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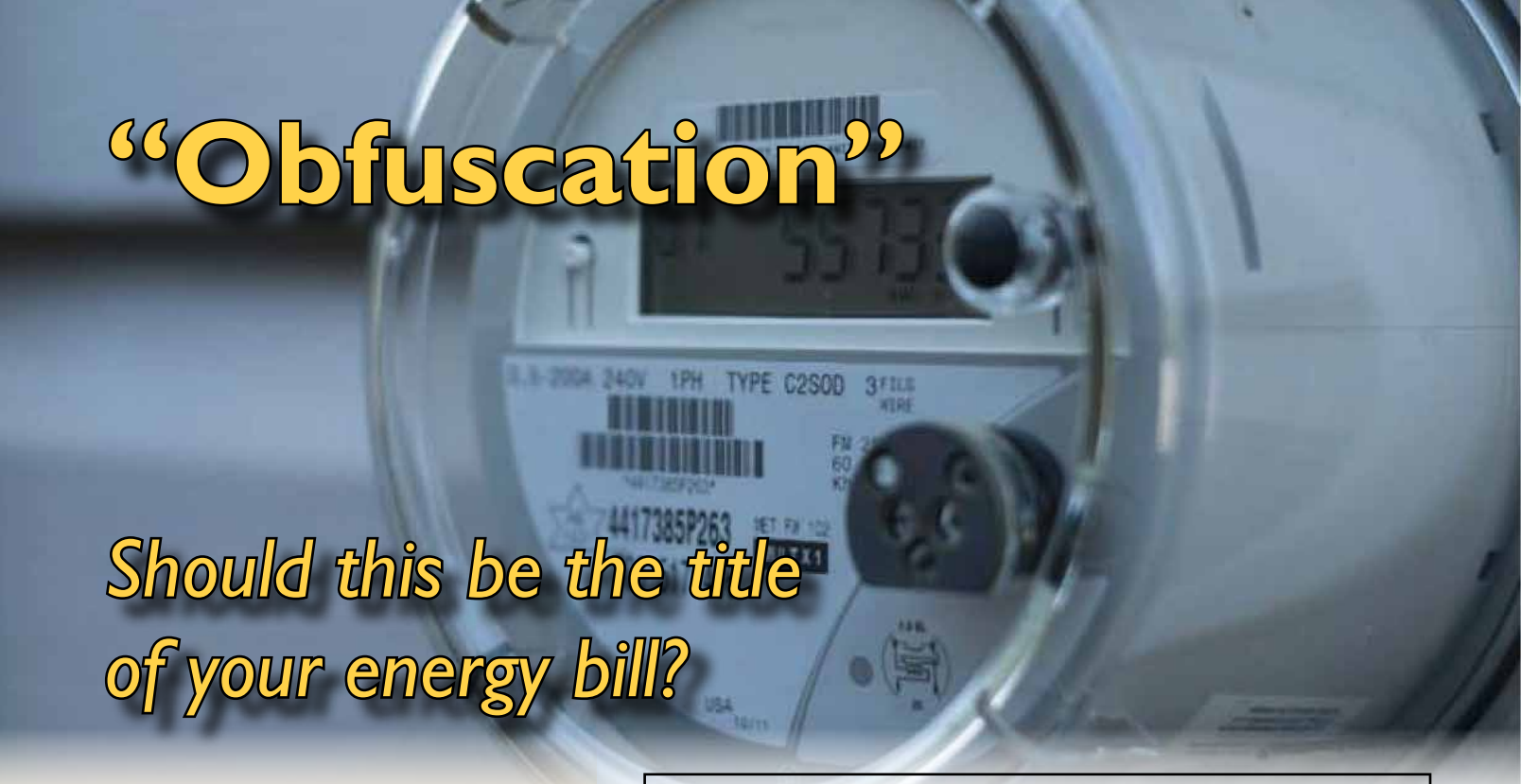

"Obfuscation"

Should this be the title of your energy bill?

