Energy Efficiency Master Planning: A Florida Utility Case Study

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With the recent slowdown in revenue growth for many water and wastewater utilities, operational and capital spending is being heavily scrutinized by utility leaders and stakeholders. Flat and declining revenues, coupled with cost reduction efforts, and in some cases, the political unwillingness to adjust utility rates, have created an environment where planning efforts, activities, and decision making require the development of a sound business plan.

As a result of these competing factors, many utilities across Florida and the United States consider energy efficiency master planning (EEMP) to be a necessity. The article presents a brief outline of the EEMP process and summarizes the results of an EEMP completed for a Florida utility.

A water industry survey is completed on an annual basis by Black & Veatch, entitled, "Strategic Directions: U.S. Water Industry." This report summarizes the results of responses from about 400 utilities across the U. S. related to the current challenges faced by these utilities in operating their water systems. For the utilities surveyed, energy efficiency is viewed as low-hanging fruit when it comes to reducing operational cost.

The following is a brief summary of the survey results related to energy efficiency:

- Energy use is a major sustainability issue.
- Nearly 80 percent of utilities have replaced some level of inefficient equipment.
- More than 70 percent of utilities are using supervisory control and data acquisition (SCADA) and data analytics.
- More than 60 percent of utilities have conducted energy audits.

As understood by all utility operators, there is an implicit focus on maintaining adequate levels of service through the timely maintenance and replacement of utility system assets. The survey highlights that most respondents are actively attempting to replace inefficient assets, utilizing data analytics to build business cases to replace inefficient assets, and initiating the activities necessary to address issues around energy efficiency in order to reduce operational and capital cost. The EEMP process is a coordinated approach that builds an energy management business plan through aligning the technical requirements and the business imperatives of the utility system.

Overview of the Energy Efficiency Master Planning Approach

To understand the technical requirements of a utility's energy efficiency program and align these requirements with business process imperatives requires a dedicated focus on understanding the vision of the utility and assimilating these tenets through all stages of the EEMP. The planning approach consists of three phases:

Phase 1 - Strategy (alignment of the vision)
Phase 2 - Technical (an optimized portfolio of projects to implement over time)
Phase 3 - Business (informed decision making process that mitigates risk)

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The EEMP approach, as summarized in Figure 1, incorporates the existing vision of the utility during all phases. In the process of determining the energy efficiency solutions and developing the business case to justify these solutions, distinct focus is placed on a utility's overarching mission and vision. This is critical in aligning the strategic core of the utility through all the business functions of the utility.

Descriptions of the three phases of the EEMP process are:

Strategy. The strategy phase requires the project team to gain a deep understanding of the utility's mission, vision, and business imperatives. Upon understanding these imperatives, the strategic purpose of the utility will be to understand which of them will drive the technical and business process solutions that are determined in order to meet the goals and objectives of the EEMP. The strategy component of the EEMP provides the purpose and direction for developing it.

Technical. The technical phase of the EEMP evaluates the existing energy usage conditions and potential of the utility. In essence, this analysis entails a bottom-up assessment of the total energy output, a conditions assessment of utility system assets and processes, and the determination of the major energy contributors by utility function. At the completion of this assessment, the total utility system energy cost, the major en-

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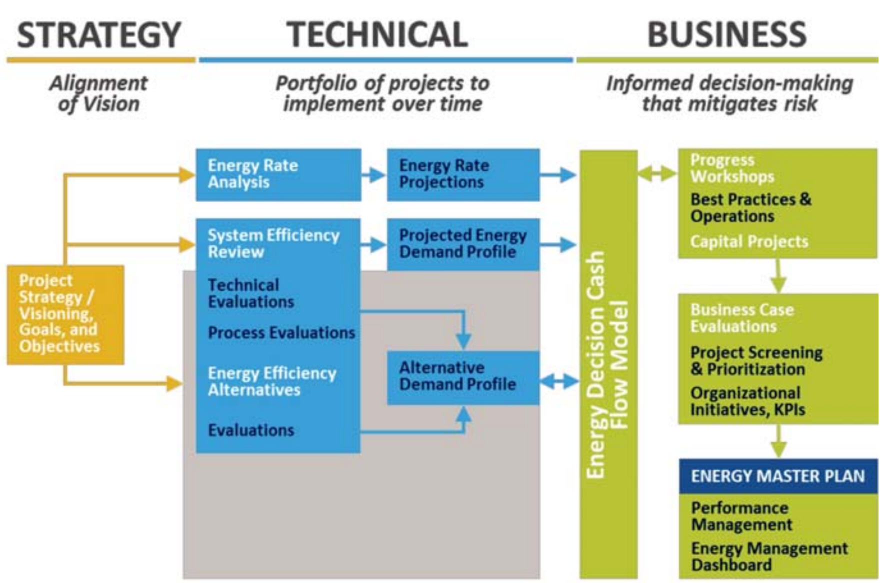

Figure 1. Energy Efficiency Master Planning Approach

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ergy contributors by function or major asset group, and the technical solutions by function will be determined to maximize energy usage.

