Michigan's Wastewater Treatment Plants
Energy Survey and Estimate of Energy Baseline

Prepared for

Michigan Department of Environmental Quality

Water Resources Division

By

April 15, 2017

Michigan's Wastewater Treatment Plants
Energy Survey

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Table of Contents

Transformation

The wastewater industry is undergoing changes that may be more profound than at any time in its history. Those changes will have a major impact on the industry and those who are a part of it.

In June 2015, Ed McCormick of Oakland, California, then president of the Water Environment Federation (WEF), spoke at the opening session of the annual conference of the Michigan Water Environment Association (MWEA), and talked about the Water Resource Utility of the Future. He spoke of a new vision for improved energy, nutrient and solids recycling and recovery at wastewater treatment plants throughout the country.

This vision sparked an impassioned interest in Mr. William "Bill" Creal, then Chief of the Water Resources Division (WRD) of the Michigan Department of Environmental Quality (MDEQ), about the opportunities this could offer communities in Michigan.

Later that year, Mr. Creal proposed, with the support of the Governor's office and the head of DEQ, developing recycling metrics for the state's wastewater treatment plants. The metrics focus on biosolids, nutrients (nitrogen and phosphorus), and energy resources. In late summer, WRD leadership invited the Michigan Water Environmental Association (MWEA) to review and comment on draft metrics. The metrics were reviewed and feedback was provided to WRD. The metrics were presented at the Michigan Water Environment Association (MWEA) Sustainable Energy Seminar on October 20, 2015.[1]

I invite you to take time to read and learn more about the background and development of the energy metrics. After you do, I think you will agree that the work completed to date establishes an excellent foundation for the transformation of Michigan's wastewater industry to Water Resource Utilities of the Future.

Peter V. Cavagnaro, P.E.
Lead Author / Editor: Michigan's Wastewater Treatment Plants,
Energy Survey and Estimate of Energy Baseline

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[1] Cavagnaro, P.V., "MDEQ Observations on Sustainability, Municipal Wastewater Recycling in Michigan – How Can We Measure?" Michigan Water Environment Association, Sustainable Energy Seminar, October 20. 2015.

Chapter 1: Survey Design

There are several reasons for monitoring energy used at Michigan WWTPs. Over the past 17 years, there has been a 74% increase in energy consumption at the nation's wastewater treatment plants[2] (Table 1).

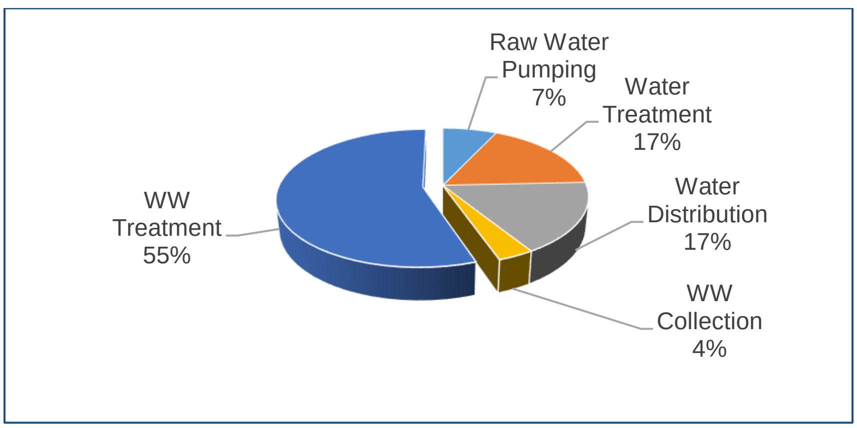
Energy is one of three major expenses involved in operating a WWTP. Having a predictable and sustainable supply of energy is critical to maintaining stable rates.

Approximately 50% of the amount spent on energy by local governments is for pumping and treating water and wastewater. As Figure 1 shows, wastewater treatment is more than 50% of the total.

Table 1: Trend in Energy Consumption at Wastewater Treatment Plants

1996 EPRI Report	17.4	Billion kWh/year
2013 EPRI Report	30.2	Billion kWh/year
17 Year Increase	74%	

Figure 1: Allocation of Energy for Water & Wastewater Systems



Clearly, implementing a "Net Zero Energy" policy at a WWTP can have a significant impact on rates and the cost of power for a community.

Planning a transformation in energy use of Michigan's wastewater treatment plants will require an understanding of how much energy is used and where. However, that information currently is not available. Consequently, the Michigan Department of Environmental Quality (MDEQ), Water Resources Division (WRD) and Michigan Water Environment Association (MWEA)

[2] Electricity Use and Management in the Municipal Water Supply and Wastewater Industries, Electric Power Research Institute, 3002001433, Final Report November 2013. With the Water Research Foundation

conducted an energy survey of Michigan wastewater treatment plants. The goals of the survey were to:

- Establish the baseline energy use at Michigan WWTPs.
- Identify projects that have been implemented to reduce energy consumption or implement energy production.
- Identify barriers being encountered.
- Provide the information needed to spur growth and development that will allow Michigan WWTPs to transition to Water Resource Recovery Facilities (WRRFs).
- Create an equalizing benchmark, so WWTPs could more easily see how they are doing compared to their peers.

Among the factors that were considered when designing the survey were:

- Energy conservation and energy production should be measured separately.
- Energy production should be broken down into energy used on site and energy exported.
- Energy production would include solar and on-site digester gas to energy, as well as waste heat to energy.
- Developing a program for periodic review and reporting.
- Monitoring the BTUs recovered annually to offset the heating / cooling.
- Developing a list of facilities that currently recover digester gas.
- Determining what % of energy used for unit process is recovered (e.g. natural gas consumption versus recovered digester gas used.)
- Determining if other energy reuse activities exist in Michigan.