Abstract: Energy bills for "users" can be intimidating and poorly understood by the person paying the bill. There are multiple causes, including: I'm the clerk and I need to pay whatever I'm billed; Energy bill? How would a close examination of this bill help me?; I don't care—I'm not paid on the basis of energy costs —at all.

As a practical matter, a careful review and a designation of responsibility for the reduction in payments for energy can almost immediately return 10% or more to the customer (be it a water utility or an industrial entity). This presentation will provide a specific set of "how to's" on the review and change (reduction) in energy costs for the "user" of energy.

The intent of this paper is to convince the reader of the value of fully understanding your electrical energy bill and tracking energy costs continuously, and reporting this information to all who contribute to the monthly cost of electrical energy.

By Don Voigt, PE

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Ralph Waldo Emerson once said, "People only see what they are prepared to see." And this is the intent of this paper: to prepare people to see and understand/act upon their energy bill (specifically, electrical energy bills).

In the case of electrical energy bills for our facilities, consider these to be an undiscovered cash trove. All of us implicitly understand that we should look at and understand and act on energy bills. We know this from basic psychology 101—What we focus on gets acted upon, and we sense that we can influence the bill but we are unsure how.

Why focus on energy bills? Based on multiple studies, when energy consumption is continuously monitored and reported to the users, that costs of energy ("the bill") is reduced anywhere from 8 to 10%, and when people are made accountable for improvements in energy cost reductions, bills decrease an average of 20 to 25%. In other words, electrical energy bills, for our facilities, can be

considered an undiscovered cash trove.

One would expect that larger consumers of energy (where bills are thousands of dollars), owners/managers would be mindful of monthly bills… daily and hourly consumption of power would be top-of-mind. In fact, very few such entities measure/report monthly energy bills. Often, the managing executives never see any aspect of the cost of energy, except, at the end of the year in a budget summary. Electric bills are most frequently simply paid as a routine practice of "doing business." As an example—based on public information—Figure 1 *(Source: Wisconsin Focus on Energy)* shows the result of energy surveys of owners of public water facilities (managers).

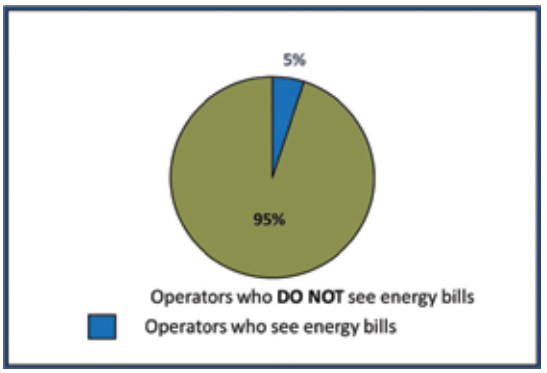


Figure 1: In order to affect change, a person needs to actually see the facts. In the case of energy bills, it is common for such bills to go "unreviewed."

However, you might suggest that such energy costs are not a significant segment of an entity's costs, but this is definitely not the case. Figure 2 (Port Wash Budget and pie chart) shows the energy costs of a city populated at 10,000.

Figure 2. Energy Costs are a significant portion of any industrial/commercial entity and budgets frequently do not isolate energy from other line items.

Energy is 10% of the entire city budget (1 MM out of 10MM) and the water/wastewater managers at the city's plants never saw a single monthly bill. Such bills were simply sent to City Hall and paid by the City Clerk (as normal practice of paying monthly bills). As can be seen, a 10% reduction in energy costs ($100,000.00) might fund a library improvement—or, park addition, etc. A 25% reduction would pay for a new city administrator and support staff! Any wonder, then, as to corporations such as Walmart having a department devoted to energy cost reductions!

