Summary Report

2009-2011 Indiana Energy Management Pilot

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Acknowledgement

This report was prepared by the Environmental Protection Agency (EPA) Region 5 with assistance from the Indiana Department of Environmental Management (IDEM). EPA and IDEM gratefully acknowledge the 10 Pilot utilities which completed the two-year Indiana Energy Management Pilot on which this report is based. Their participation and thoughtful feedback throughout are a clear demonstration of a commitment to continuous energy improvement and leadership in drinking water and wastewater treatment. We also acknowledge the participation of three Indiana utilities that began the Pilot but for various reasons did not see it through to completion. Project Managers were Louann Unger (EPA) and Jennifer Schick (IDEM).

Disclaimer

1. Introduction

This summary report presents an overview of the 2009-2011 Indiana Energy Management Pilot conducted by EPA Region 5 and IDEM, and completed by 10 drinking water and wastewater public utilities (Pilot utilities). This introductory section describes the Pilot background and approach taken. Section 2 documents outcomes in terms of utility competence and energy usage. Section 3 presents findings and recommendations, including a list of six competencies for energy management. Text boxes throughout the report are remarks from Pilot utilities.

Energy is a large operating expense for water utilities, typically second only to salary. The Pilot applies the EPA *Energy Management Guidebook for Drinking Water and Wastewater Utilities* (*Guidebook*) by walking through the *Guidebook's* step-by-step process to improve energy efficiency. At the group level, the 10 Pilot utilities reported an annual energy cost saving of over $234,669 from a simple comparison of pre- to post-pilot energy bills.[1] This is 6 per cent less than pre-Pilot energy bills, a saving that took place as the price of electricity steadily increased and natural gas prices fell.[2] Over the same two years, the group consumed 15 percent less electricity and 34 percent less natural gas. These reductions equate to 5.5 metric tons of greenhouse gas (GHG) avoided annually, roughly the amount of carbon dioxide (CO2) emitted from electricity used annually by 678 homes.[3]

Pilot background

A need to help public water utilities reduce energy use and cost and ensure the sustainability of their operations prompted EPA in 2008 to publish the *Guidebook*. Built around a Plan-Do-Check-Act (PDCA) management systems framework, the *Guidebook* describes an adaptive approach for utilities, large and small, to identify opportunities to improve their energy efficiency while still producing clean and safe water. Experience from utilities has shown the approach described in the *Guidebook* can result in substantial energy improvement.

EPA held workshops across the country to provide outreach on energy management and introduce the *Guidebook*. Figure 1 is an announcement for the "Innovative Energy Management Workshop" which EPA held at Purdue University in Lafayette, Indiana on October 29, 2008. The Purdue event engaged about 90 water utility managers, operators and consultants in group discussions and problem-solving exercises. The workshop was well received and many attendees expressed interest in "follow-on assistance" from EPA and states. In the following weeks, the EPA Region 5 office in Chicago made phone calls to workshop attendees and identified a group interested in applying the *Guidebook* at their facilities. The project was called a Pilot because this approach, use of the *Guidebook*, had not been tried before in Indiana.

[1] Meaning dollars are not adjusted for inflation but represent the actual dollars billed, and they include charges that appear on the bills other than energy unit charges.
[2] The group encompassed the service area of several power companies. The price per kWh and therm varies by location. It was estimated that natural gas decreased from about 13.7 cents (2008) to 8.6 cents (2011) per therm or a change of about -37% . Electricity increased from about 13.4 cents (2008) to 15.8 cents (2011) per kWh or a change of about +18%
[3] http://www.epa.gov/cleanenergy/energy-resources/calculator.html#results

Pilot utilities

Figure 2 shows the location of the ten Pilot utilities. Wastewater Pilot utilities ranged from about 2 to 19 million gallons per day (MGD), actual average flow. Drinking water Pilot utilities ranged from 4 to 14 MGD average finished water flow. Each was represented at the October 29, 2008 workshop and entered the Pilot with a basic understanding of the *Guidebook.* Pilot utilities received no monetary compensation for their participation in the Pilot. Energy management technical assistance was provided during year one by Global Environment Technology Foundation (GETF) through a contract with EPA"s Office of Water. GETF support continued during year two under IDEM pollution prevention grant SRA X900E00322-0. As co-author of the *Guidebook* and an instructor at the October 29, 2008 workshop, GETF is uniquely qualified for the Pilot: GETF brought structure and focus to energy management system development, led conference calls, and as a result of the Pilot developed *Guidebook* short guides, management procedures, and sample energy management system manuals.

Schedule and expectations

Because PDCA is an organizing principle of the *Guidebook,* it made sense to structure the Pilot using PDCA. As shown in Figure 3, the Pilot"s first 12 months covered "Plan" (top 5 boxes), the next six months involved "Do" (6th box), and the concluding six months covered "Check/Act." The Pilot started with a kickoff workshop on September 30, 2009 in Indianapolis, Indiana. When the kickoff was being organized, Pilot utilities reported that despite initially receiving the *Guidebook* in 2008 they had made no concerted effort to apply it at their plants. The kick-off included a refresher on the *Guidebook* along with an outline of Pilot activities. Pilot utilities were asked to:

- Work through and provide feedback on the *Guidebook*
- Share information about progress in energy management using the *Guidebook* approach
- Report on energy use and cost, preferably by entering data into an ENERGY STAR^{TM} Portfolio Manager account
- Develop an energy improvement action plan (IAP) for at least one energy conservation measure (ECM)[4]
- Submit a success story describing an activity completed during the Pilot.

Outputs

This section lists the reports and fact sheets that resulted from the Pilot.

- This report provides an overall summary of the pilot.
- Fact Sheets for each Pilot utility describe the utility and its energy progress
- Short Guides with templates to supplement the *Guidebook.* The short guides and templates were developed with input from Pilot utilities.
- Two Energy Management System Manuals show what *Guidebook* tables and short-guide templates look like when filled in with water utility data. The manuals also show how *Guidebook* outputs can fit together in one document.

[4] See Section 3.8 for a list of ECMs implemented or underway by Pilot utilities.