Chapter 2: Survey Results

An online survey was launched on March 21, 2016. Information for calendar year 2014 was collected to be consistent with information collected for solids and nutrients.

The 24 largest Michigan WWTPs were invited to participate. Twelve (12) responded and 4 additional plants volunteered their participation. The average daily wastewater flow for the plants that participated in the survey ranged from 1.9 to 670 MGD, and totaled 915 MGD. This represented 68% of total flow treated by Michigan wastewater treatment plants each day.

Information requested for the survey included:

- Date of construction and improvements.
- Facility processes.
- Influent flow.
- Influent Biochemical Oxygen Demand (BOD), Total Suspended Solids (TSS), and Ammonia.
- Natural gas & electric energy.
- Digester gas production and use.
- Electric production.

Results

A summary of data received during the survey, calculation of metrics, and presentation of select information in graph form is presented in Appendix 3. A summary of respondents and the average daily flows is presented in Table 2.

Electric Energy Intensity

Energy intensity, kWh/MG, is an important metric. Because of its simplicity, it is a metric that people understand and the information needed to calculate the metric is readily available. However, it is an imperfect metric, as energy consumption is related to other factors, such as aeration requirements, age of the facilities, and equipment efficiency.

The electric energy intensity per million gallons treated for each plant that provided data is presented in Figure 2. The data in Figure 2 is organized by facility size, from small to large, and demonstrates a trend with energy intensity decreasing with plant size. This same trend has been noted in other surveys[3][4]. Factors such as wastewater strength, flow as a percent of plant capacity, operating practices, and on-site generation of energy will also affect the energy intensity.

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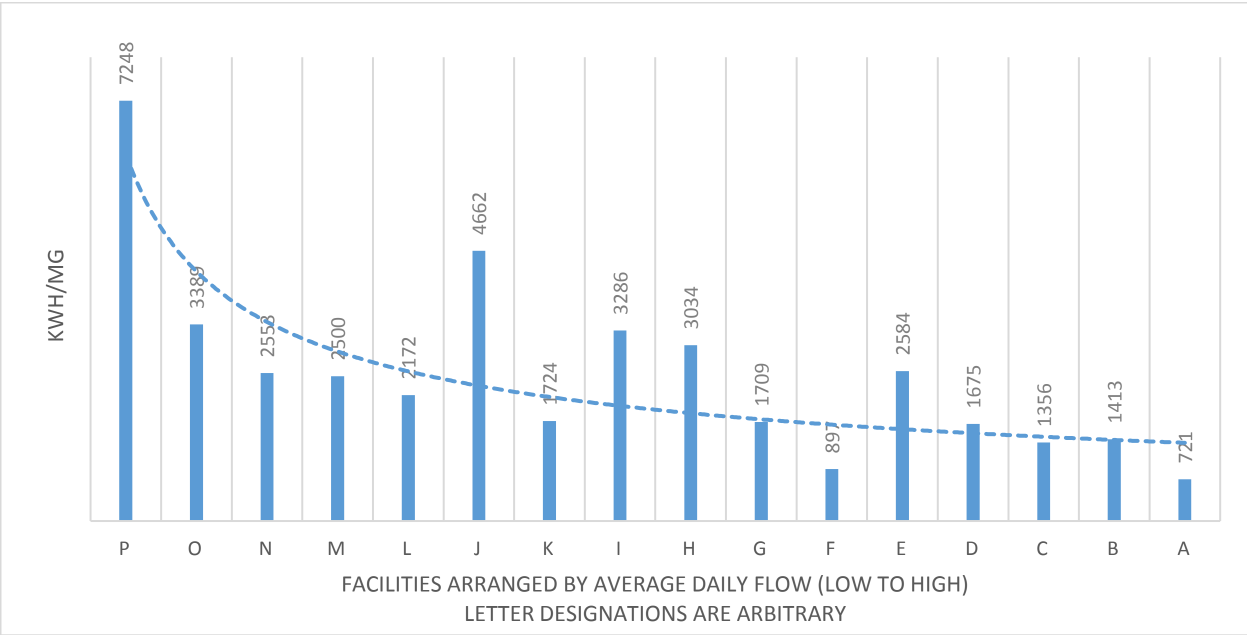
[3] New York State Energy Research and Development Authority, Yonkin, M., Clubine, K., O'Connor, K., Importance of Energy Efficiency to the Water and Wastewater Sector, NYWEA Clearwaters, Spring 2008

[4] Wisconsin Focus on Energy, "Energy Best Practices Guide: Water & Wastewater Industry", 2016, Public Service Commission of Wisconsin.

The higher energy intensities for plants P, J, I, and E can be explained by the presence of higher concentrations of Biochemical Oxygen Demand (BOD) in the raw wastewater.

