EXECUTIVE SUMMARY

The U.S. Department of Energy's (DOE) Office of Energy Efficiency and Renewable Energy (EERE) sponsors research, development, demonstration, and deployment (RD3) activities aimed at transforming the future of U.S. energy through improved efficiency of energy use and the development of new renewable energy resources. EERE invests in high-risk, high-value research and development (R&D) that—conducted in partnership with the private sector and other government agencies—accelerates the development and facilitates the deployment of advanced energy technologies and practices.

Highlights

EERE annually assesses the contribution of its work to DOE's goals of providing affordable, clean, and reliable energy. Two energy market models are used in this assessment—one that looks in detail at the midterm (through 2030) and one that looks more generally at trends in the long term (through 2050).

The midterm model is a variant of the tool used by DOE's Energy Information Administration (EIA) to report annually on the U.S. energy outlook. A snapshot of midterm benefits associated with technical and market success of EERE's programs includes the following:

- **Providing affordable energy**. More than $630 billion of consumer savings from 2008 to 2030.
- **Delivering clean energy**. Two billion tons of avoided carbon emissions from 2008 to 2030.
- **Ensuring reliable energy**. Savings of more than 6 billion barrels of imported oil from 2008 to 2030.
- **Hedging our bets**. High energy prices and the need to reduce greenhouse gas emissions are scenarios that could threaten our economy. Under each of these scenarios, EERE's portfolio saves consumers more than $1 trillion from 2008 to 2030.

The full set of both mid- and long-term benefits estimates are shown in **Tables ES-1**, **ES-2,** and **ES-3**.

What's new this year?

Expanded Metrics. This year's analysis includes new metrics intended to more fully understand the energy, environmental, and economic impacts of EERE's portfolio. For details on the definitions of the metrics, see **Chapter 1.**

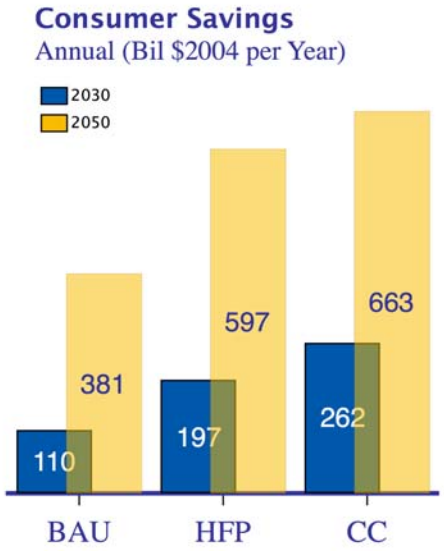
The Impact of Alternative Futures. In previous years, projected benefits of EERE's portfolio have been estimated for a single "Business-as-Usual" view of the future. This ignores the possibility of other adverse potential futures. So, this year, projected benefits are evaluated for three different scenarios:

- Business-as-Usual (BAU)—based on DOE's forecast in *Annual Energy Outlook 2006* (*AEO2006*).
- High Fuel Price (HFP)—based on DOE's high oil price forecast in *AEO2006*, with additional assumptions leading to higher natural gas prices.
- Carbon Constraint (CC)—based on a future policy requiring steady reductions in emissions of carbon dioxide from energy consumption.

This allows for evaluation of the ability of EERE's portfolio to mitigate adverse impacts of a carbon-constrained future and a high fuel price future.

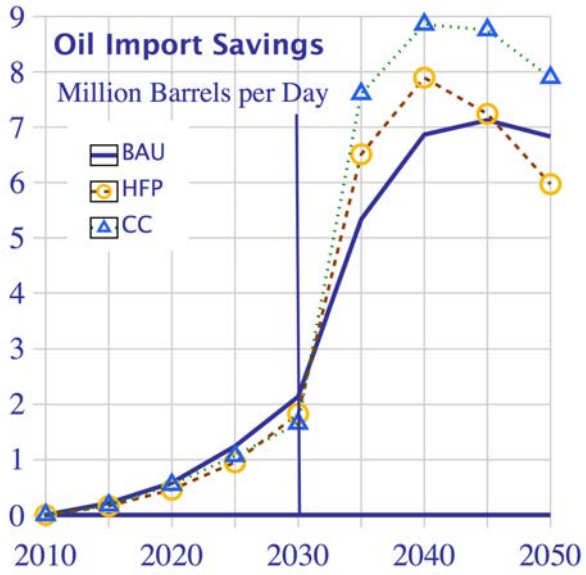
Economic security—benefits to the consumer