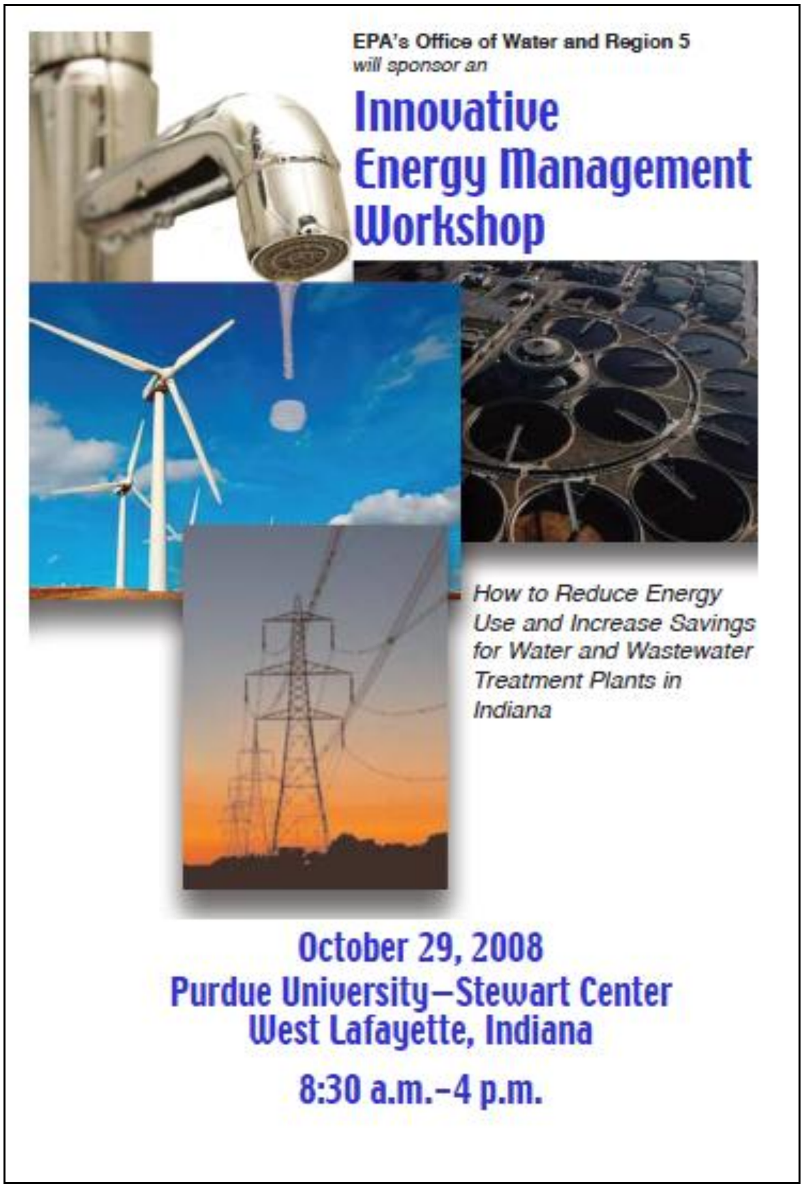

Figure 1. Indiana Workshop Announcement

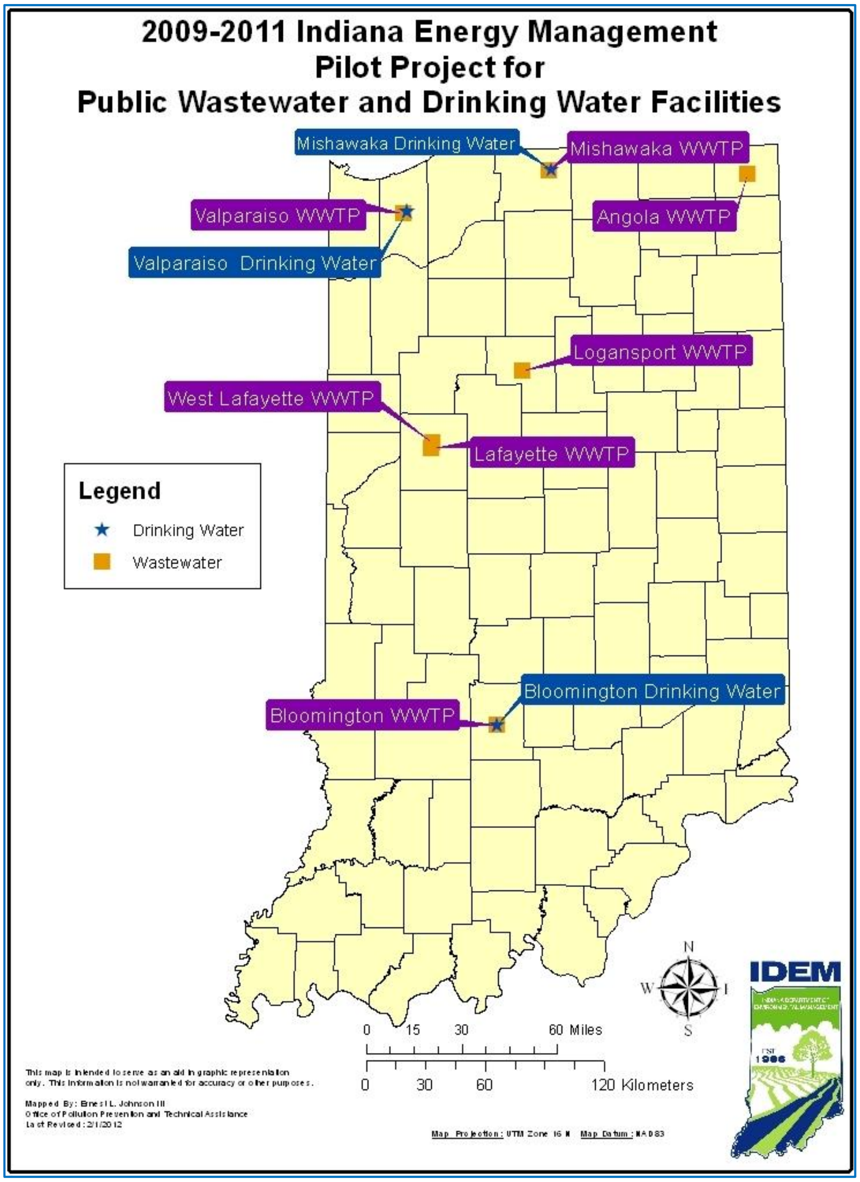

Figure 2. Pilot Utility Location

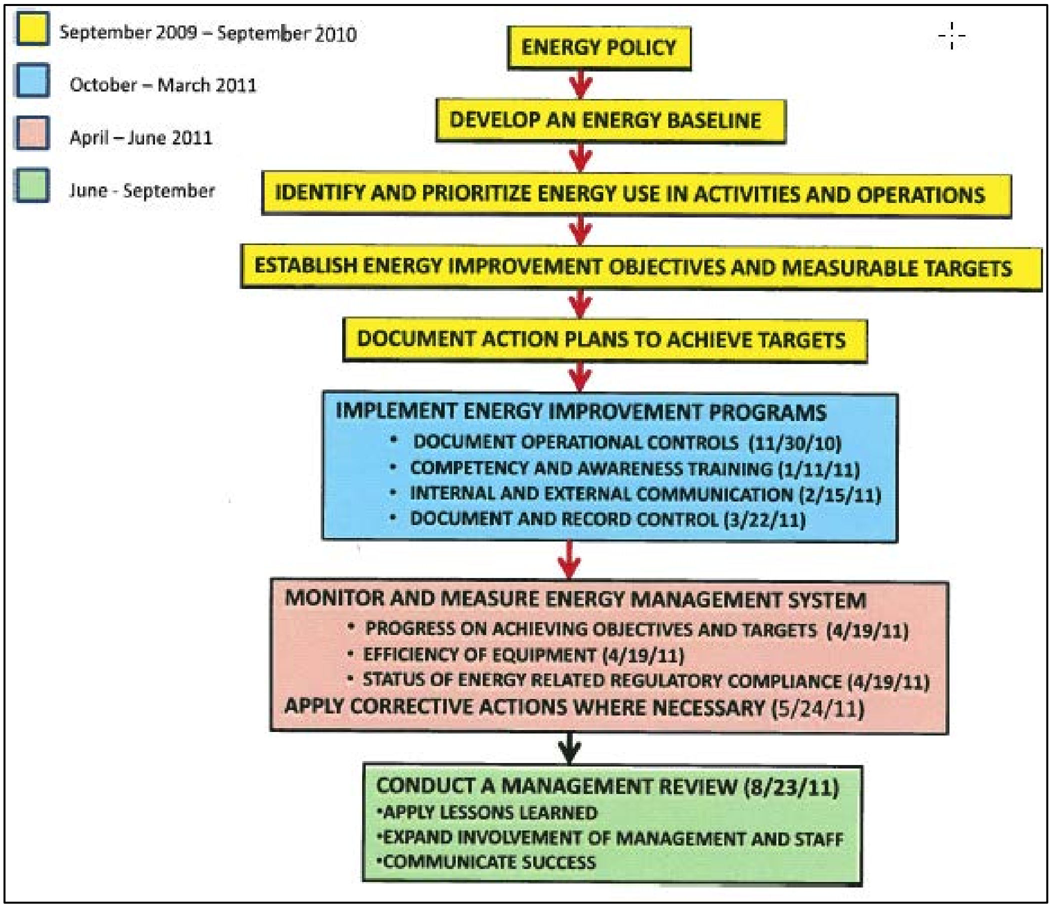

Figure 3. Pilot Schedule

2. Outcomes

The Pilot was a practical opportunity to track water utilities" progress over multiple years as they managed energy. The following three outcomes highlight how the Pilot utilities improved. The Pilot does not pretend to take full credit for these improvements. Its purpose is to document changes that took place during the Pilot timeframe (2008 to 2011) in terms of Pilot utility proficiency and awareness, energy use (with cost and greenhouse gas (GHG) emissions), and energy performance.

Improved proficiency and awareness

As the Pilot concluded, Pilot utilities were asked to complete a self-assessment by scoring themselves from 1 (low) to 15 (high) in the following 10 areas: audit, benchmarking/tracking energy use, energy policy, energy goals, energy management action plans (or EIP), training & awareness, standard operating procedures (SOPs)/operational controls, measurement (of energy management progress), adoption of PDCA management system, and renewable sources of energy. [5] The chart in Figure 4 depicts average scores of the five Pilot utilities that responded. Benchmarking and tracking energy use are the greatest strengths. The nine remaining topics are evenly ranked at around 10, suggesting comfort with accomplishments coupled with awareness of room for improvement.

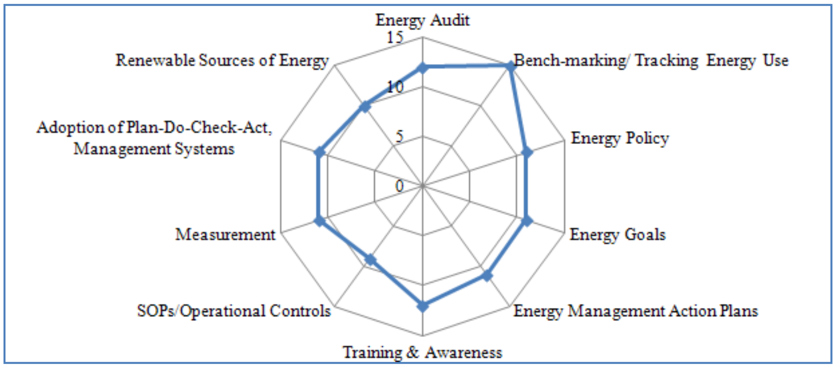

Figure 4. Post-pilot Self-assessment

Less energy use resulting in cost savings and less green house gas (GHG)

Pilot utilities reported energy, flow and energy-related costs continuously beginning with a baseline or "pre-pilot" period of 2008, except for the Mishawaka wastewater treatment plant (WWTP) which upgraded in 2008 and used 2009 as a baseline. As a benchmark for measuring progress, Pilot utilities relied on the "post pilot" year of 2011. [6] Energy and cost data are from

[5] "Energy Management Self-Assessment Tool for Water and Wastewater Utilities". Developed by Madeline Snow, UMass Lowell EMS Service Program, in partnership with the Global Environment & Technology Foundation. Funded by the U.S. EPA Office of Wastewater. December 2011.

[6] Post-pilot is a misnomer since many Pilot utilities were still completing their ECMs when the Pilot concluded in October 2011. There is every expectation that energy performance will continue to improve beyond calendar year 2011.

power company bills while flow is from water-utility-owned meters. Utilities shared their data with EPA and IDEM through a shared Portfolio Manager account or by email.

Table 1 is a summary of energy, cost and greenhouse gas outcomes at each Pilot utility. At the group level, Pilot utilities reduced electrical energy use by 6.5 gigawatt-hours (gWh) and cut natural gas use by about 192,000 therms. [7] They paid about $234,000 less for electricity and natural gas in 2011 compared to the 2008/2009 baseline, equivalent to an average annual reduction of $23,400 per utility. A detailed investigation of energy prices and billing structure was beyond the scope of the Pilot. Therefore, cost savings shown in Table 1 are based on a simple comparison of energy bills and not adjusted for inflation or energy prices changes between 2008 and 2011. During the Pilot timeframe, the price per kilowatt-hours (kWh) increased up to 18% while natural gas prices declined by roughly 37%.

GHG is emitted from the power plant that produces electricity and emitted by combustion of natural gas at the Pilot utility. Reductions in kWh and therms translate to a GHG reduction of over 5,400 metric tons CO2 equivalent (mtCO2e) annually. GHG results are reported from EPA‟s EnergyStar™ Portfolio Manager (Portfolio Manager) for each wastewater treatment plant (WWTP). For the drinking water plant (DWP), GHG was calculated according to the same Portfolio Manager methodology as described by EPA (March 2011).[8]

Better energy performance

Table 5 is an overall summary of energy, cost, and GHG avoided for all Pilot utilities. Electrical energy intensity improved for eight of the utilities. All ten Pilot utilities reduced natural gas consumption and nine reduced electrical consumption.

The far right columns of Table 5 show energy performance quantified in two ways: (1) as a performance rating calculated in Portfolio Manager, and (2) as energy intensity. The performance rating is a score from 1 (worst) to 100 (best).[9] It takes into consideration both natural gas and electrical use consumption (provided data for both are entered into the Portfolio Manager database). As discussed further in Section 3 of this report, the rating is not available for DWPs. Electrical energy intensity is the amount of electrical energy consumed per million gallons (MG) of clean water produced. As the name implies, electrical energy intensity does not include natural gas consumption.

Figure 5 compares pre- and post-Pilot performance rating for the WWTPs. Performance ratings increased from 10 to 51 points with more than half of the WWTPs ending the Pilot with scores over 75, putting them in the upper quartile of energy performers according to National statistics.[10] Figure 6 shows pre- and post-Pilot electrical energy intensity (kWh/MG) for all Pilot utilities except two. Two studies were used as external benchmarks, to compare the Pilot utilities energy intensity (Figure 6) against similar plants: a 2006 Focus on Energy report of wastewater

[7] Valparaiso Flint Lake energy cost is electrical use only.
[8] U.S. EPA (2011) ENERGY STAR Portfolio Manager Methodology for Greenhouse Gas Inventory and Tracking Calculations.
[9] Portfolio Manger is available at https://www.energystar.gov
[10] See Attachment 2 for a snapshot of Portfolio Manager outputs for each wastewater utility.

utilities in Wisconsin, and a 2012 American Water Works Association (AWWA) report on drinking water utilities in the Chicago area. [11, 12]

- Focus on Energy summarizes electrical intensity from about 100 activated sludge WWTPs in Wisconsin treating over 1 MGD. Wastewater Pilot utilities are similar to that group in that they use activated sludge and treat over 1 MGD. By comparison, top quartile performers in the Wisconsin group were about 1,300 to 1,500 kWh/MG, whereas wastewater Pilot utilities averaged 1,746 kWh/MG (range of 827 to 3,432 kWh/MG) in 2012.
- AWWA recently reported on a survey of drinking water utilities it conducted in partnership with the Chicago Metropolitan Area for Planning. The survey included 15 medium-sized (5,000 to 15,000 connected population) and 7 large (greater than 15,000 connected population) DWPs in Northeast Illinois. Electrical energy intensity of the Illinois group averaged 1,560 and 1,621 kWh/MG for medium and large facilities, respectively. By comparison, drinking water Pilot utilities averaged 1,931 kWh/MG in 2011.

