RECONNECTING FORT WAYNE: Infrastructure

System Reliability and Energy Efficiency Benchmarking

Prepared for
City of Fort Wayne, Indiana

By Anne Evens
Center for Neighborhood Technology

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CNT

Fort Wayne System Reliability and Energy Efficiency Benchmarking Report

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About the Center for Neighborhood Technology

The Center for Neighborhood Technology (CNT) was founded in 1978 to research, adapt and test new community revitalization strategies relevant to urban communities, especially strategies that harnessed the environmental and economic value of the more efficient use of naturalresources. Over the years, CNT has worked to disclose the hidden assets of the Chicagoland economy and urban areas more broadly; demonstrate the multi-bottom line benefits of more resource-efficient policies and practices; and show how the value of what we demonstrated could be captured to benefit communities and their residents inclusively. CNT's work, especially in the areas of energy, transportation, materials conservation and housing preservation, helped fuel a generation of community development institutions and learning, garnering us a reputation as an economic innovator and leader in the field of creative sustainable development.

CNT serves as the umbrella for a number of projects and affiliate organizations, all of which help the organization fulfill its mission: to promote the development of more livable and sustainable urban communities. CNT's transportation work is focused on using transportation assets to serve both the environmental and economic development goals of regions and communities. CNT works to boost demand for clean, efficient and affordable mass transit; increase the supply of traditional and non-traditional mass transit services; disclose the linkages between transportation costs and housing affordability; create model value-capture mechanisms that take advantage of the intersection of efficient transportation networks with community economic development programs; and promote policy initiatives that increase public participation in investment decisions and make more resources available for sustainable investments.

More information about CNT is available at www.cnt.org.

System Reliability & Energy Efficiency Benchmarking

Establishing measureable goals for the city's energy service is a critical step towards defining a sustainable energy plan. In order to establish realistic and achievable goals, it is necessary to define indicators and identify performance standards that have been achieved in other cities with comparable climates and housing types. Data from the following sources was reviewed to establish performance benchmarks for system reliability and for energy consumption: data provided by AEP, national studies including the Residential Energy Consumption Survey and the Commercial Building Energy Consumption Survey, regional studies including the Midwest Energy Efficiency Alliance study and the American Council for an Energy Efficient Economy (ACEEE) studies.

Reliability & Power Quality Goals for Fort Wayne

Widespread and intermittent outages experienced in the U.S. over the last few years have brought new attention to the issue of system reliability. Outages are expensive both for utilities and for customers.[1] A variety of benchmarks have been developed to measure overall system reliability.

The System Average Interruption Frequency Index (SAIFI) is commonly used as a reliability indicator by electric power utilities. SAIFI is the average number of interruptions that a customer experienced, and is calculated as:

$$\text{SAIFI} = \frac{\text{total number of customer interruptions}}{\text{total number of customers served}}$$

SAIFI is measured in the number of events (of interruption) per customer. It is usually measured over the course of a year.

The System Average Interruption Duration Index (SAIDI) is another reliability indicator commonly used and reported by electric power utilities. SAIDI is the average outage duration for each customer served, and is calculated as follows:

$$\text{SAIDI} = \frac{\text{sum of all customer interruption durations}}{\text{total number of customers served}}$$

SAIDI is measured in units of time, often minutes or hours. It is usually measured over the course of a year.

The Customer Average Interruption Duration Index (CAIDI) is also a reliability index commonly used by electric power utilities. Related to SAIDI and SAIFI, CAIDI is the average outage duration that customers experienced. CAIDI can also be thought of as the average restoration time. It is calculated by the following formula:

$$\text{CAIDI} = \frac{\text{total number of customer interruptions}}{\text{total number of customers served}} = \frac{\text{SAIDI}}{\text{SAIFI}}$$

CAIDI is measured in units of time, often minutes or hours. It is usually measured over the course of a year.

The Momentary Average Interruption Frequency Index (MAIFI) is a reliability indicator that is also used by electric power utilities, but is rarely reported. MAIFI is the average number of sub-5-minute (i.e. "momentary") interruptions that a customer would experience during a given period (typically a year), and is calculated as follows:

$$\text{MAIFI} = \frac{\text{total number of customer interruptions less than five minutes}}{\text{total number of customers served}}$$

Although the MAIFI has tended to be less reported than other reliability indicators, it is useful for tracking momentary power outages, or "blinks," that can be hidden or misrepresented by an overall outage duration index like SAIDI or SAIFI.

Momentary power outages are often caused by transient faults, such as lightning strikes or vegetation contacting a power line, and many utilities use reclosers to automatically restore power quickly after a transient fault has cleared.