Interpreting Energy Bills

Understanding your electric bill begins with understanding how power generators "operate" their generating plants. Energy generation and distribution is a highly complex and heavily regulated industry. The stockholders of such generation facilities are incentivized by the very regulations imposed upon them to build more and monitor/control every iteration of the generation/distribution process. A wonderfully illustrated and simplified explanation of the power provider is found in the text titled: *Reinventing Fire* by Amory Lovins of the Rocky Mountain Institute (www.rmi.org). Figure 3 – from aforementioned text – illustrates the dilemma for such power providers.

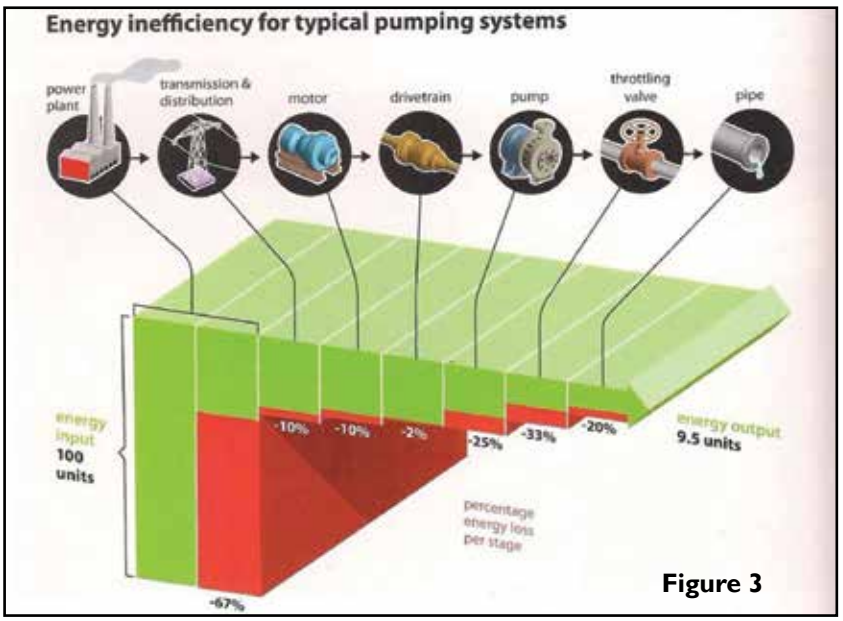


Figure 3

continued on next page

As can be graphically seen, energy generated is substantially diminished (in end product) by the time it is productively utilized. It is also helpful to understand that main power plants, unlike our usage, are not readily varied to suit sensed demand decreases/increases. Power providers might be considered "victims" of the nuances of the users—from decreases in use of AC during cool weather in the summer to hourly variations in energy needs due to manufacturing daily routines. Main power plants are simply huge facilities (from an expense and maintenance standpoint). Also, utilities/owners are struggling to meet customer needs without building more and larger facilities. Overall demand for power is not significantly increasing, while costs of operation continue to mount. Not to mention, in Florida, damaging storms exacerbated by climate change implications are only going to get worse.

The escalation of demand "peaks" due to changing habits and changing costs, have further increased costs for the generator/power utility. Electric Utilities commonly belong to associations of generators across state lines and into regions. Also, "cross selling" of energy amongst the grid of providers (think in terms of a water pressure grid) causes costs (per kilowatt) to escalate at peak times such that the cost of a kw of power can be ten-fold the billable rate ($1.00/KWh vs $0.10/KWh).