Pilot Utility	MGD	DW or WW	Change in Annual Energy Cost (all are Ngas + elect except Valpo DW which is elect only)		Change in Annual Electrical Energy Usage		Change in Annual Natural Gas Usage		Change in GHG Emissions, MTCO2e due to electricity + natural gas		Electrical Energy intensity, kWh/MG		Portfolio Manager Rating
			total Cost	%	gWh	%	kTherm	%	total GHG	%	2011	% Change	
Angola WWTP	1.1	WW	-$43,117	-29%	-0.59	-34%	-1.89	-34%	-428	-34%	2,454	-39%	77
Bloomington - Blucher Poole WWTP	4.4	WW	$77,639	23%	0.42	8%	-11.52	-32%	237	6%	3,432	-32%	20
West Lafayette WWTP	7.9	WW	-$23,726	-8%	-1.10	-23%	-10.57	-59%	-723	-21%	1,276	-18%	85
Lafayette WWTP	19.1	WW	-$103,633	-17%	-2.69	-30%	-79.98	-64%	-2331	-34%	827	-26%	91
Logansport WWTP	8.3	WW	$106	0%	-0.70	-19%	-14.96	-9%	-534	-19%	908	-23%	84
Mishawaka WWTP	10.9	WW	-$199,281	-34%	-0.56	-10%	-36.58	-26%	-559	-12%	1,184	0%	85
Valparaiso - Elden Kuhl WWTP	4.4	WW	-$77,997	-16%	-0.39	-9%	-16.42	-14%	-364	-10%	2,142	-5%	62
Bloomington - Monroe DWP	14.4	DW	$59,215	8%	-0.17	-1%	-12.56	-51%	-190	-52%	2,270	4%	not applicable
Mishawaka DWP	8	DW	$98,846	24%	-0.39	-8%	-7.81	-18%	-315	-9%	1,624	3%	not applicable
Valparaiso - Flint Lake DWP	2.3	DW	-$22,722	-14%	-0.32	-18%	not reported	not reported	-228	-18%	1,900	-11%	not applicable
total			-$234,669		-6.5		-192.3		-5,436				
Average			-$23,467	-0.1		-15%	-21.37	-34%	-544	-20%	1,802	-15%	

Table 1. Summary of Energy, Cost, and GHG Outcomes

[11] Focus on Energy (December 2006) Water and wastewater energy best practice guidebook. Wisconsin Department of Administration, Division of Energy.

[12] Illinois Section of the American Waterworks Association (March 2012) Water-energy nexus survey summary report. http://www.isawwa.org/resource/collection/82A33FB3-E26F-4EA1-932D-866A9E8E264A/FY12-0077_ISAWWA_SURVEY_REPORT_final.pdf

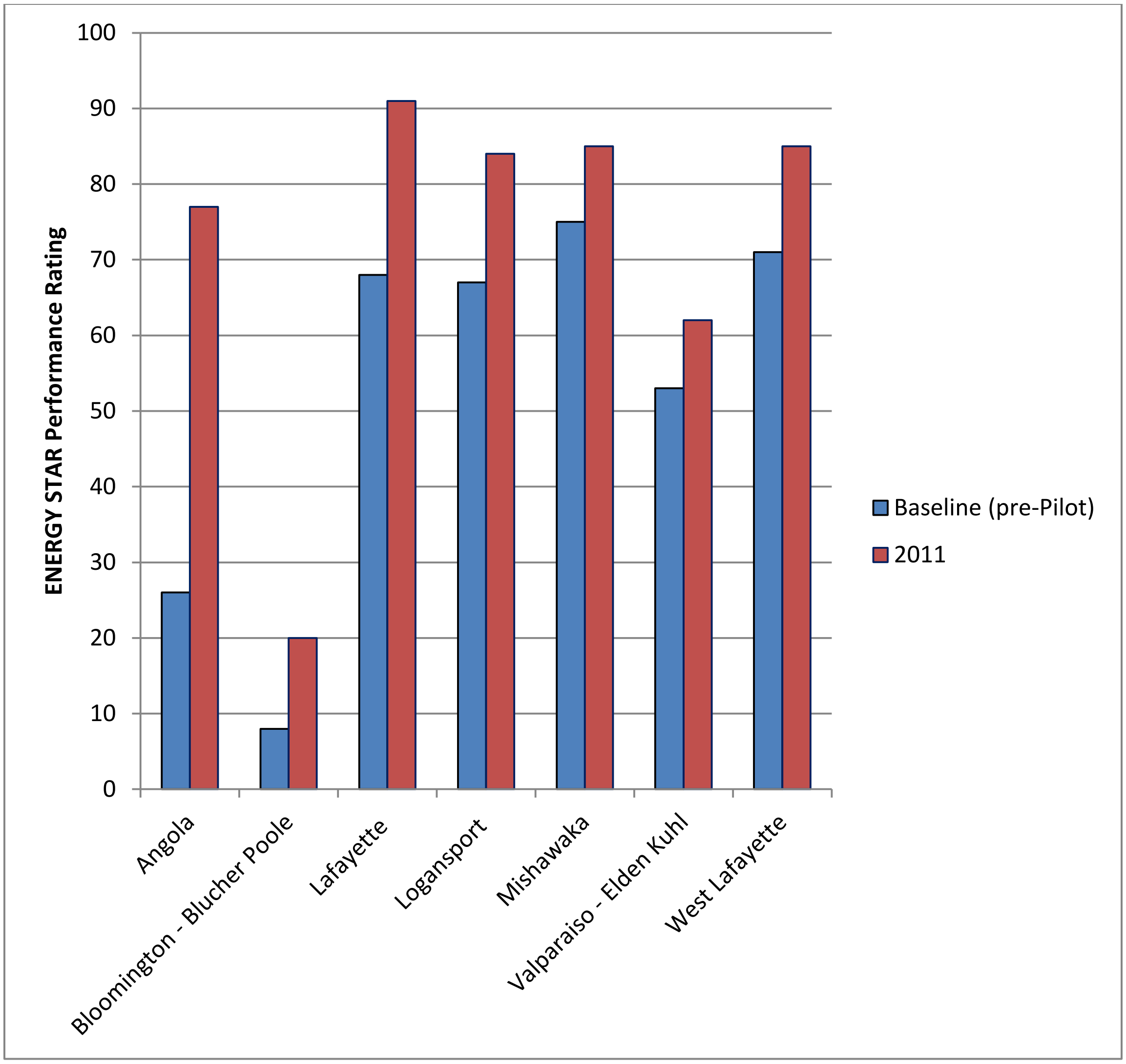

Figure 5. Pre- and Post-pilot Energy Performance Rating

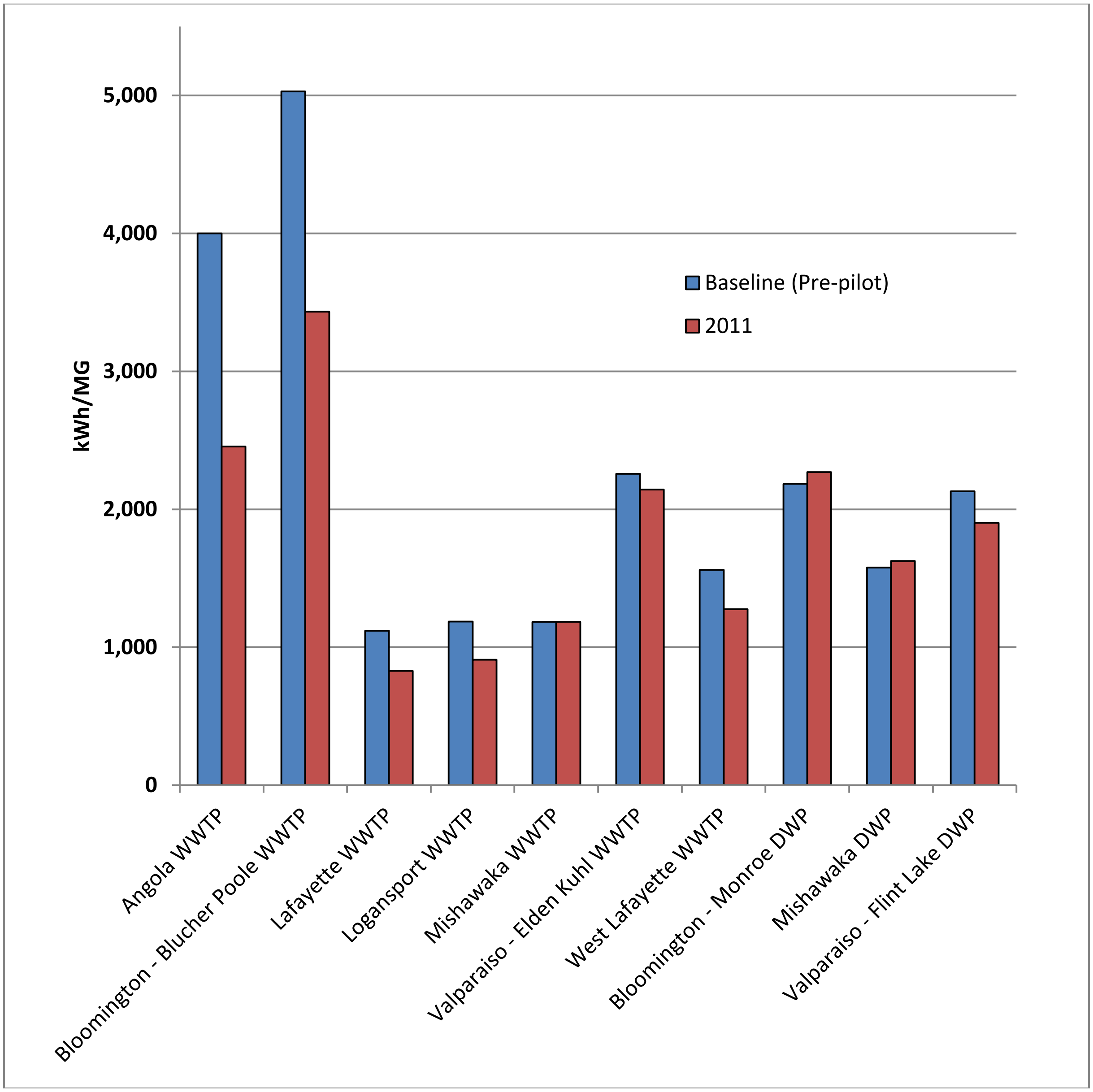

Figure 6. Pre- and Post-pilot Energy Intensity

3. Findings and Recommendations

This section presents findings from the Pilot from IDEM and EPA. It is not intended as a critique of any program or element of the *Guidebook* or Pilot utility. The goal is to support energy management by documenting lessons learned.

