										
Total Carbon	610.65	613.88	617.22	617.67	621.67	664.86	714.62	754.98	811.64	872.55
Carbon Dioxide	2239.05	2250.90	2263.13	2264.79	2279.44	2437.84	2620.26	2768.27	2976.02	3199.35
Sulfur Dioxide	11.18	10.98	10.78	10.58	10.19	9.06	8.95	8.95	8.28	7.66
Nitrogen Oxide	4.70	4.71	3.96	3.91	3.90	4.06	4.21	4.29	4.00	3.74

Note: Totals may not equal sum of components due to independent rounding.

1/ Net summer capability is the steady hourly output that generating equipment is expected to supply to system load (exclusive of auxiliary power), as demonstrated by tests during summer peak demand. Includes electric utilities, small power producers, and exempt wholesale generators. Nameplate capacity is reported for nonutilities on Form EIA-867, "Annual Nonutility Power Producer Report." Nameplate capacity is designated by the manufacturer. The nameplate capacity has been converted to net summer capacity based on historic relationships.

2/ Includes oil-, gas-, and dual-fired capability.

3/ Other includes methane, propane gas, and blast furnace gas, hydrogen, sulfur, batteries, chemicals, fish oil, and spent sulfite liquor.

4/ Includes conventional hydroelectric, geothermal, wood, wood waste, municipal solid waste, other biomass, solar thermal, photovoltaics, and wind power.

5/ Cumulative additions after December 31, 1996.

6/ Cogenerators produce electricity and another form of useful energy (such as steam or heat) through the sequential use of energy.

7/ Generation to meet system load by source.

8/ Includes fuel consumption by electric utilities, small power producers, independent power producers, and exempt wholesale generators.

9/ Estimated emissions from utilities and nonutilities (excluding cogenerators).

O&M = Operation and maintenance.

EMM = Electricity market module.

N/A = Not applicable.

Note: Totals may not equal sum of components due to independent rounding.

Source: 1997 (except for prices and nonutility data) Energy Information Administration (EIA), Annual Energy Review 1997, DOE/EIA-0384(97) (Washington, DC, July 1998). Other 1997 and projections: EIA, AEO99 National Energy Modeling System run AEO99B.D100198A.

APPENDIX C

Example Answer Sheet

An example GPRA2001 Answer Sheet is provided in this appendix to serve as a guide. The example provides information for a fictitious energy supply planning unit and should not be construed as genuine.

GPRA2001 Data Submission - EXAMPLE

Resource Metrics

Metric	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
DOE Funding Level (Millions of $'s)	$41.000	$40.000	$38.000	$38.000	$42.900					
Research (%)	50%	50%	50%	50%	50%					
Development (%)	50%	50%	50%	50%	50%					
Deployment (%)	0%	0%	0%	0%	0%					
Partner Financial Investment (Millions of $'s)	$12.000	$12.000	$12.000	$12.000	$7.000					
Partner Non-Financial Investment (Millions of $'s)	$4.000	$4.000	$4.000	$4.000	$1.000					
Partners (Number)	12	12	12	10	10					

GPRA2001 Assumptions - EXAMPLE

TECHNOLOGY CHARACTERISTICS		**2001**	**2002**	**2003**	**2004**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Technology A	Capital Cost ($/kW)	750	743	735	728	720	675	665	655	645	635
	Capacity Factor (%)	30.20	31.43	32.65	33.88	35.10	36.20	36.90	37.60	38.20	38.80
	O&M Cost ($/kW-yr)	21.10	19.68	18.25	16.83	15.40	15.90	16.15	16.40	16.60	16.80
Technology B	Capital Cost ($/kW)	750	743	735	728	720	675	665	655	645	635
	Capacity Factor (%)	40.40	41.63	42.85	44.08	45.30	46.40	47.15	47.90	48.60	49.30
	O&M Cost ($/kW-yr)	28.30	26.20	24.10	22.00	19.90	20.30	20.65	21.00	21.30	21.60
Averaging weights	Technology A	0.0	0.0	0.0	0.0	0.0	33.0	50.0	50.0	50.0	50.0
	Technology B	100.0	100.0	100.0	100.0	100.0	67.0	50.0	50.0	50.0	50.0
Weighed characteristics	Capital Cost ($/kW)	750	743	735	728	720	675	665	655	645	635
	Capacity Factor (%)	40.40	41.63	42.85	44.08	45.30	43.03	42.03	42.75	43.40	44.05
	O&M Cost ($/kW-yr)	28.30	26.20	24.10	22.00	19.90	18.85	18.40	18.70	18.95	19.20
MARKET PENETRATION (CUMULATIVE MW)		**2001**	**2002**	**2003**	**2004**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
TOTAL Cumulative MW		570	1445	2320	3195	4070	6520	13400	21500	30000	40000
ENERGY METRICS	**Units**	**2001**	**2002**	**2003**	**2004**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Total Primary Energy Displaced	Trillion Btu	22.13	55.58	92.95	125.25	152.94	197.01	406.03	641.64	918.50	1255.96
Direct Electricity Displaced	Billion kWh	2.017	5.269	8.708	12.336	16.151	24.579	49.331	80.515	114.055	154.351
Direct Natural Gas Displaced	Billion Cubic Feet										
Direct Petroleum Displaced	Million Barrels										
Direct Coal Displaced	Million Short Tons										
FINANCIAL METRICS											
Energy Cost or Savings	Billions of 1997 $	0.0381	0.1113	0.1843	0.2573	0.3254	0.4556	0.8259	1.3111	1.8015	2.3406
Non-Energy Savings or Costs	Billions of 1997 $	-0.0032	-0.0082	-0.0217	-0.0416	-0.0584	-0.0894	-0.1687	-0.2968	-0.4303	-0.5958
ENVIRONMENTAL METRICS											
Carbon Displaced	MMTons of C Equiv	0.4880	1.1239	1.8976	2.4774	2.9976	3.6327	6.9803	11.5862	17.1038	24.0818
CO Displaced	MMTons	0.0004	0.0011	0.0018	0.0025	0.0031	0.0043	0.0077	0.0121	0.0166	0.0217
SO2 Displaced	MMTons	0.0093	0.0180	0.0302	0.0350	0.0416	0.0422	0.0911	0.1599	0.2549	0.3833
NOX Displaced	MMTons	0.0045	0.0099	0.0170	0.0222	0.0267	0.0316	0.0620	0.1036	0.1552	0.2214
PM10 Displaced	MMTons	0.0002	0.0004	0.0006	0.0007	0.0009	0.0009	0.0020	0.0034	0.0055	0.0082
VOCs Displaced	MMTons	0.0000	0.0001	0.0002	0.0003	0.0003	0.0005	0.0008	0.0013	0.0018	0.0023
Conversion factors and price of electricity		**2001**	**2002**	**2003**	**2004**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Electricity heat rate (Btu/kWh)		10,972	10,548	10,674	10,153	9,470	8,016	8,231	7,969	8,053	8,137
Electricity carbon coefficient	(MMTCE/trillion Btu)	0.02205	0.02022	0.02041	0.01978	0.01960	0.01844	0.01719	0.01806	0.01862	0.01917
Electr. emission factor, NOx	(MMTons/trillion Btu)	0.000202	0.000178	0.000183	0.000177	0.000175	0.000161	0.000153	0.000162	0.000169	0.000176
Electr. emission factor, SO2	(MMTons/trillion Btu)	0.000419	0.000324	0.000325	0.000280	0.000272	0.000214	0.000224	0.000249	0.000278	0.000305
Electr. emission factor, VOCs	(MMTons/trillion Btu)	0.000002	0.000002	0.000002	0.000002	0.000002	0.000002	0.000002	0.000002	0.000002	0.000002
Electr. emission factor, CO	(MMTons/trillion Btu)	0.000016	0.000019	0.000019	0.000020	0.000021	0.000022	0.000019	0.000019	0.000018	0.000017
Electr. emission factor, PM10	(MMTons/trillion Btu)	0.000008	0.000006	0.000007	0.000006	0.000006	0.000005	0.000005	0.000005	0.000006	0.000007
		2001	**2002**	**2003**	**2004**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Pulverized coal capital cost	($/kW)	1,430	1,430	1,430	1,430	1,430	1,430	1,430	1,430	1,430	1,430
Adv comb cycle capital cost	($/kW)	620	608	597	585	573	525	478	430	383	336
Capital cost of conventional technology	($/kW)	1,049	909	947	951	900	770	748	792	818	850
Fixed O&M advanced combined cycle	($/kW)	27.0	27.0	27.0	27.0	27.0	27.0	27.0	27.0	27.0	27.0
Fixed O&M pulverized coal	($/kW)	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2
Fixed O&M conventional technology	($/kW)	28.1	27.1	28.3	29.9	29.3	28.7	27.0	28.0	28.3	28.7
Variable O&M advanced combined cycle	($/kWh)	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
Variable O&M pulverized coal	($/kWh)	0.0024	0.0024	0.0024	0.0024	0.0024	0.0024	0.0024	0.0024	0.0024	0.0024
Variable O&M conventional technology	($/kWh)	0.0016	0.0013	0.0014	0.0013	0.0012	0.0010	0.0011	0.0012	0.0013	0.0014
Price of gas ($/MMBtu)		2.67	2.74	2.80	2.87	2.94	3.08	3.17	3.24	3.37	3.50
Price of coal ($/MMBtu)		1.18	1.17	1.16	1.15	1.14	1.06	0.99	0.93	0.87	0.81
Price of petroleum ($/MMBtu)		2.49	2.63	2.83	3.03	3.29	3.89	4.05	4.33	4.71	5.13
Price of non-fossil ($/MMBtu)		0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56
Marginal fossil fuel mix (%)											
Coal		62.5%	45.2%	47.7%	44.2%	39.4%	27.6%	32.7%	39.1%	44.1%	49.1%
Natural gas		25.0%	43.2%	44.6%	54.7%	58.7%	71.4%	58.7%	54.1%	49.1%	44.1%
Oil		12.5%	11.6%	7.8%	1.2%	1.9%	0.4%	0.2%	0.8%	0.8%	0.8%
Non-fossil		0.0%	0.0%	0.0%	0.0%	0.0%	0.6%	8.4%	5.9%	5.9%	5.9%
Total		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Heat rates by fuel source (Btu per kWh)											
Coal		10889	10758	11196	10943	10962	10791	9868	8755	8755	8755
Natural gas		11111	10317	10116	9412	8387	6908	6967	7076	7076	7076
Oil		11111	10588	10667	15000	12000	10000	10000	9091	9091	9091
Non-fossil		0	0	0	0	0	10600	10641	10779	10779	10779

GPRA2001 Data Submission - EXAMPLE

Energy Metrics

Metric	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Total Primary Energy Displaced (Trillion Btu)	22.13	55.58	92.95	125.25	152.94	197.01	406.03	641.64	918.50	1,255.96
Direct Electricity Displaced (Billion Kilowatthours)	2.02	5.27	8.71	12.34	16.15	24.58	49.33	80.52	114.06	154.35
Direct Natural Gas Displaced (Billion Cubic Feet)	0	0	0	0	0	0	0	0	0	0
Direct Petroleum Displaced (Million Barrels)	0	0	0	0	0	0	0	0	0	0
Direct Coal Displaced (Million Short Tons)	0	0	0	0	0	0	0	0	0	0

Financial Metrics

Metric	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Energy Costs or Savings (Billions of 1995 $'s)	$0.038	$0.111	$0.184	$0.257	$0.325	$0.456	$0.826	$1.311	$1.802	$2.341
Non-Energy Savings or Costs (Billions of 1995 $'s)	($0.003)	($0.008)	($0.022)	($0.042)	($0.058)	($0.089)	($0.017)	($0.297)	($0.430)	($0.596)

Environmental Metrics

Metric	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
CO Displaced (MMTons)	0	0	0	0	0	0	0.01	0.01	0.02	0.02
Carbon Equivalent Emissions Displaced (MMTCe)	0.49	1.12	1.90	2.48	3.00	3.63	6.98	11.59	17.10	24.08
Other Greenhouse Emissions Displaced (MMTons)	0	0	0	0	0	0	0	0	0	0
SO2 Displaced (MMTons)	0.01	0.02	0.03	0.04	0.04	0.04	0.09	0.16	0.25	0.38
NOX Displaced (MMTons)	0	0.01	0.02	0.02	0.03	0.03	0.06	0.10	0.16	0.22
Particulates Displaced (MMTons)	0	0	0	0	0	0	0	0	0.01	0.01
VOCs Displaced (MMTons)	0	0	0	0	0	0	0	0	0	0
HCs Displaced (MMTons)	0	0	0	0	0	0	0	0	0	0
Other Environmental Benefits (Thousand Tons)	0	0	0	0	0	0	0	0	0	0
PM10 Displaced (MMTons)	0	0	0	0	0	0	0	0	0.01	0.01

Appendix B

Sector Metric Reports

The Office of Energy Efficiency & Renewable Energy

GPRA Metric List

Office of Build Tech, State, and Comm Progs (BTS)

Resource

DOE Funding Level (Millions of $'s)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Commercial Buildings Integration			4.00	7.48	8.01	8.01	8.01					
Community Energy Program			30.75	39.64	39.64	39.64	39.64					
Energy Star Program			5.96	7.52	8.28	8.28	8.28					
Equipment, Materials, and Tools			59.23	66.38	66.50	64.56	64.56					
Residential Buildings Integration			13.50	16.81	18.42	18.42	18.42					
State Energy Program			37.13	42.08	42.92	42.92	42.92					
Technology Roadmaps & Competitive R&D			7.46	7.50	7.50	7.50	7.50					
Weatherization Assistance Program												
BTS DOE Funding Level Total			158.03	187.41	191.27	189.33	189.33					

Research (%)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Commercial Buildings Integration												
Community Energy Program												
Energy Star Program												
Equipment, Materials, and Tools			0.45	0.40	0.40	0.40	0.40					
Residential Buildings Integration			0.55	0.60	0.60	0.60	0.60					
State Energy Program												
Technology Roadmaps & Competitive R&D			0.20	0.20	0.20	0.20	0.20					
Weatherization Assistance Program												

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Development (%)												
Commercial Buildings Integration			0.20	0.20	0.20	0.20	0.20					
Community Energy Program			0.09	0.09	0.09	0.09	0.09					
Energy Star Program			0.20	0.20	0.20	0.20	0.20					
Equipment, Materials, and Tools			0.20	0.20	0.20	0.20	0.20					
Residential Buildings Integration			0.40	0.35	0.35	0.35	0.35					
State Energy Program												
Technology Roadmaps & Competitive R&D			0.80	0.80	0.80	0.80	0.80					
Weatherization Assistance Program												
Deployment (%)												
Commercial Buildings Integration			0.80	0.80	0.80	0.80	0.80					
Community Energy Program			0.91	0.91	0.91	0.91	0.91					
Energy Star Program			0.80	0.80	0.80	0.80	0.80					
Equipment, Materials, and Tools			0.35	0.40	0.40	0.40	0.40					
Residential Buildings Integration			0.05	0.05	0.05	0.05	0.05					
State Energy Program			1.00	1.00	1.00	1.00	1.00					
Technology Roadmaps & Competitive R&D												
Weatherization Assistance Program												
Partner Financial Investment (Millions of $'s)												
Commercial Buildings Integration			5.50	5.50	5.50	5.50	5.50					
Community Energy Program			1.44	1.44	1.44	1.44	1.44					
Energy Star Program			30.00	30.00	30.00	30.00	30.00					
Equipment, Materials, and Tools			20.90	68.90	69.70	70.10	70.70					
Residential Buildings Integration			8.00	10.00	12.00	14.00	16.00					
State Energy Program			148.00	148.00	148.00	148.00	148.00					
Technology Roadmaps & Competitive R&D												
Weatherization Assistance Program												
BTS Partner Financial Investment Total			213.84	263.84	266.64	269.04	271.64					

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030

Partner Non-Financial Investment (Millions of $'s)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Commercial Buildings Integration												
Community Energy Program			1.00	1.00	1.00	1.00	1.00					
Energy Star Program			2.70	2.70	2.70	2.70	2.70					
Equipment, Materials, and Tools			19.90	26.00	41.00	51.00	76.00					
Residential Buildings Integration			0.75	1.00	1.25	1.50	1.75					
State Energy Program												
Technology Roadmaps & Competitive R&D												
Weatherization Assistance Program												
BTS Partner Non-Financial Investment Total			24.35	30.70	45.95	56.20	81.45					

Partners (Number)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Commercial Buildings Integration			30.00	30.00	30.00	30.00	30.00					
Community Energy Program			304.00	354.00	404.00	404.00	504.00					
Energy Star Program			100.00	125.00	150.00	175.00	200.00					
Equipment, Materials, and Tools			359.00	531.00	934.00	1,320.00	2,122.00					
Residential Buildings Integration			100.00	105.00	110.00	115.00	120.00					
State Energy Program			55.00	55.00	55.00	55.00	55.00					
Technology Roadmaps & Competitive R&D												
Weatherization Assistance Program												
BTS Partners Total			948.00	1,200.00	1,683.00	2,099.00	3,031.00					

Energy

Total Primary Energy Displaced (Trillion Btu)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Commercial Buildings Integration			0.14	0.58	1.45	4.31	7.78	41.77	110.38	158.95	216.14	278.28
Community Energy Program			20.92	37.86	58.80	83.99	113.25	293.36	478.16	575.38	685.57	793.88
Energy Star Program			25.32	36.32	53.63	71.37	91.75	218.77	324.07	278.50	317.16	362.39
Equipment, Materials, and Tools			7.02	28.54	53.68	113.47	176.48	531.58	947.66	1,235.69	1,550.27	1,858.70
Residential Buildings Integration			0.09	0.45	1.00	1.90	3.19	20.20	59.43	110.31	166.27	223.92
State Energy Program			5.57	11.11	16.39	21.68	26.71	51.14	75.28	96.62	122.73	152.06
Technology Roadmaps & Competitive R&D			9.95	19.61	28.92	37.99	46.64	87.66	128.11	161.81	202.27	242.72
Weatherization Assistance Program			6.38	13.01	19.54	25.90	32.11	62.75	93.29	91.60	91.60	91.60
BTS Total Primary Energy Displaced Total			75.39	147.49	233.40	360.61	497.92	1,307.24	2,216.39	2,708.85	3,352.02	4,003.57

Direct Electricity Displaced (Billion Kilowatthours)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Commercial Buildings Integration				0.10	0.20	0.40	0.80	4.20	11.60	18.60	26.50	35.00
Community Energy Program			1.30	2.50	4.10	6.10	8.40	24.70	44.00	59.20	74.60	90.00
Energy Star Program			2.70	3.90	5.80	7.90	10.30	26.10	39.40	33.20	36.40	40.60
Equipment, Materials, and Tools			0.40	2.00	4.00	9.10	14.70	50.20	100.00	151.90	197.50	236.90
Residential Buildings Integration						0.10	0.10	1.00	3.10	6.20	9.30	12.50
State Energy Program			0.30	0.70	1.00	1.40	1.70	3.40	5.10	6.90	8.70	10.80
Technology Roadmaps & Competitive R&D			0.60	1.10	1.70	2.20	2.80	5.60	8.40	11.20	14.00	16.80
Weatherization Assistance Program			0.10	0.30	0.50	0.60	0.80	1.50	2.30	2.30	2.30	2.30
BTS Direct Electricity Displaced Total			5.40	10.60	17.30	27.80	39.60	116.70	213.90	289.50	369.30	444.90

Direct Natural Gas Displaced (Billion Cubic Feet)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Commercial Buildings Integration				(.10)	(.20)	0.20	0.40	5.40	15.80	19.20	19.30	18.90
Community Energy Program			8.10	14.40	22.10	31.20	42.80	109.30	169.10	190.30	196.60	196.40
Energy Star Program			1.00	1.50	2.10	2.80	4.30	13.50	24.00	40.10	54.20	68.60
Equipment, Materials, and Tools			(.40)	3.70	8.30	19.90	32.90	94.70	115.40	67.10	39.60	51.70
Residential Buildings Integration				0.20	0.50	1.00	1.70	10.90	31.60	58.50	88.30	118.90
State Energy Program			1.60	3.20	4.90	6.50	8.10	16.20	24.30	32.40	41.10	51.00
Technology Roadmaps & Competitive R&D			1.00	2.00	3.10	4.10	5.10	10.20	15.30	20.40	25.50	30.60
Weatherization Assistance Program			3.40	6.90	10.30	13.80	17.20	34.10	51.00	50.80	50.80	50.80
BTS Direct Natural Gas Displaced Total			14.70	31.80	51.10	79.50	112.50	294.30	446.50	478.80	515.40	586.90

Direct Petroleum Displaced (Million Barrels)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Commercial Buildings Integration								0.10	0.30	0.40	0.30	0.30
Community Energy Program			0.20	0.30	0.50	0.70	0.90	2.10	2.80	3.00	3.10	3.10
Energy Star Program				0.10	0.10	0.10	0.20	0.50	0.90	1.40	1.90	2.30
Equipment, Materials, and Tools			0.50	0.90	1.30	1.40	1.50	2.30	3.60	4.40	5.10	5.80
Residential Buildings Integration								0.10	0.30	0.50	0.80	1.10
State Energy Program			0.10	0.20	0.30	0.40	0.50	1.00	1.40	1.90	2.40	3.00
Technology Roadmaps & Competitive R&D				0.10	0.10	0.10	0.20	0.30	0.50	0.60	0.80	0.90
Weatherization Assistance Program			0.30	0.50	0.80	1.00	1.30	2.50	3.80	3.80	3.80	3.80
BTS Direct Petroleum Displaced Total			1.10	2.10	3.10	3.70	4.60	8.90	13.60	16.00	18.20	20.30

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Direct Coal Displaced (Million Short Tons)												
Commercial Buildings Integration												
Community Energy Program												
Energy Star Program												
Equipment, Materials, and Tools												
Residential Buildings Integration												
State Energy Program												
Technology Roadmaps & Competitive R&D												
Weatherization Assistance Program												
BTS Direct Coal Displaced Total												

Financial

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Energy Costs or Savings (Billions of $'s)												
Commercial Buildings Integration					0.01	0.03	0.06	0.32	0.82	1.22	1.60	1.97
Community Energy Program			0.14	0.25	0.40	0.58	0.80	2.21	3.62	4.53	5.29	5.95
Energy Star Program			0.20	0.29	0.43	0.59	0.77	1.93	2.80	2.39	2.58	2.81
Equipment, Materials, and Tools			0.05	0.20	0.38	0.84	1.33	4.20	7.46	10.16	12.21	13.88
Residential Buildings Integration					0.01	0.01	0.02	0.15	0.43	0.81	1.17	1.52
State Energy Program			0.04	0.08	0.11	0.15	0.19	0.37	0.54	0.70	0.86	1.04
Technology Roadmaps & Competitive R&D			0.07	0.14	0.21	0.28	0.36	0.69	0.99	1.28	1.54	1.77
Weatherization Assistance Program			0.04	0.09	0.14	0.18	0.23	0.44	0.64	0.63	0.62	0.61
BTS Energy Costs or Savings Total			.54	1.05	1.70	2.68	3.76	10.31	17.30	21.73	25.87	29.55

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Non-Energy Savings or Costs (Billions of $'s)												
Commercial Buildings Integration												
Community Energy Program												
Energy Star Program												
Equipment, Materials, and Tools												
Residential Buildings Integration												
State Energy Program												
Technology Roadmaps & Competitive R&D												
Weatherization Assistance Program												
BTS Non-Energy Savings or Costs Total												

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030

Environmental

CO Displaced (MMTons)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Commercial Buildings Integration												0.01
Community Energy Program								0.01	0.01	0.01	0.02	0.02
Energy Star Program								0.01	0.01	0.01	0.01	0.01
Equipment, Materials, and Tools								0.01	0.02	0.02	0.03	0.03
Residential Buildings Integration												0.01
State Energy Program												
Technology Roadmaps & Competitive R&D												
Weatherization Assistance Program												
BTS CO Displaced Total						.01	.01	.03	.05	.05	.07	.07