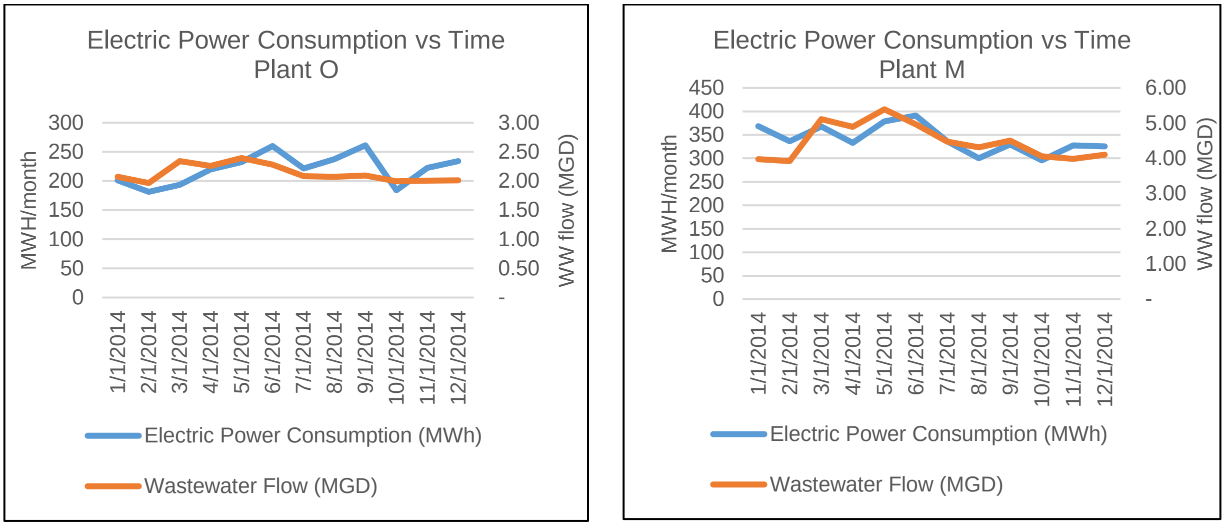
The lower energy intensities experienced at K and F can be explained by the presence of lower concentrations of BOD in the raw wastewater.

Figure 2: Energy Intensity of Survey Plants



Some facilities demonstrated a very close relationship between flow and electric power consumption, as shown in Figure 3.

Figure 3: Electric Energy Intensity vs Time / <u>Close</u> Relation to Flow



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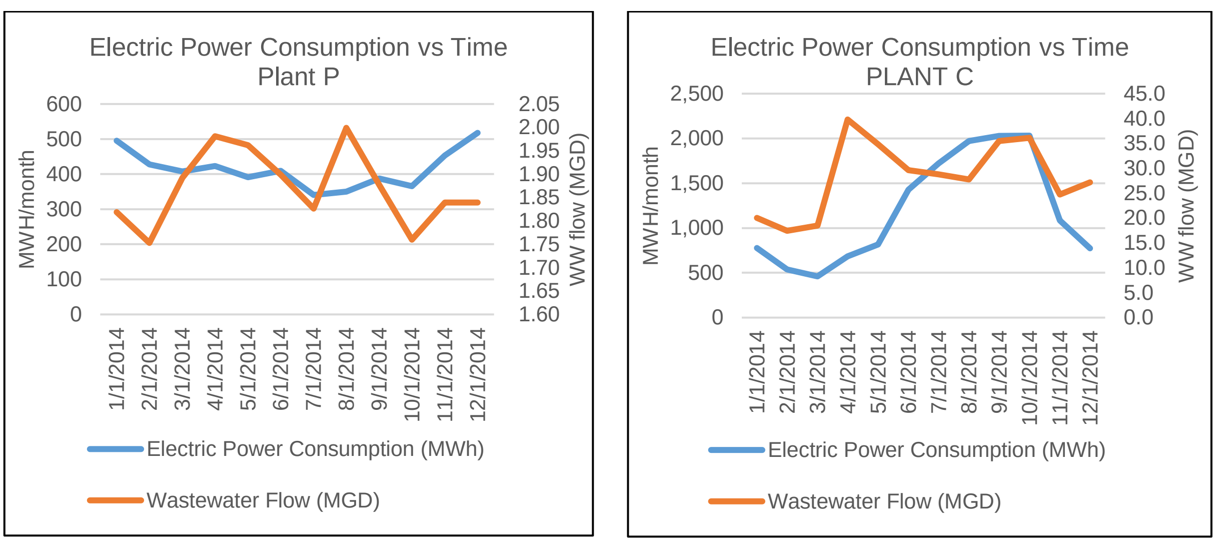
Other facilities showed a more complicated relationship between flow and electric consumption, as shown in Figure 4, demonstrating that the metric of energy per unit flow will not be consistent for all plants.

Figure 4: Energy Intensity vs. Time / <u>Poor</u> Relation to Flow



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Natural Gas Energy Intensity

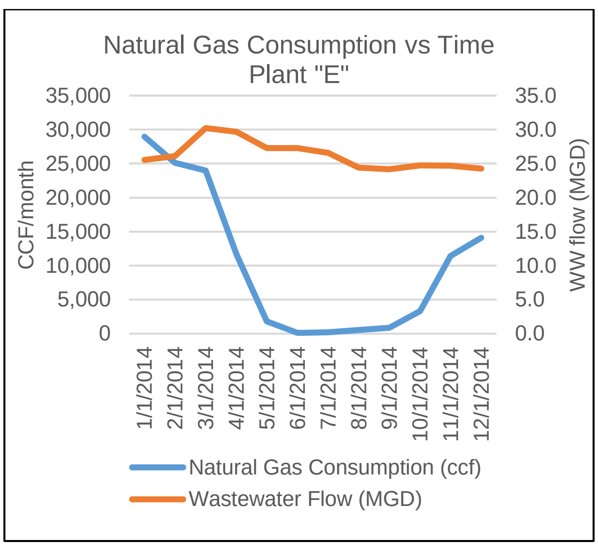
Natural gas purchases make up part of the energy profile. Figure 5 illustrates differences between facilities with and without incineration.