Six questions are at the core of energy management

The *Guidebook* was written for water utilities of any size or sophistication, and regardless of staff experience with energy efficiency or the PDCA framework. Pilot utilities began by sifting through the *Guidebook* to find sessions and modules of most relevance. Some referred to a chart in the *Guidebook* that asks, "If this characterizes your situation…then focus on… [And] use these [*Guidebook*] tools."[13] By the end of the Pilot, however, the Pilot utilities demonstrated that energy management can be narrowed down to six core questions that are a good starting place for any utility, large or small. The six questions are shown in Table 2 along with an index to the relevant *Guidebook* module(s).

In-house staff : a resource for assessing energy use and opportunities

According to the *Guidebook* (Pages 29 and 68) the energy audit or assessment is essential to energy management. Early in the Pilot, the group met with frustration when it was found that most were not in a financial position to hire a third-party energy auditor. EPA and IDEM initially considered supporting audits at Pilot utilities through supplemental funding, but a shift in budget priorities meant that dollars were not available. A decision had to be reached on how to move forward with this essential step.

Pilot utilities began to draw from the knowledge and experience of in-house operation, machine, engineering, managerial, lab, accounting and/or administrative personnel were a valuable resource. To focus the discussion, IDEM organized a series of three meetings at each Pilot utility where staff, (1) shared ideas openly with each other, (2) mentally walked through the process and examined energy use at each operation, and (3) used this information to propose ECMs. Each meeting took one to two hours and required minimal preparation from the participants, with the exception of one person who re-formatted documents between meetings one and two.

Staff participation varied by Pilot utility from a single manager to a good cross-section of departments. Pilot utilities were pleased with the outputs (including an energy-flow chart and list of ECMs) and reported on the benefitted of cross-department interaction on a single topic that impacts everyone (energy). Several commented that a lot of focused work was accomplished in a short amount of time. Two commented that the process encouraged staff to think about optimization and efficiency in new ways.

[13] See Page 7 – 8 of the *Guidebook* "Characterization of your Utility"

Core question	Corresponding *Guidebook* Session or module
1. How much energy does my plant use?	• Assess current energy baseline status (2,-) • Benchmark energy efficiency information (2,1) Choose an energy "fenceline" (1,3) • Track monthly and annual energy use (2,1, step 2)
2. What do I spend on energy each month?	Same as Question 1
3. Who is paying attention energy use and what support do I need?	• Secure and maintain management commitment… (1,2) • Establish energy improvement program leadership (1,4) • Get top management‟s commitment and approval ((5, 1, step 2)
4. What energy conservation measures(s) or ECMs can I try now?	• Conduct an energy assessment (2,2) • Prioritize activities/operations and potential energy improvement efforts (3,2 & 3,3)
5. What timeline and staffing go along with each ECM?	• Establish objectives and targets (4,- & 4,1) • Define performance indicators (4,2) • Develop Action Plans (IAPs) to implement … (5,1) • Implement action to adjust or correct … (6,1)
6. How do I keep energy efficiency efforts a priority while also meeting or exceeding product quality expectations?	• Secure and maintain employee buy-in (1,5) • Communicate results, success (1,6 & 7,4) • Maintain energy improvement programs (7,1)

Table 2. Six Core Energy Management Questions

Perhaps the most critical aspect of success of this three-meeting process was a facilitator. IDEM is commended for guiding staff through the self-assessment process. Also critical, was a private contract engineer who volunteered to sit in on meetings one and two and contribute ideas. Another third aspect of success was visual aids. IDEM furnished graphs and charts to help staff, (1) mentally walk through the operation to identify energy-using activities and processes, (2) develop a list of potential ECMs, (3) agree on decision criteria, and (4) select priority ECMs.[14] They were displayed at the meetings using a computer and projector so that all could view and adjust information as it was obtained.

> "We would probably have only listed high service pumps without considering other equipment if we had started with an audit so talking through the flow chart helped us be more thorough."

Energy data should be well documented for quality assurance

Energy management is data-driven. Data worth collecting should be good quality and useful for future comparisons. Until there is a standard protocol for energy data at water utilities, it is left to the individual water utility to document the source, manipulation and management of energy data it collects[15].

At the Pilot kick-off, power companies provided Pilot utilities a complimentary summary of monthly electricity use over the previous year (2008).[16] After that, utilities collected their own data from electricity and natural gas bills.[17] Energy bills rarely, if ever, align with the calendar month and are received a month or more after the energy is used.[18] Metering data will improve as power companies equip water utilities with smart meters that record and report usage on a daily or minute basis.

> "We needed to understand where the energy bills are and learn what they tell us about our energy use. In the past, the treatment plant did not see energy bills. They went to accounts payable."

The typical electric bill includes kWh (usage), kW (peak), and per-cent (power factor). Figure 7 is a chart from a Pilot utility showing monthly flow and energy intensity computed as natural gas and electricity both (red line) and as electricity only (blue line). The plant is steadily reducing

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[14] The visual aids are provided in a separate document called the *Guidebook Supplement* Specifically, they are contained in the Energy Management System Manuals under the heading "Activities and Operations" and "Priority Energy Using Activities and Operations" procedures.
[15] A study by the Illinois Section of the American Water Works Association (ISAWWA) points to a need for a consistent and comparable data collection methodology for the water utility. A standard methodology would lead to better benchmarking and more comparisons between and among utilities.
[16] There is usually a charge for this service.
[17] Since the Pilot was completed, the EPA Office of Water published an *Energy Use Assessment Tool* for drinking water and wastewater utilities. Version 1.0 was introduced in April 2012 and is available at http://water.epa.gov/infrastructure/sustain/energy_use.cfm

[18] The Pilot calculates the billing month as equal to the calendar month. For example, a billing month from June 12 to July 11 was treated as June 1 to 30.

energy use. The red peaks (natural gas plus electricity) reflect heating needs in the winter. Similar heating profiles found at other utilities are shown in Attachment 5.

Pilot utilities used energy data to trend,

- *Electricity consumption* – kilowatt-hours (kWh) per month from power company bills. This metric includes all electricity entering the plant from the electrical grid.
- *Natural gas consumption* – therm per month from power company bills. This metric includes all natural gas entering the plant from the gas pipeline.
- *Energy usage* – kWh per month. This is the sum of electricity and natural gas consumption where 1 therm equals 29.3 kWh.
- *Energy intensity* – the energy usage divided by treated water flow. Energy intensity was defined for the Pilot as kWh per million gallons (kWh/MG) for electrical energy only. It did not include natural gas energy. The flow used to calculate kWh/MG for drinking water utilities was based on finished water as opposed to intake water which is usually a larger number.

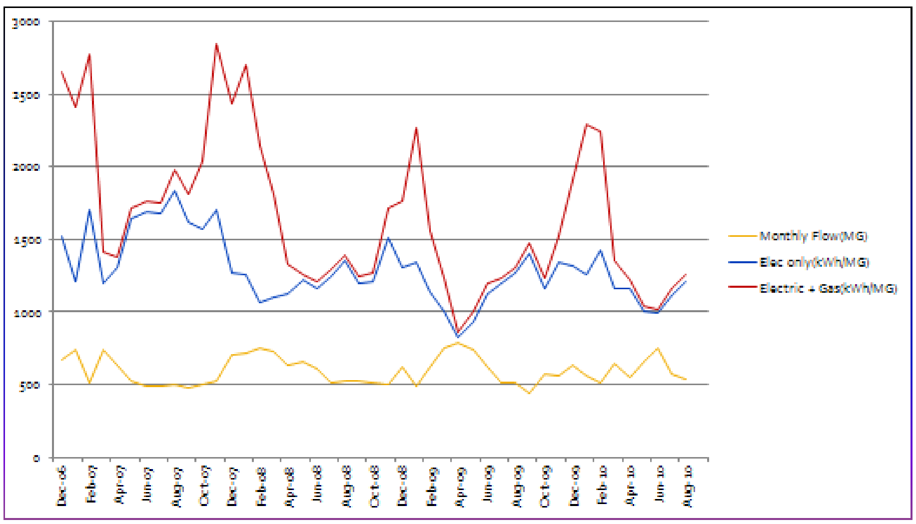

Figure 7. Lafayette Flow and Energy Trends

Biogas energy was not the focus of the Pilot, but is worth mentioning. Municipal wastewater biogas is about 60 percent methane, a fuel source that can be used to offset natural gas purchases. Several Pilot utilities use biogas energy to offset natural gas. West Lafayette cleans and uses its biogas to generate electricity.

Energy conservation measures range from no cost to high cost

Table 3 is a summary of ECMs identified by Pilot utilities. The ECMs can be grouped into five general categories: process equipment upgrades, lighting retrofit, heating, ventilation and air conditioning (HVAC) improvement, operating changes, and other. The capital cost for these ECMs ranged from $190,000 down to $0 with many low-cost measures identified.

> "It‟s all incremental and about getting employees to look for energy-saving measures. Little improvements can add up to real progress."

One Pilot (Angola) utility employed an outside expert to recommend low-cost optimization measures that improved operation and reduced energy usage. Throughout the Pilot Angola showed steady energy improvement from equipment upgrades and process optimization. It demonstrated that an integrated approach that includes operational changes with new equipment compounds energy saving potential.

Pilot utilities were fortunate to be addressing energy management at a time when funding was available from the Department of Energy (DOE) through Energy Conservation Block Grants under the American Recovery and Reinvestment Act of 2009. Three Pilot utilities received block grants during the Pilot and credit energy management records for helping them meet tight grant application deadlines. In a similar vein, the City of Bloomington Utilities leveraged energy management records to support a DWP bond issued in 2011.

More than one Pilot utility negotiated a more favorable rate tariff with its energy provider. Valparaiso Drinking Water reported a saving of about $1,000 per month through its new rate structure taking into consideration fixed and variable rates, including power factor, demand rates, and other add-ons. Utility bills are not consistent across energy companies and not always simple to read. By contacting the energy provider, utilities can learn about billing options and how to potentially save money through peak shaving.

Energy teams need access to training and resources

> "Make sure utilities are thinking about water efficiency as an energy saving strategy. Become a WaterSense partner."

According to the *Guidebook* (p. 10) energy teams are central to energy management to plan, delegate, establish deadlines, collect and evaluate work products, and provide training, guidance and assistance. For Pilot utility energy teams to lead the way, they need resources and training, much like safety teams. EPA has developed numerous outreach tools, including training modules and technical assistance, but these tools are not specific to water utility energy teams. [19] A set of resources and training modules should be developed for water utility energy teams.

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[19] The EPA‟s climate-ready water utilities toolbox is a good example of an organized, searchable database for water utilities http://www.epa.gov/safewater/watersecurity/climate/toolbox.html. Also, the ENERGY STAR website provides resources to help show teams how they are progressing in energy programs www.energystar.gov/index.cfm?c=guidelines.guidelines_index. A resources for that an energy team might find

Capital Cost Range	Energy Conservation Measure
$ 192,000 - $65,000	Process Equipment Upgrades: • High efficiency turbo blowers with on-line dissolved oxygen (DO) monitoring, • Raw sewage pumps with improved efficiency and flexibility, • Variable frequency drives on influent pumps and blowers.
$4,500 - $13,240	Lighting System Retrofit: • Replace/enhance interior and exterior existing fixtures, • Install occupancy sensors, • Upgrade digester lighting.
$1,370 - $53,000	HVAC Improvement • Adjust controls to reduce winter heating demand, • Replace HVAC chiller unit.
$1,500	New Lab or Office Equipment: Three new ENERGY STAR™-rated refrigerators.
$0 - $6,000	Operating Change: • Reduce recycle pumping needs, • Address solids and heating in digester operation, • Adjust chemical feed system, • Reset variable frequency drive (VFD) controls, • Clean aeration diffusers, • New operating procedures to control peaks, • New operating procedures to control aeration across shifts, • Adjust intake water pumping based on the previous day.
$0	Other • Change electrical switches so VFD fans and building fans run only as needed, • Work with the power company to revise the rate structure.