The following table shows the Electricity Reliability Indicators for I&M, Indiana Utilities and North American Utilities.

Table 1. Electricity Reliability Indicators

	SAIFI			SAIDI (Minutes)			CAIDI (Minutes)		
Year	I&M[2]	Indiana Utilities[3]	North American Utilities[4]	I&M[5]	Indiana Utilities[6]	North American Utilities[7]	I&M[8]	Indiana Utilities[9]	North American Utilities[10]
2002	1.681	1.47	1.1	179.1	145	90	159.3	119.9	81.6
2003	1.583	1.43	1.1	128.5	158	90	135	140.2	81.6
2004	1.424	1.42	1.1	194.1	145	90	155.6	130.1	81.6
2005	1.311			170.7			171.1		
2006	1.242			146.7			130.6		
2007**	1.237			139.1			125.6		

It should be noted that the data for I&M refers to the entire service territory and not specifically to Fort Wayne. Additionally, the data reported for North American utilities is for 1998.

Some cities, such as Austin, Texas, have established very aggressive goals for system reliability compared to Fort Wayne's current performance. Austin's benchmarks include a SAIDI of 60 minutes, compared with Fort Wayne's 129.1 to 194.1 minutes, and a SAIFI of 0.8 interruptions per year compared with Fort Wayne's 1.237 to 1.681.

It should be noted that Austin's weather patterns are different. All system reliability measures should take weather patterns into consideration.

Recommendations

1. AEP should report these data for Ft. Wayne specifically and by geography if possible. This data can be used to develop a plan for improvement.
2. The best way to improve these reliability performance measures is to address the worst performing feeders.
3. AEP and Ft. Wayne could use these data to market particularly to commercial customers.

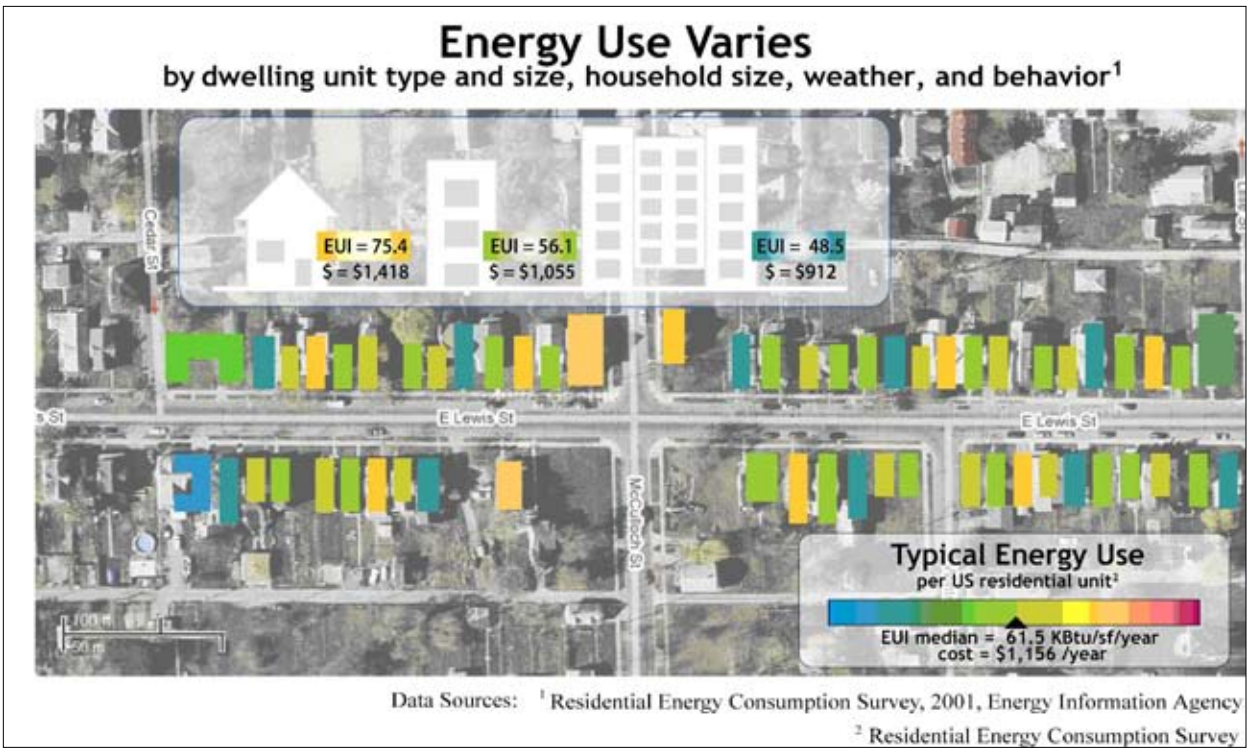
Goals for Energy Consumption in Buildings Goals for Fort Wayne