Carbon Equivalent Emissions Displaced (MMTCe)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Commercial Buildings Integration				0.01	0.03	0.08	0.15	0.75	1.86	2.81	3.96	5.26
Community Energy Program			0.40	0.69	1.08	1.51	2.02	5.05	7.87	9.86	12.15	14.53
Energy Star Program			0.55	0.73	1.08	1.40	1.78	3.99	5.52	4.90	5.70	6.64
Equipment, Materials, and Tools			0.15	0.55	1.04	2.13	3.28	9.43	16.01	22.07	28.64	35.23
Residential Buildings Integration				0.01	0.02	0.03	0.05	0.33	0.93	1.78	2.72	3.71
State Energy Program			0.11	0.20	0.30	0.39	0.48	0.88	1.25	1.64	2.12	2.67
Technology Roadmaps & Competitive R&D			0.21	0.38	0.56	0.72	0.87	1.56	2.15	2.82	3.61	4.44
Weatherization Assistance Program			0.11	0.22	0.33	0.44	0.54	1.03	1.51	1.50	1.51	1.52
BTS Carbon Equivalent Emissions Displaced Total			1.53	2.79	4.44	6.71	9.18	23.01	37.09	47.39	60.40	74.01

Other Greenhouse Emissions Displaced (MMTCe)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Commercial Buildings Integration												
Community Energy Program												
Energy Star Program												
Equipment, Materials, and Tools												
Residential Buildings Integration												
State Energy Program												
Technology Roadmaps & Competitive R&D												
Weatherization Assistance Program												
BTS Other Greenhouse Emissions Displaced Total												

SO2 Displaced (MMTons)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Commercial Buildings Integration								0.01	0.02	0.04	0.06	0.08
Community Energy Program			0.01	0.01	0.01	0.02	0.02	0.05	0.09	0.12	0.17	0.22
Energy Star Program			0.01	0.01	0.02	0.02	0.03	0.05	0.07	0.07	0.08	0.10
Equipment, Materials, and Tools				0.01	0.02	0.03	0.04	0.10	0.19	0.30	0.43	0.57
Residential Buildings Integration									0.01	0.01	0.02	0.03
State Energy Program						0.01	0.01	0.01	0.01	0.02	0.03	0.03
Technology Roadmaps & Competitive R&D					0.01	0.01	0.01	0.01	0.02	0.02	0.03	0.04
Weatherization Assistance Program							0.01	0.01	0.02	0.02	0.02	0.02
BTS SO2 Displaced Total			.03	.04	.06	.08	.11	.24	.43	.60	.84	1.09

NOX Displaced (MMTons)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Commercial Buildings Integration								0.01	0.02	0.03	0.04	0.05
Community Energy Program				0.01	0.01	0.01	0.02	0.05	0.08	0.10	0.12	0.14
Energy Star Program			0.01	0.01	0.01	0.01	0.02	0.04	0.05	0.05	0.05	0.06
Equipment, Materials, and Tools				0.01	0.01	0.02	0.03	0.08	0.14	0.20	0.26	0.33
Residential Buildings Integration									0.01	0.01	0.02	0.03
State Energy Program								0.01	0.01	0.01	0.02	0.02
Technology Roadmaps & Competitive R&D							0.01	0.01	0.01	0.02	0.02	0.03
Weatherization Assistance Program								0.01	0.01	0.01	0.01	0.01
BTS NOX Displaced Total			.01	.02	.04	.06	.08	.20	.33	.42	.55	.68

Particulates Displaced (MMTons)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Commercial Buildings Integration												
Community Energy Program												
Energy Star Program												
Equipment, Materials, and Tools												
Residential Buildings Integration												
State Energy Program												
Technology Roadmaps & Competitive R&D												
Weatherization Assistance Program												
BTS Particulates Displaced Total												

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
VOCs Displaced (MMTons)												
Commercial Buildings Integration												
Community Energy Program												
Energy Star Program												
Equipment, Materials, and Tools												
Residential Buildings Integration												
State Energy Program												
Technology Roadmaps & Competitive R&D												
Weatherization Assistance Program												
BTS VOCs Displaced Total											.01	.01
HCs Displaced (MMTons)												
Commercial Buildings Integration												
Community Energy Program												
Energy Star Program												
Equipment, Materials, and Tools												
Residential Buildings Integration												
State Energy Program												
Technology Roadmaps & Competitive R&D												
Weatherization Assistance Program												
BTS HCs Displaced Total												
Other Environmental Benefits (MMTons)												
Commercial Buildings Integration												
Community Energy Program												
Energy Star Program												
Equipment, Materials, and Tools												
Residential Buildings Integration												
State Energy Program												
Technology Roadmaps & Competitive R&D												
Weatherization Assistance Program												
BTS Other Environmental Benefits Total												

PM10 Displaced (MMTons)	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Commercial Buildings Integration												
Community Energy Program												0.01
Energy Star Program												
Equipment, Materials, and Tools										0.01	0.01	0.01
Residential Buildings Integration												
State Energy Program												
Technology Roadmaps & Competitive R&D												
Weatherization Assistance Program												
BTS PM10 Displaced Total									.01	.01	.02	.03

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GPRA Metric List

Federal Energy Management Program (FEMP)

Resource

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
DOE Funding Level (Millions of $'s)												
FEMP	23.80	31.87	31.87	31.87	31.87	31.87	31.87	31.87				
FEMP DOE Funding Level Total	23.80	31.87	31.87	31.87	31.87	31.87	31.87	31.87				
Research (%)												
FEMP												
Development (%)												
FEMP												
Deployment (%)												
FEMP	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Partner Financial Investment (Millions of $'s)												
FEMP	53.00	75.00	100.00	300.00	400.00	500.00	500.00	832.00				
FEMP Partner Financial Investment Total	53.00	75.00	100.00	300.00	400.00	500.00	500.00	832.00				
Partner Non-Financial Investment (Millions of $'s)												
FEMP												
FEMP Partner Non-Financial Investment Total												
Partners (Number)												
FEMP		40.00	50.00	150.00	200.00	250.00	250.00	416.00				
FEMP Partners Total		40.00	50.00	150.00	200.00	250.00	250.00	416.00				

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030

Energy

Total Primary Energy Displaced (Trillion Btu)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
FEMP			26.14	33.51	41.78	47.86	52.62	67.18	68.35	66.92	67.38	67.84
FEMP Total Primary Energy Displaced Total			26.14	33.51	41.78	47.86	52.62	67.18	68.35	66.92	67.38	67.84

Direct Electricity Displaced (Billion Kilowatthours)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
FEMP			1.71	2.26	2.79	3.32	3.83	5.44	5.44	5.44	5.44	5.44
FEMP Direct Electricity Displaced Total			1.71	2.26	2.79	3.32	3.83	5.44	5.44	5.44	5.44	5.44

Direct Natural Gas Displaced (Billion Cubic Feet)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
FEMP			4.25	5.61	6.94	8.23	9.50	13.67	13.67	13.67	13.67	13.67
FEMP Direct Natural Gas Displaced Total			4.25	5.61	6.94	8.23	9.50	13.67	13.67	13.67	13.67	13.67

Direct Petroleum Displaced (Million Barrels)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
FEMP			0.26	0.34	0.42	0.50	0.57	0.82	0.82	0.82	0.82	0.82
FEMP Direct Petroleum Displaced Total			.26	.34	.42	.50	.57	.82	.82	.82	.82	.82

Direct Coal Displaced (Million Short Tons)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
FEMP			0.06	0.08	0.10	0.11	0.13	0.19	0.19	0.19	0.19	0.19
FEMP Direct Coal Displaced Total			.06	.08	.10	.11	.13	.19	.19	.19	.19	.19

Financial

Energy Costs or Savings (Billions of $'s)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
FEMP			0.12	0.16	0.20	0.23	0.27	0.37	0.36	0.35	0.33	0.32
FEMP Energy Costs or Savings Total			.12	.16	.20	.23	.27	.37	.36	.35	.33	.32

Non-Energy Savings or Costs (Billions of $'s)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
FEMP												
FEMP Non-Energy Savings or Costs Total												

Environmental

CO Displaced (MMTons)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
FEMP												
FEMP CO Displaced Total												

Carbon Equivalent Emissions Displaced (MMTCe)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
FEMP			0.55	0.65	0.82	0.92	1.00	1.22	1.19	1.20	1.23	1.27
FEMP Carbon Equivalent Emissions Displaced Total			.55	.65	.82	.92	1.00	1.22	1.19	1.20	1.23	1.27

Other Greenhouse Emissions Displaced (MMTCe)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
FEMP												
FEMP Other Greenhouse Emissions Displaced Total												

SO2 Displaced (MMTons)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
FEMP			0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02
FEMP SO2 Displaced Total			.01	.01	.01	.01	.01	.01	.01	.02	.02	.02

NOX Displaced (MMTons)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
FEMP			0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
FEMP NOX Displaced Total			.01	.01	.01	.01	.01	.01	.01	.01	.01	.01

Particulates Displaced (MMTons)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
FEMP												
FEMP Particulates Displaced Total												

VOCs Displaced (MMTons)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
FEMP												
FEMP VOCs Displaced Total												

HCs Displaced (MMTons)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
FEMP												
FEMP HCs Displaced Total												

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Other Environmental Benefits (MMTons)												
FEMP												
FEMP Other Environmental Benefits Total												
PM10 Displaced (MMTons)												
FEMP												
FEMP PM10 Displaced Total												

The Office of Energy Efficiency & Renewable Energy

GPRA Metric List

Office of Industrial Technologies (OIT)

Resource

DOE Funding Level (Millions of $'s)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Advanced Industrial Materials (AIM)	9.10	9.30	9.50	9.70	9.90	10.10	10.30					
Agriculture Vision			5.00	5.00	6.00	7.00	7.00					
Aluminum Vision	8.18	8.18	8.00	9.70	10.50	12.00	12.00					
Best Practices	10.50	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00
CFCCs/Engineered Ceramics		9.00	8.50	8.40								
Chemicals Vision			13.80	15.20	16.70	18.40	20.20					
Distributed Generation		28.30	28.30	28.30	28.30	28.30						
Forest & Paper Products Vision			28.40	36.60	35.60	35.60	29.60					
Glass Vision			6.00	6.50	7.00	7.50	8.00					
Industrial Assessment Centers (IAC)	8.22	8.30	8.30	8.30	8.30	8.30	8.30	8.30	8.30	8.30	8.30	8.30
Inventions & Innovations	4.75	5.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
Metals Casting Vision			5.80	5.90	6.00	66.10	6.10					
Mining Vision			4.00	5.00	6.00	7.00	7.00					
NICE3	5.94	7.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
Petroleum Refining Vision			2.00	2.00	3.00	4.00	4.50					
Sensors and Controls												
Steel Vision												
OIT DOE Funding Level Total	46.70	87.08	151.60	164.60	161.30	228.30	137.00	32.30	32.30	32.30	32.30	32.30

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Research (%)	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Advanced Industrial Materials (AIM)	0.50	0.50	0.50	0.50	0.50	0.50	0.50					
Agriculture Vision			0.20	0.20	0.20	0.20	0.20					
Aluminum Vision	0.50	0.50	0.50	0.50	0.50	0.50	0.50					
Best Practices												
CFCCs/Engineered Ceramics		0.15	0.05	0.05								
Chemicals Vision			0.20	0.20	0.20	0.20	0.20					
Distributed Generation		0.25	0.25	0.25	0.25	0.25						
Forest & Paper Products Vision			0.25	0.25	0.25	0.25	0.25					
Glass Vision	0.20	0.20	0.20	0.20	0.20	0.20	0.20					
Industrial Assessment Centers (IAC)												
Inventions & Innovations												
Metals Casting Vision			1.00	1.00	1.00	1.00	1.00					
Mining Vision			0.60	0.60	0.60	0.60	0.60					
NICE3												
Petroleum Refining Vision			0.20	0.20	0.20	0.20	0.20					
Sensors and Controls												
Steel Vision												

Development (%)	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Advanced Industrial Materials (AIM)	0.50	0.50	0.50	0.50	0.50	0.50	0.50					
Agriculture Vision			0.80	0.80	0.80	0.80	0.80					
Aluminum Vision	0.50	0.50	0.50	0.50	0.50	0.50	0.50					
Best Practices												
CFCCs/Engineered Ceramics		0.75	0.80	0.80								
Chemicals Vision			0.80	0.80	0.80	0.80	0.80					
Distributed Generation		0.75	0.75	0.75	0.75	0.75						
Forest & Paper Products Vision			0.15	0.15	0.15	0.15	0.15					
Glass Vision	0.80	0.80	0.80	0.80	0.80	0.80	0.80					
Industrial Assessment Centers (IAC)												
Inventions & Innovations												
Metals Casting Vision												
Mining Vision			0.40	0.40	0.40	0.40	0.40					
NICE3												
Petroleum Refining Vision			0.80	0.80	0.80	0.80	0.80					
Sensors and Controls												
Steel Vision												

Deployment (%)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Advanced Industrial Materials (AIM)												
Agriculture Vision												
Aluminum Vision												
Best Practices	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
CFCCs/Engineered Ceramics		0.10	0.15	0.15								
Chemicals Vision												
Distributed Generation												
Forest & Paper Products Vision			0.60	0.60	0.60	0.60	0.60					
Glass Vision												
Industrial Assessment Centers (IAC)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Inventions & Innovations	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Metals Casting Vision												
Mining Vision												
NICE3	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Petroleum Refining Vision												
Sensors and Controls												
Steel Vision												

Partner Financial Investment (Millions of $'s)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Advanced Industrial Materials (AIM)	2.80	2.80	2.90	2.90	3.00	3.00	3.10					
Agriculture Vision			5.00	5.00	6.00	7.00	7.00					
Aluminum Vision	2.20	2.60	3.50	4.20	4.80	5.50	5.50					
Best Practices	39.40	45.02	45.02	45.02	45.02	45.02	45.02	45.02	45.02	45.02	45.02	45.02
CFCCs/Engineered Ceramics		2.00	4.00	4.00								
Chemicals Vision			12.00	13.00	15.00	16.00	17.00					
Distributed Generation												
Forest & Paper Products Vision			14.10	23.20	22.30	22.30	15.20					
Glass Vision			4.00	4.50	5.50	7.00	8.00					
Industrial Assessment Centers (IAC)	57.69	58.24	58.24	58.24	58.24	58.24	58.24	58.24	58.24	58.24	58.24	58.24
Inventions & Innovations	29.40	30.90	37.10	37.10	37.10	37.10	37.10	37.10	37.10	37.10	37.10	37.10
Metals Casting Vision			1.75	1.78	1.82	1.85	1.88					
Mining Vision			1.00	1.00	2.00	2.00	3.00					
NICE3	22.94	27.02	23.16	23.16	23.16	23.16	23.16	23.16	23.16	23.16	23.16	23.16
Petroleum Refining Vision			2.00	2.00	3.00	4.00	4.50					
Sensors and Controls												
Steel Vision												
OIT Partner Financial Investment Total	154.43	168.58	213.77	225.10	226.94	232.17	228.70	163.52	163.52	163.52	163.52	163.52

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Partner Non-Financial Investment (Millions of $'s)												
Advanced Industrial Materials (AIM)	1.00	1.00	1.00	1.10	1.10	1.10	1.20					
Agriculture Vision			1.30	1.30	1.50	1.80	1.80					
Aluminum Vision	2.20	2.60	3.50	4.20	4.80	5.50	5.50					
Best Practices												
CFCCs/Engineered Ceramics												
Chemicals Vision			7.00	7.00	8.00	9.00	10.00					
Distributed Generation												
Forest & Paper Products Vision			3.30	3.34	3.33	3.33	3.31					
Glass Vision			1.40	1.60	1.80	2.00	2.00					
Industrial Assessment Centers (IAC)												
Inventions & Innovations												
Metals Casting Vision			6.31	6.34	6.55	6.68	6.74					
Mining Vision			4.00	5.00	6.00	7.00	7.00					
NICE3												
Petroleum Refining Vision			0.50	0.50	0.60	0.70	0.70					
Sensors and Controls												
Steel Vision												
OIT Partner Non-Financial Investment Total	3.20	3.60	28.31	30.38	33.68	37.11	38.25					
Partners (Number)												
Advanced Industrial Materials (AIM)	15.00	15.00	16.00	16.00	17.00	17.00	18.00					
Agriculture Vision			42.00	42.00	45.00	50.00	50.00					
Aluminum Vision	35.00	35.00	40.00	40.00	40.00	45.00	45.00					
Best Practices	2,500.00	2,700.00	2,900.00	3,100.00	3,300.00	3,500.00	3,700.00	4,700.00	5,700.00	6,700.00	7,700.00	8,700.00
CFCCs/Engineered Ceramics		40.00	40.00	40.00								
Chemicals Vision			46.00	48.00	50.00	55.00	57.00					
Distributed Generation												
Forest & Paper Products Vision			59.00	59.00	59.00	59.00	59.00					
Glass Vision			42.00	46.00	48.00	50.00	52.00					
Industrial Assessment Centers (IAC)	11,208.00	12,098.00	12,988.00	13,878.00	14,768.00	15,658.00	16,548.00	20,998.00	25,448.00	29,898.00	34,348.00	38,798.00
Inventions & Innovations	748.00	773.00	798.00	823.00	848.00	873.00	898.00	1,023.00	1,148.00	1,273.00	1,398.00	1,523.00
Metals Casting Vision			275.00	278.00	280.00	283.00	286.00					
Mining Vision			40.00	40.00	40.00	40.00	40.00					
NICE3	273.00	309.00	339.00	369.00	399.00	429.00	459.00	609.00	759.00	909.00	1,059.00	1,209.00
Petroleum Refining Vision			10.00	10.00	12.00	14.00	16.00					
Sensors and Controls												
Steel Vision												
OIT Partners Total	14,779.00	15,970.00	17,635.00	18,789.00	19,906.00	21,073.00	22,228.00	27,330.00	33,055.00	38,780.00	44,505.00	50,230.00

Energy

Total Primary Energy Displaced (Trillion Btu)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Advanced Industrial Materials (AIM)							7.08	21.81	50.46	86.48	120.78	147.43
Agriculture Vision							0.99	4.20	15.70	45.00	98.20	180.00
Aluminum Vision							16.47	39.75	84.66	148.19	224.76	292.77
Best Practices		2.04	8.66	19.86	35.64	56.01	78.92	162.94	249.50	336.06	422.62	509.19
CFCCs/Engineered Ceramics							21.33	58.38	101.42	152.74	205.70	254.86
Chemicals Vision							80.71	195.66	451.28	876.17	1,471.02	2,263.61
Distributed Generation							86.38	163.42	363.19	540.59	686.28	762.32
Forest & Paper Products Vision							111.00	259.00	685.00	1,510.00	2,720.00	3,870.00
Glass Vision							24.31	43.12	60.00	76.51	95.19	118.83
Industrial Assessment Centers (IAC)			3.23	6.71	10.45	15.26	20.32	39.02	47.93	54.30	55.06	55.06
Inventions & Innovations					0.30	0.80	3.00	42.50	108.40	108.40	108.40	108.40
Metals Casting Vision							9.81	24.50	56.50	95.50	133.00	165.00
Mining Vision							3.42	8.58	21.25	38.68	55.59	67.38
NICE3					0.10	0.31	1.13	16.09	49.09	97.98	97.98	97.98
Petroleum Refining Vision							74.24	206.36	317.53	417.14	484.00	521.50
Sensors and Controls							1.79	2.46	3.43	4.75	6.56	9.00
Steel Vision							27.16	78.96	157.66	238.29	302.20	349.59
OIT Total Primary Energy Displaced Total		2.04	11.89	26.57	46.49	72.38	568.06	1,366.75	2,823.00	4,826.78	7,287.35	9,772.91

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Direct Electricity Displaced (Billion Kilowatthours)												
Advanced Industrial Materials (AIM)							0.14	0.43	1.09	2.14	3.20	4.01
Agriculture Vision							0.02	0.07	0.25	0.71	1.55	2.84
Aluminum Vision							1.57	4.39	9.29	16.73	24.84	30.95
Best Practices		0.08	0.34	0.81	1.50	2.45	3.58	8.74	13.03	18.13	22.57	26.91
CFCCs/Engineered Ceramics							0.24	0.64	0.79	0.81	0.82	0.82
Chemicals Vision							2.22	5.04	10.93	21.08	36.15	57.40
Distributed Generation							15.81	40.75	85.96	136.40	169.57	184.53
Forest & Paper Products Vision							8.84	59.10	128.00	166.00	344.00	440.00
Glass Vision							0.56	1.01	1.47	2.07	2.89	4.11
Industrial Assessment Centers (IAC)			0.21	0.46	0.74	1.12	1.55	3.50	4.19	4.91	4.92	4.87
Inventions & Innovations					0.01	0.03	0.11	1.77	4.65	4.99	5.38	5.38
Metals Casting Vision							0.76	1.99	4.48	7.78	10.90	13.70
Mining Vision							0.29	0.82	1.99	3.71	5.29	6.36
NICE3						0.01	0.04	0.66	1.97	4.06	4.02	3.97
Petroleum Refining Vision							0.15	0.53	0.93	1.21	1.40	1.52
Sensors and Controls							0.02	0.03	0.04	0.05	0.06	0.07
Steel Vision							0.20	0.77	1.19	1.27	1.27	1.25
OIT Direct Electricity Displaced Total		.08	.55	1.27	2.25	3.61	36.09	130.24	270.25	392.05	638.82	788.69
Direct Natural Gas Displaced (Billion Cubic Feet)												
Advanced Industrial Materials (AIM)							2.19	8.56	19.77	33.38	47.17	58.19
Agriculture Vision							(.38)	(1.66)	(6.20)	(17.82)	(38.85)	(70.93)
Aluminum Vision							2.99	7.78	17.52	31.04	45.42	60.84
Best Practices		0.94	3.98	9.13	16.39	25.75	36.28	74.91	114.71	154.51	194.31	234.11
CFCCs/Engineered Ceramics							15.64	43.27	71.48	103.58	138.40	173.74
Chemicals Vision							16.03	41.66	80.79	116.77	127.37	110.85
Distributed Generation							(61.60)	(158.79)	(334.96)	(531.52)	(660.77)	(719.05)
Forest & Paper Products Vision							4.34	12.70	26.80	46.60	65.80	80.80
Glass Vision							17.99	33.14	45.54	57.19	68.55	81.59
Industrial Assessment Centers (IAC)			0.72	1.50	2.34	3.41	4.54	8.72	10.71	12.14	12.31	12.31
Inventions & Innovations					0.08	0.24	0.87	12.39	31.61	31.61	34.08	34.08
Metals Casting Vision							1.64	4.76	11.10	19.70	28.00	35.80
Mining Vision							(.12)	(.33)	(.82)	(1.57)	(2.26)	(2.74)
NICE3					0.03	0.09	0.34	4.85	14.79	29.52	29.52	29.52
Petroleum Refining Vision							43.82	126.00	164.96	194.36	216.63	232.57
Sensors and Controls							1.36	1.93	2.74	3.85	5.39	7.48
Steel Vision							17.10	48.20	97.97	151.37	193.73	225.43
OIT Direct Natural Gas Displaced Total		.94	4.70	10.63	18.84	29.49	103.04	268.09	368.51	434.71	504.80	584.59

Direct Petroleum Displaced (Million Barrels)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Advanced Industrial Materials (AIM)											0.01	0.01
Agriculture Vision												
Aluminum Vision							0.12	0.22	0.40	0.72	1.17	1.65
Best Practices		0.01	0.03	0.08	0.14	0.22	0.31	0.64	0.98	1.32	1.66	2.00
CFCCs/Engineered Ceramics												
Chemicals Vision							0.03	0.06	0.14	0.36	0.78	1.40
Distributed Generation												
Forest & Paper Products Vision							0.29	0.58	1.13	1.88	2.62	3.30
Glass Vision							0.10	0.17	0.19	0.22	0.24	0.26
Industrial Assessment Centers (IAC)			0.02	0.05	0.07	0.11	0.14	0.27	0.33	0.37	0.38	0.38
Inventions & Innovations					0.01	0.04	0.15	2.12	5.42	5.42	5.84	5.84
Metals Casting Vision							0.03	0.05	0.10	0.17	0.27	0.39
Mining Vision							0.13	0.38	0.93	1.75	2.50	3.01
NICE3					0.01	0.02	0.06	0.80	2.45	4.90	4.90	4.90
Petroleum Refining Vision							4.56	11.56	22.74	34.23	41.58	44.93
Sensors and Controls												
Steel Vision							0.01	0.03	0.08	0.13	0.17	0.20
OIT Direct Petroleum Displaced Total		.01	.05	.13	.23	.39	5.93	16.89	34.89	51.47	62.12	68.27