Table 3. ECM and Cost Range

useful is on EPA‟s website at http://water.epa.gov/infrastructure/sustain/cut_energy.cfm Another model program is the EPA WaterSense partnership, which offers free WaterSense materials and ideas to conserve water, and by reducing the need to pump and treat, saves energy http://www.epa.gov/watersense/partners/partner_website.html.

A menu or checklist can simplify the Plan-stage

About half of the *Guidebook's* 78 pages cover the Plan stage, starting with an overall awareness of energy management leading toward a list of priority ECMs.[20] Observations during the Pilot suggest that no matter how diligent the utility, it is unlikely that all Plan-stage sessions can be completed within a few months. The Pilot budgeted a full year for the Plan stage. Given that Plan is not a short-term proposition, it is important to make it manageable.

As Pilot utilities worked through that first year, they were given a Plan-stage checklist shown in Figure 8. This checklist was used as a menu as Pilot utilities selected which items to do immediately and which they might postpone to a later PDCA cycle, or indefinitely. By the end of year one, only four Pilot utilities had developed any energy policy (Session 2, Module 3). None had completed the table of previously implemented energy projects (Session 1, Module 4), opting to roll the table of previously implemented projects into a single list of ECMs. One Pilot utility went through the entire first year without a list of strategic goals and did not fully engage internally and externally interested parties. It was clear from the experience of that Pilot utility that top management support and commitment are very important and should be pursued as soon as possible. [21]

Utilities helped clarify aspects of the *Guidebook*

The Pilot helped use real-world situations to clarify and support the ***Guidebook***. Two aspects are worth noting: formatting the energy improvement action plan (IAP) and system vs. operation.

- IAP. Pilot utilities defined IAP as a table of tasks, key personnel, performance measures, and decision points for each ECM. Table 4 shows an IAP developed for the Pilot. It is a combination of what the *Guidebook* calls an action plan, energy improvement action plan, or energy improvement management plan.
- Treatment System versus System Thinking/Activity versus Operation. Depending on context, "System," can mean "treatment system" or "systems thinking." Similarly, "activity" and "operation" can be interpreted from different perspectives, as shown in Table 5. Therefore, it is important to talk through the *Guidebook* in cases where terms may seem unclear. Appendix E (List of Activities and Operations) was challenging to some until "activity" and "operation" was sorted out. During the Pilot, operation referred to a unit process, whereas activity was the equipment involved in that process. The *Guidebook* frequently refers to system, activity and operation so it is important to build understanding through examples.[22]

Additional observations about *Guidebook* documents are provided in Attachment 4 of this report.

[20] The Pilot used the phrase "energy conservation measure" or ECM rather than "potential energy improvement effort" (See *Guidebook* Session 3, Module 3) to refer to actions that improve energy efficiency or conserve energy.
[21] Session 1, Module 4 says that top management support is critical.
[22] Activity and operation are in: identifying activities and operations that consume energy (Session 3, Module 2); prioritizing activities/operations (Session 3, Module 3), development of action plans or IAPs (Session 5, Module 1), developing management system controls (Session 5, Module 2), Determine what else you need …(Session 6, Module 2).

2009-2011 Indiana Energy Pilot Projects
Checklist of Activities for the Plan Stage

PLAN

TIME FRAME (1.5 MONTHS): APRIL 1 - MAY 15, 2010

- ☐ List of Utility Strategic Goals (Guidebook p. 12)
- ☐ Project fenceline (Guidebook p.14)
- ☐ Name/role of members on energy team (Guidebook p. 15)
- ☐ List of internal/external interested parties (Guidebook p. 18)
- ☐ Portfolio Manager monthly and annual energy inputs
- ☐ Baseline energy use (kWh/month, therms/month, kWh/MG, $/month for 2008)
- ☐ Energy policy draft or final
- ☐ List of Previously Implemented Projects (Guidebook p. 16)
- ☐ Energy Baseline Data (Guidebook Appendix B)
- ☐ Equipment Inventory (Guidebook Appendix C)
- ☐ List of Activities and Operations (Guidebook Appendix E)
- ☐ Current Monitoring and Measuring (Guidebook Appendix L)

TIME FRAME (3.0 MONTHS): MAY 15 – AUGUST 15, 2010

- ☐ Energy Priority Ranking Table (Guidebook Appendix E, left most columns)
- ☐ List of ranking criteria
- ☐ Energy Priority Ranking Table (Guidebook Appendix H)
- ☐ Select an energy conservation measure (ECM) to implement
- ☐ Develop Objectives and Targets for each ECM (Guidebook Appendix I)

TIME FRAME (1.5 MONTHS): AUGUST 15 - SEPTEMBER 30, 2010

- ☐ Continue to benchmark energy use and cost
- ☐ Continue to implement Guidebook (action plan, communication, …)

Figure 8. Checklist / Menu of Plan Stage Activities

Subject: Energy Improvement Action Plan ECM #2. Reduce energy used by RAS Pumps	Document No.:
Approved by: John Doe	Date Issued:

Activity: Return Activated Sludge Pumping
Operation: Final Clarification
Objective and Target: Reduce electricity in RAS pumping by 2% by December 31, 2011

Action Plan

Task	Responsible Party	Timeframe	Performance Measure	Comments
Develop baseline	S. Adams	12/31/2010	kWh	
Research different operating scenarios	J. Armstead	12/31/2010	Report to operators	
Implement and monitor new operating scenarios	Maintenance staff	8/31/2011	kWh, process condition	
Implement final scenario	Maintenance staff	9/30/2011	kWh, process condition	
Conduct employee training	E. Kerns	10/31/2011	Sign-in sheet	
Track energy saving and process condition	J. Armstead and C. Turner	11/30/2011	kWh, process condition	Collect information from VFDs
Report saving to wastewater staff	B. Davis	12/31/2011	kWh, process condition	

Table 4. Energy Improvement Action Plan

Energy metering is usually plant-wide and influences the fenceline

The *Guidebook* defines "fenceline" as the equipment, operations or processes that are the focus of energy improvement goals. Selecting the right fenceline is an important first decision for a utility in the Plan stage. Pilot utilities discovered that there is more than one purpose for a fenceline and often set the fenceline where they could measure kilowatt-hour or therm. Since, most Pilot utilities are not equipped to measure energy consumption of individual operations, unit processes or components, their fenceline became the entire plant (See Figure 9).

> "If I was coming into this fresh and you asked me to create an equipment inventory, I would stop right there."

Oversized fencelines led to delay in *Guidebook* Appendix C, List of Energy-using Equipment. The list became unmanageable as a planning effort and by the end of month Pilot utilities started to report delays. Eventually, the Pilot utilities developed strategies to work within large fencelines:

- Employ graduate school interns. At Indiana University‟s School of Public and Environmental Affairs, the college pays 75 percent of the intern‟s salary and the city pays the remaining 25 percent. Interns work up to 9 hours per week for a total of 120 to 150 hours of experience that can be applied toward college credit. An intern collected Pilot utility data and through a regression analysis discovered anomalies in the energy performance of two large pumps. The data led operators to cut peak energy usage and led mechanics to a malfunctioning pump.
- Address the lack of sub-metering by estimating energy and costs from horsepower and hours of operation. Then re-draw the fenceline around the five largest pieces of equipment. As one utility manager said, "I tend to think in horsepower." One horsepower running 24/7 at $0.10 per kWh costs about $35.00 in energy per month.
- Install portable meters. One Pilot utility‟s power company installed a portable power meter and left it on site, recording real-time energy use for several months.

> "We have our big picture for the plant and now we are going to have to measure individual processes."

- Develop an energy improvement action plan for design and installation of process sub-meters and a data acquisition system to track the energy consumed along with other process variables. Energy metering is not traditionally thought of as an ECM, but it was clear from Pilot utilities that better metering will improve future PDCA cycles.

Term	How the term is used in the *Guidebook*	How the term is used by the Pilot utility
Operation	Pumping, building heating, service truck, aeration, dewatering, heating ventilation and air conditioning, sludge handling	Headworks, receiving station, influent lift station, grit removal, Primary clarification, Final clarification, including reaeration, Sludge handling blending, thickening, dewatering, dissolved air floatation, digestion (anaerobic or aerobic), Disinfection,
Activity	Equipment, lighting, vehicle use, heating, ventilation and air conditioning	Blowers (e.g. aeration, air scouring), Pumps (e.g. chemical feed, pressurization pump, jet aeration, high service, recycling, filter backwash, mixing, etc.), Shop (air compressor, hoist), Lab equipment (e.g. autoclaves and refrigerators) Office equipment, Fleet equipment, HVAC (air conditioner and cooler, air handling unit, exhaust fans, boiler), Lighting, Miscellaneous machinery (door openers, flights and hoists), vending machines, generators.

Table 5. Activity and Operation

Figure 9. Fencelines for Mishawaka (left) and Lafayette (right)

Portfolio Manager is not fully enabled for water utilities

The *Guidebook* recommends using Portfolio Manager to keep track of energy use. However, at the time of the Pilot, Portfolio Manager did not offer a performance rating for DWPs and did not offer the energy star for either WW or DWPs.[23] Figure 10 shows space types eligible for the Energy Star™. A high performance rating in Portfolio Manager can merit the Energy Star™ certificate, for all space types in Figure 10 except water utilities. On the plus side, WWTPs and DWPs can use Portfolio Manager for a statement of performance as shown in Figure 11. Portfolio Manager also calculates GHG from kWh and therm data. Also, it is a way to generate a summary table similar to those shown in Attachment 2 of this report.

> "Urge the person keeping track of energy use to review it with superiors and make sure they become aware their energy consumption…Sometimes it is too easy to say „we will get to it later.‟"

[23] As discussed in Section 2.2 of this report, WWTPs are eligible for an energy performance rating.

Figure 10. Space Types Eligible for Energy Star

OMB No. 2060-0347

STATEMENT OF ENERGY PERFORMANCE
City of West Lafayette Wastewater

Building ID: 1555998
For 12-month Period Ending: December 31, 2011[1]
Date SEP becomes Ineligible: N/A

Date SEP Generated: February 27, 2012

Facility
City of West Lafayette Wastewater
500 S. River Road
West Lafayette, IN 47906

Facility Owner
N/A

Primary Contact for this Facility
N/A

Year Built: 1959
Energy Performance Rating[2] (1-100) 85

Site Energy Use Summary[3]	
Electricity - Grid Purchase(kBtu)	12,362,012
Natural Gas (kBtu)[4]	2,843,425
Total Energy (kBtu)	15,205,437
Energy Intensity[4]	
Site (kBtu/gpd)	2
Source (kBtu/gpd)	6
Emissions (based on site energy use)	
Greenhouse Gas Emissions ($MtCO_2e$/year)	2,715
Electric Distribution Utility	
Duke Energy Indiana	
National Median Comparison	
National Median Site EUI	3
National Median Source EUI	9
% Difference from National Median Source EUI	-38%
Building Type	Wastewater

Stamp of Certifying Professional

Based on the conditions observed at the time of my visit to this building, I certify that the information contained within this statement is accurate.

