

CHAPTER 2

Energy Use by Type of Fuel

UW Oshkosh Uses Digester Technology to Generate **Renewable Electricity** from Waste

Often when people think of renewable energy, they think of solar or wind power. However, in 2011, biogas was responsible for 20 percent of Wisconsin's renewable electricity generation. Biodigesters turn waste into energy by taking advantage of the natural process of decomposition. In nature, decomposing materials release methane into the atmosphere where it becomes a greenhouse gas. In a biodigester, the methane is captured and combusted to generate renewable electricity.

UW-Oshkosh is serious about biodigester technology—not just because of the renewable electricity, but also because of the research opportunities. UWO is affiliated with three different biodigesters—one 'dry' and two 'wet'.

The 'dry' biodigester is one-of-a-kind in this part of the world. The digester is filled with agricultural plant and food waste, and campus food waste from the student dining halls. This waste decomposes, produces biogas, and is combusted in the on-site turbine, generating electricity that is sold to the grid.

But that's not all, the dry digester also provides an opportunity to research and understand how bioplastics and bioproducts degrade. Understanding how well bioplastics decompose and how much biogas is produced from plastics provides valuable information to bioplastics manufacturers seeking to develop food packing and other materials that can safely be disposed of without long-term environmental impacts.

UWO's wet biodigesters use a different kind of waste of which Wisconsin has plentiful suppliers...cow manure.

At Wisconsin's largest Dairy Farm, Rosendale Dairy, the biodigester serves two functions—renewable electricity generation and a living, learning, renewable-energy laboratory. The Rosendale biodigester will process approximately 240 tons per day of separated solids—23 percent total solids will be combined with up to 58,000 gallons per day of liquid manure produced by the dairy's 8,500 cows.

Small dairies can also benefit from biodigester technology. UWO worked with the State Energy Office and BIOFerm to install an anaerobic biodigester at the Allen Farm—a farm with fewer than 500 head of cattle. While also producing waste-to-energy renewable electricity, the research component of this biodigester focuses on providing an answer to concerns about livestock waste infiltrating ground and surface waters.



"There are research opportunities at all three of our biodigesters. We have undergraduate students, graduate students and faculty working at each site and in conjunction with our Environmental Research and Innovation Center (ERIC) lab. The research includes improvement of operations, feedstock optimization, development of new technologies, logistical optimization, development of value-added products," said Greg Kleinheintz, the UWO Associate Dean of the College of Letters and Sciences and Professor of Engineering Technology.

Funding for the research and renewable energy efforts comes from the UW-Oshkosh Foundation, private industry, utilities and the State Energy Office.

Wisconsin Petroleum Use, by Economic Sector

OVERALL
PETROLEUM
USE
1.5%

Overall petroleum use measured in British thermal units (Btu) decreased 1.5 percent in 2011. Eighty-seven percent of the petroleum used in Wisconsin was for transportation, which saw a decrease of 1.9 percent.

Agriculture sector numbers do not include agricultural processing plants; these are classified in the commercial sector.

