Reference Projection of Hawaii's Greenhouse Gas Emissions, 2007- 2020

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Prepared for:

State of Hawaii
Department of Business, Economic Development and Tourism (DBEDT)

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Acronyms & Definitions

ACES Act	American Clean Energy & Security Act of 2009
AEO	Annual Energy Outlook (published by EIA)
Bunker Fuel	Fuel supplied to ships and aircraft, both domestic and foreign.
Btu	British Thermal Units
CAC	Criteria Air Contaminants (SO_x, NO_x, PM, etc.)
CFL	Compact Fluorescent Light bulb
CHP	Combined Heat and Power
CO_2e	Carbon Dioxide equivalent
GDP	Gross Domestic Product
GO	Gross Output
GWP	Global Warming Potential
DBEDT	Department of Business, Economic Development and Tourism
DG	Distributed Generation
DOE	United States Department of Energy
DSM	Demand Side Management
EIA	Energy Information Administration
EPA	Environmental Protection Agency
EEPS	Energy Efficiency Portfolio Standard
EERE	US DOE Energy Efficiency and Renewable Energy
GHG	Greenhouse Gas
HECO	Hawaiian Electric Company Limited
HELCO	Hawaiian Electric Light Company Limited
HCEI	Hawaii Clean Energy Initiative
IECC	International Energy Conservation Code
IPCC	Intergovernmental Panel on Climate Change
IRP	Integrated Resource Plan
KIUC	Kaua'I Island Utility Cooperative
Kt	kilotonne
kW	Kilowatt
kWh	Kilowatt-hour
MECO	Maui Electric Company
MJ	Megajoule
Mt	Megatonne
MW	Megawatt
MWe	Megawatt electric
Mt CO_2e	Megatonne Carbon Dioxide Equivalent
NERC	North American Electric Reliability Corporation
NHTSA	National Highway Traffic Safety Administration
NRDC	Natural Resources Defense Council
NOx	Nitrogen Oxides
PUC	Public Utilities Commission
REMI	Regional Economic Models, Inc.
RECS	Renewable Energy Certificates
RPS	Renewable Portfolio Standard
SLH	Session Laws of Hawaii
SO_x	Sulfur Oxides (including sulfur dioxide – SO2)
SSI	Systematic Solutions, Inc.

1 The Role of the Reference Projection in Modeling Hawaii's Greenhouse Gas Policy Options

In 2007, the Governor of Hawaii signed the Greenhouse Gas Reduction Law (Act 234) committing the state to reduce its greenhouse gas emissions to, or below, 1990 levels by 2020. Act 234 ('the Act') required the Department of Business, Economic Development and Tourism (DBEDT) to update the state's inventory of greenhouse gas (GHG) emissions for 1990. ICF was retained by DBEDT to assist in updating the inventory for 1990 and develop an estimate of 2007 emissions. ICF was also contracted to develop a projection of emissions to 2020 as part of an effort to develop proposes work plans to reduce emissions to targeted levels by 2020.

The inventory developed by ICF in December, 2008 indicates Hawaii's greenhouse gas emissions in 1990 were 20.46 Mt CO_2e including sinks. The Act specifically excludes emissions associated with aviation, given the limited ability of the state to influence these emissions. The state target is therefore to reduce greenhouse gas emissions to 13.66 Mt CO_2e by 2020[1]; this level of emissions includes sinks and is adjusted to remove aviation.

In order to conduct a quantitative modeling exercise of the emission reduction options for achieving this target, it is necessary to have a baseline projection to the year 2020 that represents Hawaii in sufficient detail to support analysis of individual measures for reducing emissions through improved efficiency, greater reliance on low carbon and renewable fuels, and other sector and source specific emissions reduction opportunities. The Reference Projection fulfills this role in the modeling exercise – it is the baseline against which proposed policies are measured.

The Reference Projection is an analytical device, not a prediction. In this analysis, the starting year is 2007, building on the analysis conducted for the inventory. The analysis extends to 2020, the target year for bringing emissions down to 1990 levels (13.66 Mt CO_2e). It starts with a calibration of the model to existing greenhouse gas levels (in 2007), and then uses assumptions with respect to the growth of population and economic activity to drive the model forward[2]. It is not a "frozen efficiency" projection, insofar as the model will continue to replace new energy using capital and equipment with capital and equipment that reflects current marginal technology choices, the assumed outlook for energy prices, and other established and ongoing trends that affect the energy intensity of the Hawaiian economy.

