



Energy Consumption

Formerly Indicator # 7057

Overall Assessment

Trend: Increasing

Rationale:

The trend of total energy consumption in the eight Great Lakes States and Ontario has increased over the eighteen-year examined period. Between 1990 to 2008, energy consumption has increased 10.0%. However, the short term trend assessment of energy consumption from 2005-2008 illustrates that the total energy usage has decreased (a drop of 3.0% from 2005).

Lake-by-Lake Assessment

Trends were not made on an individual lake basis.

Purpose

- To provide energy consumption use trends in the Great Lakes region
- The energy consumption indicator is used in the Great Lakes indicator suite as a Driving Force indicator in the Economic/Social category

Ecosystem Objective

Resource conservation and minimizing the unnecessary use of resources are endpoints for ecosystem integrity. Impacts from energy consumption should be managed so that beneficial uses of the Great Lakes are not impaired, and pollution is controlled as outlined in Annex 2 and Annex 15 of the Great Lakes Water Quality Agreement.

Ecological Condition

In this report, the Great Lakes region is defined as the eight Great Lakes States and the province of Ontario. Energy consumption within the Great Lakes region is examined by data extracted primarily from the Statistics Canada, Natural Resources Canada, Canadian Industrial Energy End-Use Data and Analysis Centre, and the United States Information Administration. The unit of analysis for energy consumption is secondary energy use as reflected in Megawatts Hour (MWh).

Secondary energy is energy used by the final consumer. It includes energy used to heat and cool homes and workplaces, as well as to operate appliances, vehicles and factories. Table 1 lists the total secondary energy use in the Great Lakes States and Ontario from 1990 and 1995-2008. As seen in Table 1, in 2008, the total secondary energy consumption rate in the Great Lakes region is 8,247,276,452 MWh. Secondary energy does not include intermediate uses of energy for transporting energy to market or transforming one energy form to another; this is primary energy (State of the Great Lakes 2009; 294). This report will focus on examining the secondary energy usage in the Great Lakes region.

A) Great Lakes Region as a whole (Ontario + Eight Great Lakes States)

The energy consumption for the entire Great Lakes region has fluctuated over the eighteen-year period (Figure 1). Comparing the 1990 and 2008 total energy consumption data, the Great Lakes region total energy use grew by 10%. Within the four specific sectors, the industry sector is the most energy consuming sector in the Great Lakes region (Figure 2). However, the most recent data available from 2008 indicates that whereas in 1990 the industrial sector consumed 37% of the total energy, it has since decreased to 30.0% (Figure 3 & 4). The remaining three sectors, residence, transportation and commercial have increased their share of energy use by 1%, 3% and 3% respectively since 1990.

In examining the short-term trend analysis, the energy consumption from 2005 to 2008 shows a fluctuation range between a decline of 1.4% to an increase of 3.7%. There was a decrease in energy consumption from 2005 to 2006 (3.7 %); but in the next year (2006 to 2007), the consumption rate experienced an increase of 2.5% (Figure 5). Re-

turning to 2007-2008, the energy usage in the Great Lakes region decreased once again by another 1.0%, leaving the total energy consumption rate in 2008 as 8,247,276,452 MWh.

To obtain a greater understanding of the energy consumption rate within the region, population data from the U.S. Census and Statistics Canada have been included to examine the average energy use per person within the region (energy consumption per capita). In 1990, the total population within the Great Lakes region as defined in this report was 86,323,139 (Table 2). The total population's total energy consumption was 7,429,731,790 MWh/h, and its per capita usage was 87 MWh/per person/per year. It is worth noting that while the energy consumption has increased, per capita usage has dropped slightly. Compared to 1990, although the 2008 population in the Great Lakes region had an increase of 10.6%, its energy usage per capita declined by 3.4% to 84 MWh/per person per year.

B) Comparison between Ontario and the Eight Great Lakes States

The overall trends in energy consumption by sector were quite similar on both sides of the basin. In Ontario, the total secondary energy consumption by the four sectors in 2008 was 763,472,222 MWh (Table 3). The transportation sector accounted for the largest end user percentage of energy consumption at 32%. Energy consumption in the other three sectors was as follows: residence with 21%, commercial/institutional with 18% and industrial with 30% (Figure 6).