1970-2011 TRILLIONS OF BTU AND PERCENT OF TOTAL

Year	Residential		Commercial		Industrial		Agricultural ^a		Transportation ^b		Electric Utility		Total	Total End Use
1970	107.9	23.6%	31.5	6.9%	21.1	4.6%	18.1	4.0%	271.2	59.3%	7.9	1.7%	457.7	449.8
1975	87.6	18.4%	27.5	5.8%	19.3	4.1%	18.8	4.0%	314.0	66.1%	7.8	1.6%	475.0	467.2
1980	71.2	15.7%	14.6	3.2%	13.2	2.9%	21.4	4.7%	329.2	72.4%	4.8	1.1%	454.4	449.6
1985 ^r	54.2	13.0%	22.3	5.4%	4.4	1.1%	19.3	4.6%	314.4	75.6%	1.4	0.3%	416.0	414.6
1990 ^r	47.9	10.9%	17.6	4.0%	11.2	2.5%	16.0	3.6%	346.6	78.7%	1.0	0.2%	440.3	439.4
1995 ^r	42.0	9.0%	11.3	2.4%	13.8	3.0%	15.6	3.3%	383.6	82.1%	0.8	0.2%	467.2	466.3
1996 ^r	44.5	9.2%	11.7	2.4%	16.6	3.4%	16.0	3.3%	392.9	81.4%	0.9	0.2%	482.6	481.7
1997 ^r	39.8	8.1%	13.1	2.7%	17.6	3.6%	15.3	3.1%	401.6	82.1%	1.5	0.3%	489.0	487.4
1998 ^r	34.8	7.1%	14.4	2.9%	16.3	3.3%	14.5	2.9%	411.3	83.4%	1.8	0.4%	493.0	491.2
1999 ^r	39.1	7.6%	14.7	2.9%	18.7	3.7%	15.2	3.0%	422.2	82.5%	2.0	0.4%	511.9	509.9
2000 ^r	38.8	7.7%	14.0	2.8%	17.2	3.4%	14.6	2.9%	416.1	82.8%	1.6	0.3%	502.2	500.7
2001 ^r	39.4	7.8%	14.7	2.9%	16.0	3.2%	14.2	2.8%	417.5	82.8%	2.2	0.4%	504.0	501.8
2002 ^r	37.6	7.3%	14.3	2.8%	14.8	2.9%	14.5	2.8%	430.1	83.9%	1.5	0.3%	512.9	511.3
2003 ^r	37.3	7.3%	15.6	3.0%	14.4	2.8%	14.6	2.8%	430.3	83.7%	1.8	0.3%	514.0	512.2
2004 ^r	36.6	7.0%	13.6	2.6%	16.4	3.2%	14.3	2.7%	438.7	84.1%	1.8	0.3%	521.4	519.6
2005 ^r	34.4	6.9%	13.3	2.7%	18.2	3.6%	13.5	2.7%	418.5	83.7%	1.9	0.4%	499.8	498.0
2006 ^r	35.3	7.1%	10.5	2.1%	16.5	3.3%	17.2	3.5%	413.3	83.6%	1.5	0.3%	494.3	492.7
2007 ^r	32.8	6.6%	10.7	2.2%	17.4	3.5%	19.0	3.8%	415.4	83.5%	1.9	0.4%	497.2	495.3
2008 ^r	33.4	7.0%	12.2	2.6%	13.7	2.9%	17.9	3.7%	399.9	83.6%	1.1	0.2%	478.1	477.1
2009 ^r	29.4	6.5%	10.5	2.3%	7.5	1.7%	21.6	4.8%	381.0	84.6%	0.6	0.1%	450.6	450.0
2010 ^r	25.5	5.6%	8.0	1.7%	5.1	1.1%	18.5	4.1%	397.8	87.4%	0.5	0.1%	455.4	454.8
2011 ^p	24.3	5.4%	8.8	2.0%	4.8	1.1%	20.1	4.5%	390.2	87.0%	0.5	0.1%	448.6	448.1

^a In 2005, the SEO discontinued a per-acre approach to gathering fuel data for the agriculture sector and substituted data from the Wisconsin Department of Revenue and the federal National Agriculture Statistics Service (NASS). Data from NASS were not available previous to 2005.

^b These figures do not include any ethanol. In 2011 these figures were historically revised to remove ethanol.

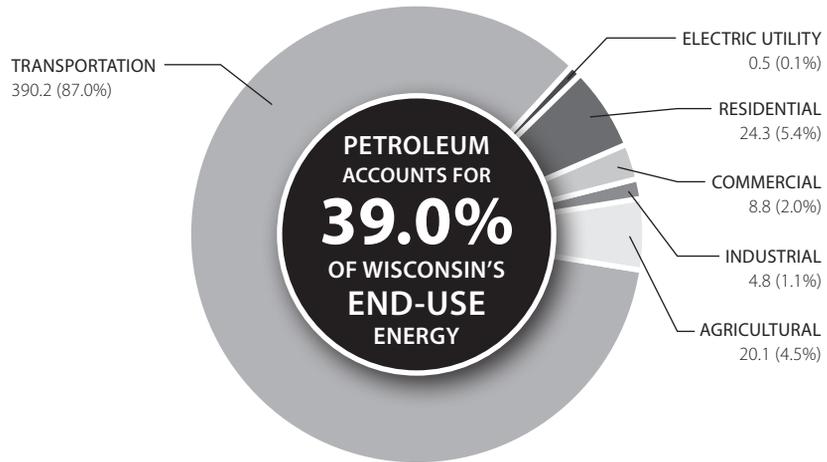
^p Preliminary estimates.