[1] This represents total emissions in 1990, including sinks but excluding aviation, as indicated in Table 2 of the ICF Inventory. ICF International, Hawaii Greenhouse Gas Inventory,: 1990 and 2007, December 10, 2008.

[2] A description of the model structure, data input to the model and assumptions used in developing the Assumptions Book are described in the Hawaii Greenhouse Gas Emission Reductions Modeling: ENERGY 2020 Model Inputs and Assumptions (Assumptions Book).

Energy-related greenhouse gas emissions, which constitute over 90% of Hawaii's greenhouse gas emissions, are computed in the model by multiplying the fuel consumed in various sectors and end-uses[3] by the corresponding greenhouse gas emission factors for each fuel. This is the same technique used to generate the energy portion of the Hawaiian greenhouse gas inventory. By feeding the model historical data on fuel and electricity consumption in Hawaii, we can ensure that the model is generating a level and pattern of greenhouse gas emissions that is consistent with the historical inventories. The allocation of emissions by sector and end-use in the model, treatment of self-generation, and other issues result in some differences in the allocation of these emissions by sector, but these differences are not material to the policy evaluation process.

Non-energy sources of greenhouse gas emissions; arising from agriculture, forestry industrial processes, and other activities, represent about 9% of Hawaii's total greenhouse gas emissions. These non-energy sources are represented in the Energy2020 model with a simpler framework than for the energy-related sources. For these sources, the model projects future emissions based on the historical relationships between emission levels and the economic output of the source sectors. This leads to a simpler calibration and projection exercise than for the energy-related sources, and emissions have been tuned to the historical levels in the inventory. For Hawaii, ICF prepared a detailed projection of these non-energy emissions as part of the inventory development process. The methodology used in this analysis is described in Appendix G of the 'Assumptions Book', provided separately.

In the sections which follow, the tables show actual model outputs from the Reference projection. The model makes these projections based on the inputs and assumptions described in the Assumptions Book and based on the forecast of the economy described above.

2 Demographic and Economic Drivers

Demographic and economic data is used by the model to generate demands for services. A forecast of population growth and economic activity was developed in consultation with DBEDT. For both the population and economic data, macro-economic information provided by REMI was adjusted to conform to the DBEDT 2035 projections of population[4] and economic activity[5].

The population growth included in the projection is lower than levels forecast in the DBEDT2035 series. This was a compromise solution made in order to obtain the best

[3] A list of the specific sectors and end uses included in the Hawaii model are provided in Appendix B of the Assumptions Book.
[4] Resident population estimates (as opposed to de facto population estimates, which include visitors) were used in calibrating the baseline in REMI, per correspondence between Bansari Saha, ICF, and Fred Treyz, REMI, in May 2009. DBEDT 2035 Series. Population and Economic Projections for the State of Hawaii to 2035. Research and Economic Analysis Division; Department of Business, Economic Development and Tourism. January 2008
[5] The original and revised macro-economic forecast will be provided to DBEDT as part of the background files with this report.

possible alignment of employment and GDP, which play a much more significant role in driving energy use in ENERGY2020, with the DBEDT 2035 projections.

No significant shifts in housing types are anticipated in the Reference Case though changes in urban form can play a quite significant role in shaping future energy requirements.

Table 1. Economic Drivers of the Reference Projection of GHG Emissions for Hawaii - 2007 - 2020.

Economic Drivers (2008 M$/Year)	2007	2010	2015	2020	Avg. Annual Growth Rate 2007-2020
Personal Income	42,519	46,163	49,456	54,530	1.9%
Population (millions)	1.29	1.37	1.42	1.49	1.1%
Gross Regional Product (GRP)	60,659	69,874	74,120	81,609	2.3%

Economic growth (gross regional product) is projected to grow at an average rate of 2.2% per year over the period to 2020. Because economic growth outstrips population growth over the modeling period, personal income per capita is projected to increase. On a per capita basis, personal income grows by 1.9% per year over the 2007 to 2020 period. This increase in personal income is projected to drive up housing and travel demand, though both may be moderated by energy prices and efficiency policies.

Fuel costs can be critical in projecting the cost of electricity. ENERGY 2020 calculates future electric prices based in part on these fuel costs, which are exogenously input to the model. The Reference Projection energy price forecast is based on the Energy Information Administration's Annual Energy Outlook 2009 Reference Case price forecast for 2009 to 2030.[6] Historic energy price data is taken from US Department of Energy State Energy Data and the DBEDT Data Book.