Direct Coal Displaced (Million Short Tons)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Advanced Industrial Materials (AIM)												
Agriculture Vision							0.02	0.07	0.25	0.71	1.55	2.84
Aluminum Vision							0.03	0.05	0.08	0.13	0.19	0.26
Best Practices		0.01	0.03	0.07	0.13	0.20	0.28	0.58	0.89	1.19	1.50	1.81
CFCCs/Engineered Ceramics							0.14	0.42	1.03	1.91	2.73	3.34
Chemicals Vision							0.04	0.19	0.77	2.27	4.97	8.99
Distributed Generation												
Forest & Paper Products Vision							0.16	0.41	0.84	1.35	1.84	2.32
Glass Vision												
Industrial Assessment Centers (IAC)					0.01	0.01	0.01	0.02	0.02	0.03	0.03	0.03
Inventions & Innovations							0.01	0.12	0.31	0.31	0.34	0.34
Metals Casting Vision							0.07	0.19	0.41	0.66	0.86	1.01
Mining Vision								0.01	0.01	0.03	0.04	0.05
NICE3								0.05	0.16	0.33	0.33	0.33
Petroleum Refining Vision							0.06	0.26	0.41	0.43	0.44	0.44
Sensors and Controls							0.01	0.01	0.01	0.02	0.02	0.03
Steel Vision							0.23	0.73	1.44	2.14	2.70	3.11
OIT Direct Coal Displaced Total		.01	.03	.07	.14	.21	1.06	3.11	6.63	11.51	17.54	24.90

Financial

Energy Costs or Savings (Billions of $'s)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Advanced Industrial Materials (AIM)							0.01	0.04	0.11	0.19	0.28	0.34
Agriculture Vision								0.01	0.02	0.06	0.12	0.22
Aluminum Vision							0.08	0.21	0.42	0.73	1.04	1.27
Best Practices		0.01	0.03	0.07	0.12	0.20	0.28	0.63	0.93	1.26	1.55	1.84
CFCCs/Engineered Ceramics							0.06	0.18	0.29	0.43	0.57	0.72
Chemicals Vision							0.18	0.48	1.15	2.35	3.97	6.02
Distributed Generation							0.49	1.14	2.14	3.17	3.56	3.51
Forest & Paper Products Vision							0.52	1.29	3.36	7.37	12.29	16.25
Glass Vision							0.08	0.15	0.21	0.27	0.34	0.43
Industrial Assessment Centers (IAC)			0.02	0.03	0.06	0.08	0.11	0.20	0.25	0.28	0.28	0.28
Inventions & Innovations							0.01	0.18	0.45	0.47	0.47	0.47
Metals Casting Vision							0.03	0.08	0.19	0.32	0.42	0.48
Mining Vision							0.01	0.04	0.09	0.16	0.22	0.25
NICE3								0.06	0.19	0.38	0.39	0.39
Petroleum Refining Vision							0.20	0.59	0.90	1.20	1.39	1.50
Sensors and Controls							0.01	0.01	0.01	0.02	0.02	0.03
Steel Vision							0.07	0.21	0.41	0.61	0.78	0.91
OIT Energy Costs or Savings Total		.01	.05	.10	.18	.28	2.14	5.51	11.12	19.27	27.69	34.90

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Non-Energy Savings or Costs (Billions of $'s)												
Advanced Industrial Materials (AIM)												
Agriculture Vision							0.01	0.06	0.22	0.64	1.40	2.55
Aluminum Vision							0.01	0.04	0.10	0.22	0.39	0.51
Best Practices		0.01	0.06	0.13	0.25	0.39	0.57	1.27	1.86	2.52	3.11	3.67
CFCCs/Engineered Ceramics									(.01)	(.01)	(.01)	(.01)
Chemicals Vision							1.02	3.06	7.39	13.81	21.43	30.48
Distributed Generation												
Forest & Paper Products Vision											0.01	0.01
Glass Vision												
Industrial Assessment Centers (IAC)			0.03	0.07	0.11	0.16	0.21	0.41	0.50	0.57	0.57	0.57
Inventions & Innovations						0.01	0.02	0.36	0.90	0.93	0.94	0.94
Metals Casting Vision							1.14	3.63	9.23	17.61	26.91	36.74
Mining Vision												
NICE3							0.01	0.12	0.38	0.76	0.77	0.78
Petroleum Refining Vision												
Sensors and Controls												
Steel Vision												
OIT Non-Energy Savings or Costs Total		.01	.09	.20	.36	.56	3.00	8.94	20.58	37.06	55.52	76.26

Environmental

CO Displaced (MMTons)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Advanced Industrial Materials (AIM)												
Agriculture Vision												
Aluminum Vision								0.01	0.03	0.06	0.11	0.15
Best Practices									0.01	0.01	0.01	0.01
CFCCs/Engineered Ceramics												0.01
Chemicals Vision										0.01	0.01	0.02
Distributed Generation									0.01	0.01	0.02	0.02
Forest & Paper Products Vision									0.02	0.04	0.07	0.09
Glass Vision												
Industrial Assessment Centers (IAC)												
Inventions & Innovations												
Metals Casting Vision												
Mining Vision												
NICE3												
Petroleum Refining Vision									0.01	0.01	0.01	0.01
Sensors and Controls												
Steel Vision										0.01	0.01	0.01
OIT CO Displaced Total								.02	.07	.15	.24	.33

Carbon Equivalent Emissions Displaced (MMTCe)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Advanced Industrial Materials (AIM)							0.06	0.20	0.49	0.89	1.29	1.60
Agriculture Vision								0.03	0.10	0.30	0.65	1.18
Aluminum Vision							0.41	1.13	2.43	4.47	6.77	8.62
Best Practices		0.04	0.15	0.34	0.60	0.92	1.26	2.50	3.79	5.26	6.74	8.26
CFCCs/Engineered Ceramics							0.33	0.93	1.66	2.56	3.45	4.25
Chemicals Vision							1.08	2.49	5.32	9.95	16.46	25.44
Distributed Generation							2.48	6.41	13.51	21.44	26.66	29.01
Forest & Paper Products Vision							2.17	5.97	16.00	37.20	67.20	95.20
Glass Vision							0.36	0.66	0.92	1.20	1.52	1.95
Industrial Assessment Centers (IAC)			0.06	0.12	0.19	0.26	0.34	0.61	0.73	0.88	0.91	0.94
Inventions & Innovations					0.01	0.02	0.05	0.78	1.92	1.92	1.92	1.32
Metals Casting Vision							0.20	0.55	1.25	2.15	2.96	3.64
Mining Vision							0.07	0.20	0.49	0.92	1.31	1.58
NICE3						0.01	0.02	0.25	0.76	1.55	1.57	1.59
Petroleum Refining Vision							1.00	2.80	4.30	5.59	6.42	6.87
Sensors and Controls							0.04	0.05	0.07	0.09	0.12	0.16
Steel Vision							0.39	1.19	2.31	3.42	4.28	4.92
OIT Carbon Equivalent Emissions Displaced Total		.04	.21	.46	.79	1.20	10.26	26.74	56.06	99.79	150.24	196.53

Other Greenhouse Emissions Displaced (MMTCe)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Advanced Industrial Materials (AIM)												
Agriculture Vision												
Aluminum Vision							0.01	0.03	0.05	0.06	0.06	0.06
Best Practices												
CFCCs/Engineered Ceramics												
Chemicals Vision							0.01	0.03	0.08	0.19	0.36	0.54
Distributed Generation												
Forest & Paper Products Vision							0.19	0.26	0.38	0.53	0.75	1.04
Glass Vision												
Industrial Assessment Centers (IAC)												
Inventions & Innovations												
Metals Casting Vision									0.01	0.01	0.02	0.02
Mining Vision												
NICE3												
Petroleum Refining Vision												
Sensors and Controls							0.03	0.04	0.05	0.06	0.08	0.10
Steel Vision												
OIT Other Greenhouse Emissions Displaced Total							.24	.36	.56	.86	1.27	1.77

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
SO2 Displaced (MMTons)												
Advanced Industrial Materials (AIM)										0.01	0.01	0.01
Agriculture Vision										0.01	0.02	0.04
Aluminum Vision							0.01	0.02	0.03	0.07	0.10	0.13
Best Practices					0.01	0.01	0.01	0.02	0.03	0.05	0.07	0.09
CFCCs/Engineered Ceramics								0.01	0.01	0.03	0.03	0.04
Chemicals Vision							0.01	0.02	0.04	0.09	0.17	0.29
Distributed Generation							0.05	0.13	0.26	0.42	0.52	0.57
Forest & Paper Products Vision							0.03	0.08	0.23	0.53	0.97	1.38
Glass Vision												0.01
Industrial Assessment Centers (IAC)								0.01	0.01	0.01	0.01	0.01
Inventions & Innovations								0.01	0.03	0.03	0.03	0.02
Metals Casting Vision								0.01	0.02	0.03	0.04	0.05
Mining Vision									0.01	0.02	0.02	0.03
NICE3									0.01	0.03	0.03	0.03
Petroleum Refining Vision							0.01	0.04	0.07	0.10	0.12	0.12
Sensors and Controls												
Steel Vision								0.01	0.02	0.03	0.04	0.05
OIT SO2 Displaced Total				.01	.01	.01	.13	.36	.76	1.45	2.18	2.88
NOX Displaced (MMTons)												
Advanced Industrial Materials (AIM)										0.01	0.01	0.01
Agriculture Vision												0.01
Aluminum Vision								0.01	0.02	0.04	0.05	0.07
Best Practices					0.01	0.01	0.01	0.02	0.04	0.06	0.08	0.10
CFCCs/Engineered Ceramics								0.01	0.01	0.02	0.03	0.04
Chemicals Vision							0.01	0.02	0.03	0.06	0.11	0.17
Distributed Generation							0.02	0.06	0.12	0.20	0.25	0.27
Forest & Paper Products Vision							0.02	0.05	0.14	0.33	0.60	0.85
Glass Vision										0.01	0.01	0.02
Industrial Assessment Centers (IAC)								0.01	0.01	0.01	0.01	0.01
Inventions & Innovations								0.01	0.01	0.01	0.01	0.01
Metals Casting Vision								0.01	0.01	0.02	0.03	0.03
Mining Vision										0.01	0.01	0.01
NICE3									0.01	0.02	0.02	0.02
Petroleum Refining Vision							0.01	0.02	0.04	0.05	0.06	0.06
Sensors and Controls												0.01
Steel Vision								0.01	0.02	0.03	0.04	0.05
OIT NOX Displaced Total				.01	.01	.01	.08	.23	.46	.88	1.32	1.74

Particulates Displaced (MMTons)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Advanced Industrial Materials (AIM)												
Agriculture Vision												
Aluminum Vision										0.01	0.01	0.01
Best Practices												
CFCCs/Engineered Ceramics												
Chemicals Vision							0.01	0.03	0.07	0.13	0.19	0.24
Distributed Generation									0.01	0.01	0.02	0.02
Forest & Paper Products Vision										0.02	0.03	0.05
Glass Vision												
Industrial Assessment Centers (IAC)												
Inventions & Innovations												
Metals Casting Vision												
Mining Vision												
NICE3												
Petroleum Refining Vision												
Sensors and Controls												
Steel Vision							0.01	0.03	0.06	0.10	0.13	0.15
OIT Particulates Displaced Total							.02	.06	.14	.28	.39	.48

VOCs Displaced (MMTons)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Advanced Industrial Materials (AIM)												
Agriculture Vision												
Aluminum Vision												
Best Practices												
CFCCs/Engineered Ceramics												
Chemicals Vision								0.01	0.03	0.05	0.07	0.09
Distributed Generation												
Forest & Paper Products Vision							0.02	0.04	0.06	0.08	0.10	0.13
Glass Vision												
Industrial Assessment Centers (IAC)												
Inventions & Innovations												
Metals Casting Vision							0.75	2.13	4.96	8.69	11.90	14.30
Mining Vision												
NICE3												
Petroleum Refining Vision												
Sensors and Controls												
Steel Vision											0.01	0.01
OIT VOCs Displaced Total							.77	2.18	5.05	8.82	12.08	14.53

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
HCs Displaced (MMTons)												
Advanced Industrial Materials (AIM)												
Agriculture Vision												
Aluminum Vision												
Best Practices												
CFCCs/Engineered Ceramics												
Chemicals Vision							0.10	0.25	0.59	1.34	2.88	5.80
Distributed Generation												
Forest & Paper Products Vision												
Glass Vision												
Industrial Assessment Centers (IAC)												
Inventions & Innovations												
Metals Casting Vision												
Mining Vision												
NICE3												
Petroleum Refining Vision												
Sensors and Controls												
Steel Vision												
OIT HCs Displaced Total							.10	.25	.59	1.34	2.88	5.80

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Other Environmental Benefits (MMTons)												
Advanced Industrial Materials (AIM)												
Agriculture Vision							0.28	1.20	4.47	12.80	28.00	51.10
Aluminum Vision							0.09	0.25	0.56	0.94	1.23	1.43
Best Practices												
CFCCs/Engineered Ceramics												
Chemicals Vision							0.15	0.47	1.21	2.50	4.31	6.70
Distributed Generation												
Forest & Paper Products Vision												
Glass Vision												
Industrial Assessment Centers (IAC)												
Inventions & Innovations												
Metals Casting Vision												
Mining Vision												
NICE3												
Petroleum Refining Vision												
Sensors and Controls												
Steel Vision							0.26	0.68	1.43	2.24	2.88	3.36
OIT Other Environmental Benefits Total							.78	2.60	7.67	18.48	36.42	62.59

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
PM10 Displaced (MMTons)												
Advanced Industrial Materials (AIM)												
Agriculture Vision												
Aluminum Vision												
Best Practices												
CFCCs/Engineered Ceramics												
Chemicals Vision												
Distributed Generation												
Forest & Paper Products Vision												
Glass Vision												
Industrial Assessment Centers (IAC)												
Inventions & Innovations												
Metals Casting Vision												
Mining Vision												
NICE3												
Petroleum Refining Vision												
Sensors and Controls												
Steel Vision												
OIT PM10 Displaced Total												

The Office of Energy Efficiency & Renewable Energy

GPRA Metric List

Office of Transportation Technologies (OTT)

Resource

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
DOE Funding Level (Millions of $'s)												
Biofuels												
Fuels Utilization												
Materials Technologies												
Technology Deployment												
Vehicle Technologies												
OTT DOE Funding Level Total												
Research (%)												
Biofuels												
Fuels Utilization												
Materials Technologies												
Technology Deployment												
Vehicle Technologies												
Development (%)												
Biofuels												
Fuels Utilization												
Materials Technologies												
Technology Deployment												
Vehicle Technologies												

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Deployment (%)												
Biofuels												
Fuels Utilization												
Materials Technologies												
Technology Deployment												
Vehicle Technologies												
Partner Financial Investment (Millions of $'s)												
Biofuels												
Fuels Utilization												
Materials Technologies												
Technology Deployment												
Vehicle Technologies												
OTT Partner Financial Investment Total												
Partner Non-Financial Investment (Millions of $'s)												
Biofuels												
Fuels Utilization												
Materials Technologies												
Technology Deployment												
Vehicle Technologies												
OTT Partner Non-Financial Investment Total												
Partners (Number)												
Biofuels												
Fuels Utilization												
Materials Technologies												
Technology Deployment												
Vehicle Technologies												
OTT Partners Total												

Energy

Total Primary Energy Displaced (Trillion Btu)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Biofuels		0.05	0.49	2.15	4.96	11.59	23.24	181.97	430.02	683.11		
Fuels Utilization												
Materials Technologies		0.03	0.15	0.38	0.60	0.90	1.40	9.12	24.28	43.36		
Technology Deployment												
Vehicle Technologies		9.71	20.25	34.66	55.05	92.19	154.44	741.79	1,350.83	1,768.16		
OTT Total Primary Energy Displaced Total		9.79	20.89	37.19	60.61	104.68	179.08	932.88	1,805.13	2,494.63		

Direct Electricity Displaced (Billion Kilowatthours)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Biofuels												
Fuels Utilization												
Materials Technologies			(.01)	(.01)	(.02)	(.03)	(.05)	(.22)	(.41)	(.50)		
Technology Deployment												
Vehicle Technologies		(.01)	(.06)	(.14)	(.23)	(.33)	(.48)	(2.23)	(4.28)	(5.19)		
OTT Direct Electricity Displaced Total		(.01)	(.07)	(.15)	(.25)	(.36)	(.53)	(2.45)	(4.69)	(5.69)		

Direct Natural Gas Displaced (Billion Cubic Feet)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Biofuels												
Fuels Utilization												
Materials Technologies												
Technology Deployment		(61.89)	(95.46)	(132.75)	(171.75)	(209.74)	(244.86)	(365.17)	(426.28)	(438.97)		
Vehicle Technologies		(1.28)	(1.85)	(2.14)	(2.29)	(2.30)	(2.25)	(1.27)	(.33)	(.11)		
OTT Direct Natural Gas Displaced Total		(63.17)	(97.31)	(134.89)	(174.04)	(212.04)	(247.11)	(366.44)	(426.61)	(439.08)		

Direct Petroleum Displaced (Million Barrels)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Biofuels		0.01	0.08	0.37	0.85	2.00	4.01	31.38	74.14	117.78		
Fuels Utilization												
Materials Technologies		0.03	0.07	0.14	0.40	0.65	0.94	3.27	6.79	10.73		
Technology Deployment		12.11	18.67	25.97	33.60	41.03	47.90	71.43	83.39	85.87		
Vehicle Technologies		1.95	3.95	6.71	12.52	21.07	33.88	145.49	259.84	338.55		
OTT Direct Petroleum Displaced Total		14.10	22.78	33.19	47.37	64.76	86.72	251.57	424.16	552.93		

Direct Coal Displaced (Million Short Tons)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Biofuels												
Fuels Utilization												
Materials Technologies												
Technology Deployment												
Vehicle Technologies												
OTT Direct Coal Displaced Total												

Financial

Energy Costs or Savings (Billions of $'s)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Biofuels						(.01)	(.01)	0.01	0.11	0.13		
Fuels Utilization												
Materials Technologies					0.01	0.01	0.02	0.11	0.28	0.49		
Technology Deployment		0.03	0.09	0.16	0.25	0.33	0.39	0.78	0.98	0.96		
Vehicle Technologies		0.06	0.14	0.27	0.39	0.71	1.30	7.52	14.11	18.56		
OTT Energy Costs or Savings Total		.08	.23	.43	.64	1.04	1.70	8.41	15.48	20.14		

Non-Energy Savings or Costs (Billions of $'s)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Biofuels					0.01	0.05	0.10	0.59	1.57	1.68		
Fuels Utilization												
Materials Technologies		(.02)	(.08)	(.14)	(.12)	(.15)	(.18)	(.66)	(1.16)	(1.70)		
Technology Deployment		(.02)	(.11)	(.17)	(.19)	(.16)	(.08)	(.16)	(.60)	(.79)		
Vehicle Technologies		(.07)	(.17)	(.28)	(.68)	(1.00)	(1.01)	(.74)	0.53	1.60		
OTT Non-Energy Savings or Costs Total		(.11)	(.36)	(.58)	(.99)	(1.26)	(1.16)	(.97)	.33	.78		

Environmental

CO Displaced (MMTons)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Biofuels						0.06	0.14	0.58	1.35	1.30		
Fuels Utilization												
Materials Technologies								0.01	0.03	0.07		
Technology Deployment			0.01	0.01	0.02	0.03	0.04	0.12	0.20	0.24		
Vehicle Technologies			0.01	0.01	0.03	0.07	0.14	1.08	2.65	3.95		
OTT CO Displaced Total			.01	.03	.06	.16	.33	1.79	4.24	5.56		

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030

Carbon Equivalent Emissions Displaced (MMTCe)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Biofuels			0.01	0.04	0.09	0.22	0.44	3.43	8.10	12.86		
Fuels Utilization												
Materials Technologies				0.01	0.01	0.02	0.03	0.18	0.48	0.85		
Technology Deployment		0.29	0.46	0.66	0.85	1.03	1.20	1.83	2.18	2.25		
Vehicle Technologies		0.17	0.37	0.65	1.04	1.74	2.91	14.09	25.94	34.18		
OTT Carbon Equivalent Emissions Displaced Total		.47	.85	1.35	2.00	3.01	4.58	19.52	36.70	50.14		

Other Greenhouse Emissions Displaced (MMTCe)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Biofuels							0.01	0.03	0.06	0.07		
Fuels Utilization												
Materials Technologies												
Technology Deployment												
Vehicle Technologies												
OTT Other Greenhouse Emissions Displaced Total							.01	.03	.06	.07		

SO2 Displaced (MMTons)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Biofuels												
Fuels Utilization												
Materials Technologies												
Technology Deployment												
Vehicle Technologies												
OTT SO2 Displaced Total												

NOX Displaced (MMTons)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Biofuels												
Fuels Utilization												
Materials Technologies										0.01		
Technology Deployment												
Vehicle Technologies			0.01	0.01	0.02	0.01	0.02	0.05	0.07	0.10		
OTT NOX Displaced Total			.01	.01	.02	.01	.02	.05	.08	.10		

Particulates Displaced (MMTons)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Biofuels												
Fuels Utilization												
Materials Technologies												
Technology Deployment												
Vehicle Technologies												
OTT Particulates Displaced Total												

VOCs Displaced (MMTons)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Biofuels												
Fuels Utilization												
Materials Technologies												
Technology Deployment												
Vehicle Technologies												
OTT VOCs Displaced Total												

HCs Displaced (MMTons)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Biofuels								0.03	0.12	0.07		
Fuels Utilization												
Materials Technologies										0.01		
Technology Deployment			0.01	0.02	0.03	0.04	0.06	0.18	0.28	0.33		
Vehicle Technologies				0.38	2.25	8.31	19.06	137.63	328.58	459.38		
OTT HCs Displaced Total			.01	.40	2.28	8.36	19.12	137.83	328.98	459.79		

Other Environmental Benefits (MMTons)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Biofuels												
Fuels Utilization												
Materials Technologies												
Technology Deployment												
Vehicle Technologies												
OTT Other Environmental Benefits Total												

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
PM10 Displaced (MMTons)												
Biofuels												
Fuels Utilization												
Materials Technologies												
Technology Deployment												
Vehicle Technologies												
OTT PM10 Displaced Total												

The Office of Energy Efficiency & Renewable Energy
GPRA Metric List

Office of Power Technologies (OPT)

Resource

DOE Funding Level (Millions of $'s)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Biomass Power R&D												
Competitive Solicitation												
Concentrating Solar Power												
Energy Storage												
Geothermal Energy R&D												
High Temperature Superconductivity												
Hydrogen												
Hydropower												
Photovoltaic Systems R&D												
Solar Buildings												
Solar International												
Transmission Reliability												
Wind Energy R&D												

OPT DOE Funding Level Total

Research (%)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Biomass Power R&D												
Competitive Solicitation												
Concentrating Solar Power												
Energy Storage												
Geothermal Energy R&D												
High Temperature Superconductivity												
Hydrogen												
Hydropower												
Photovoltaic Systems R&D												
Solar Buildings												
Solar International												
Transmission Reliability												
Wind Energy R&D												

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Development (%)												
Biomass Power R&D												
Competitive Solicitation												
Concentrating Solar Power												
Energy Storage												
Geothermal Energy R&D												
High Temperature Superconductivity												
Hydrogen												
Hydropower												
Photovoltaic Systems R&D												
Solar Buildings												
Solar International												
Transmission Reliability												
Wind Energy R&D												

Deployment (%)												
Biomass Power R&D												
Competitive Solicitation												
Concentrating Solar Power												
Energy Storage												
Geothermal Energy R&D												
High Temperature Superconductivity												
Hydrogen												
Hydropower												
Photovoltaic Systems R&D												
Solar Buildings												
Solar International												
Transmission Reliability												
Wind Energy R&D												

Partner Financial Investment (Millions of $'s)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Biomass Power R&D												
Competitive Solicitation												
Concentrating Solar Power												
Energy Storage												
Geothermal Energy R&D												
High Temperature Superconductivity												
Hydrogen												
Hydropower												
Photovoltaic Systems R&D												
Solar Buildings												
Solar International												
Transmission Reliability												
Wind Energy R&D												
OPT Partner Financial Investment Total												

Partner Non-Financial Investment (Millions of $'s)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Biomass Power R&D												
Competitive Solicitation												
Concentrating Solar Power												
Energy Storage												
Geothermal Energy R&D												
High Temperature Superconductivity												
Hydrogen												
Hydropower												
Photovoltaic Systems R&D												
Solar Buildings												
Solar International												
Transmission Reliability												
Wind Energy R&D												
OPT Partner Non-Financial Investment Total												

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Partners (Number)												
Biomass Power R&D												
Competitive Solicitation												
Concentrating Solar Power												
Energy Storage												
Geothermal Energy R&D												
High Temperature Superconductivity												
Hydrogen												
Hydropower												
Photovoltaic Systems R&D												
Solar Buildings												
Solar International												
Transmission Reliability												
Wind Energy R&D												
OPT Partners Total												