^r Revised.

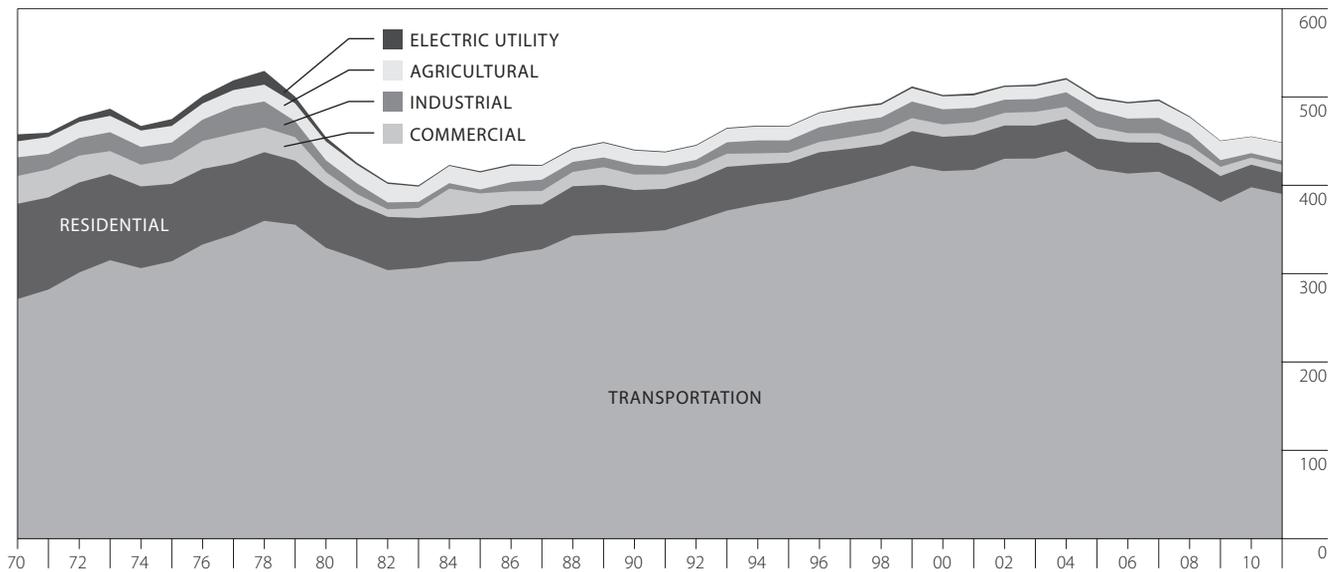
Source: Wisconsin Department of Commerce, Bureau of Petroleum Inspection, *Report on Petroleum Products Inspected and Delivered to Wisconsin* (1970-1995); Wisconsin Department of Revenue, *Collection of Petroleum Inspection Fees* (1996-2006) and *Fuel Tax Statistical Report* (1996-2011); State Energy Office phone and email surveys of airport fixed base operators (2000-2009) and railways (2000-2011); US Department of Energy, Form EIA-782C, *Monthly Report of Petroleum Products Sold into States for Consumption* (1983-2007); US Department of Energy, Form EIA-821 (2003-2011); unpublished data from the National Agriculture Statistics Service (2005-2011).

Wisconsin Petroleum Use, by Economic Sector

2011 TRILLIONS OF BTU AND PERCENT OF TOTAL



1970-2011 TRILLIONS OF BTU



Source: Wisconsin State Energy Office.

Wisconsin Petroleum Use, in Btu, by Type of Product

Middle distillate, which decreased by 0.3 percent since 2010, is used both as a heating fuel in furnaces and boilers, and as diesel fuel in trucks.

Light distillate, which decreased by 5.0 percent since 2010, includes kerosene and is primarily used as a thinner during periods of cold weather.