3 Modeling Results

Total secondary energy[7] use by sector in the Reference Projection is shown in Table 2.

[6] Energy Information Administration, Annual Energy Outlook 2008, Report #DOE/EIA-0383(2008), June 2008, http://www.eia.doe.gov/oiaf/aeo/

[7] Primary energy is a term used to describe energy that has not been subjected to any conversion or transformation. Secondary energy represents only the energy contained in a refined fuel or in electricity delivered to an end-user. For example, it y take 10,000 Btu's of fuel oil (primary energy) to produce 1 kWh containing 3,412 Btu's (secondary energy).

Primary energy use by fuel type is presented in Table 3. Table 2 includes electricity use within each sector [8] but excludes fuel inputs for electricity generation. Table 3 includes all energy use, including the fuel inputs used to generate electricity.

Energy use in residential buildings increases at 0.7% per year over the period, growing more slowly than population growth. Commercial sector energy use remains essentially flat over the period despite economic growth as greater building and equipment efficiency reduces energy intensity per dollar of output. In both sectors, increased energy efficiency is driven in part by rising lighting and equipment standards under the EISA.

Both resident and visitor passenger transportation energy use decline in the period to 2020 by 2.6% and 4.9% respectively. This decrease is driven by vehicle efficiency increases as a result of the CAFÉ standard and the shifting of some trips to the new high-capacity rapid transit line. The reference case assumes the implementation of the CAFE standard included in the Energy Independence and Security Act (EISA) will bring marginal vehicle efficiency to 35.5 mpg by 2020. A variety of other efficiency improvements and renewable fuel requirements included in the EISA are described in the Assumptions Book. Visitor passenger fuel use declines more quickly than for residents as the rental vehicle fleet is turned over more frequently and is therefore dominated by newer vehicles.

Energy use in the freight transportation sector decreases marginally (0.5% per year). Forestry & Agriculture energy use declines by about 4% per year, reflecting a continuation of recent trends, but the absolute change is quite small.

Primary energy use, which includes fuel inputs to the electricity system, shows fossil fuel use either increasing modestly; generally at less than 1% per year, or declining during the period to 2020. Jet fuel and utility gas are the only fossil fuels that show an increase over the period. Renewable fuels, such as biomass and ethanol, on the other hand, show rapid growth as their role in Hawaii's energy supply expands both to meet state requirements and those in the EISA. The table does not attempt to quantify the energy 'inputs' for such renewable sources as hydro, solar and wind. Changes in electricity production from these sources is represented in the tables describing the electricity sector in Section 4.

[8] ENERGY 2020 models 3 multiple sub-sectors within each sector as described in Appendix B of the Assumptions Book. For convenience they have been consolidated in the results which follow. The Freight sector in the tables below includes only highway freight. All other categories are as described in the Assumptions Book.

Table 2. Total Secondary Energy Use by Sector in the Reference Projection

Total Secondary Energy Use *(TBtu/year)*	**2007**	**2010**	**2015**	**2020**	**Avg. Annual Growth Rate 2007-2020**
Residential	11.8	11.9	12.4	13.0	0.7%
Commercial	24.1	24.1	24.3	24.2	0.0%
Industrial	14.0	14.2	14.3	14.1	0.0%
Passenger - Residents	39.6	35.6	31.9	28.1	-2.6%
Passenger - Visitors	6.1	4.6	3.9	3.2	-4.9%
Marine	20.9	21.0	21.0	20.5	-0.1%
Aviation	81.1	85.1	86.8	86.6	0.5%
Freight	19.0	17.9	17.5	17.7	-0.5%
Forestry & Agriculture	0.1	0.1	0.1	0.1	-4.0%
Total	**216.8**	**214.6**	**212.2**	**207.5**	**-0.3%**

Table 3. Total Energy Use by Fuel in the Reference Projection

Total Primary Energy Use *(TBtu/year)*	**2007**	**2010**	**2015**	**2020**	**Avg. Annual Growth Rate 2007-2020**
Biodiesel	-	7.7	15.4	15.5	N/A
Biomass	4.9	7.8	10.0	12.8	7.7%
Coal	15.6	15.8	15.8	15.6	0.0%
Electricity	32.1	32.1	33.1	34.0	0.4%
Ethanol	0.2	1.7	2.9	4.6	26.2%
Gasoline	57.5	49.2	43.2	37.2	-3.3%
Geothermal	2.2	2.2	2.2	2.2	0.0%
HS Diesel	-	-	-	-	N/A
HS Fuel Oil	84.0	72.3	68.8	70.6	-1.3%
Hydrogen	-	-	-	-	N/A
Jet Fuel	81.1	85.1	86.8	86.6	0.5%
LPG	2.4	2.4	2.4	2.3	-0.1%
LS Diesel	15.0	14.8	14.3	13.6	-0.7%
LS Fuel Oil	19.5	21.5	19.4	18.2	-0.5%
Oil, Unspecified	5.5	5.7	5.7	5.5	0.0%
Utility Gas	3.2	3.2	3.3	3.3	0.2%
Still Gas	-	-	-	-	N/A
Waste	5.0	5.0	5.1	6.1	1.6%
Total	**328.3**	**326.4**	**328.4**	**328.2**	**0.0%**