Under a Business-as-Usual future, EERE's portfolio enables consumers to reduce overall energy consumption and to access cost-effective renewable energy resources, both of which translate directly to reduced consumer spending for energy. The largest source of savings occur in the transportation sector, where improved vehicle technologies lead to less spending for fuel, and bioethanol and hydrogen fuel cell technologies ultimately lead to reductions in oil consumption. Consumer savings under the High Fuel Price scenario are nearly double those seen for the BAU scenario, demonstrating that success in EERE's portfolio can help protect consumers from high fuel prices. Similarly, EERE's portfolio offers consumers even greater protection from impacts of market costs for carbon emissions in a carbon-constrained world. These results illustrate that success in EERE's RD3 portfolio can lead to clean and secure energy supplies while actually providing cost savings to consumers.



Energy security—reducing our dependence on oil

Reducing oil imports is key to increasing the energy security of the Nation. Oil savings associated with EERE's portfolio are substantial. In 2030, oil savings are about 2 million barrels per day for all scenarios. By 2040, these savings climb to between 6 million and 9 million barrels per day, depending on the scenario. By 2050, EERE's portfolio could reduce oil imports to levels not seen since the 1990s.

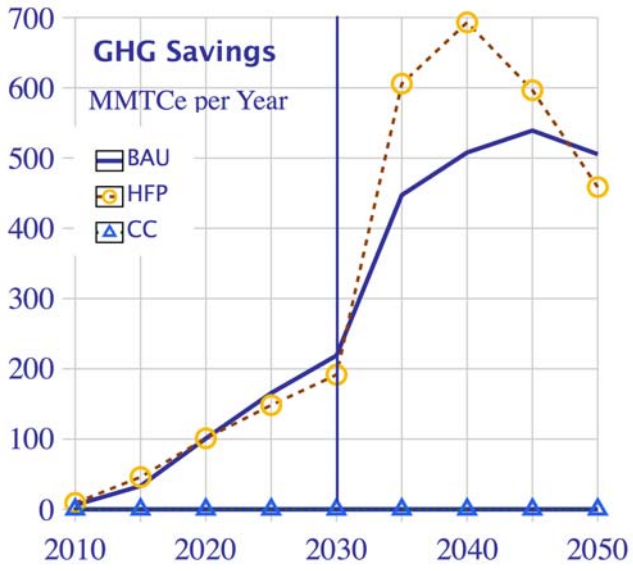


Oil savings through 2030 are actually lower in the High Fuel Price scenario than in the Business-as-Usual scenario. The impact of EERE's portfolio is less because the private sector is more motivated early on (when energy costs are high) to make progress on energy efficiency and renewable fuels technologies on their own. Even though the private sector would make more progress on its own in a High Fuel Price future, success in EERE's portfolio adds substantially more to the Nation's oil savings.

Environmental security—energy and climate change

Success in EERE's RD3 portfolio leads to more than 200 million metric tons of carbon savings per year in 2030, with savings leveling off by 2040 at about 500 million metric tons per year in both the Business-as-Usual and High Fuel Price scenarios. The technologies made available by EERE's portfolio eliminate the often-assumed (but false) choice between economic and environmental benefits.

EERE's portfolio has no carbon savings under the Carbon Constraint scenario. Because we only take credit for benefits directly attributable to the outcomes of EERE's research, a scenario in which regulation drives savings means that we cannot take any credit. But, as the economic benefits described above suggest, EERE helps society meet such a requirement with less impact on consumers.