1970-2011 TRILLIONS OF BTU

Year	Gasoline ^{a,b}	Jet Fuel	Light Distillate	Middle Distillate	Residual Fuel Oil	LPG ^c	Total
1970	244.1	7.7	35.1	123.4	21.9	25.7	457.9
1975	275.4	9.8	16.9	133.5	13.3	26.0	474.9
1980	271.3	11.0	11.3	124.7	11.0	25.2	454.5
1985 ^r	254.2	8.4	14.0	114.7	1.6	23.1	415.9
1990 ^r	267.4	11.0	10.9	120.0	6.1	24.8	440.3
1995 ^r	283.3	10.6	11.1	126.7	4.5	30.9	467.2
1996 ^r	290.0	11.1	12.1	129.6	5.8	34.2	482.6
1997 ^r	294.7	11.3	12.8	132.1	6.2	31.8	489.0
1998 ^r	301.3	11.5	13.0	133.5	6.5	27.3	493.0
1999 ^r	309.2	11.8	13.8	140.0	7.7	29.4	511.9
2000 ^r	303.9	11.7	12.9	136.6	6.8	30.3	502.2
2001 ^r	306.3	11.5	12.9	137.2	7.0	29.2	504.0
2002 ^r	316.7	11.9	12.4	134.7	7.1	30.0	512.9
2003 ^r	318.6	11.6	12.0	138.1	5.9	27.7	514.0
2004 ^r	319.4	12.5	12.5	141.7	6.9	28.3	521.4
2005 ^r	309.3	14.3	11.4	128.7	8.6	27.5	499.8
2006 ^r	299.2	13.9	11.4	133.0	5.1	31.8	494.3
2007 ^r	304.3	12.8	10.3	133.7	4.8	31.3	497.2
2008 ^r	287.9	13.8	10.6	130.7	3.9	31.2	478.1
2009 ^r	285.5	11.8	9.0	109.7	1.3	33.2	450.6
2010 ^r	291.9	13.1	9.5	111.9	0.6	28.4	455.3
2011 ^p	288.7	11.3	9.0	111.6	0.7	27.2	448.6

a Includes both vehicle and aviation gasoline.

b Does not include ethanol. In 2011 these figures were historically revised to remove ethanol. Ethanol use in motor gasoline is shown in the Renewable Energy chapter and later in this chapter.

c Liquefied petroleum gas (propane).

p Preliminary estimates.

r Revised.

Source: Wisconsin Department of Commerce, Bureau of Petroleum Inspection, *Report on Petroleum Products Inspected and Delivered to Wisconsin* (1970-1995); Wisconsin Department of Revenue, *Collection of Petroleum Inspection Fees* (1996-2006) and *Fuel Tax Statistical Report* (1996-2011); U.S. Department of Energy, Form EIA-782C, *Monthly Report of Petroleum Products Sold into States for Consumption* http://www.eia.gov/oil_gas/petroleum/data_publications/prime_supplier_report/psr.html (1983-2011); WI State Energy Office telephone and email surveys of airport fixed base operators (2000-2009) and railways (2000-2011); unpublished expenditure data from the National Agriculture Statistics Service (2005-2011).

Wisconsin Petroleum Use, in Gallons, by Type of Product

1970-2011 MILLIONS OF GALLONS

Year	Gasoline ^{a,b}	Jet Fuel	Light Distillate	Middle Distillate	Residual Fuel Oil	LPG ^c	Total
1970	1,953.0	56.7	260.2	889.7	146.2	269.0	3,574.8
1975	2,203.5	72.4	125.0	962.8	88.8	272.6	3,725.1
1980	2,170.5	81.4	83.4	899.4	73.5	264.1	3,572.3
1985 ^r	2,033.3	62.2	103.7	826.9	10.8	241.5	3,278.4
1990 ^r	2,139.5	81.6	81.0	864.9	40.7	260.2	3,467.9
1995 ^r	2,266.6	78.6	82.0	913.7	30.3	323.8	3,694.9
1996 ^r	2,319.8	82.0	89.4	934.2	38.7	357.9	3,821.9
1997 ^r	2,357.4	84.0	95.1	952.6	41.7	332.9	3,863.6
1998 ^r	2,410.3	85.0	96.0	962.6	43.5	285.9	3,883.4
1999 ^r	2,473.7	87.4	102.5	1,009.5	51.4	307.7	4,032.2
2000 ^r	2,431.2	87.0	95.7	984.6	45.5	317.5	3,961.4
2001 ^r	2,450.2	85.0	95.3	988.9	46.6	306.1	3,972.0
2002 ^r	2,533.7	88.2	91.9	971.2	47.3	314.7	4,047.0
2003 ^r	2,549.0	86.1	88.7	995.8	39.7	290.0	4,049.4
2004 ^r	2,555.6	92.5	92.3	1,021.9	46.3	296.9	4,105.4
2005 ^r	2,474.6	105.7	84.6	928.1	57.4	288.4	3,938.7
2006 ^r	2,393.6	102.9	84.1	959.0	34.1	332.6	3,906.2
2007 ^r	2,434.2	94.6	76.6	963.9	32.1	328.1	3,929.4
2008 ^r	2,303.5	102.4	78.6	942.0	25.8	327.1	3,779.5
2009 ^r	2,284.2	87.0	66.7	791.0	9.0	348.2	3,586.1
2010 ^r	2,334.8	97.0	70.5	807.1	3.9	297.2	3,610.5
2011 ^p	2,309.8	83.7	66.9	804.7	4.5	285.4	3,555.0