When combined with projected changes in non-energy sources of emissions, this energy use projection translates into the Reference Projection of greenhouse gas emissions shown in Table 4. The model projects that total emissions for the state will decline at a rate of 0.8% per year, reaching 18,289 kt CO_2e by 2020. Note that for this table information for 1990 has been added based on the ICF Inventory. The modeling

did not cover the period back to 1990 and therefore all subsequent tables compare the modeled period from 2007 to 2020.

In general, the relative growth rate in emissions from the different sectors reflects the energy projection described above. However, the inclusion of the non-energy sources, along with some ongoing trends toward lower carbon energy forms (particularly in power generation), slightly change the emission growth rates for some sectors, as compared with the energy growth rates. Emissions from passenger vehicles (residents and visitors) and the power sector decline more quickly than energy use as higher levels of non-emitting biofuels are introduced. In the industrial sector emissions grow more quickly than energy use as process emissions are projected to increase.

Table 4. Reference Projection of Hawaiian Greenhouse Gas Emissions, 1990 - 2020, by Sector

GHG Emissions *(kt)*	**1990**	**2007**	**2010**	**2015**	**2020**	**Avg. Annual Growth Rate 2007-2020**
Residential	30	66	63	64	66	*0.0%*
Commercial	380	329	329	327	315	*-0.4%*
Industrial	880	637	650	649	635	*0.0%*
Passenger - Residents	3,230	2,918	2,534	2,185	1,818	*-3.6%*
Passenger - Visitors	n/a	453	331	271	211	*-5.7%*
Marine	1,650	2,173	2,182	2,184	2,135	*-0.1%*
Aviation	6,800	4,839	5,075	5,180	5,167	*0.5%*
Freight	1,530	1,402	1,298	1,240	1,204	*-1.2%*
Power Sector	6,790	8,745	7,957	7,545	7,684	*-1.0%*
Waste	850	1,032	1,143	1,209	1,320	*1.9%*
Agriculture & Forestry	*(1,690)*	*(2,267)*	*(2,267)*	*(2,266)*	*(2,266)*	*0.0%*
Total	***20,450***	***20,326***	***19,294***	***18,588***	***18,289***	***-0.8%***

It should be noted that the distribution of emissions and energy use for 2007 in the model do not correspond exactly to those shown in the inventory. For the most part this simply reflects differences in how energy use and emissions are distributed by economic sector and end use in the model, however there are also some minor difference resulting from the operation of the power sector and passenger transportation mix in the model. Overall, the modeled level of emissions for 2007 are within 0.5% of inventory levels.

The contribution to total emissions from different sectors shows some change between 2007 and 2020, as shown in Table 5. Transportation (including Aviation) and the Power Sector continue to dominate Hawaii's greenhouse gas emissions in the Reference Projection, together accounting for over three-quarters of total emissions in 2020. However, the contribution from vehicle transportation shrinks as a proportion of the total as higher efficiency takes effect. As passenger transportation becomes more efficient, other forms of transportation start to represent a larger share of total emission implying that they will need to be addressed in order to reduce state emissions.

Table 5. Sector Shares of Hawaiian Greenhouse Gas Emissions, excluding offsets, 2007-2020

Share of Total GHG Emissions	2007	2020
Residential	0.3%	0.3%
Commercial	1.5%	1.5%
Industrial	2.8%	3.1%
Passenger - Residents	12.9%	8.8%
Passenger - Visitors	2.0%	1.0%
Marine	9.6%	10.4%
Aviation	21.4%	25.1%
Freight	6.2%	5.9%
Power Sector	38.7%	37.4%
Waste	4.6%	6.4%

A comparison of reference projection emissions from the model with the state target as established from the inventory indicates that by 2020 emissions included in the target will actually fall to below 1990 levels, falling from 113% of 1990 levels in 2007 to 96% of 1990 levels by 2020. This indicates that policies already in place reduce targeted GHG emissions to below the State's target by 2020.