Meets Industry Standards[5] **for Indoor Environmental Conditions:**

Ventilation for Acceptable Indoor Air Quality	N/A
Acceptable Thermal Environmental Conditions	N/A
Adequate Illumination	N/A

Certifying Professional
N/A

Notes:
1. Application for the ENERGY STAR must be submitted to EPA within 4 months of the Period Ending date. Award of the ENERGY STAR is not final until approval is received from EPA.
2. The EPA Energy Performance Rating is based on total source energy. A rating of 75 is the minimum to be eligible for the ENERGY STAR.
3. Values represent energy consumption, annualized to a 12-month period.
4. Values represent energy intensity, annualized to a 12-month period.
5. Based on Meeting ASHRAE Standard 62 for ventilation for acceptable indoor air quality, ASHRAE Standard 55 for thermal comfort, and IESNA Lighting Handbook for lighting quality.

Figure 11. Energy Performance Statement

New short guides, templates and examples supplement the *Guidebook*

During year 2 of the Pilot, GETF held conference calls with Pilot utilities to delve into eleven topics or key elements of energy management: (1) energy policy, (2) legal and other requirements and compliance status, (3) activities and operations, (4) objectives and targets, (5) operational controls, (6) awareness and competency training, (7) internal and external communication, (8) document control, (9) monitoring and measurement, (10) corrective action, and (11) management review. The calls led to eleven short guides and templates to supplement the *Guidebook* and assist utilities with energy management.

Each short guide and template provides a description of the key element, a checklist showing exactly how to get started, and a template to document procedures. In addition to the templates and short guides, GETF used Pilot utility input to package worked examples into two energy system manuals, one for a DWP and the other for a WWTP. Though the manuals represent fictitious plants, they are based on real-world situations from the Pilot and show how a utility might assemble *Guidebook* outputs into one cohesive document.

It is hoped that the short guides, templates and example manuals can serve as useful resources for other utilities.

4. Conclusion

The Pilot confirms that by paying attention to energy management water utilities can reduce operating expense and curb GHG emissions. Energy management also offers opportunity for treatment plant improvement and better management overall. The *Guidebook* provides a flexible yet comprehensive process to address energy management. This paper identifies ten strategies or lessons learned to advance energy management across the water sector. They include six common questions every water utility manager should answer as core energy management competencies.

> "This program has been excellent in that we are more diligent in observing our surroundings and how it affects our energy consumption."

As a group the 10 Pilot utilities saved energy, reduced cost and lowered GHG emissions. Their input was the basis for this report and was included in instructional short guides, templates and examples published separately to supplement the *Guidebook.* Energy management planning and implementation is not an exact science. Whether a water utility chooses to develop all or just some of the *Guidebook* sessions*,* it will want to get a commitment by top management and establish an energy improvement action plan with objectives and targets to meet energy efficiency goals. It is recommended that water utilities consult the short guides and templates, and the sample energy management system manuals along with the *Guidebook* and brag about accomplishments in cumulative annual energy reports for boards and ratepayers. Attachment 6 shows a reporting format.

Key Energy Management System Element	***Guidebook*** **(Section, Module) that the Key Energy Management System Element Supports**
Energy policy	• Develop an energy policy (3,1)
Legal and other requirements and compliance status	• Review Legal and other requirements and establish a compliance baseline (2,6) • Monitor/reassess compliance status (6,6)
Activities and operations	• Identify activities and operations that consume energy (3,2)
Objectives and targets	• Identify energy objectives and targets (4,1)
Training	• Develop management systems „operating controls" to support energy improvements – TRAINING (5,2)
Communication	• Communicate results (1,6) • Develop management system „operating controls" to „support energy improvements" (5,2) • Communicate success (7,4)
Document control	• Develop management system „operating controls" to support energy improvements - CONTROLLING DOCUMENTS AND MANAGING RECORDS (5,2)
Monitoring and measurement	• Monitoring and measuring your energy improvement management program (6,-)
Corrective action	• Implement action plans to adjust or correct when you are not progressing toward your energy goals (6,5)
Management review	• Review the progress of your energy targets (6,4)

Table 6. New Resources for Energy Management: A Supplement to the Guidebook

Attachment 1. List of acronyms in this report

CBU – City of Bloomington Utilities
CO2e – carbon dioxide equivalent
DO – dissolved oxygen
DW – drinking water
ECM – energy conservation measure
EPA – U.S. Environmental Protection Agency
GETF – Global Environment Technology Foundation
GHG – greenhouse gas
gWh – gigawatt-hour
HVAC – heating, ventilation and air conditioning
IAP – energy improvement action plan
IDEM – Indiana Department of Environmental Management
kWh – kilowatt-hour
MG – million gallons
MGD – million gallons per day
Mt – million ton
PDCA – Plan-Do-Check-Act
VFD-variable frequency drive

Attachment 2. Portfolio Manager Summary Tables (Wastewater)

Angola

12 Months Ending	Average Flow (MGD)	Current Rating (1-100)	Current Site Electric Use (kWh)	Current Site Natural Gas Use (therms)	Current Site Energy per Flow (kBtu/gpd)	Current Total GHG Emissions (MtCO2e)	Annual Energy Cost (US Dollars ($))
December 2007	1.2	37	1,528,704.7	5,116.9	4.6464	1,108.77	$132,902.76
December 2008	1.2	26	1,752,035.5	5,570.4	5.3011	1,269.19	$149,893.37
December 2009	1.3	38	1,536,096.6	4,328.0	4.4191	1,109.80	$131,577.80
December 2010	1.1	61	1,262,415.6	3,996.2	4.2473	914.41	$106,549.38
December 2011	1.3	77	1,161,096.7	3,683.7	3.3156	841.07	$106,776.20

City of Bloomington Utilities/Blucher Poole

12 Months Ending	Average Flow (MGD)	Current Rating (1-100)	Current Site Electric Use (kWh)	Current Site Natural Gas Use (therms)	Current Site Energy per Flow (kBtu/gpd)	Current Total GHG Emissions (MtCO2e)	Annual Energy Cost (US Dollars ($))
December 2008	2.9	8	5,324,379.4	36,558.5	7.4388	3,961.45	$345,022.70
December 2009	3.7	19	4,904,873.3	34,960.2	5.4699	3,656.15	$372,242.06
December 2010	4.0	18	5,524,598.7	33,621.9	5.4847	4,087.49	$402,645.05
December 2011	4.6	20	5,746,045.8	25,040.5	4.7876	4,198.50	$422,661.46

City of West Lafayette

12 Months Ending	Average Flow (MGD)	Current Rating (1-100)	Current Site Electric Use (kWh)	Current Site Natural Gas Use (therms)	Current Site Energy per Flow (kBtu/gpd)	Current Total GHG Emissions (MtCO2e)	Annual Energy Cost (US Dollars ($))
December 2008	8.3	71	4,724,992.7	17,865.5	2.1452	3,437.94	$307,729.12
December 2009	7.8	68	4,418,463.9	33,628.2	2.3714	3,304.94	$317,722.51
December 2010	7.5	73	4,262,417.9	41,203.7	2.5028	3,234.84	$319,051.35
December 2011	7.8	85	3,623,098.4	28,434.2	1.9381	2,714.59	$284,004.23

City of Lafayette

12 Months Ending	Average Flow (MGD)	Current Rating (1-100)	Current Site Electric Use (kWh)	Current Site Natural Gas Use (therms)	Current Site Energy per Flow (kBtu/gpd)	Current Total GHG Emissions (MtCO2e)	Annual Energy Cost (US Dollars ($))
December 2007	18.5	55	10,284,689.6	120,207.5	2.5435	7,915.85	$616,475.69
December 2008	21.7	68	8,837,455.3	124,806.4	1.9629	6,916.41	$592,906.98
December 2009	19.8	69	8,264,700.7	57,221.8	1.7114	6,151.64	$564,598.22
December 2010	18.2	76	8,058,425.0	61,440.0	1.8436	6,028.14	$557,214.52
December 2011	20.4	91	6,144,520.5	44,830.0	1.2472	4,585.70	$489,273.61

Logansport Municipal Utilities

12 Months Ending	Average Flow (MGD)	Current Rating (1-100)	Current Site Electric Use (kWh)	Current Site Natural Gas Use (therms)	Current Site Energy per Flow (kBtu/gpd)	Current Total GHG Emissions (MtCO2e)	Annual Energy Cost (US Dollars ($))
December 2008	9.2	69	3,678,000.0	37,438.6	1.7674	2,801.33	$270,081.20
December 2009	8.8	68	3,504,000.0	32,638.8	1.7300	2,652.69	$292,846.12
December 2010	8.3	81	3,140,770.0	28,565.3	1.6339	2,374.04	$249,923.83
December 2011	9.0	84	2,976,000.0	34,625.8	1.5174	2,289.71	$270,187.35

Mishawaka City Utilities

12 Months Ending	Average Flow (MGD)	Current Rating (1-100)	Current Site Electric Use (kWh)	Current Site Natural Gas Use (therms)	Current Site Energy per Flow (kBtu/gpd)	Current Total GHG Emissions (MtCO2e)	Annual Energy Cost (US Dollars ($))
December 2009	12.6	75	5,430,400.0	140,532.6	2.5806	4,589.61	$585,832.00
December 2010	10.5	83	4,873,600.0	108,722.1	2.6295	4,026.44	$396,225.00
December 2011	11.4	85	4,915,200.0	103,948.6	2.3761	4,030.48	$386,551.34

Valparaiso City Utilities/Elden Kuehl

12 Months Ending	Average Flow (MGD)	Current Rating (1-100)	Current Site Electric Use (kWh)	Current Site Natural Gas Use (therms)	Current Site Energy per Flow (kBtu/gpd)	Current Total GHG Emissions (MtCO2e)	Annual Energy Cost (US Dollars ($))
December 2007	5.3	75	4,200,000.0	N/A	2.7092	2,971.47	$345,123.00
December 2008	5.3	53	4,367,920.0	113,994.7	4.9445	3,696.73	$475,456.00
December 2009	5.0	45	4,727,040.0	78,584.2	4.8365	3,762.42	$439,112.00
December 2010	4.3	47	4,425,600.0	80,661.8	5.4227	3,560.20	$377,777.34
December 2011	5.1	62	3,976,440.0	97,569.8	4.5524	3,332.38	$397,459.31