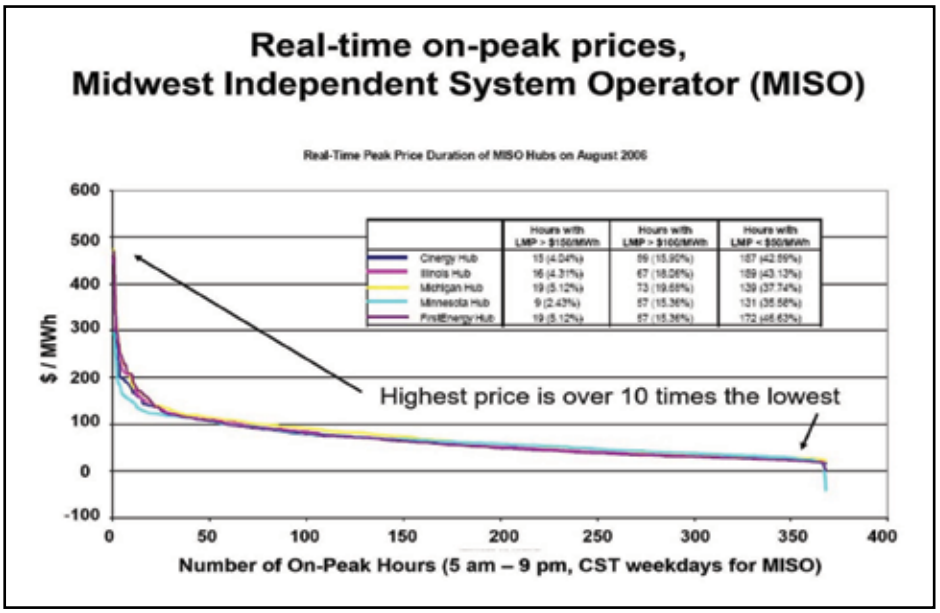
So, the utilities are being squeezed on both ends – PSC regulators vs. customers.

Smart Meters bring large amounts of new ways to control power distribution….and, to bill in accordance with the cost to the provider of power.

Enter "Smart Meters"

Power utilities/generators have been scrambling to install "Smart Meters" (SMs). For instance, Florida Power and Light (FP&L) has nearly all of their customers "on" these devices. Why? Well, several reasons were initially given—such as; knowledge of where power failed; faster and less costly connection and disconnection via remote digital switching; improved diagnostic data to pinpoint equipment problems and outages before they occur; remote meter reading…and others. In fact, when smart meters are not installed at customer sites (some folks cry "privacy"), FP&L charges $89/meter up front and $13/month in perpetuity because of proven added costs to FP&L for lack of digital information.

And, the incredible wealth of an enormous amount of very detailed information has facilitated an entirely new awareness of "where the power generator's costs are coming from." IBM, Schneider Electric, and other major manufacturers and providers of hardware and software are scrambling to develop the data into more meaningful resources—and, guess what? A whole new set of "how bills are calculated" is on the way. Increasing data/knowledge is bringing a whole new level of sophistication in tracing our usage patterns and invoices/bills will reflect such knowledge at an ever-increasing pace. Examples—"time of day" rates, seasonal rates, "demand charges," power factor premium charges and the list will continue. For a more detailed review of the elaborate future of demand vs. rates, see Chapter 5 of *Reinventing Fire* as previously referenced. In essence, SMs have or are changing or will have changed the so-called rules of engagement. And, for those wishing to reduce energy costs, you will be tracking the details of power costs,



This chart shows wholesale cost of energy can exceed 10X the billed rate….though for short periods.

minute by minute, in a "spy vs. spy" type of duel!

Sometimes, energy cost interchange can seem like "spy vs spy" – where each party (provider and user) are attempting to outsmart the other!

Not really maliciously, though—rather as a partner in the quest for "most efficient overall delivery."

From the end user's perspective, SM data allows refinements of what the user is consuming of the power provider's product, and at the costs reflecting a synergy amongst seller and user.

Specific examples of how this symphony plays out include:

1. Time of Day rate structures (higher rates at peak demand times and lower rates on off peak)
2. Seasonal Rates—reflecting substantial changes from summer to winter
3. System Demand charges (highest demand for any 15-minute average interval 24-7 for the 30-day period of the past month's bill).
4. Customer Demand Charges (sometimes called rachet demand charges) (highest demand for any 15-minute average interval for the past 12 months' bills).
5. Power Factor premium—a charge which is mostly industrial oriented and reflects the fact that underloaded motors have an inherent demand on the grid —even though the KW being utilized does not reflect this "low load" condition.