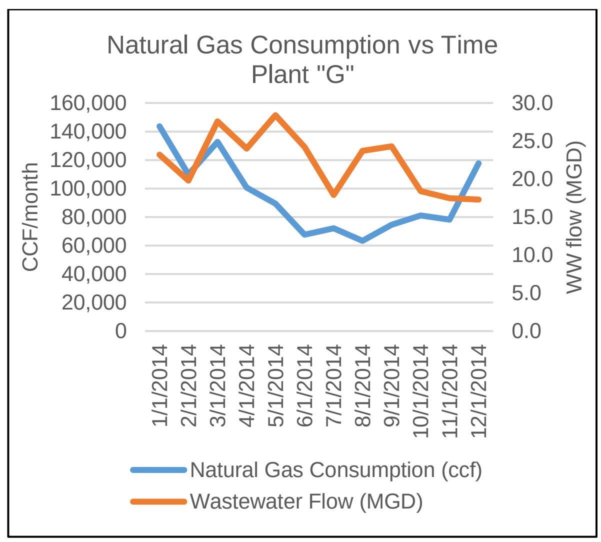
The graph on the left is for a plant without incineration. Note how the seasonal impact on NG consumption with consumption going to zero in the summer months. The natural gas usage is exclusively for heating, and perhaps some hot water.

The graph on the right represents a facility with incineration. There is still a seasonal variation, but the amount of natural gas required for incineration can be seen during the summer months.

Natural gas is an important source of energy at Michigan's wastewater treatment plants, but it is important to know whether the plant uses incineration when evaluating the results. A plant without incineration may use all natural gas for building related functions, in which case a Btu/MG metric would not make sense. The same care must be used in assessing natural gas consumption at a plant with anaerobic digestion, as natural gas may be used for none, a portion of, or all digester heating needs.

Figure 5: Natural Gas Consumption vs. Time





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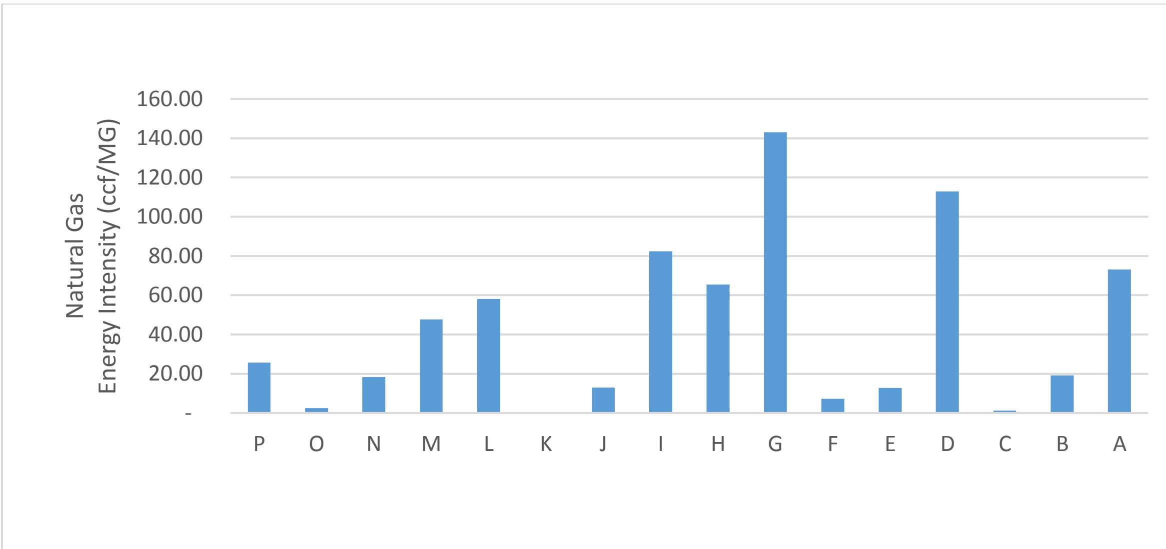
The information in Figure 6 indicates that the energy intensity for natural gas does not vary with plant size, the way electric energy intensity does.

Figure 6: Natural Gas Energy Intensity vs. Plant Flow



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Chapter 3: Estimation of Michigan's Energy Baseline

An accurate account of the amount of energy used to treat wastewater in Michigan does not exist. A number of methods were used to estimate the energy consumption and compared. The value recommended for use was selected based on the review of the various methods of analysis.

Basis of this Analysis

The two principle forms of energy used are electricity and natural gas. There are other potential sources of energy, such as propane and chemicals, but information was not available for these at this time. Future surveys should consider requesting information on other sources of energy used or purchased at Michigan WWTPs.

Combining electricity and natural gas into a single metric, such as mmBtu, would be accurate, but difficult to understand and use. Therefore, the metrics are handled separately.

Natural Gas Baseline

This analysis presents information on natural gas and electricity separately. Natural gas requirement depends on whether or not the plant has incineration, the amount of building space, local climate, and age of buildings and condition of weather proofing.