Summary of projected benefits

Tables ES-1, **ES-2,** and **ES-3** summarize all of the metrics for EERE's portfolio from 2010 to 2050.

Table ES-1. The Benefits of EERE's Portfolio Under the Business-as-Usual Scenario

	MIDTERM BENEFITS					LONG-TERM BENEFITS			
Metric	2010	2015	2020	2025	2030	2035	2040	2045	2050
ECONOMIC BENEFITS ("AFFORDABLE")									
Reduction in Average Delivered Natural Gas Price	1%	0%	3%	5%	2%	5%	10%	16%	12%
Energy System Cost Savings (bil $2004)	nr	nr	nr	nr	nr	120	146	173	203
Consumer Savings, Annual (bil $2004)	4	12	43	86	110	232	322	385	381
Consumer Savings, NPV (bil $2004)	6	46	148	359	632	1,518	2,088	2,707	3,278
Electric Power Industry Savings, Annual (bil $2004)	1	5	13	21	26	51	63	77	69
Electric Power Industry Savings, NPV (bil $2004)	2	18	54	110	174	419	536	658	766
Reduction in Fraction of Household Income Spent on Energy	0.3%	0.7%	2.0%	3.6%	4.8%	8%	9%	10%	10%
Reduced Energy Intensity of Economy	0.3%	1.7%	3.9%	6.1%	7.8%	10%	13%	15%	17%
ENVIRONMENTAL BENEFITS ("CLEAN")									
Avoided Greenhouse Gas Emissions, Annual (MMTCE/year)	6	33	101	165	219	447	508	539	505
Avoided Greenhouse Gas Emissions, Cumulative (MMTCE)	12	116	470	1,158	2,136	4,630	7,047	9,680	12,276
Reduced Cost of Criteria Pollutant Control, NPV (bil $2004)	0	1	3	9	13	nr	nr	nr	nr
SECURITY BENEFITS ("RELIABLE")									
Avoided Oil Imports, Annual (mbpd)	ns	0.2	0.6	1.2	2.1	5.3	6.9	7.1	6.8
Avoided Oil imports, Cumulative (bil barrels)	ns	0.3	1.0	2.8	6.1	17	28	41	54
Security Fuel Economy Improvement (MPG of Crude Oil)	0.1	0.5	1.3	2.8	5.3	23	38	51	64
Improved Transportation Fuel Diversity	ns	ns	4%	10%	24%	82%	86%	67%	42%
Reduced Oil Intensity of the Economy	0.2%	1%	3%	6%	9%	26%	32%	33%	33%

Table ES-2. The Benefits of EERE's Portfolio Under the High Fuel Price Scenario

	MIDTERM BENEFITS					LONG-TERM BENEFITS			
Metric	2010	2015	2020	2025	2030	2035	2040	2045	2050
ECONOMIC BENEFITS ("AFFORDABLE")									
Reduction in Average Delivered Natural Gas Price	1%	4%	4%	8%	7%	14%	15%	22%	15%
Energy System Cost Savings (bil $2004)	nr	nr	nr	nr	nr	258	303	325	341
Consumer Savings, Annual (bil $2004)	4.3	28	66	133	197	510	558	629	597
Consumer Savings, NPV (bil $2004)	10	85	246	553	1,012	2,681	3,758	4,794	5,703
Electric Power Industry Savings, Annual (bil $2004)	2	9	14	21	25	99	103	97	73
Electric Power Industry Savings, NPV (bil $2004)	5	28	68	123	185	532	735	907	1,031
Reduction in Fraction of Household Income Spent on Energy	0.21%	1.1%	2.9%	5.0%	6.7%	14%	15%	16%	14%
Reduced Energy Intensity of Economy (Percent)	0.42%	2.0%	3.8%	6.0%	7.4%	15%	18%	18%	16%
ENVIRONMENTAL BENEFITS ("CLEAN")									
Annual Avoided Greenhouse Gas Emissions (MMTCE/year)	9	46	101	148	192	606	693	597	459
Cumulative Avoided Greenhouse Gas Emissions (MMTCE)	14	158	562	1,204	2,072	5,628	8,918	12,095	14,665
Reduced Cost of Criteria Pollutant Control, NPV (bil $2004)	0.5	1.2	5.0	8.7	15	nr	nr	nr	nr
SECURITY BENEFITS ("RELIABLE")									
Avoided Oil Imports, Annual (mbpd)	ns	0.2	0.5	1.0	1.8	6.5	7.9	7.2	6.0
Avoided Oil imports, Cumulative (bil barrels)	ns	0.2	0.8	2.2	4.8	18.5	32.0	45.7	57.5
Security Fuel Economy Improvement (MPG of Crude Oil)	0.1	0.5	1.3	2.8	5.8	63	136	223	285
Transportation Fuel Diversity Improvement	ns	ns	6.2%	6.0%	16%	94%	91%	66%	48%
Reduced Oil Intensity	ns	1.0%	2.8%	5.3%	9.5%	36%	43%	42%	39%