GASOLINE
USE

1.1%

JET FUEL

13.7%

LP USE

4.0%

In 2011, gasoline use decreased by 1.1 percent, jet fuel decreased by 13.7 percent, and LP use decreased by 4.0 percent.

^a Includes both vehicle and aviation gasoline.

^b Does not include the ethanol. In 2011, these numbers were historically revised to remove all ethanol. Ethanol use in motor gasoline is shown in the Renewable Energy chapter and later in this chapter.

^c Liquefied petroleum gas (propane).

^p Preliminary estimates.

^r Revised.

Source: Wisconsin Department of Commerce, Bureau of Petroleum Inspection, *Report on Petroleum Products Inspected and Delivered to Wisconsin* (1970-1995); Wisconsin Department of Revenue, *Collection of Petroleum Inspection Fees* (1996-2006) and *Fuel Tax Statistical Report* (1996-2011); U.S. Department of Energy Form EIA-782C, *Monthly Report of Petroleum Products Sold into States for Consumption* (1983-2011) http://www.eia.gov/oil_gas/petroleum/data_publications/prime_supplier_report/psr.html; WI State Energy Office telephone and email surveys of airport fixed base operators (2000-2009) and railways (2000-2011); unpublished data from the National Agriculture Statistics Service (2005-2011).

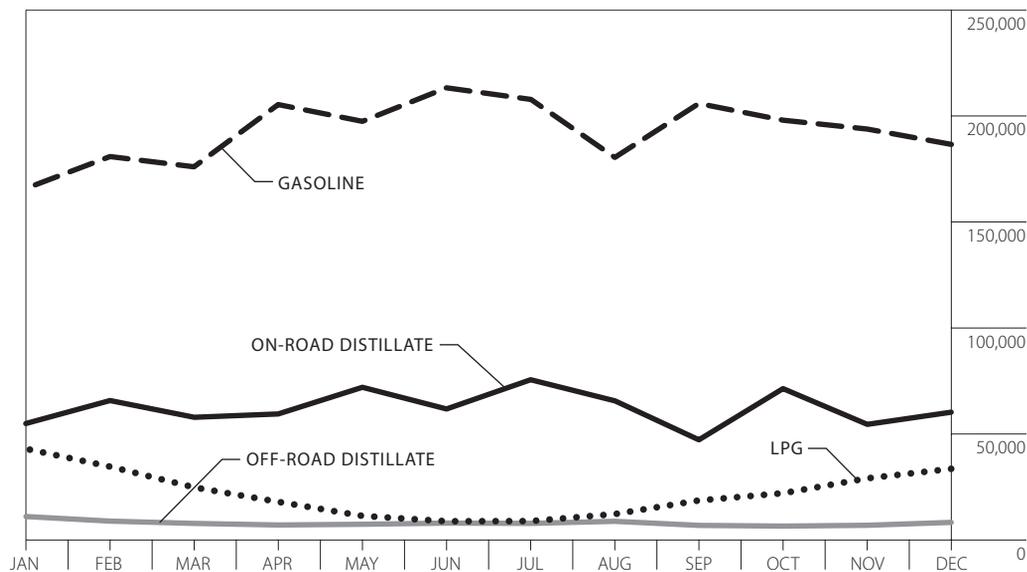
Petroleum Product Deliveries to Wisconsin, by Month

In general, gasoline sales peaked during the summer vacation months, while deliveries of fuels used for heating (off-road distillate and LPG) peaked during winter months.