Figure 7: Natural Gas Consumption of Surveyed Michigan WWTPs

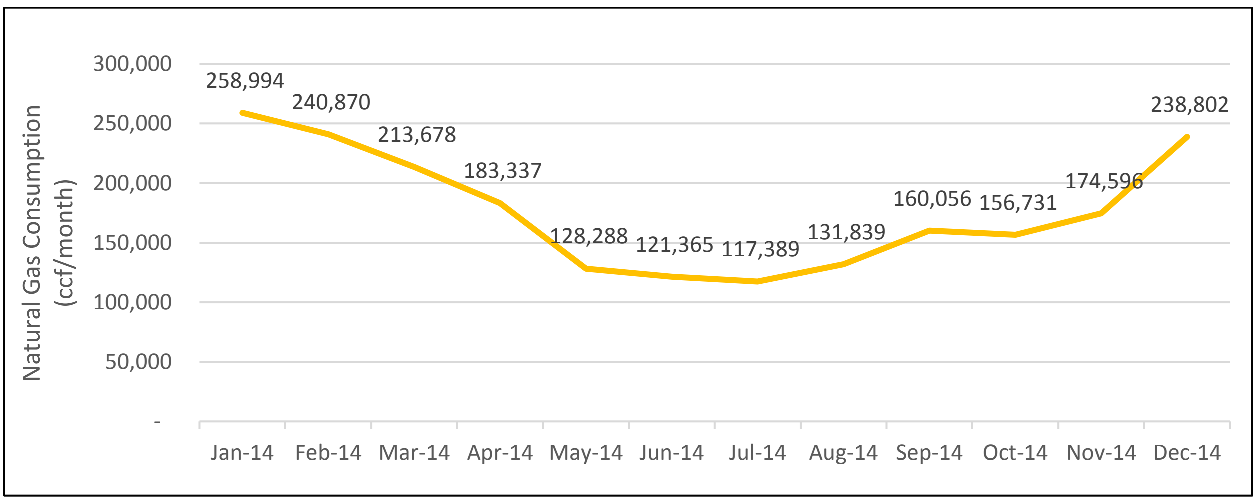

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Figure 7 demonstrates how natural gas consumption at plants that participated in the survey varies throughout the year. The minimum value of about 117,000 ccf represents the approximate amount used for incineration at the surveyed plants. It is likely that gas consumption will vary based on the square footage of buildings that are being heated. Future analysis should also account for waste heat energy recovered on site, such as that at Grand Rapids where excess heat from the blower building is used to heat an adjacent building.

The reported values of natural gas consumption for the surveyed plants were totaled, and summed to 2,126,000 kcf. The corresponding wastewater flow rate was 907 MGD.

Proportioning this upward, using a total daily flow of 1,364 MGD for all of Michigan, results in an annual projection of 3,197,000 kcf per year. If the BTU content is taken as 1,000 Btu/cf, the resulting thermal requirement is 3,197,117 million Btu's per year, or 364 million Btu's per hour.

At a flow of 1,364 MGD, there are 474 million pounds of water per hour. Extracting heat equivalent to 1^{o} Fahrenheit would more than offset the need for natural gas. Since equipment efficiency is not 100%, the actual delta T might be $2\text{-}3^{o}$ Fahrenheit.

Electric Baseline

The amount of electricity used is more important to know than natural gas because the amount of electricity used varies so closely with the amount of wastewater treated, and the amount of organics in the wastewater, as measured by Chemical Oxygen Demand (COD). Plants do not routinely measure COD, but do monitor Biochemical Oxygen Demand (BOD), which was the information collected as part of the survey. There is no one single source of information on electric consumption. The annual consumption was estimated using several methods. The trend in results for all methods was considered for selecting an electric baseline for Michigan.

<u>Rule of Thumb Estimate</u>

The first estimate of energy use by Michigan WWTPs was presented on October 20, 2015,[5] and was 1,007,400,000 kWh per year (1,007,400 MWh per year). This value was based on an estimated average energy intensity of 2,300 kWh/MG treated and an average daily wastewater flow of 1,200 MGD. The flow was based on the GLWA plant treating approximately 600 MGD and representing approximately half of the wastewater treated in Michigan each day.

A refinement was made to this number based on an adjustment of average daily wastewater flow, based on information from the 2012 Clean Watershed Needs Survey (CWNS)[6], which indicates that the average daily flow is approximately 1,364 MGD. This increased the estimate of energy consumption to 1,145,311 MWh per year. These calculations are summarized in Table 3.

Table 2: Preliminary Estimate of Energy Consumption

Description	kWh/MG	MGD	kWh/day	MWh/year
2015 total for all Michigan WWTPs	2,300	1,200	2,760,000	1,007,400
2015 total for all Michigan WWTPs, adjusted	2,300	1,364	3,137,000	1,145,000

[5] Cavagnaro, P.V., "MDEQ Observations on Sustainability, Municipal Wastewater Recycling in Michigan – How Can We Measure?" Michigan Water Environment Association, Sustainable Energy Seminar, October 20. 2015.
[6] https://www.epa.gov/cwns

Statistical Analysis of Survey Data

The first analysis of survey data was to compute the simple average energy intensity for all plants in the survey, resulting in a value of 2,548 kWh/MG. When applied to the total daily flow for all plants, and estimated consumption of electricity was 1,268,808 MWh/year.

A flow weighted average was considered to be more appropriate, which resulted in an estimate of 1,066 kWh/MG when all surveyed plants were used, and an estimate of 1,995 kWh/MG when all but the smallest and largest plants were used in the calculation. The latter value was used to estimate electric consumption at 993,435 MWh/year.