Energy

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Total Primary Energy Displaced (Trillion Btu)												
Biomass Power R&D							186.29	503.29	678.33	826.43	1,002.10	1,181.34
Competitive Solicitation							2.98	2.98	2.98	2.98	2.98	2.98
Concentrating Solar Power							2.82	12.09	25.95	42.71	53.77	65.05
Energy Storage							0.42	0.98	2.13	3.98	7.45	13.62
Geothermal Energy R&D							23.15	94.06	237.00	306.93	388.03	471.55
High Temperature Superconductivity							5.31	85.47	290.78	343.03	408.79	475.84
Hydrogen							1.00	43.44	142.95	303.06	463.17	623.28
Hydropower												
Photovoltaic Systems R&D							6.21	21.47	59.59	97.70	139.16	181.46
Solar Buildings							34.25	63.53	104.39	164.16	250.64	362.83
Solar International												
Transmission Reliability							64.53	163.62	278.61	339.16	375.26	424.69
Wind Energy R&D							245.56	585.16	950.78	1,231.44	1,523.84	1,832.94
OPT Total Primary Energy Displaced Total							572.52	1,576.10	2,773.51	3,661.60	4,615.19	5,635.58

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Direct Electricity Displaced (Billion Kilowatthours)												
Biomass Power R&D							17.40	50.20	74.40	99.40	120.60	141.80
Competitive Solicitation												
Concentrating Solar Power							0.30	1.50	3.20	5.40	6.70	8.00
Energy Storage												
Geothermal Energy R&D							2.40	11.70	28.80	38.50	48.20	58.00
High Temperature Superconductivity												
Hydrogen												
Hydropower												
Photovoltaic Systems R&D							0.66	2.68	7.24	12.26	17.28	22.30
Solar Buildings												
Solar International												
Transmission Reliability												
Wind Energy R&D							25.90	73.00	115.50	154.50	189.20	225.30
OPT Direct Electricity Displaced Total							46.66	139.08	229.14	310.06	381.98	455.40

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Direct Natural Gas Displaced (Billion Cubic Feet)												
Biomass Power R&D												
Competitive Solicitation												
Concentrating Solar Power												
Energy Storage												
Geothermal Energy R&D												
High Temperature Superconductivity												
Hydrogen												
Hydropower												
Photovoltaic Systems R&D												
Solar Buildings												
Solar International												
Transmission Reliability												
Wind Energy R&D												
OPT Direct Natural Gas Displaced Total												

Direct Petroleum Displaced (Million Barrels)	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Biomass Power R&D												
Competitive Solicitation												
Concentrating Solar Power												
Energy Storage												
Geothermal Energy R&D												
High Temperature Superconductivity												
Hydrogen												
Hydropower												
Photovoltaic Systems R&D												
Solar Buildings												
Solar International												
Transmission Reliability												
Wind Energy R&D												
OPT Direct Petroleum Displaced Total												

Direct Coal Displaced (Million Short Tons)	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Biomass Power R&D												
Competitive Solicitation												
Concentrating Solar Power												
Energy Storage												
Geothermal Energy R&D												
High Temperature Superconductivity												
Hydrogen												
Hydropower												
Photovoltaic Systems R&D												
Solar Buildings												
Solar International												
Transmission Reliability												
Wind Energy R&D												
OPT Direct Coal Displaced Total												

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030

Financial

Energy Costs or Savings (Billions of $'s)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Biomass Power R&D							0.08	0.18	0.24	0.32	0.43	0.59
Competitive Solicitation										0.01	0.01	0.01
Concentrating Solar Power							0.01	0.04	0.08	0.14	0.18	0.23
Energy Storage									0.01	0.01	0.02	0.04
Geothermal Energy R&D							0.05	0.24	0.57	0.70	0.85	0.99
High Temperature Superconductivity							0.01	0.21	0.69	0.78	0.90	1.00
Hydrogen												
Hydropower												
Photovoltaic Systems R&D							0.01	0.05	0.14	0.22	0.31	0.38
Solar Buildings							0.22	0.39	0.63	1.00	1.51	2.13
Solar International												
Transmission Reliability							0.30	0.65	1.15	1.43	1.68	2.00
Wind Energy R&D							0.55	1.47	2.27	2.80	3.34	3.85
OPT Energy Costs or Savings Total							1.23	3.23	5.78	7.41	9.23	11.22

Non-Energy Savings or Costs (Billions of $'s)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Biomass Power R&D							0.01		(.08)	(.16)	(.25)	(.33)
Competitive Solicitation												
Concentrating Solar Power												
Energy Storage							0.87	1.80	2.78	3.82	4.85	6.04
Geothermal Energy R&D							(.01)	(.04)	(.08)	(.08)	(.08)	(.07)
High Temperature Superconductivity												
Hydrogen												
Hydropower												
Photovoltaic Systems R&D							0.01	0.03	0.09	0.16	0.23	0.31
Solar Buildings												
Solar International												
Transmission Reliability								0.42	0.88	1.38	1.92	2.50
Wind Energy R&D							0.03	0.08	0.14	0.20	0.26	0.34
OPT Non-Energy Savings or Costs Total							.91	2.29	3.74	5.32	6.95	8.77

Environmental

CO Displaced (MMTons)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Biomass Power R&D												
Competitive Solicitation												
Concentrating Solar Power												
Energy Storage												
Geothermal Energy R&D												
High Temperature Superconductivity												
Hydrogen												
Hydropower												
Photovoltaic Systems R&D												
Solar Buildings												
Solar International												
Transmission Reliability												
Wind Energy R&D												
OPT CO Displaced Total												

Carbon Equivalent Emissions Displaced (MMTCe)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Biomass Power R&D							4.42	11.70	14.59	17.43	20.95	24.73
Competitive Solicitation							0.06	0.06	0.05	0.05	0.06	0.06
Concentrating Solar Power							0.06	0.22	0.45	0.77	1.00	1.25
Energy Storage							0.01	0.02	0.04	0.07	0.14	0.26
Geothermal Energy R&D							0.45	1.73	4.07	5.54	7.23	9.04
High Temperature Superconductivity							0.10	1.58	5.00	6.20	7.61	9.12
Hydrogen							0.02	1.87	6.30	13.45	20.60	27.75
Hydropower												
Photovoltaic Systems R&D							0.12	0.40	1.02	1.76	2.59	3.48
Solar Buildings							0.50	0.93	1.53	2.46	3.84	5.67
Solar International												
Transmission Reliability							1.07	2.78	4.72	5.50	6.04	6.77
Wind Energy R&D							4.81	10.79	16.34	22.24	28.37	35.14
OPT Carbon Equivalent Emissions Displaced Total							11.63	32.08	54.12	75.48	98.43	123.27

Other Greenhouse Emissions Displaced (MMTCe)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Biomass Power R&D												
Competitive Solicitation												
Concentrating Solar Power												
Energy Storage												
Geothermal Energy R&D												
High Temperature Superconductivity												
Hydrogen												
Hydropower												
Photovoltaic Systems R&D												
Solar Buildings												
Solar International												
Transmission Reliability												
Wind Energy R&D												
OPT Other Greenhouse Emissions Displaced Total												

SO2 Displaced (MMTons)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Biomass Power R&D							0.10	0.25	0.29	0.33	0.39	0.46
Competitive Solicitation												
Concentrating Solar Power									0.01	0.01	0.01	0.02
Energy Storage												
Geothermal Energy R&D							0.01	0.02	0.05	0.08	0.11	0.14
High Temperature Superconductivity												
Hydrogen												
Hydropower												
Photovoltaic Systems R&D									0.01	0.02	0.04	0.06
Solar Buildings												
Solar International												
Transmission Reliability												
Wind Energy R&D							0.07	0.13	0.21	0.31	0.42	0.56
OPT SO2 Displaced Total							.17	.40	.57	.75	.98	1.24

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
NOX Displaced (MMTons)												
Biomass Power R&D							0.04	0.12	0.14	0.17	0.20	0.24
Competitive Solicitation												
Concentrating Solar Power										0.01	0.01	0.01
Energy Storage												
Geothermal Energy R&D								0.02	0.04	0.05	0.07	0.08
High Temperature Superconductivity												
Hydrogen												
Hydropower												
Photovoltaic Systems R&D									0.01	0.02	0.02	0.03
Solar Buildings												
Solar International												
Transmission Reliability												
Wind Energy R&D							0.04	0.09	0.15	0.20	0.26	0.32
OPT NOX Displaced Total							.09	.23	.34	.44	.56	.69

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Particulates Displaced (MMTons)												
Biomass Power R&D												
Competitive Solicitation												
Concentrating Solar Power												
Energy Storage												
Geothermal Energy R&D												
High Temperature Superconductivity												
Hydrogen												
Hydropower												
Photovoltaic Systems R&D												
Solar Buildings												
Solar International												
Transmission Reliability												
Wind Energy R&D												
OPT Particulates Displaced Total												

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
VOCs Displaced (MMTons)												
Biomass Power R&D												
Competitive Solicitation												
Concentrating Solar Power												
Energy Storage												
Geothermal Energy R&D												
High Temperature Superconductivity												
Hydrogen												
Hydropower												
Photovoltaic Systems R&D												
Solar Buildings												
Solar International												
Transmission Reliability												
Wind Energy R&D												
OPT VOCs Displaced Total												
HCs Displaced (MMTons)												
Biomass Power R&D												
Competitive Solicitation												
Concentrating Solar Power												
Energy Storage												
Geothermal Energy R&D												
High Temperature Superconductivity												
Hydrogen												
Hydropower												
Photovoltaic Systems R&D												
Solar Buildings												
Solar International												
Transmission Reliability												
Wind Energy R&D												
OPT HCs Displaced Total												

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
Other Environmental Benefits (MMTons)												
Biomass Power R&D												
Competitive Solicitation												
Concentrating Solar Power												
Energy Storage												
Geothermal Energy R&D												
High Temperature Superconductivity												
Hydrogen												
Hydropower												
Photovoltaic Systems R&D												
Solar Buildings												
Solar International												
Transmission Reliability												
Wind Energy R&D												
OPT Other Environmental Benefits Total												

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	2025	2030
PM10 Displaced (MMTons)												
Biomass Power R&D												
Competitive Solicitation												
Concentrating Solar Power												
Energy Storage												
Geothermal Energy R&D												
High Temperature Superconductivity												
Hydrogen												
Hydropower												
Photovoltaic Systems R&D												
Solar Buildings												
Solar International												
Transmission Reliability												
Wind Energy R&D												
OPT PM10 Displaced Total												

Appendix C

Arthur D. Little Report on Review of Planning Unit Estimates

Summary of Findings – Peer Review of the FY2001 GPRA Assumptions

Report to
National Renewable Energy Laboratory

April 17, 2000

In response to TOA Number KDC-9-18631-00

Arthur D. Little, Inc.
Acorn Park
Cambridge, Massachusetts
02140-2390

Reference 69393-01

Department of Energy
Washington, DC 20585

As we enter the 21st century, there is a tremendous need for federal investment in the research, development, and deployment of clean, efficient, and cost-effective energy technologies. Accompanying this need for federal investment is the federal government's requirement under the Government and Performance Results Act (GPRA) that federal programs are managed well and achieve significant benefits for the nation.

Over the past seven years the Office of Energy Efficiency and Renewable Energy (EERE) has estimated the benefits of its programs, assuming program goals are achieved. Estimates of program impacts on energy savings, energy-cost savings, and carbon equivalent emissions reductions have been used to inform budget decisions and enable program managers to describe the expected returns of their programs. EERE has also developed trended performance measures and near term milestones that are specific to each program and link with the longer term impacts. Together, the near-term milestones, trended performance measures and longer-term impacts are presented in documents required by the Government Performance and Results Act (GPRA) and the Secretary's Performance Agreement with the President.

EERE is committed to providing credible and reliable program impact estimates. This is evidenced by our insistence for the past six years that external reviewers evaluate the program impact estimates and assumptions. Arthur D. Little (ADL) has played an important role in these external reviews, actually conducting four of the reviews and managing a fifth peer review that included experts from academia, industry, trade associations, and other non-government organizations. In addition to providing recommendations for revising the program impact estimates, ADL has worked with EERE's sectors to improve the analysis methodologies and the credibility of the assumptions underlying the impact estimates, as well as the trended performance measures. These efforts have resulted in a continual improvement in the quality of our program impact estimates.

This report details ADL's review of our program estimates for the Fiscal Year 2001 budget request. We would like to extend our thanks to ADL for conducting this year's external review. Their expertise and insights into the assumptions and methodologies underlying the program impact estimates have provided valuable information that is contributing to our continual effort to improve the credibility and quality of our performance measurements and program impact estimates.

David Leiter
Principal Deputy Assistant Secretary
Energy Efficiency & Renewable Energy
Department of Energy

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Introduction

The Government Performance and Results Act (GPRA) requires federal agencies to establish performance goals for their programs. Programs within the U.S. Department of Energy's (DOE) Office of Energy Efficiency and Renewable Energy (EERE) develop goals through a process referred to as the GPRA data call. EERE systematically develops and confirms in an annual GPRA process and data call, credible, quantitative goals, both near term and longer-term, for the performance and impact of its programs. The goal of the EERE GPRA process is to measure, manage, and improve program performance and meet GPRA requirements for strategic planning and annual performance plans and reports.

Approach

Arthur D. Little worked with DOE staff to review the estimates and assumptions for selected Planning Units within five sectors of EERE. The review process is an interactive, iterative process between the individual Planning Unit managers and Arthur D. Little experts, in each case leading to a consensus regarding the final submissions. Arthur D. Little evaluated two primary metrics for the FY2001 data call:

- The energy and carbon emissions savings of each technology projected for the years 2001 through 2030, which depend on estimates of market penetration, cost, and performance assumptions for each technology.
- The performance measurements of each Planning Unit, which include near-term goals and milestones for the next five years designed to achieve the market penetration, cost, and performance objectives underlying the energy savings metrics.

In addition to the above, Arthur D. Little focused on sector-level Performance Measures (PMs) as well as sector-level accomplishments. We provided feedback on whether DOE was measuring the most important things at the sector level and recommended other PMs when appropriate. For the sector accomplishments, we reviewed and commented on the cumulative benefits presented for the sector.

The discussions between Arthur D. Little and the Planning Units within EERE have resulted in agreement on revised program impact estimates and related performance measures for the Planning Units reviewed.

The 14 Planning Units reviewed for GPRA FY2001 include:

Office of Power Technologies (OPT)
- Hydrogen Research and Development
- Power System Integration – Transmission Reliability
- Solar Buildings
- Energy Storage Systems

Office of Industrial Technologies (OIT)
- Steel Vision
- Industrial Assessment Center
- Inventions & Innovations

Office of Building Technologies, State and Community Programs (BTS)
- Community Energy Program
- Technology Roadmaps and Competitive Research and Development
- Weatherization

Office of Transportation Technologies (OTT)
- Materials Technologies
- Technology Deployment
- Vehicle Technologies - Heavy Vehicle Systems

FEMP

The majority of the Planning Units were selected based on the following criteria:

- large expected energy savings
- large program visibility
- significant changes in a Planning Unit from previous year
- desire to review all Planning Units every four years

The following tables summarize the results of the GPRA FY2001 analysis. In general, Arthur D. Little has seen improvement in the credibility of the GPRA information while working with DOE on this effort since 1994. Arthur D. Little has worked with the DOE staff to develop credible estimates/assumptions impacting energy savings and emissions reduction estimates. Our overall findings are provided in Tables 1 through 10. Table 11 shows the final energy savings estimates for all of the EERE Planning Units.

Office of Power Technologies (OPT)

Table 1. OPT Sector Summary

OPT Sector Level PMs/Accomplishments
MAJOR FINDINGS FOR SECTOR LEVEL PM • The goal of tripling installed U.S. renewable generation capacity by 2010 is an appropriate Performance Measure (PM). • OPT needs to develop additional quantitative sector-level PMs that reflect more than one program and that reflect OPT goals that are not directly related to energy and emissions savings. **MAJOR FINDINGS FOR SECTOR ACCOMPLISHMENTS** • OPT did not develop sector-level accomplishments for the FY2001 GPRA submission. They will need to be developed for FY2002.

Table 2. OPT Planning Unit Summaries

Planning Unit							
Hydrogen Research and Development							
	Total Primary Energy Displaced (Trillion Btus)						
	2001	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Preliminary Draft	0	45	165	363	588	Not avail.	Not avail.
Final Submission	0	1	43	143	303	460	620
	MAJOR FINDINGS FOR QM • Market size estimates were initially too high and occurred too soon for the applications considered given current product status and the timing of planned demonstrations. • Fuel cell mini-grids require more detailed analysis to strengthen the rationale and the benefits calculation. **MAJOR FINDINGS FOR PLANNING UNIT PM** • OPT has presented several useful trended PMs that need to be added to the budget document. Several additional, complementary PMs may be beneficial. • The links between the QM, PM and Planned Accomplishments need to be strengthened within the GPRA documentation. • A single, self-contained GPRA document needs to be developed that includes QM, PM and Planned Accomplishments. This document would draw upon, and be consistent with, other Hydrogen program documentation. **DOE RESPONSES AND ACTIONS** • OPT has appropriately modified the FY2001 QM analysis, and has agreed to several other recommendations for future GPRA analyses. • OPT provided information showing the link between the PM, QM and Planned Accomplishments, and agreed that a self-contained GPRA document needs to be developed.						

Table 2. OPT Planning Unit Summaries (continued)

Planning Unit							
Power Systems Integration - Transmission Reliability							
	Total Primary Energy Displaced (Trillion Btus)						
	2001	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Preliminary Draft							
Trans. Reliability		119	124	129	132		
Distributed Power		41	89	150	207	250	290
Trans. Reliability		24	74	129	132	135	139
Distributed Power		41	89	150	207	240	286
Final Submission		65	163	279	339	375	425

MAJOR FINDINGS FOR QM

- Energy savings from Transmission Reliability come from reductions in spinning reserve in the United States. ADL supports the concept, but believes that savings in the early years are too optimistic and should be adjusted downward.
- Distributed Power produces savings by increasing the amount of renewable generation sources, and by decreasing energy losses in the T&D system. ADL supports these concepts, and believes that the stated savings are defendable, although possibly overstated. More detailed analysis is needed by OPT to refine these estimates.

MAJOR FINDINGS FOR PLANNING UNIT PM

- Energy savings and carbon displacement are inappropriate metrics for measuring the primary value of this program.
- Current PM are not graphable and are more appropriate as Planned Accomplishments.
- White Papers offer good insight into the Transmission Reliability issues currently faced by the US power industry.

DOE RESPONSES AND ACTIONS

- DOE has made the recommended changes to the QM estimates.

Table 2. OPT Planning Unit Summaries (continued)

Planning Unit							
Solar Buildings							
	Total Primary Energy Displaced (Trillion Btus)						
	2001	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Preliminary Draft		56	104	169	256	371	515
Final Submission		34	64	104	164	251	363

MAJOR FINDINGS FOR QM SDHW and SPH

- The GPRA analysis assumes the introduction of a low cost, polyethylene solar domestic hot water (SDHW) collector by 2005. Discussions with NREL, however, indicate that this type of collector is not likely to be introduced into the market until 2008 – 2010 given current funding levels.
- There was no economic analysis conducted for the market penetration of SDHW. The analysis took the annual installations of approximately 7,700/yr in 1998 and applied market growth rates. There was no convincing explanation in the original analysis that would justify the significant increases in market penetration prior to 2005.
- ADL suggests that the solar pool heating (SPH) analysis use a savings per pool heating system of 1,600 therms rather than 2,700 therms.
- A high level issue that needs to be addressed is whether the DOE program should be taking credit for solar pool heating savings when the primary focus of the program is SDHW.

MAJOR FINDINGS FOR PLANNING UNIT PM

- PMs are only shown for SDHW and not for SPH.
- A graphed PM is shown for $/kWh of projected delivered energy cost. A better and clearer metric might be the installed cost of a SDHW system and clear pathways of how these cost reductions will be achieved.
- A convincing story has not been presented as to how the PM shown for SDHW will achieve the QM energy saving targets.
- The PM cost reduction target for the period 2002 – 2006 is too aggressive. In addition, there should be annual targets shown for 2002, 2003, 2004, and 2005.

DOE RESPONSES AND ACTIONS

- DOE has agreed to the above adjustments.
- In FY00, Congress appropriated only $1.97 million of the $5.5 million DOE requested for SDHW development. DOE has requested $3.0 million for SDHW in the FY01 request (plus another $1.5 million for other solar R&D related to the zero energy building concept). The new low-cost technology could be introduced by 2005 if Congress were to fully fund the program.
- Although pool heating is not the focus of the program, it still maintains support of the solar pool industry. In addition, the pool heating industry is heavily involved in the program's low-cost SDHW activity, which devotes considerable effort to the use of polymers in the collector. Solar pool heaters are made of polymers, and the pool heating industry can be expected to benefit from the program's polymer R&D. The program should, therefore, be given credit for solar pool metrics.

Planning Unit	
Solar Buildings	
	• Pool heating is not the focus of the solar buildings program, so DOE felt the PM's should reflect the major effort in SDHW. • In future background analyses, DOE will ask that installed cost also be used as a graphed PM.

Table 2. OPT Planning Unit Summaries

Planning Unit					
Energy Storage Systems					
	2001	**2005**	**2010**	**2015**	**2020**
Preliminary Draft: Primary Energy Displaced	-	-	-	-	-
Final Submission: Primary Energy Displaced (Trillion Btus)		0.42	1	2.13	4
Preliminary Draft: Displaced Carbon from Integrating Renewables and Peak Shaving (MMTCE)	0.4	-	0.8	-	1.5
Final Submission: "Displaced Carbon from Integrating Renewables" (MMTCE)	0.01	0.01	0.018	0.037	0.072
Preliminary Draft: Non-Energy Cost Savings ($billions)	1.7	-	3.5	-	5.5
Final Submission: "Non-Energy Cost Savings from PQ and Peak Shaving" ($billions)	0.1	0.87	1.8	2.78	3.8

MAJOR FINDINGS FOR QM

- ADL and DOE agree that traditional GPRA metrics of energy savings and carbon displacement do not adequately convey the importance of the energy storage program.
- DOE estimates of carbon displacement include increased use of renewables, peak shaving, and a conversion of all non-energy cost savings (industry productivity) into carbon savings, based on a 4kWh/$GNP. ADL agrees that carbon displacement is achieved when storage is combined with renewables, but not through peak shaving. We also disagree with converting non-energy cost savings to carbon. ADL, therefore, recommends adjusting displaced carbon to reflect increased use of renewable energy only (photovoltaics specifically).
- DOE estimates of non-energy cost savings suggest that the ESS program will eliminate 1% of the power quality (PQ) problems affecting US industry by 2000. This number has been adjusted to more closely reflect the existing 12 storage systems in place. Year 2010 benefits have been adjusted to $1.8 billion (from $3.5 billion) based on a 1% (rather than 2%) improvement in PQ and 1% penetration of customer sited peak shaving applications. Year 2020 benefits now assume a 2% (rather than 3%) improvement in PQ and a 2% penetration of customer-sited peak shaving.

MAJOR FINDINGS FOR PLANNING UNIT PM

- PMs as currently stated reflect targets for FY2001 only. It is not clear from the available material that the PMs will help achieve cost and power density goals stated for 2003.

DOE RESPONSES AND ACTIONS

- DOE agrees with the ADL recommendations.

Office of Industrial Technologies (OIT)

Table 3. OIT Sector Summary

OIT Sector Level PMs/Accomplishments

MAJOR FINDINGS FOR SECTOR LEVEL PM

- **Industrial delivered energy intensity or energy intensity per unit output. The goal is a reduction of 25% from 1990 levels by 2010.**
    - A main issue for OIT is tracking of progress in energy reduction with calibration points during the period between Manufacturing Energy Consumption Survey (MECS) measurements, which occur every four years. OIT is collaborating with the Energy Information Administration (EIA) to develop methodologies to extrapolate energy consumption data during the period between MECS measurement years.
    - The sector level should also include a PM to track energy savings directly associated with program investment, in addition to the MECS-based numbers, which are based on total energy savings. The sector level acknowledges the limited scope of OIT's investment compared with that made by industry, and that a large part of the savings in energy intensity will be achieved by investment made by industry. It is recommended that the sector track the energy saved attributed to sector programs per investment dollar for use in overall internal planning, in addition to the overall numbers.
- **Btus of energy saved through the deployment of OIT-sponsored technologies and programs**
    - The key issue is tracking the OIT investment dollar portion of the benefit gained through the technology introductions and program implementations. Most of the Industry of the Future technology programs entail cost sharing and leveraging of industry efforts. The metric should indicate what that portion is. If the DOE activities are enabling or accelerating, it should highlight how this enabling/accelerating works.
- **Number of technologies successfully commercialized per year**
    - The current definition of "successfully" commercialized is one sale after prototype introduction. The definition of success should be standardized across Planning Units. "Successful" commercialization should be defined in terms of market share achieved. The measures of success should also include a dimension that incorporates energy savings, environmental benefit or productivity gains.
    - For the IOF technology introductions, a metric should be made to track which Planning Unit(s) has the greater success rate for technology introduction.
    - The assumption of using historical success rates to predict future introduction rates should be calibrated with yearly sales data.
    - In order to sustain the technology introductions, the overall sector program management will also have to manage the quality and quantity of programs "in the pipeline" on the path to commercialization. At the Planning Unit level, the use of milestones tied to go/no-go decision points will have to be increased to ensure that the limited amount of investment available is made in the most promising technology programs.