Attachment 3. Summary Tables for Drinking Water Utilities

Valpo DW Flint Lake 2.3 MGD	Total Electricity (GWh/year)	Total Natural Gas (Ktherms/year)	GHG Emissions, (MtCO2e)	Elect Energy Charges	Total Elect + NG use, kWh	Total elect Charges	Electrical Energy Intensity, kWh/MG
2007	1.81	n/a	1,268	$165,450	n/a	$ 165,450	2,121
2008	1.76	n/a	1,224	$159,380	n/a	$ 159,380	2,119
2009	1.83	n/a	1,290	$165,904	n/a	$ 168,904	2,441
2010	1.65	n/a	1,168	$153,588	n/a	$ 153,588	1,981
Value change 2010 (baseline = 2008)	-0.16		-56	-$5,792		$ (5,792)	-138
% change 2010 (baseline = 2008)	-9%		-5%	-4%		-4%	-7%

Mishawaka DW 8.0 MGD	Total Electricity (GWh/year)	Total Natural Gas (Ktherms/year)	GHG Emissions, (MMtCO2e)	Elect Energy Charges	Total Elect + NG use, kWh	Total elect + NG Charges	Electrical Energy Intensity, kWh/MG
2008	4.47	42	528	$342,823	5,713,629	$ 390,649	1,489
2009	4.09	37	475	$349,822	5,186,170	$ 383,626	1,424
2010	4.75	44	554	$437,039	6,033,173	$ 454,876	1,653
Value change 2010 (baseline = 2008)	0.28	1	26	$94,216	319,544	$ 64,227	164
% change 2010 (baseline = 2008)	6%	3%	5%	27%	6%	16%	11%

CBU Monroe (Intake + Filtration Plant) 14.4 MGD	Total Electricity (GWh/year)	Total Natural Gas (Ktherms/year)	GHG Emissions, (MMtCO2e)	Elect Energy Charges	Total Elect + NG use, kWh	Total elect + NG Charges	Electrical Energy Intensity, kWh/MG
2008	11.80	24.75	924	$380,757	12,526,919	$ 804,905	2,250
2009	17.45	15.20	1,357	$369,678	17,897,055	$ 794,431	3,399
2010	11.82	18.28	958	$389,129	12,359,637	$ 768,126	2,198
Value change 2010 (baseline = 2008)	0.02	-6.47	34	$8,372	-167,282	$ (36,779)	-52
% change 2010 (baseline = 2008)	0%	-26%	4%	2%	-1%	-5%	-2%

Attachment 4. Critical Review of Guidebook Tables

This attachment to the Indiana Pilot summary report shows how Pilot utilities applied tables in the *Guidebook,* for possible revision should a new edition of the *Guidebook* be published.

1. **Previously Implemented and Planned Improvement Projects**

Pilot utilities did not use Table 1.1, below. Instead, table headings were addressed in checklist fashion during a self-assessment. Pilot utilities were not interested in an inventory of previously implemented projects, choosing instead to gain momentum with current and future projects. The track improvement feature in Portfolio Manger (see Table 1.2) was used to list energy conservation measures. Additional columns could be added to right of Table 1.2 showing whether results are or were communicated and to whom, relevant SOPs, etc.

Table 1.1. Improvements Projects (*Guidebook* p. 16)

Energy Use (type)	Projects completed	results	Who did you communicate results to?	Were there associated SOPs, training records?	Current activities in planning	How will you measure results?	Who could you communicate results to?	What SOPs and training records will be needed

Table 1.2. Portfolio Manager Track Improvements Feature

Start Date	Upgrade Category (e.g. recomissioning, lighting, load reduction, HVAC, other technologies/strategies)	Upgrade cost (U.S. dollars)	Short description

Table 1.3. Portfolio Manager Track Improvements Table (with suggested revisions)

<table>
<tr><td rowspan="2">Start Date (end date)</td><td colspan="3">Project</td><td colspan="2">Estimated Annual Savings</td></tr>
<tr><td>Upgrade Category</td><td>Brief Description</td><td>Capital Cost</td><td>kWh</td><td>Energy Dollars</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

2. Energy-related Data Elements, *Guidebook* page 25 and 26, and Appendix B

Tables 2.1 through 2.4 were not completed as Pilot deliverables. It was suggested that these tables be consolidated as shown in Table 2.5.

Table 2.1. Energy Baseline Data Table (*Guidebook* P. 25)

Data Need	Units	Desired Frequency of Data	Data Source	Availability of Data

Table 2.2 Energy Baseline Data Table (*Guidebook* Appendix B)

Data Need	Units	Desired Frequency of Data	Data Source	Accessibility

Table 2.3. Energy Baseline Data Table (*Guidebook* P. 26)

Data Need	Units	Frequency of Data	Data Source

Table 2.4. Energy Baseline Data Table (*Guidebook* Appendices B and L)

Data Element	Units	Data Source

Table 2.5 Data Collection Profile (suggested)

Data Element (e.g. natural gas, biogas, electricity)	Measurement Unit (e.g. kWh, MGD, Therms)	Data Collection Frequency (e.g. continuous, hourly, daily, monthly)	Data Source (e.g. meter number or location)	Data Report frequency (e.g. daily, monthly)	Entity or Person(s) Responsible for data collection

3. **Monthly energy consumption, *Guidebook* p. 27**

When the Guidebook was written in 2008, Portfolio Manager did not track monthly flow. Today it does, making the table on p. 27 very similar to that used by Portfolio Manager. However, Portfolio Manager provides monthly consumption data not daily as shown on p. 27, and does not allow input of billing items such as peak flow or power factor. Pilot utilities that assessed their electric bills found significant opportunities to save money by peak shaving, addition of capacitors to reduce power factor charges, and negotiating more favorable rate tariffs or contracts. Table 3.1 identifies energy cost (cents/kWh). Table 3.4 adds a column to distinguish between usage charge (the charge per kWh by the power company) and realized charge (the total billed amount including all charges divided by the kWh used). The ratio of rate versus realized charges may suggest efficiency.

Table 3.1. Energy Consumption Tracking Table (*Guidebook* p. 27)

2006 Energy Consumption (Month)	Average Daily Consumption (kWh)	Peak Demand (kW)	Cost (cents/kWh)	Daily flow (million gallons)

The table on p. 28 is identical to Table 3.1 except it is a yearly, not monthly summary.

Table 3.2. Energy Consumption Tracking Table (suggested)

2006 Energy Consumption (Month)	Average Daily Consumption (kWh)	Peak Demand (kW)	Usage Charge ($/kWh)	Realized Charge ($/kWh)	Daily flow (million gallons)
			0.05/kWh	0.08/kWh	

4. **List of Activities and Operations, *Guidebook* p. 36 and Appendix E**

Pilot utilities avoided Table 4.1. There was confusion over the terms "operations" and "activities." On page 36, "activity" is defined similar to "category" in the Portfolio Manager. Ultimately, it was left up to each Pilot utility to define "activity" and "operation." Typical "operations" and "activities" are shown in Tables 4.2 and 4.3. Although each covered the categories in a slightly different way, a pattern emerged where the operation is a broad category made up of many similar activities. Utilities developed the list of Activities and Operations by mentally walking through the facility with the aid of:

Table 4.1 Example List of Activities and Operations (*Guidebook* p. 36, and Appendix E)

Activity	Operation or location	Type of energy used	Current Use and Costs

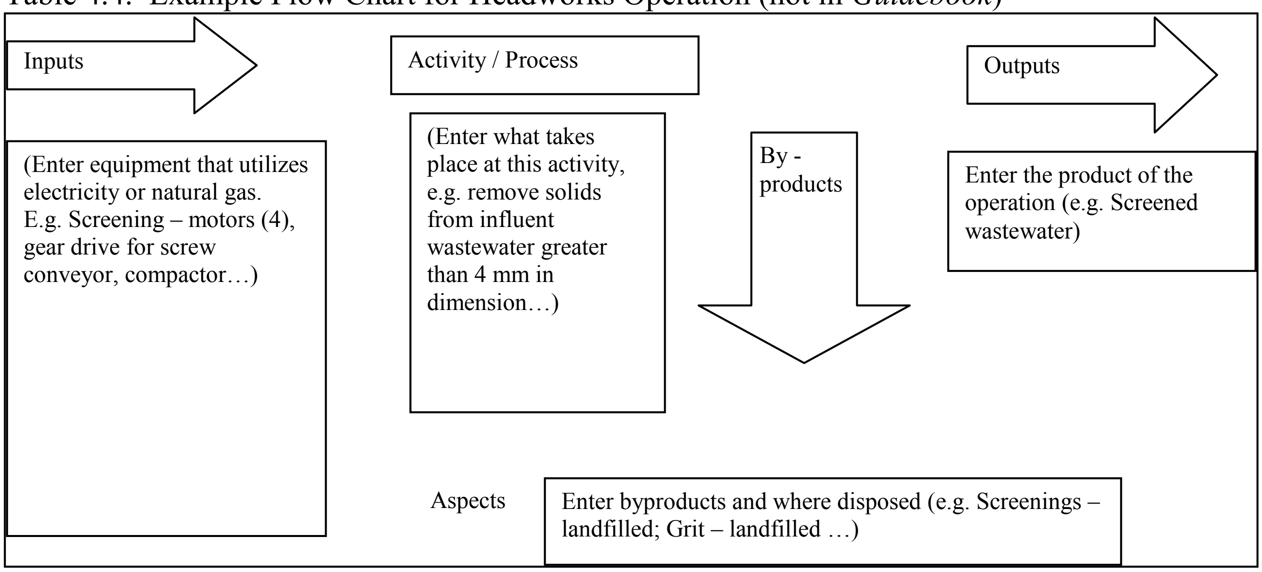
Table 4.2 Typical Operations and Activities Defined by Pilot Utilities (Wastewater)

"Operations"	"Activities"
Headworks, septage receiving station, influent lift station, grit removal, primary clarification, gravity filters, final clarification, sludge blending, belt filter press, dissolved air floatation, anaerobic digestion, aerobic digester, primary sludge thickening, disinfection, reaeration, miscellaneous	Aeration blower, air scour blower, peristaltic pump, feed pump, polymer pump, pressurization pump, turbidity sampling pump, jet aeration pump, dilution water pump, cavity pump, clear well pump, filter backwash pump, mixing pump, air compressor, flight drive, hot water boiler, lab equipment, diesel equipment, vending machine, holding tank aerator, air conditioner, air handling unit, hot water boiler, lighting, actuator gate, exhaust fan, garage door opener, electric hoist, air compressor, refrigerator, autoclave.

Table 4.3 Typical Operations and Activities Defined by Pilot Utilities (Drinking Water)

"Operations"	"Activities"
Filtration, high service pump, wellfield, chemical treatment, disinfection, booster station and elevated tanks, low service pumping, sludge handling, dewatering, water distribution, miscellaneous	Backwash pump, refrigerator, microwave, dehumidifier, generator, HVAC, lab equipment, lighting, diaphragm pump, peristaltic pump, pre-chlorination pump, high service pump, post chlorination pump, pressure filter, raw water pump, well house heater, well house exhaust fan, thiosulfate pump, natural gas heating, vending machine, microwave, ice machine, traveling screen motor, low service pump, slow mix motor, sludge clarification pump and motor, skid steer, natural gas boiler, fluoride pump, motorized entrance gate, electric hoist, office equipment, lab equipment, generators, vehicle, lawn equipment,

Table 4.4. Example Flow Chart for Headworks Operation (not in *Guidebook*)



5. Equipment Inventory Worksheets, Appendix C

Pilot utilities did not complete the last column in Table 4.1 because they had no estimates of current use and cost by operation or activity. Appendix C provides a worksheet that can be used to estimate current use and cost for process and equipment. Totals from Appendix C can be used for Table 4.1. However, this was not done for the Pilot because the utilities chose to use estimates for the first PDCA cycle. The equipment inventory will probably be used only for very large energy consuming equipment.