Table ES-3. The Benefits of EERE's Portfolio Under the Carbon Constraint Scenario

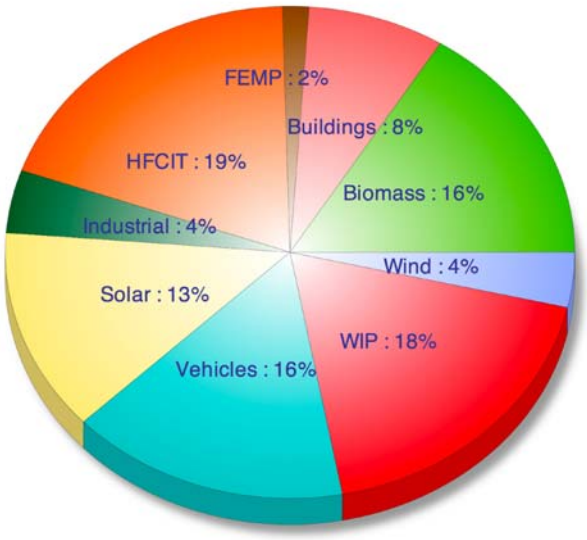
	MIDTERM BENEFITS					LONG-TERM BENEFITS			
Metric	2010	2015	2020	2025	2030	2035	2040	2045	2050
ECONOMIC BENEFITS ("AFFORDABLE")									
Reduction in Average Delivered Natural Gas Price	0%	1%	9%	11%	13%	40%	42%	35%	28%
Energy System Cost Savings (bil $2004)	nr	nr	nr	nr	nr	177	221	247	271
Consumer Savings, Annual (bil $2004)	2.1	21	104	179	262	641	751	750	663
Consumer Savings, NPV (bil $2004)	4.4	53	302	749	1,359	4,106	5,519	6,814	7,856
Electric Power Industry Savings, Annual (bil $2004)	1.9	12	37	45	52	113	104	103	92
Electric Power Industry Savings, NPV (bil $2004)	4.3	34	137	269	405	887	1103	1282	1425
Reduction in Fraction of Household Income Spent on Energy	0.17%	1.0%	3.8%	5.9%	8.2%	15%	16%	15%	12%
Reduced Energy Intensity of Economy (Percent)	0.20%	1.5%	2.6%	4.7%	8.0%	9.2%	13%	14%	14%
ENVIRONMENTAL BENEFITS ("CLEAN")									
Annual Avoided Greenhouse Gas Emissions (MMTCE/year)	ns	ns	ns	ns	ns	10	0	0	0
Cumulative Avoided Greenhouse Gas Emissions (MMTCE)	ns	ns	ns	ns	ns	28	28	28	28
Reduced Cost of CO2 Allowances, (bil $2004)	0.0	11	59	80	97	nr	nr	nr	nr
Reduced Cost of CO2 Allowances, NPV (bil $2004)	0.0	15	167	382	624	nr	nr	nr	nr
Reduced Cost of Criteria Pollutant Control, NPV (bil $2004)	0.8	0	-1	-3	-4	nr	nr	nr	nr
SECURITY BENEFITS ("RELIABLE")									
Avoided Oil Imports, Annual (mbpd)	ns	0.18	0.55	1.1	1.7	7.6	8.9	8.8	7.9
Avoided Oil imports, Cumulative (bil barrels)	ns	0.17	0.85	2.4	5.0	24	40	56	71
Security Fuel Economy Improvement (MPG of Crude Oil)	0.1	0.5	1.4	2.7	4.9	41	71	106	128
Transportation Fuel Diversity Improvement	ns	ns	10%	14%	23%	191%	184%	139%	111%
Reduced Oil Intensity	ns	0.9%	2.7%	5.3%	7.7%	35%	40%	41%	39%