Figures will not match the consumption figures in earlier pages in this chapter because deliveries do not always translate to sales during the same time frame.

A map of Wisconsin's petroleum pipelines can be found in the Map Appendix at the back of the book.

2011 THOUSANDS OF GALLONS



Month	Off-Road Distillate ^a	On-Road Distillate ^b	LPG ^c	Gasoline ^d
January	10,751	54,621	42,675	165,501
February	8,588	65,447	34,278	180,523
March	7,502	57,555	24,481	175,690
April	6,762	59,135	17,664	205,039
May	7,102	71,690	11,042	197,128
June	7,659	61,466	8,520	212,952
July	7,524	75,260	8,603	207,492
August	8,491	65,312	11,910	180,069
September	6,570	46,888	18,333	205,532
October	6,231	71,046	21,750	197,684
November	6,624	54,213	28,764	193,503
December	7,989	59,963	33,254	186,268
Total	91,792	742,596	261,272	2,307,382

a Kerosene, No. 1 and No. 2 fuel oil used for heating and processing, jet fuel and aviation gasoline used for flying. Does not include non-taxed diesel fuel used on farms.

b On-road diesel fuel sales in Wisconsin.

c Liquefied petroleum gas (propane) deliveries.

d Vehicle gasoline sales; does not include aviation gasoline or ethanol.

Source: Wisconsin Department of Revenue, *Monthly Motor Fuel Consumption Report* (2008-2011); U.S. Department of Energy, Form EIA-782C, *Monthly Report of Petroleum Products Sold into States for Consumption* (2011)

http://www.eia.gov/oil_gas/petroleum/data_publications/prime_supplier_report/psr.html

Wisconsin Production and Use of Ethanol in Reformulated Gasoline, E10 and E85

1994-2011 THOUSANDS OF GALLONS

Year	Production	Consumption			Total
		RFG ^a	E10 ^b	E85 ^c	
1994	NA	NA	13,331	9	13,340
1995	NA	38,048	10,461	17	48,526
1996	NA	49,784	6,973	36	56,793
1997	NA	49,460	8,012	54	57,526
1998	NA	66,571	4,877	58	71,506
1999	NA	67,400	7,937	63	75,400
2000	NA	70,724	23,080	43	93,847
2001	NA	67,449	18,458	32	85,939
2002	15,529	71,152	17,026	48	88,226
2003	76,947	77,302	23,536	86	100,924
2004	106,886	74,816	27,617	106	102,539
2005	171,764	73,046	49,191	723	122,960
2006	210,386	77,614	50,498	2,302	130,414
2007	283,873	69,963	86,472	4,800	161,235
2008	447,388	68,047	143,849	5,100	216,996
2009	462,022	74,142	150,347	5,200	229,689
2010	438,260	77,968	174,399	2,995	255,362
2011	496,366	76,927	147,704	2,447	227,078

ETHANOL
PRODUCTION
13.3%

In 2011, Wisconsin ethanol production increased 13.3 percent. Ethanol use in Wisconsin decreased 11.1 percent with decreased consumption of RFG (1.3 percent), E10 (15.3 percent) and E85 (18.3 percent).

The decreased consumption of ethanol in Wisconsin in 2011 is related to a number of factors, including: the sunset of a per-gallon tax credit (valued at \$0.45/gallon) for producers and distributors, and increased prices for corn feedstock due to the drought.

Ethanol is one of the few energy sources that Wisconsin exports.

a RFG is reformulated gasoline. Starting January 1, 1995, the federal government mandated its sale in six southeastern Wisconsin counties to comply with the Clean Air Act. Ethanol is used to provide the oxygenate required in RFG.

b E10 is a motor fuel blend consisting of 10 percent ethanol and 90 percent conventional gasoline (non RFG).

c E85 is a motor fuel consisting of 85 percent ethanol and 15 percent gasoline.

p Preliminary.

r Revised.

NA – Not Available.

Source: Wisconsin Department of Revenue; Wisconsin State Energy Office survey of E85 distributors; U.S. Department of Energy, Form EIA-782C, *Monthly Report of Petroleum Products Sold into States for Consumption* (2011)
http://www.eia.gov/oil_gas/petroleum/data_publications/prime_supplier_report/psr.html.