Table 3: Estimate of Energy Consumption Based on Energy Survey

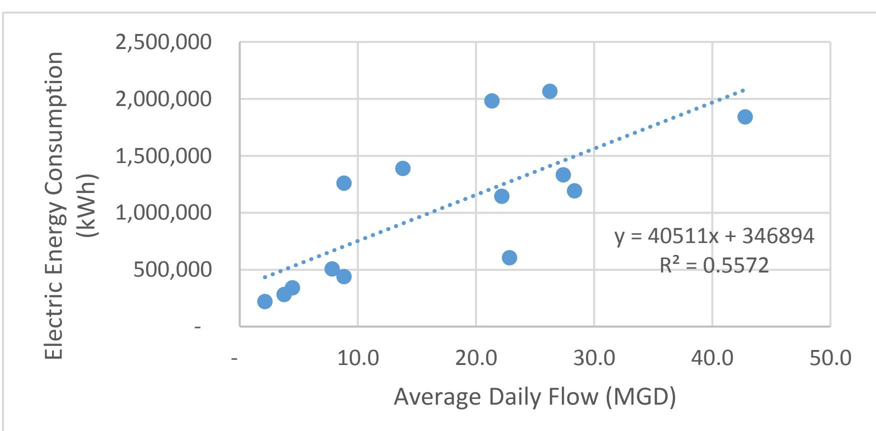
Description	**kWh/MG**	**MGD**	**kWh/day**	**MWh/year**
Estimate based on simple average energy intensity of all surveyed WWTPs	**2,548**	**1,364**	**3,475,000**	**1,268,000**
Estimate based on flow weighted energy intensity of all surveyed WWTPs	**1,066**	**1,364**	**1,454,000**	**531,000**
Estimate based on flow weighted energy intensity computed without the smallest and largest WWTP	**1,995**	**1,364**	**2,721,000**	**993,000**

Best Fit Curve of Survey Data

The 2012 CWNS reports on the average daily flow for the municipal WWTPs in Michigan. The goal of this analysis was to develop an equation that could be applied to the flows to obtain an estimate of energy consumption at each plant. The sum of these values would then provide an estimate of total electric consumption for Michigan WWTPs.

The kWh for each surveyed plant was plotted vs flow, a trend-line was added and an equation developed. The R^2 value is relative low – a value in the range of 0.85 to 0.95 being preferred (Figure 8).

Figure 8: kWh vs Flow MGD



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Results were compared with data from other statewide surveys.

New York State Energy Research and Development Authority

The New York State Energy Research and Development Authority (NYSERDA) funded a multi-year study to assess energy use within the New York's water and wastewater sector[7]. The study began in early 2005. Among the findings were that flow rate and biochemical oxygen demand (BOD) are the primary determinants of energy consumption.

Energy Intensities were presented for a series of brackets of facility sizes. The values of energy intensity for New York include both the wastewater treatment plant and collection system.

Wisconsin Focus on Energy

Wisconsin's Focus on Energy program published "Energy Best practices Guide: Water & Wastewater Industry"[8] that reported on the use of energy at Wisconsin's WWTPs. This work included an analysis of sampled facilities to determine the potential energy savings from applying best practices, which were established at benchmarks (see the next Chapter for more information on this topic).

Information from the NYSERDA and Wisconsin surveys were used to help establish reasonable energy intensity to use for each of the flow ranges established in the NYSERDA project. Selected Michigan WWTPs were used to establish a reasonable energy intensity for each flow range, as presented in Table 5. This information was plotted, Figure 9, and a simple model developed for estimating the energy consumption for each plant in the 2012 CWNS report.

Applying this model to the flow data in the 2012 CWNS results in the data listed in Table 6.

Table 4: Energy Intensity Comparison

Flow Range	NYSERDA[9]	Wisconsin Focus on Energy[10]	Michigan	Value to use for MI Model
	kWh/MG		kWh/MG	
Less Than 1 MGD	4,620	5440		4,620 (1)
1 to 5 MGD	1,580	2503	2,495	2,500 (2)
5 to 20 MGD	1,740	2288	2,358	2,360 (3)
20 to 75 MGD	1,700	2288	1,801	1,800 (4)
Greater than 75 MGD	1,100	2288	1,400	1,400 (5)

(1) Based on NYSERDA
(2) Based on MI Survey, rounded up to 2,500
(3) Based on MI Survey, rounded up to 2,360
(4) Based on MI Survey, rounded down to 1,800
(5) Based on MI Survey

[7] New York State Energy Research and Development Authority, Yonkin, M., Clubine, K., O'Connor, K., Importance of Energy Efficiency to the Water and Wastewater Sector, NYWEA Clearwaters, Spring 2008
[8] Wisconsin Focus on Energy, "Energy Best Practices Guide: Water & Wastewater Industry", 2016, Public Service Commission of Wisconsin.
[9] New York State Energy Research and Development Authority, Yonkin, M., Clubine, K., O'Connor, K., Importance of Energy Efficiency to the Water and Wastewater Sector, NYWEA Clearwaters, Spring 2008
[10] Wisconsin Focus on Energy, "Energy Best Practices Guide: Water & Wastewater Industry", 2016, Public Service Commission of Wisconsin.

Figure 9: Energy Intensity Model

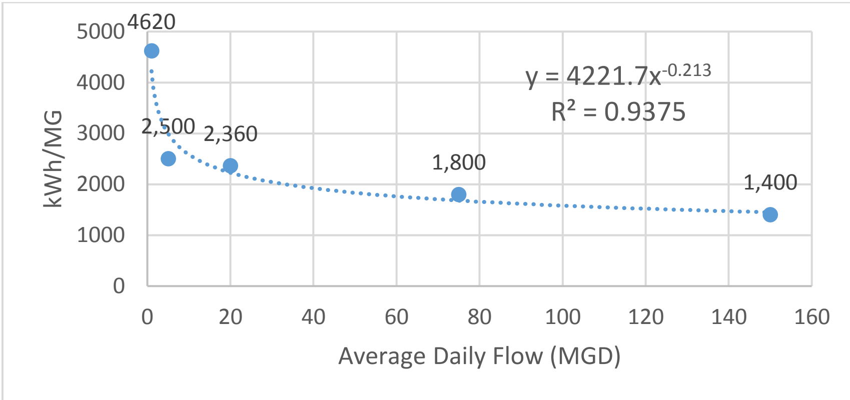

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Table 5: Estimate of Energy Consumption based on Energy Model

	kWh/MG	MGD	kWh/day	MWh/year
Estimate Based on Model	**1,649**	**1,364**	**2,249,000**	**821,000**

Baseline Summary

Table 7 presents a summary of the analysis performed in this section. Averaging the various estimates results in an estimate of 952,000 MWh/year. This value is consistent with the previous estimate of 1,007,400 MWh/year.