Notes for Tables ES-1, ES-2, and ES-3

1. Midterm benefits modeled using NEMS-GPRA08
2. Long-term benefits modeled using MARKAL-GPRA08
3. NPV is "net present value" of cumulative savings beginning in 2008
4. nr is "not reported"
5. ns is "not significant"

The benefits of individual programs

In addition to assessing the benefits of 100% success across the EERE portfolio, this report includes assessments of the individual programs in the portfolio. The benefits reflect the impact of success in only one program at a time. The FY 2008 budget request for each of EERE's nine programs is shown below:

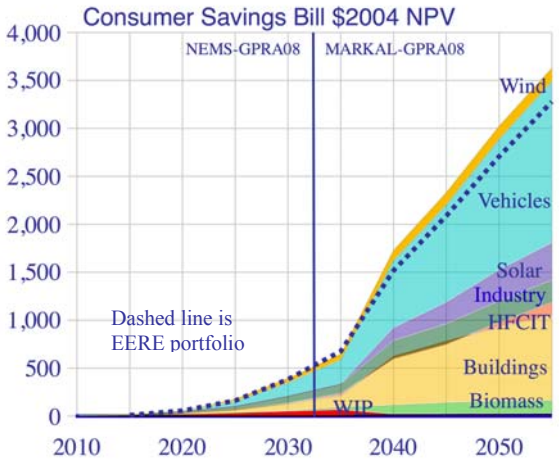


Federal Energy Management	$16,791
Wind	$40,069
Industry	$45,998
Buildings	$86,456
Solar	$148,304
Vehicles	$176,138
Biomass	$179,263
Weatherization/Intergovt	$204,904
H_2 Fuel Cell Infrastructure	$213,000

The two largest program budgets are $213 million for the Hydrogen, Fuel Cell, and Infrastructure Technologies (HFCIT) Program, and $205 million for the Weatherization and Intergovernmental Program (WIP). The latter includes $144 million for Low-Income Weatherization Assistance.

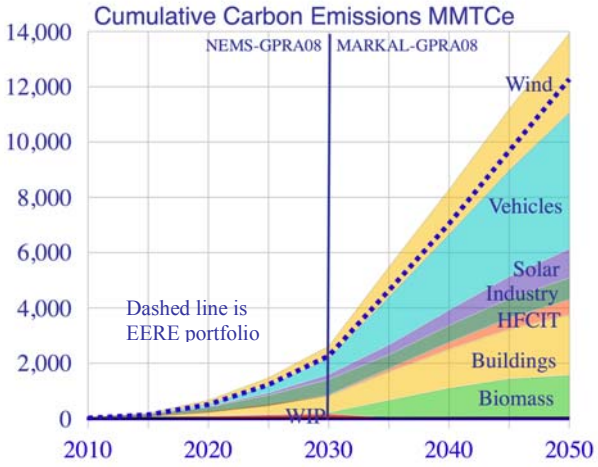
Impact of individual programs on consumer savings

The sum of the individual programs' consumer savings is generally greater than the EERE portfolio's savings—due to some overlap in markets served by each program. The biggest contributors to consumer savings are the FreedomCAR and Vehicle Technologies Program and the Building Technologies Program. Both of these programs reduce energy consumption through efficiency improvements. Less energy consumption translates directly into savings for consumers. By 2050, the Biomass Program, the Solar Technologies Program, and the Hydrogen, Fuel Cells, and Infrastructure Technologies Program offer significant savings.