Wisconsin Liquefied Petroleum Gas Use, by Economic Sector

LPG USE
4.0%

Liquefied petroleum gas (LPG), (propane), use decreased 4.0 percent in 2011.

Agriculture sector numbers do not include agricultural processing plants; these are classified in the commercial sector.

1970-2011 MILLIONS OF GALLONS AND PERCENT OF TOTAL

Year	Residential		Commercial		Industrial		Agricultural ^a		Transportation		Total
1970	190.9	70.9%	23.8	8.8%	28.2	10.5%	26.2	9.7%	NA	0.0%	269.1
1975	176.5	64.7%	36.5	13.4%	29.5	10.8%	30.1	11.0%	NA	0.0%	272.6
1980	176.3	66.7%	33.5	12.7%	17.5	6.6%	36.9	14.0%	NA	0.0%	264.2
1985 ^r	158.2	65.5%	29.4	12.2%	19.3	8.0%	34.6	14.3%	NA	0.0%	241.5
1990 ^r	162.1	62.3%	36.5	14.0%	35.7	13.7%	25.9	10.0%	NA	0.0%	260.2
1995 ^r	203.8	62.9%	48.0	14.8%	35.0	10.8%	30.9	9.5%	6.1	1.9%	323.8
1996 ^r	219.5	61.3%	51.7	14.5%	43.9	12.3%	36.8	10.3%	6.0	1.7%	357.9
1997 ^r	210.3	63.2%	48.7	14.6%	35.0	10.5%	33.1	9.9%	5.8	1.7%	332.9
1998 ^r	183.5	64.2%	42.5	14.9%	30.1	10.5%	24.2	8.5%	5.7	2.0%	285.9
1999 ^r	197.9	64.3%	45.8	14.9%	31.4	10.2%	27.6	9.0%	5.1	1.7%	307.7
2000 ^r	211.0	66.5%	47.2	14.9%	28.7	9.0%	25.3	8.0%	5.3	1.7%	317.5
2001 ^r	204.0	66.7%	45.8	15.0%	28.3	9.2%	23.5	7.7%	4.6	1.5%	306.1
2002 ^r	213.1	67.7%	47.6	15.1%	26.0	8.3%	24.0	7.6%	4.0	1.3%	314.7
2003 ^r	198.9	68.6%	43.7	15.1%	20.7	7.1%	22.8	7.9%	3.8	1.3%	290.0
2004 ^r	203.2	68.5%	44.7	15.1%	21.2	7.1%	24.1	8.1%	3.7	1.2%	296.9
2005 ^r	198.5	68.8%	43.6	15.1%	20.7	7.2%	22.6	7.8%	3.0	1.0%	288.4
2006 ^r	228.3	68.6%	50.2	15.1%	23.8	7.1%	27.1	8.1%	3.2	1.0%	332.6
2007 ^r	224.6	68.5%	49.4	15.1%	23.4	7.1%	28.4	8.6%	2.3	0.7%	328.1
2008 ^r	221.2	67.6%	48.7	14.9%	23.1	7.1%	31.8	9.7%	2.4	0.7%	327.1
2009 ^r	232.6	66.8%	51.2	14.7%	24.3	7.0%	37.8	10.9%	2.2	0.6%	348.2
2010 ^r	201.0	67.6%	44.2	14.9%	21.0	7.1%	28.7	9.7%	2.3	0.8%	297.2
2011^p	197.3	69.1%	43.4	15.2%	20.6	7.2%	22.5	7.9%	1.6	0.6%	285.4

^a Starting with 2005 data, the SEO discontinued a per-acre approach to gathering fuel data for the agriculture sector and substituted data from the Wisconsin Department of Revenue and from the federal National Agriculture Statistics Service (NASS).

^p Preliminary estimates.

^r Revised.

NA - Not available.

Source: U.S. Department of Energy, Form EIA-25, *Prime Supplier's Monthly Report* (1974-2011) and Form EIA-782C, *Monthly Report of Petroleum Products Sold into States for Consumption* (1983-2011) http://www.eia.gov/oil_gas/petroleum/data_publications/prime_supplier_report/psr.html; National Agricultural Statistics Service, unpublished data (2005-2011); Wisconsin Department of Revenue, *Monthly Motor Fuel Consumption Report* (2008-2011).