A general comment on the PMs is the weakness of PMs aimed at tracking success in environmental impact of sector program funds. ADL understands that there is some controversy over which environmental metric to use, whether CO_2 displaced, sulfur, or NO_x and how to calibrate it.

OIT Sector Level PMs/Accomplishments

PMs should also eventually be developed that track non-energy savings such as the improvement of labor and capital productivity and/or waste reduction, which is also in the mission statement of the OIT.

OIT Sector Level Accomplishments

	1999	**Cumulative through 1999**[1]
Primary Energy Displaced (quads)	0.176	1.64
Energy Savings ($ billions)[2]	0.87	4.39
Carbon Reduction (million metric tons)[3]	3.2	29.5

Notes:
1. The cumulative benefits for 1999 were obtained by extrapolating from 1997 PNL data using a growth rate of 10% for OIT Impact Book projects (IOF and IOF cross-cutting technologies). Cumulative benefits for the IAC program are based upon the benefits of 750 assessments per year (7-year duration of savings) and 140 graduated students per year. The Best Practices program begins in year 2000.
2. The energy savings in dollars are estimated using a 1997 fuel mix and the ADL emission factors for the fuels.
3. Carbon reduction is expressed as carbon equivalents.

MAJOR FINDINGS FOR SECTOR ACCOMPLISHMENTS
- In general, the accumulated energy benefits from the aggregate OIT programs are credible and the methodology is reasonable, representing 2% of projected total consumption of off-site produced energy for heat and power for IOF industries.
- The demonstrated impact of the OIT programs is promising in that OIT is leveraging industry efforts with the IOF program with cross-industry programs, such as the cross-cutting technologies and Best Practices programs. ADL agrees that the use of the Integrated Delivery program will hasten the introduction of OIT technologies and generated knowledge across the focused industries.
- Accomplishments should be as quantitative as possible, highlighting technical or market progress resulting from program activity, in addition to, or instead of, administrative accomplishments.
- The definition of technology commercialization should be standardized across planning units (in terms of a market share.) The growth rate used for benefits projections should be tied to the industry growth rates within each planning unit instead of a common growth rate across all of OIT.

DOE RESPONSES AND ACTIONS
- OIT sector level will have an environmental PM next year that will be derived from fuel use.

Table 4. OIT Planning Unit Summaries

Planning Unit						
Steel Industry Vision (Industries of the Future Specific)						
	Total Primary Energy Displaced (Trillion Btus)					
	2005	**2010**	**2015**	**2020**	**2025**	**2030**
Preliminary Draft	27	79	158	238	302	350
Final Submission	27	79	158	238	302	350

MAJOR FINDINGS FOR QM

- Overall the QM numbers for the steel industry are reasonable. The extrapolated savings for the steel industry are 0.35 quad of energy savings per year in 2030 (12% of projected fuel use for primary metals [projected growth of 2% per year]).
- Energy savings should be tied to activities in steel vision programs. The PM of reducing the unit energy use for steel manufacture is accomplished by a combination of industry efforts, steel vision programs, and other cross cutting programs. The steel team acknowledged that the percentage of actual savings derived directly from steel programs is a portion of the efforts to reduce MMBtu/ton of steel manufactured. The metrics should indicate what that portion is. If the DOE activities are enabling or accelerating, it should highlight how this enabling/accelerating works.
- The metrics should be expressed in terms of total absolute energy saved, not as a number relative to production (i.e., in MMBtus instead of MMBtu/ton). OIT/ADL have made a simple projection of US steel production based on consumption growth rates and typical production numbers for the past five years (zero growth, 100 MM ton/yr. Production). Import/export swings could not be taken into account, despite the fact that they could strongly impact annual fluctuations in production.

MAJOR FINDINGS FOR PLANNING UNIT PM

- The current PM in the Steel Vision program is energy consumption for manufacturing, MMBtu/ton steel. The goal for the industry vision roadmap is to reduce energy consumption from 18.5 MMBtu/ton in 1997 to 15 MMBtu/ton in 2010. It is important that the Btu/ton steel metric is used in the context of benefits derived from steel program efforts. It is understood that Steel Vision program efforts alone will not achieve the 3.5 MMBtu/ton reduction. It is important, however, to quantify the benefits that steel programs contribute to achieving the overall reduction.
- Another suitable metric could be cost of energy savings (capital and operating) per MMBtu saved for each of the program technologies. A metric of this type will help to rank programs in terms of cost effectiveness in reducing energy consumption for the steel industry.
- An important metric of interest to the steel industry is capital productivity. Programs that save energy also may have more impact in terms of capital productivity such as the use of nickel aluminide in rolls in a pre-heating furnace (longer run lengths in between roll change-outs). A metric for productivity could be defined in terms of a payback concept.
- Additional metrics of use could be the number of patents, patent applications,

Planning Unit	
Steel Industry Vision (Industries of the Future Specific)	
	and other general industry knowledge generated as a result of the steel programs. • Additional PMs should be formulated to address the environmental benefits of Steel Vision programs in the area of NO_x, C-emissions, metal waste generation, etc. • The planned accomplishments or milestones should be expanded so it is clearer what and when milestones have to meet the goal of reducing energy consumption to 15 MMBtu/ton. • The current steel industry portfolio contains technologies that could be leveraged across other industries, in particular the development of high temperature/severe condition sensor and controls, and improved lower CO_2, and low NO_x burner development. **DOE RESPONSES AND ACTIONS** • No action was required with respect to energy saving QM. The steel team is working on establishing additional PMs, and on linking energy savings more directly to DOE activities.

Table 4. OIT Planning Units Summaries (continued)

Planning Unit							
Industrial Assessment Centers (IAC)							
	Total Primary Energy Displaced (Trillion Btus)						
	2001	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Preliminary Draft	77	91	100	104	107	109	112
Final Submission	3	20	39	48	54	55	55

MAJOR FINDINGS FOR QM

- The preliminary QM results reflected the effect of a cumulative impact of students in the marketplace as a result of past year efforts. The resubmitted QM numbers reflect the changes detailed in the DOE response, mainly changing the impact of graduated students and revising the impact of replication effects.
- There is real value to training students in the IAC program, but attributing energy savings to student’s activities is difficult to quantify. ADL recommends that QM extrapolations be revised to reflect a smaller realized impact of student-derived savings. The energy impacts derived from audits can be calibrated; the effect of student efforts are not easily quantified. ADL recommends that the effect of graduated students, since it is not easily calibrated, be reduced further to a 7-10 year career impact to reflect an average time in a particular job function. ADL also recommends that a minimum participation level be defined in order to standardize the definition of a “graduated student” from the IAC program.

Planning Unit	
Industrial Assessment Centers (IAC)	
	MAJOR FINDINGS FOR PLANNING UNIT PM • The PM of energy cost savings from audits should be augmented with follow-up interviews with plant participants to provide a calibration point on actual savings incurred. This would also provide a possible check on intra-company replication rates. The energy cost savings should also be supplemented with the equivalent savings in Btus to decouple the effects of fuel price fluctuations. • The use of a non-energy savings performance metric is appropriate. If possible, it would be useful to specify the waste savings from the productivity savings. • The number of audits is a reasonable metric. • The focus of audits in the past has been on operational issues, so-called "low hanging fruit". ADL recommends that the focus be placed on more long term savings so that energy and productivity savings can be replicated in subsequent audits. There is a concern as to how many times an audit can realize savings if only "low hanging fruit" options are recommended. • Additional emphasis should be placed on identifying investment options for future retrofit opportunities (both for energy and productivity savings and waste minimization). Through the post-audit interview program, recommendations could be tracked for implementation information. The post-interview program could also be used to track the implementation of state-of-the-art technologies in industry. For example, data on the convergence of technologies (time it takes until "a large fraction" is using a particular energy or productivity saving technology) could be useful for technology introduction projections across OIT programs. • The student's trained metric should be made with a defined minimum participation level to avoid multiple counting of students. • Discussions with the IAC program mention the presence of "stars" of the program who have since founded firms that specialize in audit activities. The number and effect of such firms could be a PM. • There is a question about including the energy effects due to information disseminated via the internet and other electronic media. The IAC program has set up a web site that includes manuals on the use of databases that document historical audit results and self-audit manuals and other energy savings documents. It is difficult to attribute and verify possible energy savings gained from electronic media. • The use of the database of past audit recommendations and results should be linked to IOF program developments where feasible. The database could be rationalized by industry segment, highlighting past recommendations that resulted in significant energy and productivity savings. • ADL recommends that energy savings and productivity gains that are viewed as cross-cutting be identified for possible inclusion in Best Practices demonstrations. **DOE RESPONSES AND ACTIONS** • The resubmitted QM numbers reflect the following assumption changes: ➢ The extrapolated energy savings are a summation of original plant audit savings, plant replication effects, and secondary effects of graduated

Planning Unit	
Industrial Assessment Centers (IAC)	
	students in industry. A place holder for derived savings from web site information was made at 0.5 trillion Btus in 2000 and increased to 1 trillion Btus in 2001. ➢ The estimated savings for a plant audit are based on historical data (16 years of experience) incorporating savings from energy savings, productivity gains, and waste reduction. The historical savings from an audit should be updated as data becomes available. ➢ Savings from student alumni were reduced. Initially the student alumni estimates were for the number of students participating in the program (student-years of participation), which did not take into account a student's participation for more than one year (resulting in double counting of students). The impact for student alumni was taken as 25% of the graduating year students having an impact equivalent to 2 audits worth of energy savings per year for a 15 year career impact (from 25 year career with ½ audit savings per year). ➢ Intra-company replication effects were scaled back to provide additional energy savings of 30% from the previous value of 80% additional savings. ADL feels the assumptions for audit savings are reasonable, but should be calibrated with data (see performance metric notes). ➢ Savings continue for 7 years.

Table 4. OIT Planning Unit Summaries (continued)

Planning Unit							
Inventions & Innovations (I&I) (Industries of the Future Cross Cutting)							
	Total Primary Energy Displaced (Trillion Btus)						
	2001	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Preliminary Draft	111	103	107	117	117	117	117
Final Submission	0	3	43	108	108	108	108
	MAJOR FINDINGS FOR QM • The preliminary QM results reflected the effect of a cumulative impact of total number of program sponsored inventions in the marketplace as a result of past year funding. The resubmitted QM numbers reflect the impact of inventions of the "class of 2001" funding, a "sliced" QM. • ADL thinks it is reasonable that a "sliced" single year savings QM be used in order for the savings from I&I programs to be compared with other DOE program efforts on a yearly basis. • The extrapolated energy savings for the I&I program assumes that 25% of those inventions receiving funding ultimately are commercialized. The 25% success rate was based on historical data. ADL questions whether the historical success rate of 25% will be translated into the future where emphasis is placed more on inventions resulting in energy savings and focused on applications in the industries of the future programs. • The definition of commercially "successful" was one sale in addition to a sale of						

Planning Unit	
Inventions & Innovations (I&I) (Industries of the Future Cross Cutting)	
	a prototype. ADL recommends that "successful" commercialization also be defined in terms of market share achieved. • In the past, the I&I program did not necessarily involve programs that resulted in energy savings. The new focus on energy savings in the proposal evaluation criteria and emphasis on the energy-intensive industry of the future program will probably result in more energy savings than achieved in the past. **MAJOR FINDINGS FOR PLANNING UNIT PM** • A PM in use is to track the cumulative number of inventions that were supported currently in the marketplace. ADL recommends that this be supplemented with a metric that tracks "slices" of program years, such as 1997-2001 program awardees. • The Planning Unit also uses annual energy cost savings from I&I inventions in the marketplace. ADL recommends that the actual Btus saved be tracked in order to decouple the effect of energy cost fluctuations. • ADL recommends that the definition of "successful" include a dimension that reflects the cost effectiveness of energy reduction and/or productivity gains, and market share or number of installations. • The I&I program should also track the number of proposals received and the number of proposals that were "suitable" for funding and did not receive funding due to unavailability. By tracking "suitable" proposals in addition to proposals awarded, the program management could track the success of the program in fostering an increasing number of potential inventions that could be commercialized. • It is recommended that a PM be used that also tracks the capital efficiency of the programs in achieving energy savings. A suitable metric could be dollars invested per trillion Btus saved. • A metric should be instituted that measures productivity gains that do not necessarily translate into energy savings. One metric could be yield improvements for feedstock use, for example. • A program management tool to track the success rate of programs could be to track patent applications and the generation of intellectual property. **DOE RESPONSES AND ACTIONS** • DOE resubmitted the QM numbers to reflect the energy savings as a result of technologies commercialized for the budget year only.

Office of Building Technology, State and Community Programs (BTS)

Table 5. BTS Sector Summary

Sector Level PMs/Accomplishments

MAJOR FINDINGS FOR SECTOR LEVEL PM

- BTS has developed PM for residential buildings, commercial buildings, and equipment, incorporating all programs.
- The baseline could be more clearly stated by saying that the energy savings are being measured from the beginning of the year 2001 and include savings generated from BTS programs and technologies funded since FY2001.
- The sample of technologies used in developing the PMs needs to be stated.
- Additional measures need to be developed, including:
  - Technologies commercialized or square footage retrofitted
  - Energy consumption/intensity in commercial and residential buildings
  - Emissions avoided

BTS Sector Level Accomplishments

	1999	Cumulative through 1999
Primary Energy Displaced (quads)	2.1	12.6
Energy Savings	$15.2	$90.6
Carbon Reduction (million metric tons)	33.8	201.3

MAJOR FINDINGS FOR SECTOR ACCOMPLISHMENTS

- Discussion is needed to explain the difference between sector accomplishments and the QM submission. Sector accomplishments represent benefits prior to FY2001 and beyond. QM includes only benefits from FY2001 and beyond.

Table 6. BTS Planning Unit Summaries

Planning Unit							
Community Energy Program							
	Total Primary Energy Displaced (Trillion Btus)						
	2001	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Preliminary Draft	23	126	333	549	664	788	905
Final Submission	21	113	293	478	575	686	794

MAJOR FINDINGS FOR QM

- Overall, the DOE/BTS numbers seem reasonable. Decreases from the preliminary draft to the final submission represent decreases in the level of funding for this Planning Unit.
- Savings are a combination of various programs.
- The market penetrations assumed for the various programs appear to be reasonable.
- For competitively selected community projects, ADL suggests basing savings on the project applicant claims.
- More work is needed to support information outreach. ADL suggests viewing this program as a necessary overhead, and attributing a percentage of savings from other programs to this activity.
- For codes training and assistance, more documentation is needed to support the assumptions behind the analysis. Specifically, more documentation is needed to support the long-term impact of DOE's assistance to code activities, as well as the potential available market impact.

MAJOR FINDINGS FOR PLANNING UNIT PM

- Additional milestones should be added to verify the energy savings projected. Also, some consideration should be given to the costs to achieve each milestone. Additional information is recommended, including:
  - Number of new residential homes being built to Building America standards
  - Number of square feet retrofitted under Rebuild America (680 million sq. ft. through 2001)
  - Cost of achieving the energy savings associated with upgraded/improved residential and commercial buildings
  - States adopting ASHRAE/IESNA Standard 90.1 (BTS will assist 14 states)
  - States updating their residential energy code to meet the 1999 International Energy Conservation Code (BTS will assist 10 states)
- These additional PM would support and enhance BTS's discussion relating to the benefits of the Community Energy Program.
- While the stated PM are reasonable considering the goals of each of the programs, greater consideration needs to be given by BTS in connecting the QM energy savings calculations to the PM.

DOE RESPONSES AND ACTIONS

- DOE agrees with ADL's findings.

Table 6. BTS Planning Unit Summaries (continued)

Planning Unit							
Technology Roadmaps and Competitive Research and Development							
	Total Primary Energy Displaced (Trillion Btus)						
	2001	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Preliminary Draft	7	32	59	87	110	137	165
Final Submission	10	47	88	128	162	202	243

MAJOR FINDINGS FOR QM

- Overall, the DOE/BTS numbers seem reasonable. Increases from the preliminary draft to the final submission represent increases in the level of funding for this Planning Unit.
- The majority of funding is used to fund research and development through competitive procurement. Since this is the first year, estimates were developed using the average Btu/$ for other BTS programs. Now that awards have been made, BTS will be able to calculate the benefits attributable to the projects for FY2002.

MAJOR FINDINGS FOR PLANNING UNIT PM

- Additional milestones should be added to verify the energy savings achieved. Also, some consideration should be given to including the costs to achieve each milestone. Additional information is recommended, including:
  - Technology Roadmaps published
  - Savings expected in Btu/$ invested
  - Additional technologies commercialized due to adoption of the Technology Roadmaps and Competitive Research and Development
  - Increased market acceptance of BTS technologies due to adoption of Technology Roadmaps and Competitive Research and Development
- These additional PM would support and enhance BTS's discussion relating to the benefits of Technology Roadmaps and Competitive Research and Development.
- While the stated PM are reasonable considering the goals of each of the programs, greater consideration needs to be given by BTS in connecting the QM energy savings calculations to the PM.

DOE RESPONSES AND ACTIONS

- DOE agrees with ADL's findings.

Table 6. BTS Planning Unit Summaries (continued)

Planning Unit							
Weatherization							
	Total Primary Energy Displaced (Trillion Btus)						
	2001	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Preliminary Draft	9	44	85	122	117	117	117
Final Submission	6	32	63	93	92	92	92

MAJOR FINDINGS FOR QM

- Overall, the DOE/BTS numbers seem reasonable. Decreases from the preliminary draft to the final submission represent decreases in the level of funding for this Planning Unit.

MAJOR FINDINGS FOR PLANNING UNIT PM

- Additional milestones should be added to verify the energy savings achieved. Also, some consideration should given to including the costs to achieve each milestone. Additional information is recommended, including:
  - Number of homes/year weatherized (67,330 homes in 1999)
  - Consumer savings attributable to the Weatherization Program ($200/yr)
  - Cost/year to achieve savings in weatherized homes
  - Additional resources identified to leverage federal funding for Weatherization
  - Technologies successfully deployed in the Weatherization Program
- These additional PM would support and enhance BTS's discussion relating to the benefits of the Weatherization Program

DOE RESPONSES AND ACTIONS

- DOE agrees with ADL's findings.

Office of Transportation Technologies (OTT)

Table 7. OTT Sector Summary

OTT Sector Level PMs/Accomplishments

MAJOR FINDINGS FOR SECTOR LEVEL PM

- No explicit sector-level Performance Measures were defined. OTT and ADL are working to define appropriate sector-level PMs.
- Fleet-wide PMs are somewhat difficult to define since the key indices of fleet-average emissions and fuel economy are driven by regulations. Automakers are expected to meet, but not exceed these regulations.
- Sector-level PMs should therefore focus on the new vehicle fleet and on measures that are relatively independent of government standards.

OTT Sector Level Accomplishments

	1999	Cumulative through 1999
Primary Energy Displaced (quads)	0.6	3.3
Energy Cost Savings ($ billions)	$3.7	$26.4
Carbon Reduction (million metric tons)	8.9	65.3

MAJOR FINDINGS FOR SECTOR ACCOMPLISHMENTS

- The cumulative benefits presented for the Sector are plausible and reasonable. No changes have been suggested.

Table 8. OTT Planning Unit Summaries

Planning Unit

Materials Technology

	Total Primary Energy Displaced (Trillion Btus)						
	2001	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Preliminary Draft	0**	2	11	29	53	Not avail.	Not avail.
Final Submission	0**	1	9	24	43	64	80
	Total Primary Oil Displaced (Trillion Btus)						
Preliminary Draft	0**	2	14	36	62	Not avail.	Not avail.
Final Submission	0**	2	12	29	49	70	85

****** Data for 2000

MAJOR FINDINGS FOR QM

- The OTT analysis is based on reasonable methodologies and assumptions.
- The relationship between fuel economy and gross vehicle weight used by OTT is somewhat conservative with respect to other published data, which leads to a conservative estimate of this program's impact.
- The projections assume that the benefits of the Materials Technology program will only be realized in alternative vehicles (i.e., electric, hybrid, and fuel cell vehicles). This assumption is also somewhat conservative, but fundamentally sound.

Planning Unit	
Materials Technology	
	MAJOR FINDINGS FOR PLANNING UNIT PM • Definition of independent PM for the Propulsion Materials Program is not practical. However, the Planned Accomplishments for the program follow a logical and realistic timeline, which supports the achievement of the more general PM for Vehicle Technologies R&D. • The PM for the Lightweight Materials Program (number of lightweight material vehicles on the road, and cost of carbon fiber and aluminum sheet) provide useful measures for assessing the success of the program. • Since manufacturing costs are also an integral part of the Lightweight Materials Program and ultimately impact consumer vehicle choice, an additional PM related to both the material and manufacturing costs is recommended. **DOE RESPONSES AND ACTIONS** • All issues and suggestions have been discussed with and agreed to by OTT staff. They are now working to address the recommendations.

Table 8. OTT Planning Unit Summaries (continued)

Planning Unit							
Technology Deployment[1]							
	Total Primary Energy Displaced (Trillion Btus)						
	2001	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Preliminary Draft	0	0	0	0	0	0	0
Final Submission	0	0	0	0	0	0	0
	Total Primary Oil Displaced (Trillion Btus)						
Preliminary Draft	70**	272	394	449	450	Not avail.	Not avail.
Final Submission	70**	278	414	484	498	502	509
** Data for 2000	**MAJOR FINDINGS FOR QM** • OTT needs to review the various aspects of the DOE/EIA EPAct fleet projections, which form part of the Technology Deployment QM. Specifically, OTT needs to ensure that the near-term projections for alternative fuel use (e.g., fuel mix, market size) are consistent with current conditions and trends. • QM estimates of private use of CNG vehicles appears reasonable. **MAJOR FINDINGS FOR PLANNING UNIT PM** • OTT needs to develop appropriate trended PMs for Technology Deployment as a whole. • Programs appear to cover the range of necessary activities to meet QM targets, but OTT should clarify the linkages between the various activities within Technology Deployment. • Additional detail is needed in some areas for the Planned Accomplishments						

1 This planning unit is not expected to reduce energy consumption, but rather to displace petroleum. Thus, this second metric has been reported here.

	DOE RESPONSES AND ACTIONS • All issues and suggestions have been discussed with and agreed to by OTT staff. They are now working to address the recommendations.

Table 8. OTT Planning Unit Summaries (continued)

Planning Unit							
Vehicle Technologies - Heavy Vehicle Systems							
	Total Primary Energy Displaced (Trillion Btus)*						
	2001	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Preliminary Draft[a]	7**	69	186	275	358	Not avail.	Not avail.
Final Submission	9**	75	229	351	451	Not avail.	Not avail.
	Total Primary Oil Displaced (Trillion Btus)*						
Preliminary Draft[a]	9**	71	187	276	358	Not avail.	Not avail.
Final Submission	9**	75	229	351	451	Not avail.	Not avail.
** Data for 2000 *** Includes benefits from research performed in the advanced combustion, light truck CIDI R&D program	**MAJOR FINDINGS FOR QM** • The projected QMs associated with Heavy Vehicle Systems R&D program represent a plausible progression and are consistent with the achievement of the goals of this program. • For next year, OTT needs to define a consistent policy for how to allocate benefits from research performed as part of the Advanced Heavy Duty Diesel Engine R&D Program. **MAJOR FINDINGS FOR PLANNING UNIT PM** • OTT has defined three effective and suitable PM for tracking progress: (1) increased efficiency of Heavy Duty Diesel Engines, (2) market penetration of advanced diesel technology, and (3) aerodynamic reduction of drag. • The defined PMs need to be complemented to cover all key aspects of achieving the overall program goal. Specifically, there is no explicit PM addressing the cost-effective reduction of rolling resistance. • ADL recommends the use of additional PMs to address the cost-effectiveness of new technologies. **DOE RESPONSES AND ACTIONS** • All issues and suggestions have been discussed with and agreed to by OTT staff. They are now working to address the recommendations.						