Total secondary energy consumption by the four sectors on the eight U.S. Great Lakes States in 2008 was 7,483,804,229 Megawatt hours (MWh) (Table 3). For the U.S Great Lakes States, the industrial sector was the largest consuming sector with 30% in 2008. The remaining three sectors account for 70% of the total, as follows: transportation and residential with 25% each and the commercial/institutional sector with 20% (Figure 6).

Linkages

Both Canada and the United States are among the world's top per capita electricity and energy consumers; consuming energy can cause a wide range of health and environmental impacts. Environmental impacts are caused by actions required to produce energy, including oil and gas exploration and development, coal mining, hydroelectric dams and reservoirs (Boyd 2001). According to a Stockholm Environment Institute report, current pressure exerted on the ecosystem as a result of energy generation and consumption is unsustainable (Persson and Noel 2010). As one of the main driving forces, energy consumption is triggering (direct and indirect) pressures on the ecosystem.

Energy consumption is a direct and indirect driving force behind many of the pressures on the Great Lakes. According to the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), energy consumption has a direct effect on greenhouse gas emissions, emission of air pollutants, acid precipitation and pollution of toxic substance (UNESCAP 2001). Consequently, these effects have a direct impact on biodiversity and the ecosystem.

There is, for example, a direct correlation between energy consumption and the emission of air pollutants. Burning fossil fuels can cause emission of air pollutants into the atmosphere and via atmospheric deposition on to land and water surfaces. Water is a "dangerously effective carrier of pollutants emitted into the air from the combustion of coal and other fossil fuels" (Krantzberg and Bassermann 2010). Rain transports pollutants to watersheds, lakes and rivers, and can therefore compromise water quality. For this reason, initiatives such as the UNEP global Mercury Partnership are calling for mercury global partnerships between governments and other stakeholders to reduce risks to human health and the environment from the release of mercury and its compounds to the environment from sources such as fossil fuel consumption (UNEP 1).

For other renewable energies such as hydroelectricity, solar power and wind power, the debate surrounding these usages has been controversial. While the use of renewable energy sources is considered more environmentally friendly and fairly economically feasible, it still elicits reactions from local communities and environmental policy-makers on their limited benefits, potential tradeoffs and visual pollution.

In the case of hydroelectric power, while its usage is seen as more environmentally friendly, it does come at some environmental cost, particularly on water resources (Krantzberg and Bassermann 2010). Large hydro power can cause disruption in natural river cycles, which in turn affects the aquatic ecosystem, degrades upstream catchment

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areas and impacts crop productivity (Persson and Noel 2010). In addition, building hydroelectric dams often leads to the loss of forests, wildlife habitat, and species populations.

In the case of solar energy, use of toxic chemicals in the manufacturing of solar energy cells presents a problem both during use and disposal (IUCN 2008).

In the case of wind power, the usage of wind turbines has been controversial. On one hand, recent studies report that wind farms pose no serious environmental threats, and in some cases an off-shore wind-farm may even improve the marine ecosystem (Phadke 2010, and Bergman et al.2011). On the other hand, there are concerns that building wind turbines can result in ecosystem disruption in terms of habitat loss at large wind farms, and with rotors causing mortality of migratory birds (IUCN 2008).

Management Challenges/Opportunities

The linkages between energy use and stress on the Great Lakes health are outlined above. The Great Lakes community and decision makers should continue to support global, national, regional and local energy use conservation initiatives and, seek ways to minimize the stress that energy use and energy production can cause to the Great Lakes ecosystem.

Comments from the author(s)

In comparison to the Great Lakes region as defined in this report, the total energy use for the Great Lakes watershed would be less. Nonetheless, this data serves the indicator report’s purpose well by illustrating a socio-economic trend that is a driving force behind many of the pressures on the Great Lakes conditions, and the socio-economic context is which decision-makers are working within. The investment required to breakdown energy use trends specifically for the Great lakes watershed boundary and/or on a lake-by-lake level would only be worthwhile should formal energy use conservation reduction targets be set for that defined geographic boundary.