The cost of energy is one of the largest, fastest growing, and least predictable components of the operating costs of buildings in the Midwest. Energy costs are dependent upon both price and consumption. As energy prices continue to rise, it becomes increasingly important to invest in improvements that reduce energy consumption. The Energy Use Intensity (EUI) as measured in Kilo-Btu's per square foot per year, is the standard measure of energy consumption in buildings. This measure can summarize all energy consumption (natural gas, electricity, and other fuels) or it can be reported by fuel type. The EUI values included in this report reflect total energy consumption from all fuel types.

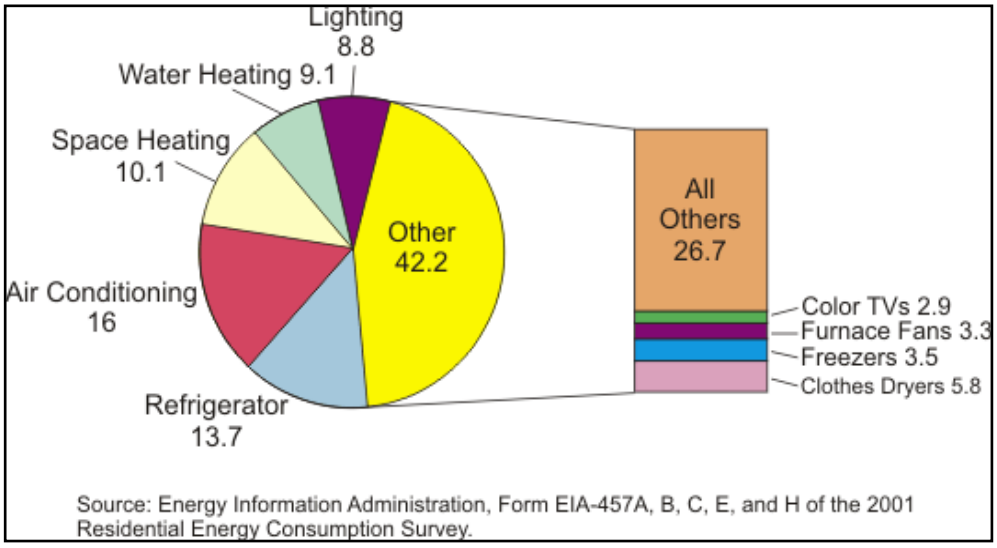
The US Department of Energy has conducted regular surveys of the energy consumption in buildings for residential and commercial buildings approximately every three years since 1980. These surveys called the Residential Energy Consumption Survey (RECS) and the Commercial Building Energy Consumption Survey (CBECS) are the best source of comparable EUI data.[11] The following sections and charts summarize EUI comparison data for several types of buildings and commercial establishments that are relevant to the City of Fort Wayne. The comparison data is for the East North Central Region represented in the RECS and CBECS dataset which includes Illinois, Indiana, Michigan, Ohio and Wisconsin.

Residential Buildings

The EUIs for average energy consumption in existing residential buildings for the East North Central Region are 75.4 KBtu/sqft/year for single family homes, 56.1 KBtu/sqft/year for two to four unit buildings, and 48.5 KBtu/sqft/year for multi-family buildings with five units and greater. The following graphic shows how EUIs could vary in a sample neighborhood in Fort Wayne and with a benchmark for the average EUI by type of building which provides context to the homeowner, real estate agent or community member. In this graphic, the bluer homes are the most energy efficient per square foot and the pink or red homes are less energy efficient per square foot. This information can be used to help people identify how their homes compare with other homes in their community.



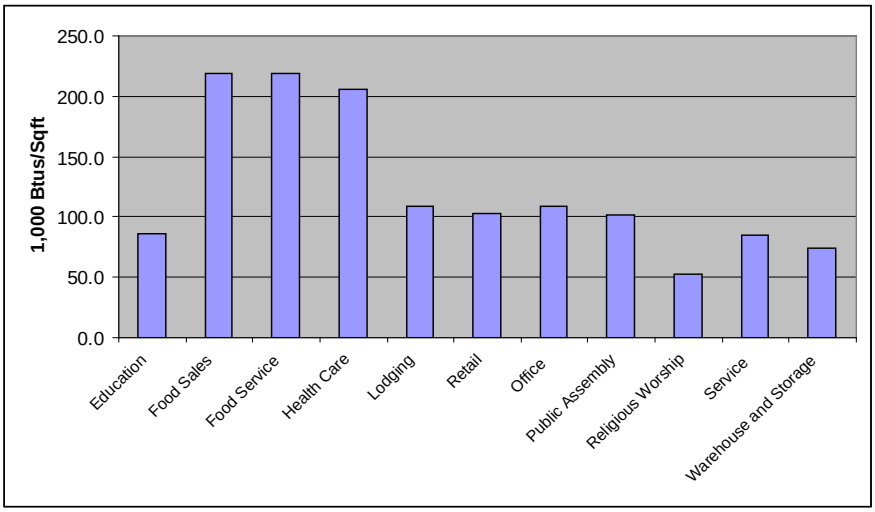
The following chart displays how energy is consumed in a typical home. The numbers show the percent of total energy consumption that can be attributed to each end use. While energy consumption benchmarks can be established for each residential end use, these indicators are difficult to measure without expensive sub-metering. Therefore, total energy consumption is the default measure of energy consumption in buildings