Federal Energy Management Program (FEMP)

Table 9. FEMP Sector Summary

FEMP Sector Level PMs/Accomplishments

MAJOR FINDINGS FOR SECTOR LEVEL PM

- FEMP has developed several useful trended PMs that are consistent with the QM analysis. ADL believes they are sufficient for tracking the overall progress of FEMP.
- FEMP is developing additional PMs to track its new responsibilities in renewable energy use and agency reporting.
- FEMP should increase the use of graphs and tables to display its PMs.

FEMP Sector Level Accomplishments

	1999	Cumulative through 1999
Primary Energy Displaced (quads)	0.1	0.4
Energy Cost Savings ($ billions)	$0.2	$1.2
Carbon Reduction (million metric tons)	1.3	8.1

MAJOR FINDINGS FOR SECTOR ACCOMPLISHMENTS

- FEMP sector-level accomplishments to date are consistent with historical changes in federal energy use and appear reasonable.

Table 10. FEMP Planning Unit Summary

Planning Unit

FEMP (all programs)

	Total Primary Energy Displaced (Trillion Btus)						
	2001	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Preliminary Draft	26	53	67	68	67	67	68
Final Submission	26	53	67	68	67	67	68

MAJOR FINDINGS FOR QM

- QM estimates are reasonable and no changes are needed.
- Slight discrepancies were found between the information contained within FY2001 Draft OBM Budget Request and the latest QM analysis provided by PNNL staff.
- After appropriate PMs are developed, future QM analyses should include the impacts of renewable energy use in Federal buildings.

MAJOR FINDINGS FOR PLANNING UNIT PM

- FEMP has developed several useful trended PMs that are consistent with the QM analysis. ADL believes they are sufficient for tracking the overall progress of FEMP.
- FEMP is developing additional PMs to track its new responsibilities in renewable energy use and agency reporting.
- FEMP should increase the use of graphs and tables to describe its PMs.
- FEMP should develop appropriate Planned Accomplishments for the period FY2002 – 2005.

DOE RESPONSES AND ACTIONS

- All issues have been discussed with FEMP and they agree with ADL's recommendations. FEMP is implementing the recommendations.

Table 11. Final Planning Unit Submissions

Sector/Planning Unit	Total Primary Energy Displaced (Trillion Btus)		
	2005	2010	2020
BTS			
Commercial Buildings Integration	8	42	159
Community Energy Program	113	293	575
Energy Star	92	219	279
Equipment, Materials & Tools	177	532	1,236
Residential Buildings Integration	3	20	110
State Energy Program	27	51	97
Technology Roadmaps and Competitive R&D	47	88	162
Weatherization Assistance Program	32	63	92
OIT			
Advanced Industrial Materials (AIM)	7	22	86
Agriculture Vision	1	4	45
Aluminum Vision	16	40	148
Best Practices	79	163	336
CFCCs/Engineered Ceramics	21	58	153
Chemicals Vision	81	196	876
Distributed Generation	86	163	541
Forest & Paper Products Vision	111	259	1,510
Glass Vision	24	43	77
Industrial Assessment Centers (IAC)	20	39	54
Inventions & Innovations	3	43	108
Metals Casting Vision	10	25	96
Mining Vision	3	9	39
NICE-3	1	16	98
Petroleum Refining Vision	74	206	417
Sensors and Controls	2	2	5
Steel Vision	27	79	238
OPT			
Biomass Power R&D	186	503	826
Competitive Solicitation	3	3	3
Concentrating Solar Power	3	12	43
Energy Storage	0	1	4
Geothermal Energy R&D	23	94	307
High Temperature Superconductivity	5	85	343
Hydrogen	1	43	303
Photovoltaic Systems R&D	6	21	98
Solar Buildings	34	64	164
Transmission Reliability	65	164	339
Transmission Reliability	*24*	*74*	*132*
Distributed Power	*41*	*89*	*207*
Wind Energy R&D	246	585	1,231
OTT			
Biofuels	23	182	683
Fuel Utilization (1)	0	0	0
Materials Technology	1	9	43
Technology Deployment (2)	0	0	0
Vehicle Technologies	154	742	1,768
FEMP	53	67	67

(1) Benefits for Fuels Utilization are included in the benefits for Vehicle Technologies
(2) There is no net energy displaced for OTT Technology Deployment because petroleum based fuels are being replaced by alternative fuels. However, since the alternative fuels are less costly and produce less carbon, there are energy cost savings and carbon reduction.

Appendix D

Integrated Modeling Report for GPRA 2001

Integrated Modeling for GPRA 2001

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OVERVIEW

We have conducted an integrated assessment of the impact of the Office of Energy Efficiency and Renewable Energy (EE) programs as part of EE's GPRA analysis. The purpose of this assessment is to analyze the impact of successful EE programs in a consistent economic framework and to account for the interactive effects among the various programs. Each of the sector offices performs an independent estimate of the savings for their programs, but these cannot be simply summed to create a value for all of EE. There will be feedback and interactive effects resulting from (1) changes in energy prices resulting from lower energy consumption, (2) the interaction between OPT programs affecting the mix of generation sources and the end-use sector programs affecting the demand for electricity, and (3) additional savings from reduced energy production and delivery.

The National Energy Modeling System (NEMS) was used again this year as the integrated model. The Annual Energy Outlook 1999 (AEO99) version was used as the starting point. We then made several changes to the model to enhance its ability to represent the EE programs. The most significant changes were the addition of an endogenous building shell efficiency component and the inclusion of the Energy Information Administration's (EIA's) preliminary distributed generation and biomass cofiring structures. We made significant parametric changes in some sectors, for example the behavioral assumptions for modeling alternative technology vehicles and various parameters affecting the expansion of renewable capacity in the electricity sector. The modified version of the model is referred to as NEMS-GPRA01.

The No EE Case

The baseline forecast, called the No EE Case, is a projection meant to represent the future U.S. energy system without the effect of continued EE programs. The idea is to remove any effects of EE programs that are already included in the AEO99 Reference Case in order to avoid double counting energy consumption reductions. As recommended by the various EE sector offices, we made the following modifications for the No EE Case. For the transportation sector, we assumed that no advanced gasoline vehicles and no alternative fuel vehicles would be purchased except those mandated in California. Similarly, in the utility sector, we assumed that there would be no new renewable capacity constructed except as part of state set-asides as represented in the AEO99. As will be discussed in the buildings section, the No EE Case includes the modified shell efficiency structure and assumes that part of the shell efficiency improvement in the Residential sector in the AEO99 is attributable to EE programs. No changes were made to the industrial sector for the No EE Case. See Appendix A for the No EE Case projected energy consumption by sector and fuel.

Representation of EE Programs

After the No EE Case was established, the EE programs were represented in the various NEMS-GPRA01 modules. Each sector was treated separately to derive estimated energy savings without the interaction of the other sectors' programs[1]. We received the inputs for the programs from the sector offices and their contractors. To the maximum extent possible, we represented the programs through their impacts on technology characteristics and allowed NEMS-GPRA01 to project the market penetration and savings resulting from their development. In some cases, where the model

[1] The modeling of the individual demand models was done using PC stand-alone versions of the module that speed the run time and facilitate data changes.

had insufficient technology representation or the programs were of a market deployment rather than R&D nature, we based our projections on the program office penetration estimates and simply used NEMS-GPRA01 as an accounting tool. A major exception is the treatment of the industrial sector. The OIT programs and technologies are very specialized and beyond the capability of the model to represent. For this sector we simply input estimated energy savings.

Energy savings were estimated at the planning unit level for each sector, except for industry. In this step, the primary savings for electricity were computed using the marginal heat rates supplied in the GPRA Data Call. The use of these heat rates makes the savings directly comparable to the sectors' estimates. The integration with electricity is kept separate and is introduced as part of the integration effect. Preliminary comparison tables were shared with EE, and minor modeling adjustments were made based on their comments. The revised tables are shown in the sector descriptions below.

The full NEMS-GPRA01 model was then run for each of the sector office programs individually. In these scenarios the energy savings include the effect that a single sector's programs have on fuel consumption in the other sectors. For example, reductions in energy usage generally lead to lower energy prices, which may stimulate additional demand, both in the sector that is being analyzed and in all other sectors. The primary energy associated with reduced electricity generation is calculated endogenously within the electricity module. In addition, reductions in oil and gas use affect the energy required for oil and gas production, petroleum refining, and pipeline gas consumption.

Lastly, the full integrated model was run with all programs in all sectors to derive the Full EE Case. The total primary energy savings (fossil and nuclear savings because renewables are not included), carbon savings, and energy expenditures were then allocated to the individual sectors. Because the total savings were not equal to the sum of the individual sectors, they were allocated to the sectors based on the single-sector integrated savings estimates. In the individual sector tables, the "integrated effect" reported is the difference between the stand-alone results (no price or other feedback) and the scaled totals for the Full EE Case.

Integrated Modeling Projected Savings

Table 1 shows the final aggregate results for primary energy and Table 2 shows the carbon emission reductions. The EE sector office results, shown for comparison purposes, are their updated values that were available in early January 2000. The integrated energy savings vary from 50 percent to over 100 percent of the sector estimates, for an average of 73 percent in 2020. Greater detail for each sector is presented in the sections following. The level of projected carbon emission savings relative to energy savings is similar in the integrated model compared to the sector estimates. The model output for the Full EE Case can be found in Appendix B.

Table 1: Total Non-Renewable Energy Savings Projections (Quadrillion Btu/Year)										
Year	**BTS**		**OIT**		**OTT**		**OPT**		**Totals**	
	Intgtd. Results	**Sector Results**	**Intgtd. Results**	**Sector Results**	**Intgtd. Results**	**Sector Results**	**Intgtd. Results**	**Sector Results**	**Intgtd. Results**	**Sector Results**
2005	0.57	0.50	0.60	0.57	0.28	0.18	0.22	0.57	1.67	1.82
2010	1.02	1.31	1.49	1.37	1.01	0.93	0.74	1.58	4.27	5.19
2020	1.87	2.71	3.76	4.83	2.49	2.49	1.93	3.66	10.05	13.69

Table 2: Total Carbon Equivalent Emissions Savings (Million Metric Tons of Carbon/Year)										
Year	**BTS**		**OIT**		**OTT**		**OPT**		**Totals**	
	Intgtd. Results	**Sector Results**	**Intgtd. Results**	**Sector Results**	**Intgtd. Results**	**Sector Results**	**Intgtd. Results**	**Sector Results**	**Intgtd. Results**	**Sector Results**
2005	11.2	9.2	11.9	10.3	3.8	4.6	2.0	11.7	28.9	35.7
2010	17.1	23.0	26.0	26.7	17.9	19.5	12.1	32.1	73.1	101.4
2020	34.4	47.4	65.3	99.8	46.0	50.1	35.0	75.5	180.8	272.8

Tables 3 and 4 show the energy expenditure reductions by sector from two perspectives. In Table 3 the energy expenditures are computed for each sector in isolation without any effects due to changing energy prices. In other words, the expenditure savings are just a function of each sector's change in energy consumption. This is comparable to the estimates produced by the sector offices.

For OPT the reduction in expenditures is measured as the product of the delivered electricity prices and end-use electricity demands, rather than the fuel savings for the electric generators themselves, which is the methodology used by the OPT office. The consumer perspective is taken here, so that the expenditure savings can be added to the other sectors' savings for a view of the total economy savings. The expenditure savings are relatively high in the 2005 because much of the OPT energy savings are from exogenously specified green power renewable capacity additions, and the model lacks the cost accounting associated with the capital costs for these plants. In those regions where prices are regulated and based on cost-of-service, the capital investment required for these plants should be reflected in the delivered electricity prices, but is not. Furthermore, investment for other new construction is displaced, so the total capital cost is lower than the No EE Case. Even in regions with competitive marginal cost pricing, the higher costs of green power should be paid by consumers, which the current model does not incorporate. In later years of the forecast more of OPT savings are from model derived new renewable capacity. The regulated price of electricity reflects the offsetting effects of reduced fuel costs but higher capital costs.

Table 4 displays the expenditure savings when computed on an integrated basis. Here the changes in energy prices as well as energy quantities are included, and the sum of the sector savings equals the integrated expenditure savings for the whole economy. The savings here are significantly larger than the stand-alone savings. A small change in energy prices that results from reduced consumption or improved technology produces a large savings when applied to all the energy consumed in the economy.

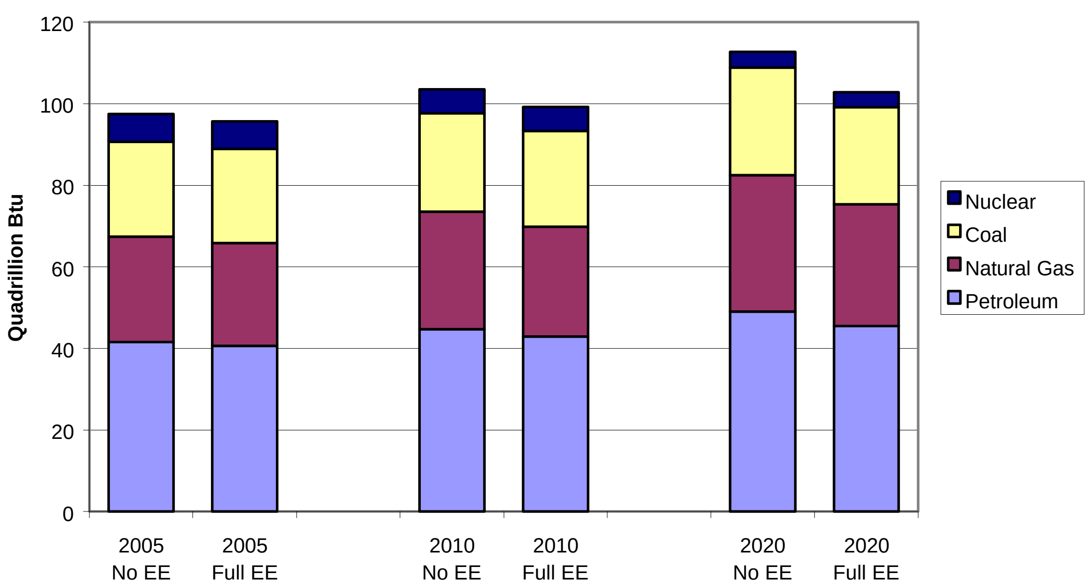
Table 3: Total Sector Only Energy Expenditure Savings (Billion 1997 Dollars/Year)										
Year	**BTS**		**OIT**		**OTT**		**OPT**		**Totals**	
	Stand-Alone Results	**Sector Results**	**Stand-Alone Results**	**Sector Results**	**Stand-Alone Results**	**Sector Results**	**Stand-Alone Results**	**Sector Results**	**Stand-Alone Results**	**Sector Results**
2005	3.8	3.8	2.2	2.1	3.3	1.7	2.2	1.2	11.5	8.8
2010	8.4	10.3	6.8	5.5	9.9	8.4	5.0	3.2	30.1	27.5
2020	15.0	21.7	17.3	19.3	22.6	20.1	6.4	7.4	61.3	68.6

Table 4: Total Integrated Energy Expenditure Savings (Billion 1997 Dollars/Year)										
Year	**BTS**		**OIT**		**OTT**		**OPT**		**Totals**	
	Intgtd. Results	**Sector Results**	**Intgtd. Results**	**Sector Results**	**Intgtd. Results**	**Sector Results**	**Intgtd. Results**	**Sector Results**	**Intgtd. Results**	**Sector Results**
2005	4.7	3.8	4.1	2.1	5.7	1.7	1.1	1.2	15.6	8.8
2010	9.5	10.3	12.6	5.5	21.6	8.4	4.2	3.2	48.0	27.5
2020	19.5	21.7	32.1	19.3	33.4	20.1	11.4	7.4	96.4	68.6

Figure 1 illustrates the projected primary non-renewable energy consumption under the two scenarios. The savings in 2020 represent 9 percent of the projected base consumption.

Figure 1

Primary Non-Renewable Energy Consumption



BUILDINGS SECTOR

Modifications in NEMS-GPRA01

Many programs of the Office of Building Technology, State, and Community Programs (BTS) affect the shell efficiency of buildings, so it is important to have a mechanism for representing shell technologies in the NEMS-GPRA01 building modules. The AEO99 version of the model represents the shell efficiencies through user defined indices which are then adjusted based on energy prices. Last year, we created a new structure that performs an economic comparison of various shell technology measures and have incorporated it into this year's version of NEMS-GPRA01. The BTS envelope technologies can be represented directly in the model and the adoption rates endogenously determined. We have also incorporated EIA's preliminary structure for distributed generation for the residential and commercial modules, which includes a representation of fuel cells and photovoltaics.

The No EE Case

In the No EE Case, as in the AEO99, most delivered energy prices are projected to increase only slightly or to decline. As a result, very little shell improvements are projected based on price. The residential sector autonomous shell improvement parameters that lead to improved shell efficiencies in the AEO99 were incorporated in the No EE Case. However, these parameters were reduced to reflect the assumption that part of the AEO99 shell improvements are due to BTS energy efficiency programs. Additionally, a few equipment technologies were introduced and modified. The new technologies were introduced so that they would exist as a technology choice for the BTS programs and standards when modeled. The modified technologies were changed so that they could be more realistically compared to the BTS technologies. In addition, we added a residential electric water heater standard, which was not included in the AEO99, because it had already been funded and its savings are not be included in the GPRA 2001. Overall, the equipment additions and modifications had minimal affect on the No EE case.

Representation of the BTS Programs

The Pacific Northwest National Laboratory (PNNL) provided the data for the planning units. For most equipment technologies, we received actual NEMS data inputs. Most of the BTS planning units were represented in the residential and the commercial NEMS-GPRA01 modules by changing the cost and/or efficiency characteristics of equipment or shell technologies. Programs with no incremental costs, such as many of the components of the Community Energy Program, cannot be modeled as a technology choice. For these programs we performed an off-line analysis based on the BTS penetration rates to compute a target savings. These savings were achieved in NEMS-GPRA01 by lowering the consumer hurdle rates for the appropriate end-uses or by modifying the autonomous shell efficiency indices.

There are two planning units, State Grants and Technology Roadmaps, which we did not model directly because they are general programs not tied to specific technologies or end-uses. In addition, there is insufficient technology representation to include the distributed transformer standard and the commercial refrigeration program from the Equipment, Materials & Tools planning unit. Therefore, we added a computation within the model to include the savings from these programs, but reduced the BTS estimates[2] using the ratio of the NEMS-GPRA01 savings to the BTS savings for the programs that were modeled explicitly. The combined additional primary energy savings added to the model to represent these programs are 0.09 quads in 2005, 0.16 quads in 2010, and 0.24 quads in 2020.

Model Scenarios and Results

A scenario was run for each planning unit individually using only the Residential and Commercial modules without the other NEMS-GPRA01 modules. For this computation of savings, delivered electricity was converted to primary using the GPRA Data Call values in order to make the results comparable to the BTS estimated savings. Next an All BTS program was created where all the planning units were included, again using only the buildings modules. The savings in this case were slightly lower than the sum of the individual planning unit savings because of interaction among the programs. For example, programs that raise the overall shell efficiency of new buildings mean that the introduction of new equipment produces smaller savings and vice versa. In Table 5 below, the estimated savings per planning unit have been scaled so that the sum matches the non-integrated All BTS program case.

Overall, our total savings estimates are roughly the same as the BTS estimate in 2005 and approximately 70 percent of the BTS estimate in 2020. Differences in planning unit savings are partially a result of allocation differences. For example, our savings are much lower than BTS savings for the Community Energy Program because BTS allocates a portion of code savings to this program, whereas all of our code savings were modeled within Residential and Commercial Buildings Integration. Additionally, the BTS programs in NEMS-GPRA01 are adopted based upon an economic evaluation and may not be consistent with the BTS penetration rates, which tend to adopt the new technologies more gradually. Therefore, we tend to have higher energy savings in the early years for cost-effective technologies, although we may not achieve BTS penetration rates in the later years.

The integrated effect is calculated by running two additional sets of runs. The first includes running the BTS programs in NEMS-GPRA01 with all the other modules on but not including the other EE programs. This scenario captures the feedback effects of changing prices due to the energy consumption reductions in buildings, the primary energy associated with electricity reductions, and any changes associated with oil and gas production and transportation. The second case is the Full EE Case with all the EE programs included which produces the total primary savings across the economy. Scaling the individual sector savings to the Full EE total produces the bottom line savings for each sector. Thus the integrated effect includes the interaction of buildings with other parts of the energy system and with other EE programs. The integration effect is positive in 2005 because the savings total from the combined Full EE Case is greater than the sum of the savings from the individual sectors, and a portion is allocated to BTS. After 2005, the integrated effect is negative principally because of the reduction in energy prices and resulting increase in energy consumption. The endogenously derived primary energy associated with reduced electricity consumption is very similar from the values calculated using the GPRA Data Call heat rates, so there is little impact on the integration effect. There is also a slight increase in energy savings from pipeline gas use and petroleum refining.

[2] BTS raised their estimated savings for the Technology Roadmaps in December to reflect revised budget values, but there was insufficient time to update the integrated modeling results.

Table 5: Energy Savings by BTS Planning Units (Quadrillion Btu)						
	2005		2010		2020	
	NEMS* Results	BTS Results	NEMS* Results	BTS Results	NEMS* Results	BTS Results
State Energy Program	0.03	0.03	0.04	0.05	0.08	0.10
Weatherization Assistance	0.03	0.03	0.05	0.06	0.11	0.09
Community Energy Program	0.05	0.11	0.10	0.29	0.20	0.58
Energy Star	0.07	0.09	0.15	0.22	0.20	0.28
Technology Roadmaps	0.03	0.05	0.05	0.09	0.08	0.16
Residential Buildings Integration	0.01	0.00	0.04	0.02	0.14	0.11
Commercial Buildings Integration	0.03	0.01	0.07	0.04	0.24	0.16
Equipment, Materials & Tools	0.26	0.18	0.53	0.53	0.93	1.24
Subtotal	0.51	0.50	1.04	1.31	1.97	2.71
Integration Effect*	0.05		-0.02		-0.09	
Total Fossil Energy Savings	0.57		1.02		1.87	

* NEMS here is the modified version NEMS-GPRA01.

INDUSTRIAL SECTOR

Because the industrial sector of NEMS-GPRA01 is not well suited to representing specific alternative technologies, we have not attempted to model individual planning units for this sector. In consultation with the Office of Planning, Budget, and Outreach (OPBO) and NREL, we created a target level of "sector-only" savings for the industrial sector. This was based on the Office of Industrial Technology's (OIT's) estimates and a scaling factor derived from the relationship of the NEMS-GPRA01 projected non-integrated energy savings with the other end-use sector office estimates. The scaling factor varied from 100 percent in 2005 to 87 percent in 2020. The model was then used to produce the integrated results, which incorporate the interactions with the electricity sector and any price feedback. Because of this approach, there is greater uncertainty in our NEMS-GPRA01 projections for OIT than for the other sectors.

As for all the sectors, the estimated savings were provided by OIT for total primary savings and for four fuel types: oil, gas, coal, and electricity. The primary savings do not equal the sum of the four fuel types in OIT's case because of the inclusion of other types of fuels, such as feedstocks, wastes, renewables, and other. In the integrated modeling, we do not include renewable consumption changes in order to measure the effect of OPT's renewable programs. As a simplifying assumption, we used the sum of the four fuel types for the Forest and Paper Products program, and assumed that any difference between the total primary and this sum was due to renewables. In some years this difference is positive and in some years negative. In addition the difference between primary and the four fuels for the Chemicals program was assumed to be feedstocks: 50 percent oil and 50 percent natural gas. The various fuels (including feedstocks separately) and purchased electricity savings were simply subtracted from the projected industrial energy consumption derived endogenously. By including feedstock savings explicitly, we avoid potentially overestimating carbon savings, because only a fraction of the carbon in fuel used for feedstocks is released into the atmosphere.

Scenarios and Results

As for the other sectors, the industrial module of NEMS-GPRA01 was first run by itself with the targeted savings. The electricity savings are input as billion kilowatt-hours and are accounted for on a primary basis in Table 6 using the GPRA heat rates to make the conversion. Next, the whole NEMS-GPRA01 model was run with the OIT savings to include price and other sector feedback effects and an endogenous primary electricity calculation. In the table below, the first subtotals are the scaled stand-alone savings without any feedback, while the final savings are the corresponding integrated savings. As discussed above, the subtotal of sector only savings does not equal OIT's total primary estimates due to our exclusion of renewable savings and the application of the scaling factors. In 2010, OIT projects an increase in renewable fuel, so the sum of the three fossil fuels and electricity are greater than the primary energy reported.