Assessing Data Quality

Insert “x” under the statement that best corresponds with each data characteristic

Data Characteristics	Strongly Agree	Agree	Neutral or Unknown	Disagree	Strongly Disagree	Not Applicable
1. Data are documented, validated, or quality-assured by a recognized agency or organization	X					
2. Data are traceable to original sources	X					
3. The source of the data is a known, reliable and respected generator of data	X					
4. Geographic coverage and scale of data are appropriate to the Great Lakes basin	X					
5. Data obtained from sources within the U.S. are comparable to those from Canada	X					
6. Uncertainty and variability in the data are documented and within acceptable limits for this indicator report	X					
Clarifying Notes:						

Acknowledgments

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Source:

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Source:

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Source:

Last Updated

State of the Lakes Ecosystem Conference (SOLEC) 2011

Year	Total Energy Use (MWh)	Residence	Commercial	Industrial	Transportation
1990	7,429,731,790	1,720,089,146	1,266,281,782	2,711,060,722	1,732,300,141
1995	7,953,728,327	1,881,985,073	1,430,974,398	2,791,232,982	1,849,535,875
1996	8,193,830,538	1,965,544,382	1,478,911,839	2,867,398,314	1,881,976,003
1997	8,188,486,379	1,889,090,097	1,494,270,762	2,884,634,732	1,920,490,789
1998	8,009,460,149	1,760,838,819	1,466,623,015	2,816,275,765	1,965,722,550
1999	8,296,601,235	1,878,856,669	1,535,890,162	2,840,141,925	2,041,712,479
2000	8,462,325,567	1,948,509,147	1,615,126,033	2,820,664,154	2,078,026,233
2001	8,134,622,104	1,899,472,020	1,610,799,287	2,585,355,733	2,038,995,064
2002	8,244,054,100	1,983,378,737	1,636,049,498	2,561,858,399	2,062,767,466
2003	8,338,580,794	2,030,464,961	1,639,774,499	2,581,586,950	2,086,754,383
2004	8,426,769,846	1,987,371,590	1,648,665,008	2,634,747,673	2,155,985,576
2005	8,472,930,380	2,052,945,322	1,649,586,013	2,575,162,448	2,195,236,598
2006	8,157,785,682	1,877,010,541	1,585,196,860	2,512,107,037	2,183,471,244
2007	8,364,775,670	1,998,980,762	1,641,411,359	2,530,691,551	2,193,691,997
2008	8,247,276,452	2,001,826,800	1,664,997,902	2,441,979,930	2,138,471,820

Table 1. Energy Consumption in the Great Lake Region from 1990, 1995-2008.

Source:

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State/Province	Total Energy Consumption within the Great Lakes Region (1990)	Population within the Great Lakes Region (1990)	Total Energy Consumption within the Great Lakes Region (2008)	Population within the Great Lakes (2008)
Ontario	653,166,666	(1991) – 10,085,000	763,472,222	12,932,300
Illinois	1,055,466,152	11,430,602	1,198,279,684	12,842,954
Indiana	738,685,632	5,544,159	837,421,275	6,388,309
Michigan	832,058,075	9,295,297	855,269,304	10,002,486
Minnesota	407,456,708	4,357,099	580,016,955	5,230,567
New York	1,099,309,583	17,990,455	1,168,826,041	19,467,789
Ohio	1,125,979,052	10,847,115	1,155,286,158	11,528,072
Pennsylvania	1,085,505,936	11,881,643	1,142,889,252	12,566,368
Wisconsin	432,103,986	4,891,769	548,815,561	5,627,610
Total:	7,429,731,790	86,323,139	8,250,276,452	96,586,455

Table 2. Energy Consumption and Population within the Great Lakes Region (Ontario + 8 States).
Source:

State/Province	Total Energy Consumption by State/Province(MWh)
Ontario	763,472,222
U.S. Basin Total (2008)	7,483,804,229
Illinois	1,198,279,683
Indiana	837,421,275
Michigan	855,269,304
Minnesota	580,016,955
New York	1,168,826,041
Ohio	1,155,286,158
Pennsylvania	1,142,889,252
Wisconsin	545,815,561

Table 3. Total Energy Consumption Rate by State/Province in 2008.
Source:

	2005	2006	2007	2008
Ontario	733,250,000	748,861,111	775,055,556	763,472,222
Illinois	1,218,794,659	1,169,969,019	1,198,836,519	1,198,279,684
Indiana	855,591,682	836,981,669	852,455,821	837,421,275
Michigan	929,504,206	879,682,124	880,971,636	855,269,304
Minnesota	550,709,848	543,353,764	559,003,759	580,016,955
New York	1,219,820,408	1,149,160,973	1,190,161,615	1,168,826,041
Ohio	1,189,194,481	1,143,475,394	1,186,820,605	1,155,286,158
Pennsylvania	1,185,150,100	1,149,922,957	1,176,475,196	1,142,889,252
Wisconsin	550,914,997	536,378,672	544,994,962	548,815,561

Table 4. Total Energy Consumption Rate from 2005 – 2008.
Source:

Figure 1: Total Energy Consumption in all Great Lakes Locations in 1990, 1995-2008

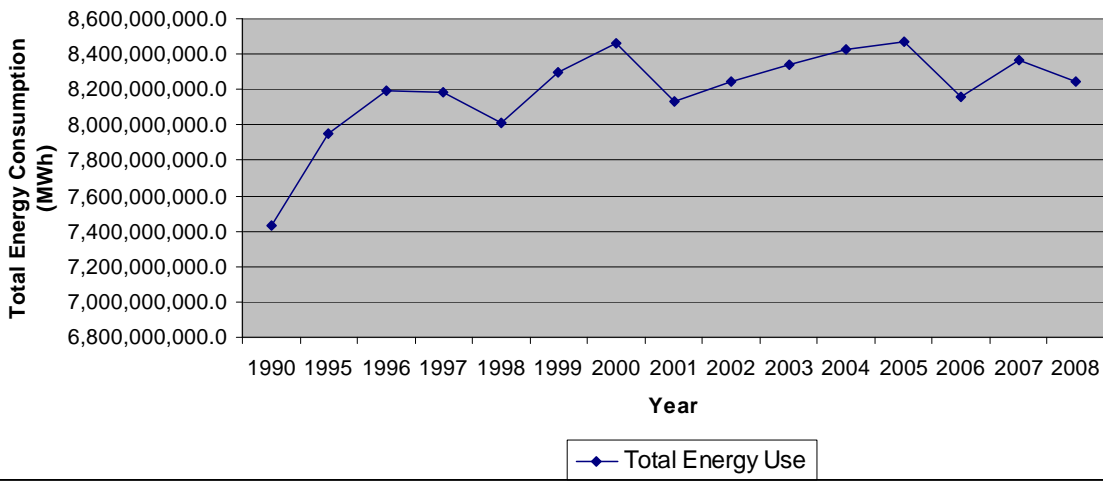


Figure 2: Total Energy Consumption by Sectors in all Great Lake Locations in 1990, 1995-2008