Commercial & Industrial Buildings

The commercial building stock is diverse and consists of business establishments and other organizations that provide services. The sector includes service businesses (e.g., retail stores, hotels, restaurants), health care, public and private schools, correctional institutions, and religious and fraternal organizations. Municipal buildings are also included in the commercial sector. The industrial and manufacturing sector includes a variety of businesses including metal working, electronics manufacturing, construction and food processing. Energy consumption patterns vary by type of building and by process.

Figure 1. Figure 1: Energy Intensity in Midwest Commercial Building in 2003s (Thousand Btu per square foot)



Source: Energy Information Administration, Commercial Building Energy Consumption Survey <www.eia.doe.gov>

To illustrate the variation among sectors, the figure below shows electricity consumption by Standard Industrial Characterization (SIC) code for the forty largest users in a large Midwestern city.[12]

Table 2. Samples of Electricity Consumption by SIC

SIC_CODE_DESCRIPTION	Average Annual Consumption (kwh)
Electric, Gas, And Sanitary Services	2,484,498
Justice, Public Order, And Safety	2,119,197
Hotels And Other Lodging Places	1,769,420
Food And Kindred Products	1,215,575
Primary Metal Industries	988,867
Holding And Other Investment Offices	785,466
Rubber And Misc. Plastics Products	781,225
Paper And Allied Products	751,589
Museums, Botanical, Zoological Gardens	741,627
Executive, Legislative, And General	732,787
Educational Services	705,981
Chemicals And Allied Products	651,668
Fabricated Metal Products	576,021
Electronic & Other Electric Equipment	485,664
Administration Of Human Resources	457,174
Textile Mill Products	393,944
Leather And Leather Products	389,791
Petroleum And Coal Products	382,089
Amusement & Recreation Services	373,598
Wholesale Trade--Nondurable Goods	349,705
Wholesale Trade--Durable Goods	333,142
Metal Mining	315,956
General Merchandise Stores	313,960
Depository Institutions	312,661
Real Estate	289,669
Stone, Clay, And Glass Products	283,752
Communication	279,984
Transportation Equipment	268,084
Security And Commodity Brokers	263,734
Furniture And Fixtures	263,584
Insurance Carriers	257,243
Instruments And Related Products	237,575
Lumber And Wood Products	237,378
Trucking And Warehousing	236,493
Health Services	229,370
Food Stores	215,521
Water Transportation	208,468
Environmental Quality And Housing	193,780
Business Services	193,593

Recommendations

1. The City of Fort Wayne should request energy consumption data from I & M and commission a study to calculate actual EUI's for Fort Wayne's building stock by type of building in order to establish performance benchmarks as a baseline. Both average EUIs and the distribution of EUI values for each building type should be calculated.
2. The baseline data should be compared with the EUI values provided in this report for the East North Central Region and from other city data as it becomes available.
3. The City of Fort Wayne should prioritize its energy efficiency programs and goals for reducing energy consumption in buildings based on this data analysis and measure progress of on-going energy efficiency programs to the baseline.

Endnotes

1 ACEEE, “Energy Efficiency and Electric System Reliability:A Look at Reliability-Focused Energy Efficiency Programs Used to Help Address the Electricity Crisis of 2001,”Martin Kushler, Ed Vine, and Dan York, April 2002, Report Number U021.

2 As reported in the current rate case.

3 As reported on the IURC website.

4 IEEE Standard 1366-1998

5 As reported in the current rate case.

6 As reported on the IURC website.

7 IEEE Standard 1366-1998

8 As reported in the current rate case.

9 As reported on the IURC website.

10 IEEE Standard 1366-1998

11 Energy Information Administration, Official Energy Statistics from the U.S. Government. http://www.eia.doe.gov/

12 CNT analysis of utility data, July 13, 2007.