The integration effect is quite small because of two major offsetting effects. On the one hand, the lower energy consumption leads to lower energy prices and there is some rebound in energy use in all sectors. On the other hand, the reductions in fossil fuel consumption lead to reduced energy used for production and refining, which increases the direct savings. The endogenous calculation of non-renewable energy in the electricity sector was not very different from that produced by using the factor for electricity conversion in the GPRA Data Call, and so does not contribute significantly to the integration effect. Also, in 2010 and 2020 the total savings from the Full EE Case are slightly less than the sums of all the sector cases individually, so OIT savings are scaled down a bit as are all the other sector savings.

Table 6: Energy Savings by OIT Planning Units (Quadrillion Btu)

	2005		2010		2020	
	NEMS* Results	**OIT Results**	**NEMS* Results**	**OIT Results**	**NEMS* Results**	**OIT Results**
Agriculture Vision		0.00		0.00		0.05
AIM		0.01		0.02		0.09
Aluminum Vision		0.02		0.04		0.15
Best Practices		0.08		0.16		0.34
CFCCs		0.02		0.06		0.15
Chemicals Vision		0.08		0.20		0.88
Cogeneration		0.09		0.16		0.54
Forest & Paper Products Vision		0.11		0.26		1.51
Glass Vision		0.02		0.04		0.08
IAC		0.02		0.04		0.05
Inventions & Innovations		0.00		0.04		0.11
Metals Casting Vision		0.01		0.02		0.10
Mining Vision		0.00		0.01		0.04
NICE-3		0.00		0.02		0.10
Petroleum Refining Vision		0.07		0.21		0.42
Sensors and Controls		0.00		0.00		0.00
Steel Vision		0.03		0.08		0.24
Subtotal	0.54	0.57	1.49	1.37	4.01	4.83
Integration Effect	0.06		0.00		-0.25	
Total Energy Savings	0.60		1.49		3.76	

* NEMS here is the modified version NEMS-GPRA01.

TRANSPORTATION SECTOR

No EE Base Case

The No EE base case is created by removing Office of Transportation Technology (OTT) programs already represented in the AEO99 base case either in the code or in the input files. For GPRA 2001, this includes no penetration of alternate technology vehicles (ATVs), no technology penetration for gasoline direct injection (SIDI) and gasoline hybrid vehicles, and the removal of EPACT ATV fleet sales mandates.

Representation of OTT Programs

<u>Independent or Exogenous OTT Programs</u>

The programs which are fairly independent were modeled sequentially and accounted for independently. Each of these was modeled in turn and their results were added to the totals.

Ethanol Blends. Ethanol blends are represented in the refinery model and are fairly independent of the other programs except for integration effects due to price of gasoline and ethanol. The conversion costs for ethanol were modified to reflect EE's assumptions, and the AEO99 assumption about the maximum rate of growth of ethanol production was increased.

EPACT. EPACT fleet sales mandates were modeled by adding the AEO99 mandates back into the No EE base case.

Heavy Vehicles. Heavy duty vehicles are represented in the transportation freight model, where they are completely independent of the other transportation modes. The heavy vehicle planning unit was implemented as another technology in the freight model technology slate as if it were a new program with a date of introduction, a penetration rate, and an amount of incremental savings.

<u>Separately Modeled but Interdependent OTT Programs</u>

Some programs which are not independent were first modeled individually from the same base, and then modeled in combination. Their individual proportional savings were used to allocate the total combined savings.

Gasoline Direct Injection (SIDI). Gasoline direct injection was modeled by using two slots (for each of cars and light trucks) in the transportation model technology slate, substituting the OTT attributes for those used in the AEO99 model. Small and large cars from OTT were combined into one car category and put into the two technology slots with different dates of introduction. Trucks from OTT were handled the same way. The OTT attributes for price and savings had to be allocated up and weighted together (using sales) in order to be implemented.

Gasoline Hybrid. Gasoline hybrids were also modeled by using light duty vehicle technology slots. One slot was already being used by the AEO99 model and two more were added for a total of three slots (for each of cars and light trucks). Small and large cars from OTT were combined into one car category and put into the three technology slots with different dates of introduction. Trucks from OTT were handled the same way.

Lightweight Materials. Lightweight materials were not directly represented in the modeling, but some extra savings were allocated to this program. Since a large portion of these savings is in hybrid vehicles, we added extra savings to that program to get approximately the OTT savings and then allocated the savings to this program.

Alternate Technology Vehicles (ATVs) Technology Competition

ATVs compete against each other, so they must be modeled together. The end result is a total savings for all ATVs combined, which is allocated to individual ATVs (programs) based upon the specific characteristics of each program and upon the marginal vehicle miles traveled (VMT). The marginal VMT share is the change in the VMT for any one vehicle type between the *before* run and the *after* run, divided by the change in VMT for all vehicles together. The thirteen ATVs in the NEMS model were limited to the following six categories to represent the OTT programs.

- *Advanced Diesel (CIDI)*
- *Hybrid Vehicles*
- *Electric Vehicles*
- *Fuel Cells (Gasoline)*
- *Compressed Natural Gas (CNG)*
- *Ethanol Flex-Fuel*

Use of OTT ATV Attributes. The ATVs were modeled using the attributes provided by OTT, which include the date of introduction, vehicle price (relative to gasoline vehicles), range, maintenance cost, acceleration, top speed, luggage space, and fuel economy. (The ethanol flex-fuel vehicle uses the AEO99 attributes, and the CNG fuel availability was modified to reflect the OTT assumption). The OTT attributes were provided by two car classes and three light truck classes and were disaggregated to the level used in the NEMS model – six EPA car classes and six light truck classes.

Modeling Assumptions. The NEMS model uses a two-stage logit distribution of a utility weighting function based on vehicle attributes. The equation and coefficients are a somewhat modified version of that estimated in a nationwide survey. This was again modified for the GPRA analysis in order to remove some changes introduced by the NEMS model and to better reflect the behavioral expectations of OTT. The major changes were to remove some calibration weights that were added to certain terms in the equations and to assess and change the various transformations of the range variable used in the equations.

Scenarios and Results

Various scenarios were run in order to allocate the transportation savings to the individual planning units. These included the scenarios described above consisting of cases for No EE, for ethanol blends, for EPACT, for heavy vehicles, for gasoline direct injection, for gasoline hybrid vehicles, for lightweight materials, and for the combination of various alternate technology vehicles (ATVs). Table 7 and Table 8 show the level of primary non-renewable energy and oil savings for each program unit. The overall results for the standalone primary energy savings in 2020 in Table 7 are very similar to those estimated by OTT, with a slight difference in the allocation to planning units. We projected a slightly lower savings in fuels development and a slightly higher savings in vehicle technologies, primarily due to different penetration rates. In general the ATV penetration rates increase more rapidly in NEMS-GPRA01 than projected by OTT, although the ultimate share is lower for some technologies. The overall standalone results for oil savings in 2020 in Table 8 are also very similar, although we have a slightly smaller total due primarily to the smaller savings in technology deployment.

The standalone results do not include the feedback effects in a full integrated run. As done for the other sectors, the integrated effect is calculated by creating two integrated runs in NEMS-GPRA01. The first scenario consists of running an OTT All Case which includes all the OTT programs implemented in the transportation and refinery sector models. This run also turns on all the other sectoral modules, but without the implementation of the other EE programs. This scenario captures the feedback effects of changing prices due to energy consumption changes, the primary energy associated with net electricity increases, feedback effects on other sectors of the change in refinery mix, and any other changes associated with oil and gas production and transportation. The second scenario consists of running a Full EE Case which includes all the EE program changes implemented in all the sectoral modules. This scenario captures the full impact of all the EE programs and their interactions with each other and the feedback effects. In some cases the effects may supplement each other causing the feedbacks to be greater and the total savings to be smaller, and in other cases the effects can be the opposite. The net result is that integrated primary energy savings in 2020 are about 0.1 quads less than in the standalone case.

In general, the integration effect reduces the amount of savings that were projected in the standalone run. The primary mechanism for this is that the decreases in energy consumption that lead to the savings in the standalone runs cause energy prices to decrease in the integrated run, which in turn causes a small rebound in energy consumption. The most significant change due to the OTT programs is a large decrease in gasoline consumption (due to ATV competition) along with a substantial increase in diesel consumption (due to penetration of advanced diesel vehicles). This leads to a significant decrease in the price of motor gasoline, a small increase in the price of diesel, and an overall net decrease in the price of petroleum products, leading to feedback effects on petroleum consumption in all sectors, including all modes of transportation. Changes in petroleum consumption also have cascading effects on the industrial sectors through the reduction in energy consumption in the refinery sector. The change in the supply curve for ethanol in the refinery sector to represent the EE fuels program causes the price of ethanol to decrease with an impact on ethanol consumption in vehicles.

Table 7: Primary Non-Renewable Energy Savings by OTT Planning Units (Quadrillion Btu)

	2005		2010		2020	
	NEMS* Results	**OTT Results**	**NEMS* Results**	**OTT Results**	**NEMS* Results**	**OTT Results**
Vehicle Technologies	0.35	0.15	0.90	0.74	1.98	1.77
Materials Technologies	0.00	0.00	0.01	0.01	0.05	0.04
Technology Deployment	-0.02	0.00	-0.01	0.00	0.00	0.00
Fuels Development	0.05	0.02	0.18	0.18	0.56	0.68
Subtotal	0.38	0.18	1.09	0.92	2.59	2.49
Integration Effect	-0.10		-0.08		-0.10	
Total Petroleum Savings	0.28		1.01		2.49	

Table 8: Oil Savings by OTT Planning Units (Quadrillion Btu)						
	2005		2010		2020	
	NEMS* Results	OTT Results	NEMS* Results	OTT Results	NEMS* Results	OTT Results
Vehicle Technologies	0.45	0.16	1.00	0.85	2.07	1.98
Materials Technologies	0.00	0.00	0.01	0.01	0.06	0.05
Technology Deployment	0.19	0.28	0.29	0.41	0.39	0.50
Fuels Development	0.06	0.02	0.20	0.18	0.57	0.68
Subtotal	0.70	0.46	1.49	1.46	3.09	3.21
Integration Effect	-0.08		-0.12		-0.28	
Total Petroleum Savings	0.62		1.37		2.81	

* NEMS here is the modified version NEMS-GPRA01.

ELECTRICITY GENERATION SECTOR

Modifications to NEMS-GPRA01

Several changes were made to the NEMS model to better represent the Office of Power Technologies (OPT) programs. EIA's preliminary code for distributed generation in the buildings sectors and for biomass cofiring in coal-fired power plants have been included in NEMS-GPRA01. For the cofiring, we used the AEO2000 assumption for the maximum amount of cofiring that is possible in each region. Other parameter changes were made to reflect updated information. The short term supply elasticities that increase the costs when renewable capacity grows rapidly and the long term regional elasticities that increase costs as more of a resource is developed have been updated to the AEO2000 values. In addition the limit on new construction of one gigawatt of wind per region per year has been removed. Finally, the waiting period for addition of geothermal plants at the same site has been eliminated.

The No EE Case

For this case, we have assumed that there are no future renewable capacity additions beyond the plants currently under development and the state set-asides assumed in the AEO99[3]. This was implemented by raising the cost of the renewable technologies sufficiently to preclude their construction. The hurdle rate for biomass cofiring was set sufficiently high so that no cofiring occurs in the No EE Case.

Representation of OPT Programs

The OPT programs can be grouped into three types: central renewable electric generation, renewables in buildings, and other. The first of these groups is the largest and the most straightforward to represent in a modeling framework. Based on projected values in EPRI-DOE *Technology Characteristics* report, we adjusted the capital costs, O&M costs, capacity factors, and heat rates (where applicable) for the various renewable technologies, overwriting the endogenous

[3] This is the same assumption used in previous years.

learning functions in the AEO99. This year we also added projections of renewables built to meet Green Power demands by adding to the “planned additions.” The plant data file modifications for these planned additions were provided by Lawrence Berkeley National Laboratory (LBNL) and were based on green power modeling by Princeton Economic Research Inc. (PERI). The concentrated solar power capacities were subsequently updated, but too late to be incorporated in the integrated modeling. The Green Power renewable capacity totals roughly 21 GW by 2020. An unintended side-effect of adding planned capacity to the plant file is to undercount the cost of these renewables and to overestimate the reduction in electricity price and resulting consumer energy expenditures.

In order to model the cofiring element of the biomass planning unit, we incorporated into NEMS-GPRA01 the biomass cofiring code developed by EIA after the AEO99 was published. In the No EE Case the hurdle rate for cofiring was set sufficiently high that no cofiring occurs. For the OPT case, we allowed the hurdle rate to decline from 1 cent/kWh in 2000 to zero in 2020.

Two of OPT’s planning units affect buildings: solar buildings and PVs. We modeled the solar buildings program’s penetration of solar water heaters by specifying a penetration rate in the residential module of NEMS-GPRA01. We were unable to model the pool heaters. The savings that we derived are smaller than the OPT estimates for the water heater portion, because the NEMS-GPRA01 base usage for electric water heaters was much lower. For PVs we used EIA’s preliminary distributed generation module and increased the exogenous penetration for PVs based on the capacity values we received from PERI.

High Temperature Superconductivity was represented in NEMS-GPRA01 by reducing the losses associated with transmission and distribution by the kilowatt-hour savings specified by OPT. We have not modeled some of the other smaller planning units, because they can not be easily modeled in the NEMS-GPRA01 framework. These include energy storage, transmission reliability, and competitive solicitation. The hydrogen planning unit consists of fuel cell vehicles and power generation and were not include because no technology information was provided, and there was a concern of overlap with the OTT and BTS fuel cell programs.

Scenarios and Results

The savings by planning unit in Table 9 were calculated by running the electricity module by itself, without any interaction with the rest of NEMS-GPRA01, and adding the solar building and PV savings which were run separately in the buildings modules. The endogenous resulting energy savings from the electricity sector was used rather than converting the renewable generation to primary energy avoided using the heat rates provided in the Data Call. The non-renewable energy savings are allocated to the individual programs based on the projected increase in generation of each renewable technology. For the major renewable power technologies our estimates are similar to OPT’s because the their estimates were also derived from the NEMS model, although not implemented in exactly the same way. The largest difference between them is in biomass, where the cofiring was estimated separately, and the NEMS-GPRA01 values are much smaller.

The integration effect and final savings are the result of two additional scenarios: the OPT programs run within the integrated NEMS-GPRA01 and the Full EE Case with all the EE programs. Because of the feedback of fuel and electricity prices and other sector programs reducing electricity demands, the savings are lower in the integration case. With all of EE programs, the projected growth in electricity demand is 0.6 percent per year from 2005 to 2020, compared with 1.3 percent in the No EE Case. The lower growth provides less need for new generation sources, which leads to reduced renewable and capacity additions. However, this reduction in savings due to lower demands is allocated to all sectors, not just OPT, by scaling each individual sector savings to the Full EE Case. Table 10 shows the incremental capacity projections. With higher demand and base fuel prices, incremental OPT capacity is projected to be 59 GW in 2020. Once the impact of the other EE programs is included, the 2020 capacity increase is only 44 GW. The Green Power and distributed PV capacities are unaffected, because these have been exogenously specified.

Table 9: Energy Savings by OPT Planning Units (Quadrillion Btu)

	2005		2010		2020	
	NEMS* Results	OPT Results	NEMS* Results	OPT Results	NEMS* Results	OPT Results
Photovoltaics	0.00	0.01	0.02	0.02	0.08	0.10
Wind	0.14	0.25	0.52	0.59	1.05	1.23
Geothermal	0.03	0.02	0.14	0.09	0.31	0.31
Biomass	0.09	0.19	0.15	0.50	0.45	0.83
Concentrating Solar Power	0.00	0.00	0.00	0.01	0.01	0.04
Solar buildings	0.00	0.03	0.00	0.06	0.01	0.16
High Temp Superconductivity	0.00	0.01	0.08	0.09	0.33	0.34
Hydrogen		0.00		0.04		0.30
Energy storage		0.00		0.00		0.00
Transmission Reliability		0.06		0.16		0.34
Competitive Solicitation		0.00		0.00		0.00
Subtotal	0.27	0.57	0.92	1.58	2.25	3.66
Integration Effect	-0.04		-0.17		-0.32	
Total Fossil Energy Savings	0.22		0.74		1.93	

* NEMS here is the modified version NEMS-GPRA01.
Note the shaded areas indicate planning units not modeled in NEMS-GPRA01.

Table 10: Incremental Capacity by OPT Planning Units (GW)

	2005		2010		2020	
	NEMS Results	OPT Results	NEMS Results	OPT Results	NEMS Results	OPT Results
Photovoltaics	0.2	0.4	1.2	1.5	6.1	6.8
Wind	5.7	7.8	17.6	21.3	38.4	43.6
Geothermal	0.5	0.3	2.2	1.4	5.1	4.6
Biomass	1.9	2.4	2.7	6.9	8.7	13.8
Concentrating Solar Power	0.0	0.1	0.0	0.3	0.2	1.2
Hydrogen		0.0		0.2		1.7
Total	8.4	10.9	23.7	31.6	58.5	71.7
Integration Effect	-0.3		-4.3		-14.6	
Total Integrated	8.2		19.4		43.8	

* NEMS here is the modified version NEMS-GPRA01.

APPENDIX A – NO EE CASE

N A T I O N A L   E N E R G Y   M O D E L I N G   S Y S T E M

Table 2. Energy Consumption by Sector and Source

(Quadrillion Btu per Year, Unless Otherwise Noted)

Sector and Source	2000	2005	2010	2015	2020
Energy Consumption					
Residential					
Distillate Fuel	.87	.81	.77	.74	.71
Kerosene	.08	.07	.07	.07	.07
Liquefied Petroleum Gas	.44	.44	.44	.43	.41
Petroleum Subtotal	1.39	1.32	1.28	1.23	1.19
Natural Gas	5.24	5.42	5.74	6.06	6.31
Coal	.06	.05	.05	.05	.05
Renewable Energy	.61	.62	.63	.65	.66
Electricity	4.01	4.33	4.63	5.00	5.38
Delivered Energy	11.30	11.75	12.33	12.99	13.59
Electricity Related Losses	8.78	8.93	9.16	9.37	9.76
Total	20.08	20.68	21.50	22.35	23.35
Commercial					
Distillate Fuel	.37	.36	.35	.36	.35
Residual Fuel	.09	.09	.09	.09	.09
Kerosene	.02	.02	.03	.03	.03
Liquefied Petroleum Gas	.08	.08	.09	.09	.09
Motor Gasoline	.03	.03	.03	.02	.02
Petroleum Subtotal	.59	.58	.58	.59	.58
Natural Gas	3.54	3.66	3.83	3.97	4.01
Coal	.09	.09	.10	.10	.10
Renewable Energy	.00	.00	.00	.00	.00
Electricity	3.69	3.96	4.25	4.54	4.71
Delivered Energy	7.91	8.30	8.76	9.20	9.40
Electricity Related Losses	8.07	8.16	8.41	8.51	8.56
Total	15.97	16.46	17.17	17.71	17.96
Industrial ..					
Distillate Fuel	1.14	1.26	1.35	1.42	1.49
Liquefied Petroleum Gas	2.15	2.31	2.46	2.60	2.71
Petrochemical Feedstocks	1.47	1.44	1.52	1.60	1.67
Residual Fuel	.29	.32	.33	.35	.34
Motor Gasoline	.21	.24	.26	.28	.29
Other Petroleum	4.54	4.72	4.91	4.96	5.02
Petroleum Subtotal	9.81	10.29	10.83	11.21	11.53
Natural Gas	10.23	10.82	11.43	11.99	12.50
Metallurgical Coal	.78	.70	.63	.58	.53
Steam Coal	1.56	1.61	1.67	1.73	1.80
Net Coal Coke Imports	.11	.17	.20	.24	.27
Coal Subtotal	2.44	2.48	2.51	2.55	2.60
Renewable Energy	1.96	2.12	2.31	2.45	2.56
Electricity	3.61	3.86	4.13	4.38	4.58
Delivered Energy	28.05	29.57	31.20	32.58	33.76
Electricity Related Losses	7.91	7.95	8.17	8.20	8.30
Total	35.96	37.52	39.38	40.78	42.06

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Table 2. Energy Consumption by Sector and Source (Continued)

(Quadrillion Btu per Year, Unless Otherwise Noted)

Sector and Source	2000	2005	2010	2015	2020
Transportation					
Distillate Fuel	5.14	5.59	5.96	6.21	6.42
Jet Fuel	3.79	4.36	5.09	5.68	6.26
Motor Gasoline	16.12	17.82	19.25	20.16	21.04
Residual Fuel	.74	.87	1.02	1.16	1.30
Liquefied Petroleum Gas	.04	.04	.04	.04	.04
Other Petroleum	.30	.32	.34	.35	.36
Petroleum Subtotal	26.14	28.99	31.70	33.61	35.43
Pipeline Fuel Natural Gas	.74	.84	.90	.98	1.02
Compressed Natural Gas	.01	.02	.04	.05	.06
Renewables (E85)	.00	.00	.00	.00	.00
Methanol	.00	.00	.00	.00	.00
Liquid Hydrogen	.00	.00	.00	.00	.00
Electricity	.06	.10	.15	.18	.22
Delivered Energy	26.95	29.95	32.78	34.82	36.73
Electricity Related Losses	.13	.21	.29	.34	.39
Total	27.08	30.16	33.07	35.16	37.12
Deliver.Energy Cons.All Sectors					
Distillate Fuel	7.52	8.02	8.43	8.73	8.96
Kerosene	.13	.13	.13	.13	.13
Jet Fuel	3.79	4.36	5.09	5.68	6.26
Liquefied Petroleum Gas	2.71	2.87	3.02	3.15	3.26
Motor Gasoline	16.36	18.09	19.54	20.46	21.36
Petrochemical Feedstocks	1.47	1.44	1.52	1.60	1.67
Residual Fuel	1.12	1.28	1.44	1.60	1.75
Other Petroleum	4.81	5.00	5.21	5.28	5.35
Petroleum Subtotal	37.92	41.18	44.39	46.64	48.73
Natural Gas	19.76	20.77	21.93	23.05	23.89
Metallurgical Coal	.78	.70	.63	.58	.53
Steam Coal	1.70	1.75	1.82	1.88	1.95
Net Coal Coke Imports	.11	.17	.20	.24	.27
Coal Subtotal	2.59	2.63	2.66	2.70	2.75
Renewable Energy	2.57	2.74	2.94	3.10	3.22
Methanol	.00	.00	.00	.00	.00
Liquid Hydrogen	.00	.00	.00	.00	.00
Electricity	11.37	12.25	13.16	14.10	14.89
Delivered Energy	74.21	79.57	85.08	89.58	93.48
Electricity Related Losses	24.89	25.24	26.03	26.42	27.01
Total	99.1	104.8	111.1	116.0	120.5

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N A T I O N A L   E N E R G Y   M O D E L I N G   S Y S T E M

Table 2. Energy Consumption by Sector and Source (Continued)

(Quadrillion Btu per Year, Unless Otherwise Noted)