Table 6: Summary of Energy Baseline Analysis

Description	kWh/MG	MGD	kWh/day	MWh/year
2015 estimated total for all Michigan WWTPs, adjusted	2,300	1,364	3,137,000	1,145,000
Estimate based on simple average energy intensity of all surveyed WWTPs	2,548	1,364	3,475,000	1,268,000
Estimate based on flow weighted energy intensity of all surveyed WWTPs	1,066	1,364	1,454,000	531,000
Estimate based on flow weighted energy intensity computed without the smallest and largest WWTP	1,995	1,364	2,721,000	993,000
Estimate Based on Model	1,649	1,364	2,249,000	821,000
Range				**531,000 to 1,269,000**
Average				**952,000**

Chapter 4: Statewide Energy Benchmark

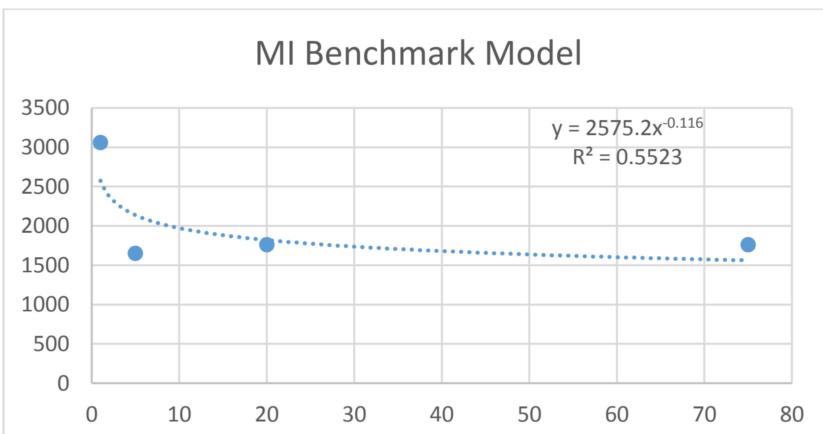
In keeping with the goals set by the Governor's Solid Waste Task Force, it is recommended that a preliminary goal be set to reduce the amount of electric energy consumed by 50%. Reaching this goal will require a combination of energy conservation and energy production.

An estimate of the amount of energy consumption that can be reduced by conservation was made using Wisconsin Focus on Energy Best Practice Benchmark (Table 8).

Table 7: Table of Energy Intensities for Energy Benchmark[11]

Flow Range	Wisconsin Focus on Energy Best Practice Benchmark
MGD	**kWh/MG**
0 to 1	3060
1 to 5	1650
> 5	1760

Figure 10: Benchmark Model



Wisconsin's Focus on Energy Best Practice Guide, presents data for a best in class bench mark. This benchmark was used as the basis of the model for Michigan WWTPs presented in Figure 10. The equation from the best fit curve in Figure 10, was applied to the flow data for each WWTP reported in the 2012 CWNS. The estimate for each plant was summed to obtain a statewide benchmark of 803,000 MWh. This represents a 13% reduction in energy use. The balance of the recommended 50% "reduction" would have to be achieved by generation of power on-site. This corresponds to:

1,056,000 MWh/year x 0.5 = 528,000 MWh/yr

803,000 MWh/yr - 528,000 MWh/yr = 275,000 MWh/yr

[11] Wisconsin Focus on Energy, "Energy Best Practices Guide: Water & Wastewater Industry", 2016, Public Service Commission of Wisconsin.

Chapter 5: Energy Benchmark for Individual Facilities

Suggestions for Benchmarking Individual Plants

A number of options are available to an individual WWTP for establishing an electric energy benchmark. These include:

- Energy Star Portfolio Manager
- WE&RF Energy Models
- EPRI Reports / WEF MOP Tables
- Process Models

Energy Star Portfolio Manager

Energy Star Portfolio Manager is a well-known energy site operated by the EPA. Its purpose is to provide an assessment of the energy performance of a property and includes provision for wastewater treatment plants. The Energy Star program identifies aspects of a type of a building that are affect energy use, and normalizes those factors to create a statistical analysis of like facilities.

Energy Star for wastewater treatment plants uses inputs including flow, wastewater characteristics, type of treatment process, energy consumption, type of plant, and other factors to create a prediction of energy use which is compared to actual energy use to yield a 1 to 100 percentile ranking.

Portfolio Manager does not account for plants that use High Purity Oxygen Activated Sludge (HPO), incinerators, have flows less than 0.6 MGD, produce energy on-site, or that use less than 100,000 kWh. Three of Michigan's largest plants use HPO, accounting for more than half the wastewater treated in the state of Michigan. A number of the state's larger plants also use incineration. And several plants generate power on site.

Given these complexities, Portfolio Manager was not selected as a basis for gathering information or establishing a benchmark for Michigan's wastewater treatment plants as part of this effort. It may be useful for individual WWTPs.

Electric Producers Research Institute

In 1996, the Electric Producers Research Institute (EPRI) published "Water and Wastewater Industries: Characteristics and Energy Management Opportunities."[12] Franklin Burton, the report's author, included four tables that presented energy intensity benchmarks for four (4) different types of treatment plants at varying flows. These Tables were subsequently published in the 2009 edition of the Water Environment Federations Manual of Practice No. 32, Energy Conservation in Water and Wastewater Facilities.[13]

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[12] Franklin L. Burton, "Water and Wastewater Industries: Characteristics and Energy Management Opportunities", Electric Producers Research Institute (EPRI), EPRI Community Environmental Center, Municipal Water and Wastewater Program, CR-106941, Sep 1996.