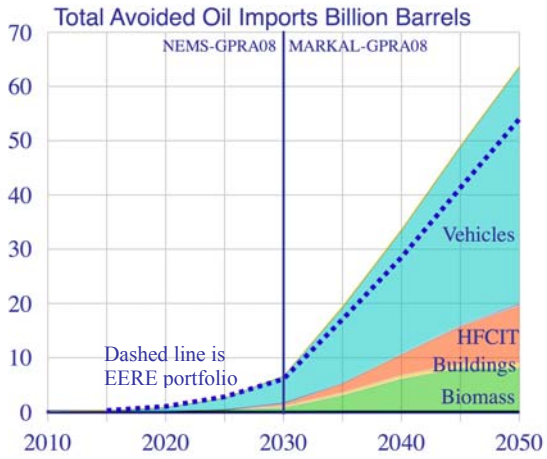
Impact of individual programs on carbon savings

By 2030, the Buildings Technologies Program, the Industrial Technologies Program, and the Wind Technologies Program all contribute significantly to carbon savings. While the Weatherization and Intergovernmental Program has a relatively small impact, it provides other social benefits. It also plays a role in accelerating early adoption of efficiency and renewable energy technologies, which is not readily captured in the energy market models. By 2050, savings from all of these programs continues to grow, along with savings from the Biomass Program, the Solar Technologies Program, and the FreedomCAR and Vehicle Technologies Program.



Impact of individual programs on oil savings

The transportation-related programs—the FreedomCAR and Vehicle Technologies Program; the Hydrogen, Fuel Cells, and Infrastructure Technologies Program; and the Biomass Program—dominate oil import savings among the individual programs in EERE's portfolio under the Business-as-Usual scenario. The Building Technologies and Industrial Technologies programs provide small savings. In the long run, Vehicle Technologies and the Hydrogen, Fuel Cells, and Infrastructure Technologies programs take over as the largest potential contributors to oil savings.



Summary of Individual Program Benefits

Table ES-4 summarizes FY 2008 budgets and selected benefits results for each of the individual programs, along with the benefits estimates of the full portfolio, under the Business-as-Usual scenario.

Table ES-4. Selected Benefits for Individual Programs and the EERE Portfolio Under the Business-as-Usual Scenario

	FY 2008 Budget Request	Oil Import Savings (mbpd)		Consumer Savings ($2004/yr)		Carbon Savings (MMTCe/yr)	
		2030	2050	2030	2050	2030	2050
Biomass	179,263	0.3	ns	3.3	-1.8	8.7	3.3
Building Technologies	86,456	0.1	0.1	27	78	57	77
Federal Energy Management	16,791	ns	ns	1.0	0.89	0.80	0.90
Hydrogen, Fuels and Infrastructure	213,000	0.25	2.1	7.3	55	14	31
Industrial Technologies	45,998	ns	ns	11	6	40	18
Solar Energy Technologies	148,304	ns	0.13	ns	33	23	50
Vehicle Technologies	176,138	1.8	5.9	46	220	69	210
Weatherization Intergovernmental	204,904	2.1	nr	7.8	nr	6.64	nr
Wind Technologies	40,069	ns	ns	7.8	0.85	69	139
Facilities and Infrastructure	26,052	na	na	na	na	na	na
Program Direction	101,868	na	na	na	na	na	na
Program Support	13,321	na	na	na	na	na	na
Total EERE Integrated Portfolio	1,252,164	2.1	6.8	119	381	233	505

Notes for Table ES-4

6. 2030 benefits modeled using NEMS-GPRA08
7. 2050 benefits modeled using MARKAL-GPRA08
8. NPV is “net present value” of cumulative savings beginning in 2008
9. nr is “not reported”
10. ns is “not significant”