4 Power Sector

The power sector is the single largest source of GHG emissions in many jurisdictions. This is particularly true in Hawaii, where the power sector is responsible for more than half of current total GHG emissions.

In part, this reflects the fact that demands for space heating and industry are quite low compared with other states, due to climate and economic factors; and in part reflects the relatively high emission intensity of Hawaii's power system due to its historic dependence on oil as the main source of electricity.

Electricity intensity continues to grow in Hawaii. For example, between 2000 and 2007, electricity use per customer on Oahu increased 0.8% per year for residential customers and 0.3% for other accounts[9].

Electricity sales are projected to grow by about 8% over the period to 2020 for the state as a whole (0.6% per year), with the most rapid growth occurring in Oahu and Hawaii county. The residential sector again shows the highest rate of growth (0.9% per year). Industrial sector electricity use is projected to grow very modestly (0.3% per year), well below the projected level of economic growth, implying a decrease in electrical intensity over the period. These rates reflect the impact of efficiency changes specified in the

[9] DBEDT, Hawaii Data Book – 2007, table 17.10.

EISA as well as DSM levels as proposed in the IRP3 process. Electricity use for transportation increases as the mass transit system comes into service[10].

Renewable generation is projected to grow from current levels of 8.5% of sales in 2007 to almost 20% of sales by 2020. This does not include any additional renewables planned beyond those described in the utilities IRP3 submissions. Only one plant, CT1, coming into service in 2009 is assumed to be fuelled with biodiesel under the Reference Projection.

Table 6. Reference Projection of Hawaii Electricity Sales

Utility Sales *(GWh/year)*	**2007**	**2010**	**2015**	**2020**	**Avg. Annual Growth Rate 2007-2020**
Residential	3,150	3,213	3,339	3,528	0.9%
Commercial	5,467	5,487	5,569	5,604	0.2%
Industrial	855	858	881	888	0.3%
Transportation	-	19	107	152	N/A
Military	1,242	1,364	1,390	1,437	1.1%
Total	**10,714**	**10,941**	**11,286**	**11,609**	**0.6%**

Table 7. Hawaii Generation in the Reference Projection

Utility Generation Output *(GWh/year)*	**2007**	**2010**	**2015**	**2020**	**Avg. Annual Growth Rate 2007-2020**
Gas/Oil	8,837	8,040	7,459	7,512	-1.2%
Coal Steam	1,510	1,510	1,510	1,510	0.0%
Hydro	130	130	240	240	4.8%
Biomass	291	474	632	867	8.7%
Wind	137	341	382	420	9.0%
Other Renewable	110	131	139	143	2.1%
Purchases from industry	212	841	1,468	1,469	16.0%
Total	**11,228**	**11,467**	**11,829**	**12,162**	**0.6%**

Electricity prices[11] rise at a relatively modest (2-3% per year) rate in real terms, reflecting some increase in power costs associated with new renewable capacity offset by reductions in fuel costs. Other fossil fuel prices rise in accordance with the EIA's reference price projection from the AEO 2009. Ethanol and biodiesel prices are

[10] Electricity consumption for planned mass transit system based on HECO forecast as described in Assumptions Book. Hawaiian Electric Company Inc., Integrated Resource Plan 2009-2028, Docket No. 2007-0084, September 30, 2008. Appendix L, Exhibit 7, August 2007 and March 2008 sales and Peak Forecast.

[11] Electricity prices are calculated within the model based on the economic dispatch of power plants. The costs and characteristics of new generation capacity additions are based on information provided in IRP3 reports for each utility as described in the Assumptions Book (see section 4.5).

projected to decrease very slightly, however, these prices are subject to higher levels of uncertainty as will be discussed in greater detail in the Work Plan report.