Business. The business phase establishes a platform for utility leaders to begin the business case related to implementing the technical solutions determined. All technical solutions will have varying impacts on the utility's business process. The competing forces between a utility's ability to maintain utility rates, reduce the consumption of utility services, reduce operating cost, and implement solutions to mitigate issues around aging infrastructure, aging workforce, and consent decree-related issues, to name a few, are all considered specific to the technical solutions developed. As such, an energy decision cash flow model, shown in Table 1, is utilized, which performs risk-based economic evaluations on an individual solution or a portfolio of solutions, as determined by the utility. Evaluation criteria are determined that provide a process, along with a technical and nontechnical value to evaluate the economic performance of an individual energy solution or a group of solutions. At the completion of this evaluation, an optimized and time-based list of solutions will be determined and incorporated into the EEMP.

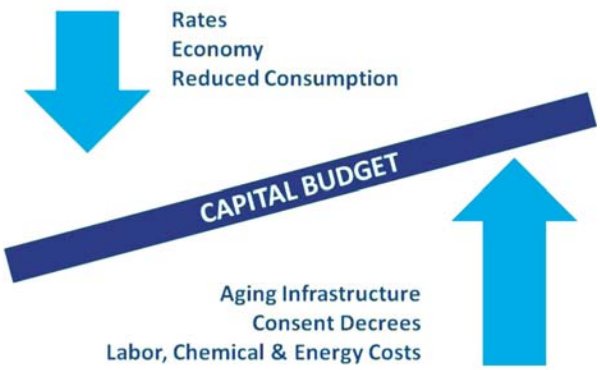

Table 1. Summary of the Energy Decision Cash Flow Model Inputs and Outputs

CASH FLOW MODEL INPUTS	CASH FLOW MODEL OUTPUTS
▪ Cost of electricity ▪ Electricity use ▪ Inflation assumptions ▪ Capital structure ▪ Alternative rate structures ▪ Energy conservation measures (ECMs) • CAPEX, OPEX, energy use, and asset life	▪ Alternative demand profile ▪ ECM and portfolio level cash flow ▪ Net Present Value (NPV) by ECM and by portfolio ▪ Cumulative portfolio cash flow ▪ Portfolio payback period

(ECM: energy conservation measures; CAPEX: capital expenditures; OPEX: operating expenditures; NPV: net present value)

The EEMP approach provides utility leaders with an integrated business planning tool that determines energy efficiency solutions, integrates the inherent business risk of implementing these energy efficiency solutions, and economically values these solutions to determine the optimal EEMP solution.

Case Study: Florida Utility

Background

The EEMP approach described was applied to a Florida utility to investigate the potential to maximize energy usage at its water and wastewater facilities. Initial project workshops were held to establish the EEMP goals and objectives and understand the overall strategic purpose of the utility. Thereafter, technical due diligence and evaluations were conducted, which included the following activities:

- Site visits
- Data collection
- Conditions assessment
- Energy baseline assessment
- Identification and evaluation of energy conservation measures (ECMs)

At the completion of the technical evaluations, the consulting team gained an understanding of the energy usage potential of the utility systems under review. Table 2 presents the breakdown of energy consumption for the water facilities studies.

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Table 2. Energy Use Distribution – Water Systems