Thus, the increasing wealth of data—and associated knowledge of where costs are incurred—results in a parallel increase in complexity of energy bills. Rate structures reflect data pools—An example of such structures is found in the below table from FPL.

The details of the more complex bills offer deeper opportunities for discounting/reducing energy bills. How is this true? Well, let's look at an example. In a recent energy audit of a public wastewater facility in Wisconsin, the customer had a power bill which shows that more than 40% of the power bill was due to "demand charges" (see page 18 copy of the bill).

Note the "Customer Demand" and the "On-Peak" costs. These "demand" charges are nearly ½ of the bill for this customer. Where did these occur and what can the customer do to reduce them?

See the graph on page 18 of the continuous power consumption for this plant—as taken from the Smart Meter located at the plant and monitored 24/7 by the power provider.

continued on page 18

Business rates, clauses and storm factors

Effective September 2018

BUSINESS RATE CLASS		Customer Charge/Month	Base Demand Charge per kW	On-Peak Demand Charge $/kW	Demand Charge Firm $/kW	Maximum Demand Charge $/kW	Energy Charge ¢/kWh	On-Peak Energy Charge ¢/kWh	Off-Peak Energy Charge ¢/kWh	Base Charge ¢/kWh	Conservation ¢/kWh or $/kW	Capacity ¢/kWh or $/kW	Environmental ¢/kWh	Fuel Charge ¢/kWh	On-Peak Fuel Charge ¢/kWh	Off-Peak Fuel Charge ¢/kWh
General Service Non-Demand (GS-1)		$10.15					5.750			0.112	0.146	0.220	0.115	2.631		
General Service Non-Demand-TOU (GST-1)		$10.15						10.019	3.630	0.112	0.146	0.220	0.115		3.010	2.447
General Service Constant Usage (GSCU-1)		$14.21					3.988			0.052	0.111	0.153	0.085	2.631		
General Service Demand (GSD-1)		$25.34	$9.54				2.125			0.080	$0.48	$0.70	0.105	2.631		
GS Load Control, General Service (GSLC-1)(2)		$151.77	$4.06	$7.68	$10.11			1.509	1.306	0.075	$0.69	$0.89	0.000		3.010	2.447
General Service Demand-TOU (GSDT-1)		$25.34		$9.54				4.335	1.147	0.080	$0.48	$0.70	0.105		3.010	2.447
High Load Factor-TOU (21 – 499 kW)		$25.34		$11.25		$2.33		1.839	1.147	0.080	$0.48	$0.70	0.105		3.010	2.447
Seasonal Demand-TOU Rider (SDTR) (21 – 499 kW) Option A	Jun-Sep	$25.34		$10.55				6.449	1.524	0.080	$0.48	$0.70	0.105		3.801	2.461
Seasonal Demand-TOU Rider (SDTR) (21 – 499 kW) Option A	Jan-May/Oct-Dec	$25.34	$9.12				2.125			0.080	$0.48	$0.70	0.105	2.631		
Seasonal Demand-TOU Rider (SDTR) (21 – 499 kW) Option B	Jun-Sep	$25.34		$10.01				5.449	1.524	0.080	$0.48	$0.70	0.105		3.801	2.461
Seasonal Demand-TOU Rider (SDTR) (21 – 499 kW) Option B	Jan-May/Oct-Dec	$25.34		$9.12				4.639	1.524	0.080	$0.48	$0.70	0.105		3.010	2.447
General Service Large Demand (GSLD-1)		$75.90	$11.66				1.679			0.080	$0.57	$0.84	0.101	2.630		