Table 8. Fuel and Electricity Prices in the Reference Projection

Prices (Including Permits) (2008 $/mmBtu)	2007	2010	2015	2020	Avg. Annual Growth Rate 2007-2020
Residential					
Electricity	79.0	93.8	100.6	101.6	2.0%
Utility Gas	43.5	43.3	43.5	44.1	0.1%
Bottled Gas	60.0	65.9	68.5	69.2	1.1%
Commercial					
Electricity	68.1	82.4	89.9	90.8	2.2%
Utility Gas	27.8	27.6	27.8	28.4	0.1%
Oil	22.4	28.3	30.9	31.5	2.7%
Bottled Gas	25.0	30.9	33.5	34.1	2.4%
Industrial					
Electricity	62.7	77.3	84.6	84.3	2.3%
Utility Gas	27.8	27.5	27.6	28.2	0.1%
#6 Fuel	9.9	15.7	18.3	19.0	5.2%
Bottled Gas	-	30.9	33.5	34.1	N/A
#2 Fuel	22.4	28.3	30.9	31.5	2.7%
Transportation					
Gasoline	28.2	34.1	36.7	37.4	2.2%
LS Diesel	25.3	31.1	33.7	34.4	2.4%
Ethanol	28.1	26.9	27.9	27.8	-0.1%
Biodiesel	26.9	25.9	25.3	24.3	-0.8%

5 Transportation

Greenhouse gas emissions in the transportation sector depend on the total vehicle-miles travelled, the fuel efficiency of the vehicles (expressed here in miles per gallon), and the carbon intensity of the fuel being consumed. In the case of passenger transportation, the vehicle miles travelled will in turn depend on the number and length of automobile trips taken, and the occupancy of the vehicles. In the case of freight transportation, the vehicle miles traveled depend primarily on the total tonne-miles of freight movement, but also on the modal split and the capacity factors of the trucks and other freight modes. Marine emissions similarly depend on shipping distances, the efficiency of the vessel and the fuel used. Aviation energy use is not included in this analysis.

In the Reference Projection, total vehicle-miles of passenger travel declines very slightly (0.1% per year) while travel due to visitors declines at 1.8% per year. While the level of travel appears relatively stable number of changes are occurring beneath the surface. Increases in population and personal income over the period result in increased travel; slightly compounded by the lower cost of driving as a result of higher vehicle efficiency.

Offsetting these increases are decreases in vehicle trips as the mass transit system comes into service and to a lesser extent in response to changing fuel prices.

Table 9. Vehicle-Miles Traveled in the Reference Projection

Distance Travelled *(millions of vehicle miles travelled)*					
	2007	**2010**	**2015**	**2020**	**Avg. Annual Growth Rate 2007-2020**
Passenger - Residents	10,284	10,101	10,117	10,153	-0.1%
Passenger - Visitors	1,520	1,371	1,296	1,206	-1.8%

The Reference Projection includes the CAFÉ provisions included in the Energy Independence and Security Act (EISA). The more aggressive standards proposed by the Obama administration were not included. As a result, improvements in the reference projection are more limited, with marginal vehicle efficiency reaching 35.5 mpg by 2020 as shown in Table below. Average vehicle efficiency increases more slowly as the overall fleet turns over and newer, more efficient vehicles enter the market. The increase is more rapid for passenger vehicles for visitors as the rental vehicle fleet turns over more quickly and is therefore more heavily weighted to newer vehicles.

Table 7. Vehicle Fuel Efficiency in the Reference Projection

Marginal Vehicle Efficiency *(miles/gallon)*					
	2007	**2010**	**2015**	**2020**	**Avg. Annual Growth Rate 2007-2020**
Light Gasoline	24.4	30.9	34.0	37.7	3.4%
Medium Gasoline	23.4	29.6	32.6	36.0	3.4%
Heavy Gasoline	17.4	20.7	22.3	24.6	2.7%
Heavy Diesel	17.2	20.3	21.8	24.0	2.6%
Fleet	23.1	29.2	32.2	35.8	3.4%

Average Vehicle Efficiency *(miles/gallon)*					
	2007	**2010**	**2015**	**2020**	**Avg. Annual Growth Rate 2007-2020**
Light Gasoline	23.5	25.0	26.3	29.4	1.7%
Medium Gasoline	21.4	23.2	24.6	27.6	2.0%
Heavy Gasoline	16.9	17.8	18.7	20.6	1.5%
Heavy Diesel	16.9	17.7	18.6	20.4	1.5%
Fleet	22.0	23.6	25.1	28.5	2.0%

The projected level of biofuel use as a result of the Energy Independence and Security Act has been tempered to reflect the levels projected by the EIA in the Annual Energy Outlook 2009. Ethanol use as a percentage of gasoline use reaches 11% by 2020, while bio-diesel as a percentage of diesel use rises to 3.4%.

Renewable Shares	2007	2010	2015	2020	Difference 2007-2020
Ethanol/Gasoline	0.4%	3.4%	6.2%	11.0%	29.3%
Biodiesel/Diesel	0.0%	1.1%	1.9%	3.4%	N/A