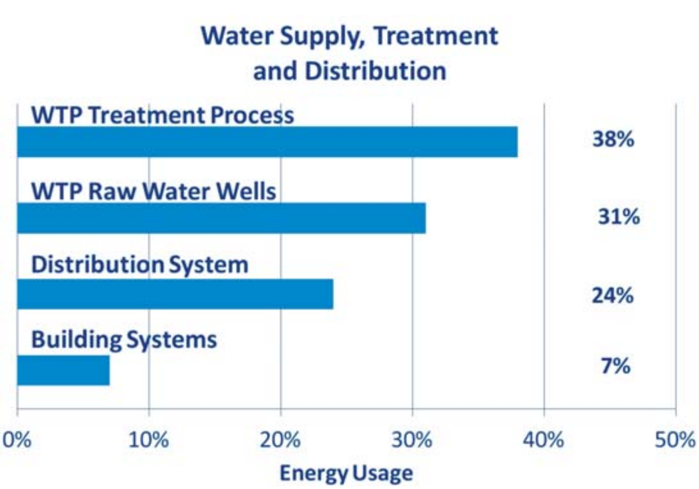

Table 3. Energy Use Distribution – Wastewater/Reclaimed Water Systems

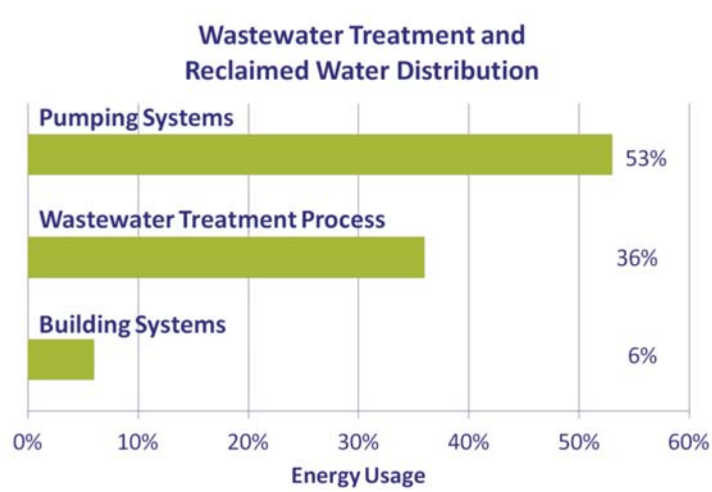

Table 4. Examples of Energy Conservation Measures - Water Supply, Treatment, and Distribution Systems

No.	ECM Description	Energy Reduction After ECM (KWh)/yr	Overall Percent Reduction (%)	Highlights
1	WTP - Wells: Well system operations and VFDs	1296000	2.6	Power cost higher at the wells. Operate at higher flow, more efficient.
2	WTP Process - Pumps: Pumps improvements	610612	1.22	Bearings, rings, seals, add stage, VFDs Replace/ refurbish, automation
3	WTP Process – Process Equipment: Membrane element type replacement	129400	0.26	More permeable membrane – water blend
4	WTP Process – Operations: *bv*ECO® for WTP – Operations optimization	900000	1.80	Off-peak energy use, filling storage tanks
5	WTP Solar PV – Roof mounted	82700	0.17	Energy utility incentives
6	Building Systems / Lighting ECMs	226600	0.45	Thermostats, infiltration, insulation, occupancy sensors

Table 5. Examples of Energy Conservation Measures - Wastewater Treatment and Reclaimed Water Distribution Systems

No.	ECM Description	Energy Reduction After ECM (KWh)/yr	Overall Percent Reduction (%)	Highlights
1	WWTP Process: Upgrade mixers with DO control, Backwash system	2057832	4.12	New mixers, VFDs, DO probes, EcoWash – reject to 1.5% from 4%
2	WWTP Pumping: Reuse and Deep injection well improvements	1891510	3.79	VFDs, new pumps
3	WWTP Process – Operations: *bv*ECO® for WWTP – Operations optimization	113900	0.23	Best pump combination, optimal polymer use
6	Building Systems / Lighting ECMs	429411	0.86	Thermostats, infiltration, insulation, occupancy sensors

Table 6. Recommended Energy Project Portfolios Financial Summary (Base Year 2012; Assessment Period 2014–2022; 2013 Dollars)

- 18 Energy Conservation Measures (ECMs) recommended (>60 total evaluated)
- Annual O&M savings = $250 k
  - 7% in annual savings
- Annual energy cost savings= $500 k
  - 14% in annual energy savings
- Estimated capital cost = $10 m
- 8 yr. NPV of $3.5 m

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As shown, 38 percent and 31 percent of the water system energy consumption is for the treatment processes (hypochlorite generation, membrane systems, pumps, etc.) and raw water well pumps, respectively.

For the wastewater and reclaimed system, as detailed in Table 3, the highest energy requirements were exhibited at the wastewater pumping systems and treatment processes at 53 percent and 36 percent of the total energy requirement for the wastewater and reuse systems, respectively.

After indentifying the largest energy users, strategies were defined and incorporated into ECMs to maximize energy usage for the systems under review. The ECMs developed were tailored around improving energy usage requirements for specific water and wastewater treatment processes, improving pumping system efficiency to reduce energy cost, and utilizing SCADA techniques to control systems more efficiently (chemical optimization, time of use electric rates, etc.).

Case Study Recommendations

The results of the EEMP outlined a portfolio of energy solutions. Table 4 presents the specific recommendations for the water supply, treatment, and distribution systems with the actual energy reduction that can be achieved. The energy reduction totals are presented as a percent of the total energy consumption for the water treatment plant facilities.

Table 5 presents the recommendations for the wastewater treatment and reclaimed water distribution system with the actual energy reduction that can be achieved. The energy reduction totals are presented as a percent of the total energy consumption for the wastewater treatment plant and reclaimed facilities.

Table 6 presents a summary of the cost savings achieved by the EEMP on a portfolio basis.

The energy project portfolios comprised a total of 18 ECMs. Once implemented, the ECMs would provide the potential for a 14 percent reduction in energy use, based on 2012 energy usage data. This reduction translates to annual energy savings of approximately $500,000 and annual operation and maintenance savings of $250,000.

The capital cost for the implementation of the energy project portfolios was estimated at $10 million. The financial analysis for these improvements resulted in a favorable net present value (NPV) of $3.5 million. For example, if a portfolio has an NPV less than zero, then the portfolio should not be done. The higher the NPV, the more valuable and higher economic benefits will be achieved as a result of the implementation of the portfolio of energy projects.