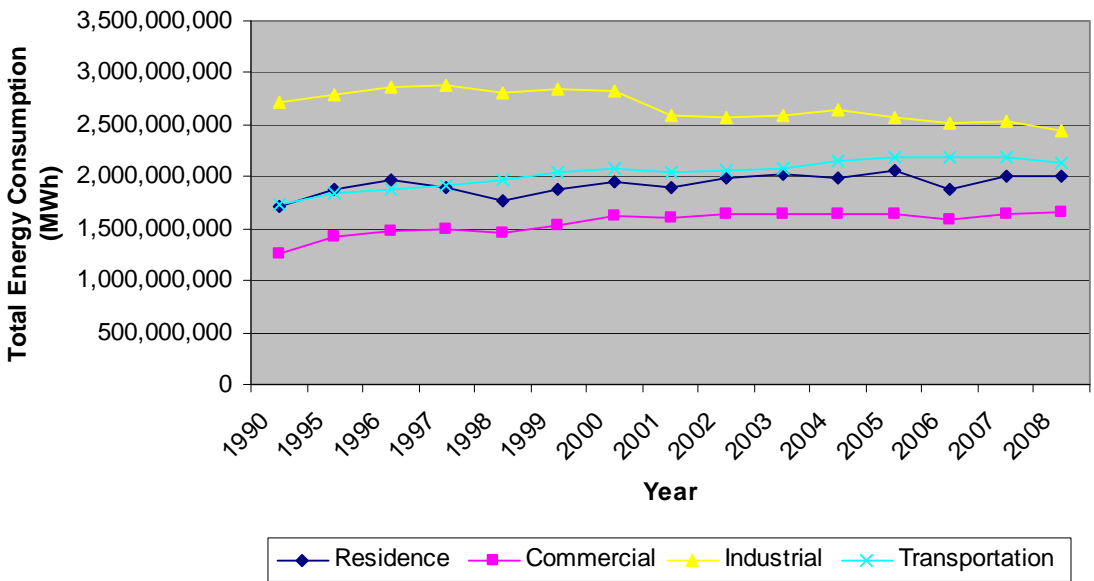


Figure 3: The percent contribution of each of the four sector within the Great Lake Region in 1990

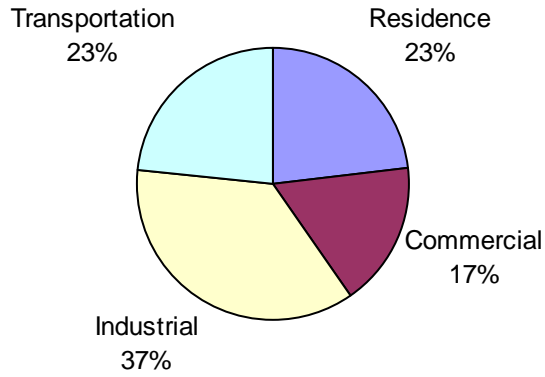


Figure 4: The percent contribution of each of the four sectors within the Great Lake Region in 2008

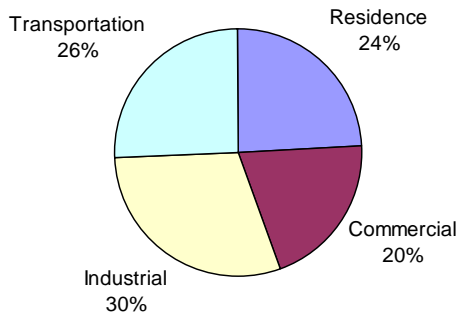


Figure 5: Total Energy Consumption in the Great Lake States and Ontario (2005-2008)

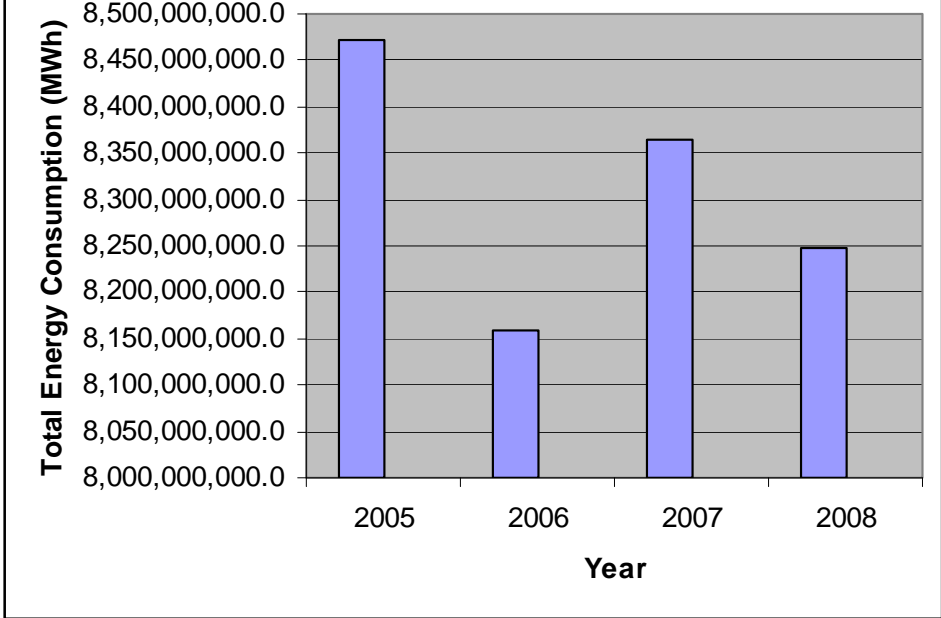


Figure 6: Comparison of total energy consumption for Ontario and all Great Lake States in 2008 (MWh)