Sector and Source	2000	2005	2010	2015	2020
Electric Generators ...					
Distillate Fuel	.09	.07	.07	.07	.07
Residual Fuel	.98	.32	.22	.19	.17
Petroleum Subtotal	1.07	.39	.29	.26	.24
Natural Gas	3.27	5.08	6.90	8.79	9.59
Steam Coal	20.20	20.66	21.45	22.39	23.61
Nuclear Power	7.04	6.73	5.91	4.47	3.83
Renewable Energy	4.24	4.30	4.33	4.32	4.34
Electricity Imports	.44	.34	.31	.28	.28
Total	36.26	37.50	39.20	40.52	41.89
Total Energy Consumption					
Distillate Fuel	7.61	8.09	8.50	8.80	9.03
Kerosene	.13	.13	.13	.13	.13
Jet Fuel	3.79	4.36	5.09	5.68	6.26
Liquefied Petroleum Gas	2.71	2.87	3.02	3.15	3.26
Motor Gasoline	16.36	18.09	19.54	20.46	21.36
Petrochemical Feedstocks	1.47	1.44	1.52	1.60	1.67
Residual Fuel	2.10	1.60	1.67	1.80	1.92
Other Petroleum	4.81	5.00	5.21	5.28	5.35
Petroleum Subtotal	38.99	41.57	44.68	46.90	48.98
Natural Gas	23.03	25.85	28.83	31.83	33.49
Metallurgical Coal	.78	.70	.63	.58	.53
Steam Coal	21.90	22.42	23.27	24.27	25.56
Net Coal Coke Imports	.11	.17	.20	.24	.27
Coal Subtotal	22.79	23.29	24.10	25.09	26.36
Nuclear Power	7.04	6.73	5.91	4.47	3.83
Renewable Energy	6.81	7.04	7.27	7.42	7.56
Methanol	.00	.00	.00	.00	.00
Liquid Hydrogen	.00	.00	.00	.00	.00
Electricity Imports	.44	.34	.31	.28	.28
Total	99.1	104.8	111.1	116.0	120.5
Energy Use & Related Statistics					
Delivered Energy Use	74.21	79.57	85.08	89.58	93.48
Total Energy Use	99.1	104.8	111.1	116.0	120.5
Population (millions)	275.2	286.5	298.3	310.7	323.4
US GDP (billion 1992 dollars)	7828	8771	9896	10802	11680
Tot. Carbon Emis.(mill m. ton)	1583	1682	1798	1906	1998

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NATIONAL ENERGY MODELING SYSTEM

Table 3. Energy Prices by Sector and Source

(1997 Dollars per Million Btu)

Sector and Source	2000	2005	2010	2015	2020
Residential	12.94	12.95	12.81	12.49	12.30
Primary Energy	6.73	6.69	6.52	6.32	6.26
Petroleum Products	7.79	8.90	9.26	9.31	9.40
Distillate Fuel	6.45	7.40	7.78	7.82	7.79
Liquefied Petroleum Gas	10.49	11.71	11.96	11.98	12.23
Natural Gas	6.51	6.20	5.95	5.76	5.70
Electricity	23.29	22.76	22.42	21.54	20.78
Commercial	12.55	12.32	11.99	11.56	11.36
Primary Energy	5.16	5.25	5.23	5.17	5.19
Petroleum Products	4.79	5.76	6.12	6.17	6.30
Distillate Fuel	4.24	5.19	5.57	5.62	5.68
Residual Fuel	2.28	2.87	3.13	3.18	3.40
Natural Gas	5.31	5.27	5.19	5.12	5.12
Electricity	21.02	20.07	19.17	18.10	17.50
Industrial	4.67	5.11	5.23	5.20	5.26
Primary Energy	3.23	3.79	4.04	4.12	4.25
Petroleum Products	4.07	5.05	5.40	5.48	5.70
Distillate Fuel	4.28	5.27	5.66	5.74	5.95
Liquefied Petroleum Gas	5.26	6.40	6.63	6.67	6.94
Residual Fuel	1.83	2.49	2.73	2.73	2.94
Natural Gas	2.77	2.99	3.15	3.26	3.33
Metallurgical Coal	1.70	1.63	1.57	1.50	1.44
Steam Coal	1.37	1.31	1.26	1.20	1.15
Electricity	13.05	12.55	11.86	11.03	10.64
Transportation	7.55	8.72	9.34	9.14	9.36
Primary Energy	7.53	8.70	9.32	9.12	9.34
Petroleum Products	7.53	8.70	9.32	9.12	9.34
Distillate Fuel	7.55	8.48	8.72	8.51	8.51
Jet Fuel	4.16	5.38	6.21	6.20	6.86
Motor Gasoline	8.69	9.99	10.78	10.59	10.82
Residual Fuel	1.28	2.21	2.66	2.61	2.93
Liquid Petroleum Gas	11.61	12.53	12.53	12.30	12.33
Natural Gas	6.63	7.04	7.15	7.15	7.13
E85	14.62	16.99	17.90	17.75	18.45
Methanol	9.86	11.87	12.57	12.77	12.96
Electricity	15.74	14.94	14.26	13.51	12.96

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N A T I O N A L   E N E R G Y   M O D E L I N G   S Y S T E M

Table 3. Energy Prices by Sector and Source (Continued)

(1997 Dollars per Million Btu)

Sector and Source	2000	2005	2010	2015	2020
Average End-Use Energy.........	7.93	8.50	8.75	8.58	8.65
Primary Energy...............	7.49	8.16	8.47	8.31	8.41
Electricity..................	19.26	18.61	17.97	17.07	16.51
Electric Generators ...					
Fossil Fuel Average..........	1.43	1.52	1.58	1.63	1.63
Petroleum Products.........	2.32	3.32	3.96	4.05	4.45
Distillate Fuel..........	3.83	4.80	5.22	5.26	5.48
Residual Fuel............	2.18	3.00	3.57	3.61	4.01
Natural Gas................	2.61	2.92	3.10	3.21	3.27
Steam Coal.................	1.20	1.14	1.06	.99	.93
Average Price to All Users ...					
Petroleum Products	6.57	7.79	8.37	8.26	8.49
Distillate Fuel	6.73	7.69	7.99	7.86	7.90
Jet Fuel...................	4.16	5.38	6.21	6.20	6.86
Liquefied Petroleum Gas....	6.30	7.40	7.58	7.56	7.78
Motor Gasoline	8.69	9.99	10.78	10.59	10.82
Residual Fuel..............	1.82	2.46	2.82	2.77	3.05
Natural Gas..................	4.11	4.08	4.05	4.03	4.05
Coal.........................	1.21	1.15	1.08	1.01	.95
E85	14.62	16.99	17.90	17.75	18.45
Methanol	9.86	11.87	12.57	12.77	12.96
Electricity..................	19.26	18.61	17.97	17.07	16.51
Non-Renewable Energy Expenditures by Sector(billion 1997 dollars)					
Residential....................	138.4	144.1	150.0	154.1	159.0
Commercial.....................	99.2	102.3	105.1	106.3	106.8
Industrial.....................	101.1	114.0	122.3	126.8	133.0
Transportation.................	197.8	253.8	297.8	309.3	334.2
Total Non-Renewable Expend...	536.5	614.2	675.1	696.4	733.0
Trans. Renew. Expenditures...	.01	.01	.01	.01	.01
Total Expenditures...........	536.5	614.3	675.2	696.4	733.0

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N A T I O N A L   E N E R G Y   M O D E L I N G   S Y S T E M

Table 17. Carbon Emissions by Sector and Source

(Million Metric Tons per Year, Unless Otherwise Noted)

Sector and Source	2000	2005	2010	2015	2020
Residential					
Petroleum	26.1	24.8	24.0	23.1	22.2
Natural Gas	75.4	78.1	82.6	87.2	90.9
Coal	1.5	1.4	1.3	1.3	1.3
Electricity	207.8	216.8	231.4	251.3	271.6
Total	310.8	321.1	339.4	362.9	386.0
Commercial					
Petroleum	11.5	11.4	11.4	11.5	11.3
Natural Gas	51.0	52.8	55.1	57.1	57.7
Coal	2.3	2.4	2.5	2.6	2.6
Electricity	190.9	198.1	212.4	228.5	238.1
Total	255.7	264.6	281.4	299.6	309.8
Industrial ..					
Petroleum	109.0	113.3	117.6	120.6	122.1
Natural Gas	144.1	153.4	161.9	169.9	177.0
Coal	61.9	62.8	63.6	64.7	66.0
Electricity	187.1	193.1	206.4	220.1	231.2
Total	502.1	522.7	549.6	575.3	596.3
Transportation					
Petroleum	500.9	555.8	606.9	644.1	679.4
Natural Gas	10.8	12.4	13.5	14.8	15.6
Other	.0	.0	.0	.0	.0
Electricity	3.1	5.0	7.3	9.1	10.9
Total	514.8	573.2	627.7	668.1	706.0
Total Carbon Emissions ..					
Petroleum	647.5	705.3	759.9	799.3	835.1
Natural Gas	281.3	296.6	313.2	329.1	341.3
Coal	65.6	66.6	67.4	68.5	69.9
Other	.0	.0	.0	.0	.0
Electricity	589.0	613.0	657.6	709.0	751.8
Total	1583	1682	1798	1906	1998
Electric Generators ..					
Petroleum	22.6	8.1	6.1	5.5	5.1
Natural Gas	47.1	73.1	99.4	126.6	138.1
Coal	519.3	531.8	552.1	576.9	608.6
Total	589.0	613.0	657.6	709.0	751.8
Total Carbon Emissions ..					
Petroleum	670.1	713.4	766.0	804.8	840.1
Natural Gas	328.4	369.7	412.6	455.7	479.4
Coal	584.9	598.4	619.5	645.4	678.5
Other	.0	.0	.0	.0	.0
Total	1583	1682	1798	1906	1998
Carbon Emissions (tons per person)	5.8	5.9	6.0	6.1	6.2

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APPENDIX B – FULL EE CASE

N A T I O N A L   E N E R G Y   M O D E L I N G   S Y S T E M
Table 2. Energy Consumption by Sector and Source
(Quadrillion Btu per Year, Unless Otherwise Noted)

Sector and Source	2000	2005	2010	2015	2020
Energy Consumption					
Residential					
Distillate Fuel..............	.87	.77	.71	.66	.62
Kerosene.....................	.08	.07	.07	.07	.07
Liquefied Petroleum Gas......	.44	.43	.41	.40	.38
Petroleum Subtotal.........	1.39	1.27	1.19	1.13	1.07
Natural Gas..................	5.23	5.28	5.49	5.76	5.96
Coal.........................	.06	.05	.05	.05	.05
Renewable Energy	.61	.61	.62	.63	.64
Electricity..................	4.01	4.27	4.47	4.77	5.10
Delivered Energy...........	11.29	11.49	11.83	12.33	12.82
Electricity Related Losses...	8.76	8.89	9.11	9.44	9.93
Total......................	20.05	20.37	20.94	21.77	22.74
Commercial					
Distillate Fuel..............	.37	.36	.36	.36	.36
Residual Fuel................	.09	.09	.09	.09	.09
Kerosene.....................	.02	.02	.03	.03	.03
Liquefied Petroleum Gas......	.08	.08	.09	.09	.09
Motor Gasoline	.03	.03	.03	.02	.02
Petroleum Subtotal.........	.59	.58	.59	.60	.59
Natural Gas..................	3.54	3.64	3.78	3.91	3.94
Coal.........................	.09	.09	.10	.10	.10
Renewable Energy	.00	.00	.00	.00	.00
Electricity..................	3.69	3.94	4.22	4.46	4.58
Delivered Energy...........	7.91	8.26	8.69	9.06	9.21
Electricity Related Losses...	8.05	8.20	8.60	8.82	8.91
Total......................	15.96	16.46	17.28	17.88	18.12
Industrial ..					
Distillate Fuel..............	1.14	1.23	1.25	1.23	1.22
Liquefied Petroleum Gas......	2.15	2.29	2.43	2.55	2.66
Petrochemical Feedstocks.....	1.47	1.42	1.47	1.48	1.44
Residual Fuel................	.29	.32	.32	.30	.31
Motor Gasoline	.21	.24	.26	.28	.29
Other Petroleum	4.51	4.66	4.78	4.79	4.81
Petroleum Subtotal.........	9.78	10.15	10.52	10.64	10.74
Natural Gas	10.31	10.71	11.14	11.57	11.81
Metallurgical Coal...........	.78	.70	.64	.58	.53
Steam Coal...................	1.56	1.57	1.58	1.57	1.56
Net Coal Coke Imports........	.11	.17	.20	.24	.27
Coal Subtotal..............	2.44	2.44	2.42	2.40	2.36
Renewable Energy	1.96	2.12	2.30	2.43	2.53
Electricity..................	3.61	3.72	3.68	3.48	3.34
Delivered Energy...........	28.11	29.14	30.06	30.51	30.75
Electricity Related Losses...	7.89	7.74	7.50	6.88	6.51
Total......................	35.99	36.88	37.56	37.39	37.26

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N A T I O N A L   E N E R G Y   M O D E L I N G   S Y S T E M

Table 2. Energy Consumption by Sector and Source (Continued)

(Quadrillion Btu per Year, Unless Otherwise Noted)

Sector and Source	2000	2005	2010	2015	2020
Transportation					
Distillate Fuel	5.20	6.09	6.95	7.55	7.99
Jet Fuel	3.79	4.36	5.10	5.71	6.29
Motor Gasoline	15.97	16.58	16.83	16.78	16.84
Residual Fuel	.74	.87	1.02	1.15	1.29
Liquefied Petroleum Gas	.05	.10	.14	.16	.17
Other Petroleum	.30	.32	.34	.35	.36
Petroleum Subtotal	26.06	28.32	30.38	31.70	32.95
Pipeline Fuel Natural Gas	.74	.82	.85	.90	.93
Compressed Natural Gas	.07	.21	.32	.39	.43
Renewables (E85)	.03	.12	.25	.34	.39
Methanol	.00	.01	.01	.01	.01
Liquid Hydrogen	.00	.00	.00	.00	.00
Electricity	.08	.14	.19	.23	.27
Delivered Energy	26.98	29.62	32.01	33.57	34.98
Electricity Related Losses	.18	.30	.40	.46	.53
Total	27.16	29.92	32.40	34.03	35.51
Deliver.Energy Cons.All Sectors					
Distillate Fuel	7.59	8.46	9.28	9.80	10.18
Kerosene	.13	.13	.13	.13	.13
Jet Fuel	3.79	4.36	5.10	5.71	6.29
Liquefied Petroleum Gas	2.72	2.90	3.07	3.20	3.30
Motor Gasoline	16.21	16.85	17.12	17.09	17.16
Petrochemical Feedstocks	1.47	1.42	1.47	1.48	1.44
Residual Fuel	1.12	1.27	1.43	1.55	1.71
Other Petroleum	4.78	4.94	5.09	5.11	5.14
Petroleum Subtotal	37.82	40.32	42.68	44.06	45.36
Natural Gas	19.89	20.66	21.59	22.53	23.04
Metallurgical Coal	.78	.70	.64	.58	.53
Steam Coal	1.70	1.71	1.72	1.72	1.71
Net Coal Coke Imports	.11	.17	.20	.24	.27
Coal Subtotal	2.58	2.59	2.57	2.55	2.51
Renewable Energy	2.60	2.85	3.17	3.40	3.56
Methanol	.00	.01	.01	.01	.01
Liquid Hydrogen	.00	.00	.00	.00	.00
Electricity	11.39	12.08	12.57	12.94	13.29
Delivered Energy	74.28	78.51	82.58	85.48	87.75
Electricity Related Losses	24.88	25.13	25.60	25.60	25.87
Total	99.2	103.6	108.2	111.1	113.6

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N A T I O N A L   E N E R G Y   M O D E L I N G   S Y S T E M

Table 2. Energy Consumption by Sector and Source (Continued)

(Quadrillion Btu per Year, Unless Otherwise Noted)

Sector and Source	2000	2005	2010	2015	2020
Electric Generators ...					
Distillate Fuel	.05	.03	.03	.03	.03
Residual Fuel	.98	.30	.20	.16	.13
Petroleum Subtotal	1.03	.33	.22	.18	.16
Natural Gas	3.27	4.51	5.31	6.08	6.71
Steam Coal	20.15	20.55	20.90	21.21	21.37
Nuclear Power	7.04	6.73	5.91	4.38	3.67
Renewable Energy	4.33	4.75	5.51	6.38	6.98
Electricity Imports	.44	.34	.31	.28	.28
Total	36.27	37.21	38.17	38.53	39.16
Total Energy Consumption					
Distillate Fuel	7.64	8.49	9.30	9.83	10.21
Kerosene	.13	.13	.13	.13	.13
Jet Fuel	3.79	4.36	5.10	5.71	6.29
Liquefied Petroleum Gas	2.72	2.90	3.07	3.20	3.30
Motor Gasoline	16.21	16.85	17.12	17.09	17.16
Petrochemical Feedstocks	1.47	1.42	1.47	1.48	1.44
Residual Fuel	2.10	1.57	1.63	1.71	1.85
Other Petroleum	4.78	4.94	5.09	5.11	5.14
Petroleum Subtotal	38.85	40.65	42.91	44.25	45.52
Natural Gas	23.16	25.17	26.90	28.61	29.75
Metallurgical Coal	.78	.70	.64	.58	.53
Steam Coal	21.85	22.26	22.62	22.93	23.08
Net Coal Coke Imports	.11	.17	.20	.24	.27
Coal Subtotal	22.73	23.14	23.47	23.76	23.88
Nuclear Power	7.04	6.73	5.91	4.38	3.67
Renewable Energy	6.93	7.60	8.67	9.78	10.53
Methanol	.00	.01	.01	.01	.01
Liquid Hydrogen	.00	.00	.00	.00	.00
Electricity Imports	.44	.34	.31	.28	.28
Total	99.2	103.6	108.2	111.1	113.6
Energy Use & Related Statistics					
Delivered Energy Use	74.28	78.51	82.58	85.48	87.75
Total Energy Use	99.2	103.7	108.2	111.1	113.6
Population (millions)	275.2	286.5	298.3	310.7	323.4
US GDP (billion 1992 dollars)	7828	8771	9896	10802	11680
Tot. Carbon Emis.(mill m. ton)	1582	1653	1725	1776	1817

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N A T I O N A L   E N E R G Y   M O D E L I N G   S Y S T E M

Table 3. Energy Prices by Sector and Source

(1997 Dollars per Million Btu)

Sector and Source	2000	2005	2010	2015	2020
Residential....................	12.94	12.91	12.55	12.00	11.72
Primary Energy	6.74	6.71	6.49	6.15	6.07
Petroleum Products	7.80	9.03	9.48	9.47	9.74
Distillate Fuel..........	6.46	7.45	7.78	7.81	7.96
Liquefied Petroleum Gas..	10.51	11.97	12.52	12.34	12.72
Natural Gas................	6.52	6.21	5.88	5.54	5.45
Electricity..................	23.26	22.49	21.69	20.51	19.57
Commercial.....................	12.57	12.18	11.47	10.66	10.27
Primary Energy	5.16	5.22	5.10	4.91	4.90
Petroleum Products	4.80	5.81	6.16	6.17	6.37
Distillate Fuel..........	4.25	5.23	5.56	5.62	5.79
Residual Fuel............	2.28	2.86	3.13	3.18	3.39
Natural Gas	5.31	5.22	5.04	4.82	4.77
Electricity..................	21.03	19.80	18.21	16.60	15.70
Industrial	4.67	5.05	5.02	4.78	4.77
Primary Energy...............	3.24	3.78	3.97	3.92	4.03
Petroleum Products	4.08	5.11	5.48	5.47	5.73
Distillate Fuel..........	4.29	5.31	5.66	5.78	5.99
Liquefied Petroleum Gas..	5.26	6.61	7.02	6.84	7.31
Residual Fuel............	1.84	2.42	2.72	2.70	2.88
Natural Gas	2.77	2.90	2.91	2.83	2.80
Metallurgical Coal.........	1.70	1.63	1.56	1.49	1.44
Steam Coal.................	1.37	1.31	1.25	1.19	1.13
Electricity..................	13.02	12.44	11.40	10.33	9.81
Transportation................	7.54	8.56	8.81	8.58	8.56
Primary Energy...............	7.52	8.53	8.78	8.55	8.52
Petroleum Products	7.51	8.50	8.72	8.48	8.45
Distillate Fuel	7.56	8.53	8.79	8.69	8.64
Jet Fuel	4.14	5.25	5.69	5.72	6.07
Motor Gasoline	8.67	9.74	10.06	9.79	9.74
Residual Fuel............	1.32	2.22	2.60	2.62	2.79
Liquid Petroleum Gas	11.69	12.97	13.34	12.92	13.04
Natural Gas	6.70	6.94	7.24	7.18	7.09
E85	14.60	17.88	17.47	16.39	16.27
Methanol	9.75	11.90	12.69	12.70	12.53
Electricity..................	15.71	14.92	14.33	13.42	12.72

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NATIONAL ENERGY MODELING SYSTEM

Table 3. Energy Prices by Sector and Source (Continued)
(1997 Dollars per Million Btu)

Sector and Source	2000	2005	2010	2015	2020
Average End-Use Energy.........	7.92	8.40	8.38	8.07	8.01
Primary Energy...............	7.48	8.04	8.08	7.79	7.73
Electricity.................	19.24	18.43	17.39	16.30	15.64
Electric Generators ...					
Fossil Fuel Average..........	1.44	1.45	1.44	1.40	1.39
Petroleum Products.........	2.28	3.15	3.79	3.96	4.23
Distillate Fuel..........	3.86	4.92	5.34	5.42	5.58
Residual Fuel...........	2.19	2.99	3.57	3.71	3.96
Natural Gas................	2.62	2.83	2.86	2.80	2.79
Steam Coal................	1.20	1.12	1.05	.98	.92
Average Price to All Users ...					
Petroleum Products	6.56	7.66	7.96	7.80	7.86
Distillate Fuel	6.76	7.81	8.16	8.15	8.18
Jet Fuel..................	4.14	5.25	5.69	5.72	6.07
Liquefied Petroleum Gas....	6.33	7.72	8.15	7.93	8.33
Motor Gasoline	8.67	9.74	10.06	9.79	9.74
Residual Fuel.............	1.84	2.45	2.77	2.76	2.92
Natural Gas..................	4.12	4.06	3.95	3.79	3.74
Coal.........................	1.22	1.14	1.07	1.00	.94
E85	14.60	17.88	17.47	16.39	16.27
Methanol	9.75	11.90	12.69	12.70	12.53
Electricity..................	19.24	18.43	17.39	16.30	15.64
Non-Renewable Energy Expenditures by Sector(billion 1997 dollars)					
Residential...................	138.3	140.4	140.7	140.5	142.8
Commercial....................	99.3	100.6	99.6	96.61	94.57
Industrial....................	101.1	111.1	112.3	107.6	107.8
Transportation................	197.5	244.3	270.2	274.8	285.1
Total Non-Renewable Expend...	536.3	596.5	622.8	619.5	630.2
Trans. Renew. Expenditures...	.37	2.22	4.35	5.53	6.33
Total Expenditures...........	536.6	598.7	627.2	625.1	636.6

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NATIONAL ENERGY MODELING SYSTEM

Table 17. Carbon Emissions by Sector and Source
(Million Metric Tons per Year, Unless Otherwise Noted)

Sector and Source	2000	2005	2010	2015	2020
Residential					
Petroleum	26.09	23.88	22.35	21.11	19.90
Natural Gas	75.28	75.99	79.09	82.92	85.87
Coal	1.46	1.39	1.33	1.30	1.27
Electricity	206.7	212.4	220.3	235.1	249.6
Total	309.6	313.6	323.1	340.5	356.6
Commercial					
Petroleum	11.53	11.39	11.45	11.63	11.55
Natural Gas	50.99	52.42	54.48	56.32	56.73
Coal	2.26	2.37	2.48	2.57	2.60
Electricity	190.1	196.1	207.9	219.8	224.0
Total	254.9	262.3	276.3	290.3	294.9
Industrial ..					
Petroleum	108.4	110.9	112.7	111.5	110.6
Natural Gas	145.2	151.7	157.9	164.1	167.5
Coal	61.82	61.87	61.28	60.72	59.84
Electricity	186.3	185.0	181.3	171.4	163.7
Total	501.7	509.5	513.3	507.6	501.6
Transportation					
Petroleum	499.9	545.2	585.6	607.4	631.0
Natural Gas	11.62	14.80	16.88	18.52	19.62
Other	.04	.14	.16	.16	.16
Electricity	4.31	7.17	9.59	11.57	13.33
Total	515.9	567.3	612.3	637.6	664.1
Total Carbon Emissions ..					
Petroleum	645.9	691.4	732.1	751.6	773.1
Natural Gas	283.1	294.9	308.4	321.9	329.7
Coal	65.54	65.63	65.10	64.59	63.71
Other	.04	.14	.16	.16	.16
Electricity	587.4	600.6	619.1	637.9	650.5
Total	1582	1653	1725	1776	1817
Electric Generators ..					
Petroleum	21.91	6.99	4.70	3.89	3.39
Natural Gas	47.09	64.98	76.49	87.59	96.60
Coal	518.4	528.6	538.0	546.4	550.5
Total	587.4	600.6	619.1	637.9	650.5
Total Carbon Emissions ..					
Petroleum	667.8	698.4	736.9	755.5	776.5
Natural Gas	330.2	359.9	384.9	409.4	426.3
Coal	583.9	594.3	603.1	611.0	614.2
Other	.04	.14	.16	.16	.16
Total	1582	1653	1725	1776	1817
Carbon Emissions (tons per person)	5.75	5.77	5.78	5.72	5.62

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