[13] "Energy Conservation in Water and Wastewater Facilities", Water Environment Federation (WEF), Manual of Practice No. 32, 2009.

EPRI updated these Tables in "Electricity Use and Management in the Municipal Water Supply and Wastewater Industries" (2013). The report presents Table 4-2 for public water supply and Table 5-2 for wastewater treatment plants.[14]

Similar tables are presented in Appendix A of the Wisconsin Focus on "Energy Best Practices Guide: Water & Wastewater Industry".[15]

The EPRI (or Franklin Burton) information, or similar tables described herein, is the most practical information for a plant to use for its first approximation of an energy benchmark.

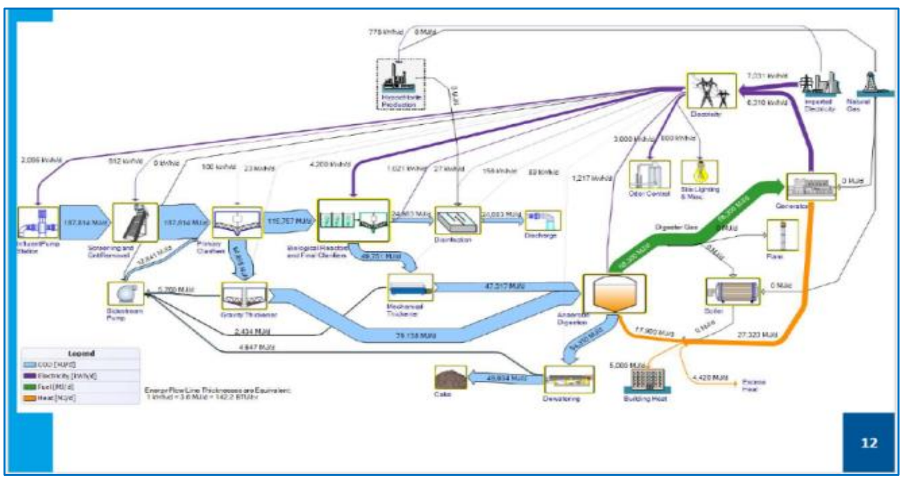
These estimates can be refined with an EXCEL worksheet that customizes the Table to a specific plants unit processes and operations.

Water Environment & Reuse Foundation

WERF has conducted research, ENER1C12, to identify the most effective way for wastewater treatment plants to achieve energy neutrality, or Net-Zero Energy. A WRRF that is energy neutral generates 100 percent or more of the energy needed for operations solely from the energy embedded in the water and wastes it treats.

Energy models were prepared for 25 typical baseline, 25 best practice, and 18 pioneering WRRF configurations. Sankey Diagrams (Figure 11) were used to show the flow of energy between each unit process. Using this information a facility can establish a benchmark by comparing one process model that most closely resembles its facility.

Figure 11: Sankey Diagrams Show Energy Flows between Each Unit Process



Process Model

Process modeling platforms are available that can be used to estimate energy consumption for individual plants. These would include BioWin™, GPS-X™, or others, as well as simple Excel spreadsheets developed specifically for each plant. This document does not promote any particular platform.

[14] Electricity Use and Management in the Municipal Water Supply and Wastewater Industries, Water Research Foundation, Electric Power Research Institute, 3002001433, Final Report November 2013.

[15] Wisconsin Focus on Energy, "Energy Best Practices Guide: Water & Wastewater Industry", 2016, Public Service Commission of Wisconsin.

Chapter 6: Important Future Work

It is recommended that:

1. The amount of purchased energy be reduced by 50%. Achieving this goal will require a combination of energy conservation and energy production.
2. The survey be continued and expanded to all plants, with the goal of helping each plant to establish and energy baseline and benchmark.
    a. The survey is more than can be performed by a volunteer effort. A sustained source of funding is needed to implement, record, and maintain the information. The team responsible for this work need to spend time at the individual sites, and be drivers for implementation of energy management programs.
    b. The program needs to be led, developed, and implemented by wastewater treatment subject matter experts.
    c. Information collected should include:
        i. Description of the treatment process,
        ii. Equipment list with horsepower,
        iii. Information on the operation of the facility.
        iv. Energy data from the energy utility (15 minute interval data)
        v. Process Flow Diagrams
    d. Information is needed about the number of and use of energy by lagoon systems.

Appendix 1: Abbreviations

BOD	Biochemical Oxygen Demand
CCP	Composite Correction Program
EPA	United States Environmental Protection Agency
LIFT	Leaders Innovation Forum for Technology
MDEQ	Michigan Department of Environmental Quality
MGD	Million Gallons per Day
MPSC	Michigan Public Service Commission
MWEA	Michigan Water Environment Association
NACWA	National Association of Clean Water Agencies
OCWA	Ontario Clean Water Agency
PPP or P3	Public-Private Partnerships
TKN	Total Kjeldahl Nitrogen
TSS	Total Suspended Solids
UBN	Utility Branding Network
UOTF	Water Resources Utility of the Future [Note to reader: this abbreviation is consistent with NACWA's abbreviation of the phrase]
WEF	Water Environment Federation
WERF	Water Environment Research Foundation
WE&RF	Water Environment & Reuse Foundation
WRD	Water Resources Division
WRRF	Water Resource Recovery Facility
WWTP	Wastewater Treatment Plant

Appendix 2: List of Tables & Figures

List of Figures

List of Tables