6. Criteria to Prioritize Opportunities for Energy Improvements

Pilot utilities decided on the four main criteria shown in boldface below.

Ranking Criteria Examples

- **Estimated cost to implement**
- **Potential for energy use reduction**
- **Technical feasibility**
- **Availability of funding**
- Cost reduction/avoidance
- Payback period (return on investment)
- Ease of implementation
- Legal/regulatory constraints
- Staff capability to implement
- Potential adverse impact on operations
- Existing need for equipment upgrade/replacement
- Support of other priorities

Table 5.1. Priority ranking options

7. **Regulatory Requirements Table, Appendix D**

Pilot utilities did not complete Appendix D, opting instead to address a procedure to describe how and when utilities identify environmental laws and regulations. Pilot utilities stated that they would not propose energy conservation measures that would negatively impact compliance and saw no need to complete Appendix D. Regulatory considerations of each energy conservation measure are addressed in a new table, Basis for Objective and Target Selection, discussed further below.

8. Energy Ranking Priority Table, *Guidebook* p. 40 and Appendix H

Pilot utilities typically used 4 ranking criteria and multiplied, rather than added them to compute a total score. A separate table was developed to describe the criterion (see Table 8.2). Pilot utilities found that multiplying the criterion using scores of 1, 3 and 5, it was easy to see which scored the highest. Also, in the final table the columns "Type of Energy Used" and "Current Use and Costs" were omitted (or they could be hidden using Excel) bring greater clarity to the ranking criterion.

Table 8.1. Energy Priority Ranking Table, Appendix H

Activity	Operation	Type of Energy Used	Current Use and Costs	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Criterion 5	Total Score

Table 8.2. Energy Priority Ranking Worksheet (revised)

Activities and Operations		**Ranking Criterion**				
Activity	**Operation**	**Freq of Use**	**Potential Energy Savings**	**Cost of Imp. Energy Savings**	**Energy Intensity**	**Total Score**
Boilers – natural or digester gas (2)	**Miscellaneous**	**5**	**3**	**5**	**5**	**375**
Air chiller unit	**Miscellaneous**	**3**	**5**	**1**	**5**	**75**
RAS pumps – 8, 6 used at a time	**Final Clarification**	**5**	**3**	**1**	**5**	**75**

Table 8.3. Definition of Ratings to Accompany Appendix H.

Definitions of Ratings	
Frequency of Use	
1 = Infrequent use (< 1 / day)	
3 = Moderate use (> 1 / day)	
5 = Frequent use (24 hours / day 7 days / week)	
Potential for Energy Savings	
1 = No potential (0%)	
3 = Potential (1% - 25%)	
5 = Significant potential (>25%)	
Cost of Implementing Energy Savings	
1 = Significant cost (>$10,000)	
3 = Moderate cost (<$10,000)	
5 = No cost ($0)	
Energy Intensity	
1 = Low intensity	
3 = Moderate intensity	
5 = High intensity	
Significance	
Determined by multiplying each row.	

9. Basis for Objectives and Targets Selection. New.

Pilot utilities use Table 9.1, which was developed for this project, to make a final decision on priority energy conservation measures. This table is not in the *Guidebook*.

Table 9.1 Basis **for Objective and Target Selection**

Activity	**Operation**	**Legal / Other Requirements**	**Technological Opportunities**	**Financial / Operational Opportunities**	**Interested Parties**	**Selected Activities**

10. Objectives and Target Worksheet and Performance Indicator Worksheet, *Guidebook* p. 44-52, Appendix I

Tables 10.1 and 10.2 are similar. Pilot utilities merged these tables into the Energy Improvement Plan, Table 10.3. Pilot utilities used the right column in Table 10.3 in place of Appendix N in the Guidebook, Energy Improvement Management Programs Progress Review Worksheet.

Table 10.1 Objectives and Target Table (*Guidebook* p. 46 and Appendix I)

Objective	Target	Timeframe

Table 10.2. Performance Indicator Worksheet (*Guidebook* p. 49, 50, 52, and Appendix I)

Target	Performance Indicator	Data Source

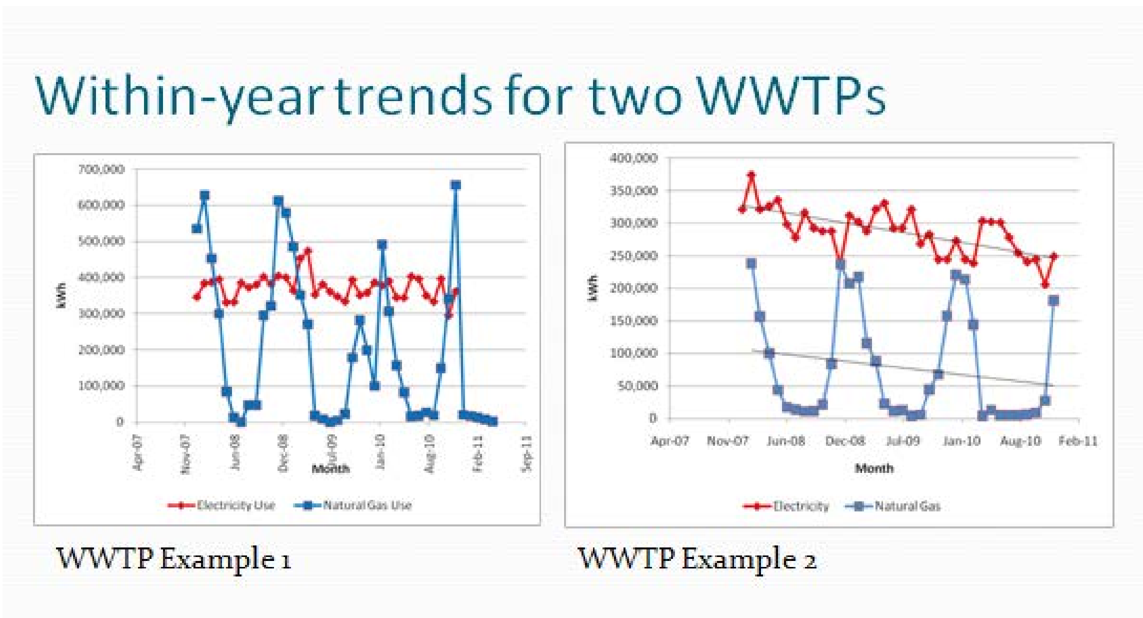
Table 10.3. Energy Improvement Plan (revised Appendix I and Appendix J)

Energy Improvement Goal #____
Activity: ____________________________
Operation: __________________________
Objective: ___________________________
Target: reduce ______________% by Date

Task	**Responsible Party**	**Timeframe**	**Performance Measure**	**Comments on Key Subtasks**

Attachment 5. Monthly profiles at 2 wastewater treatment plants

The profiles below give a picture of energy used at two WWTPs in the Pilot. It is clear that natural gas use is weather dependent, likely due to building loads and digester heating. These utilities heat office buildings, pump stations, and large buildings that house equipment. Buildings call for a different type of intensity metric than for wastewater equipment. Further investigations should explore better accounting for the heating and air conditioning at water utility buildings, for example by reporting it separately as a function of floor area or space volume rather than MG.



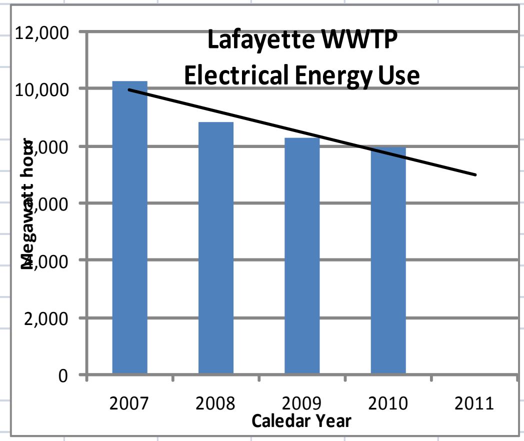
Attachment 6. Format for a Cumulative Annual Report

ANNUAL REPORT

LAFAYETTE WWTW

LAFAYETTE ELECTRICITY USED, KWH			
Calendar Year	Primary Electric Meter	Second Electric Meter	**Total kWh**
2010	3,259,495	4,722,734	**7,982,229**
2009	3,433,004	4,837,554	**8,270,558**
2008	3,722,673	5,115,705	**8,838,378**
2007	4,540,453	5,712,201	**10,252,654**

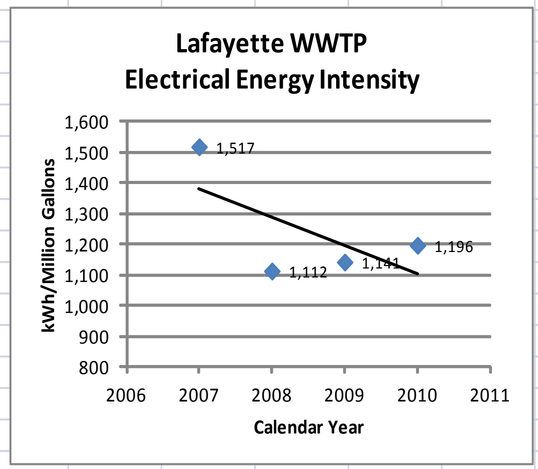
LAFAYETTE ELECTRICITY COST, $ BILLED				
Calendar Year	Primary Electric Meter	**Second Electric Meter**	**Total $**	**$/kWh**
2010	$ 223,236	**$ 288,385**	**$ 511,621**	**$ 0.06**
2009	$ 223,325	**$ 300,236**	**$ 523,561**	**$ 0.06**
2008	$ 226,265	**$ 284,236**	**$ 510,501**	**$ 0.06**
2007	$ 232,652	**$ 270,673**	**$ 503,325**	**$ 0.05**



LAFAYETTE NATURAL GAS USED, THERM		
Calendar Year	Gas meter	**Total Therm**
2010	61,440	
2009	48,101	
2008	118,177	
2007	120,960	

LAFAYETTE NATURAL GAS, $ BILLED		
Calendar Year	Gas meter	**$/therm**
2010	$ 43,022	**$ 0.70**
2009	$ 34,123	**$ 0.71**
2008	$ 123,606	**$ 1.05**
2007	$ 121,292	**$ 1.00**

ENERGY INTENSITY	
Calendar Year	Electrical Intensity (kWh/MG)
2010	**1,196**
2009	**1,141**
2008	**1,112**
2007	**1,517**



LAFAYETTE FLOW		
Calendar Year	avg DAILY (MGD)	annual total (MG)
2010	18.34	6,677
2009	19.91	7,249
2008	21.78	7,950
2007	18.57	6,761

LAFAYETTE		
Calendar Year	GHG (MtCO2e)	Energy Star Rating
2010	6,028	76
2009	6,152	69
2008	6,916	68
2007	7,916	55