General Service Large Demand-TOU (GSLDT-1)		$75.90		$11.66				2.747	1.211	0.080	$0.57	$0.84	0.101		3.074	2.446
Curtailable Service (CS-1)		$101.31	$11.66				1.679			0.080	$0.57	$0.84	0.101	2.630		
Curtailable Service-TOU (CST-1)		$101.31		$11.66				2.747	1.211	0.080	$0.57	$0.84	0.101		3.074	2.446
High Load Factor-TOU (500 – 1,999 kW)		$75.90		$12.25		$2.63		1.086	1.006	0.080	$0.57	$0.84	0.101		3.074	2.446
Seasonal Demand-TOU Rider (SDTR) (500 – 1,999 kW) Option A	Jun-Sep	$75.90		$12.06				5.979	1.211	0.080	$0.57	$0.84	0.101		3.810	2.600
Seasonal Demand-TOU Rider (SDTR) (500 – 1,999 kW) Option A	Jan-May/Oct-Dec	$75.90	$11.66				1.679			0.080	$0.57	$0.84	0.101	2.630		
Seasonal Demand-TOU Rider (SDTR) (500 – 1,999 kW) Option B	Jun-Sep	$75.90		$12.06				5.979	1.211	0.080	$0.57	$0.84	0.101		3.810	2.600
Seasonal Demand-TOU Rider (SDTR) (500 – 1,999 kW) Option B	Jan-May/Oct-Dec	$75.90		$11.45				3.575	1.211	0.080	$0.57	$0.84	0.101		3.074	2.446
LED Lighting Pilot (LT-1)							2.929			0.772	0.042	0.016	0.027	2.548		
General Service Large Demand (GSLD-3)		$227.70	$12.14				1.511			0.043	$0.56	$0.76	0.099	2.616		
General Service Large Demand-TOU (GSLDT-3)		$227.70		$12.14				2.344	1.184	0.043	$0.56	$0.76	0.099		3.060	2.434
Curtailable Service (CS-3)		$253.06	$12.14				1.511			0.043	$0.56	$0.76	0.099	2.616		
Curtailable Service-TOU (CST-3)		$253.06		$12.14				2.344	1.184	0.043	$0.56	$0.76	0.099		3.060	2.434
High Load Factor-TOU (3,000 kW or more)		$227.70		$12.14		$2.62		0.993	0.993	0.043	$0.56	$0.76	0.099		3.060	2.434
Seasonal Demand-TOU Rider (SDTR) (3,000 kW and greater) Option A	Jun-Sep	$227.70		$12.62				4.738	1.184	0.043	$0.56	$0.76	0.099		3.809	2.988
Seasonal Demand-TOU Rider (SDTR) (3,000 kW and greater) Option A	Jan-May/Oct-Dec	$227.70	$11.02				1.511			0.043	$0.56	$0.76	0.099	2.616		
Seasonal Demand-TOU Rider (SDTR) (3,000 kW and greater) Option B	Jun-Sep	$227.70		$12.62				4.738	1.184	0.043	$0.56	$0.76	0.099		3.809	2.438
Seasonal Demand-TOU Rider (SDTR) (3,000 kW and greater) Option B	Jan-May/Oct-Dec	$227.70		$11.02				3.262	1.184	0.043	$0.56	$0.76	0.099		3.060	2.434
Traffic Signal Service (SL-2M)		$6.09					6.886			0.082	0.111	0.153	0.085	2.631		
General Service Large Demand (GSLD-3)		$2,020.90	$9.41				1.086			0.003	$0.57	$0.79	0.000	2.564		
General Service Large Demand-TOU (GSLDT-3)		$2,020.90		$9.41				1.240	1.000	0.003	$0.57	$0.79	0.000		2.998	2.395
Curtailable Service (CS-3)		$2,047.56	$9.41				1.086			0.003	$0.57	$0.79	0.000	2.564		
Curtailable Service-TOU (CST-3)		$2,047.56		$9.41				1.240	1.000	0.003	$0.57	$0.79	0.000		2.998	2.395
Street Lighting (Mulvane) (SL-1M)		$14.24					3.075			0.772	0.042	0.016	0.027	2.548		
GS Load Control Program, Transmission (GSLC-1(T))		$2,240.34		$9.22	$11.79			0.941	0.941	0.003	$0.61	$0.80	0.000		2.998	2.395
GS Load Control Program, Distribution (GSLC-1(D))		$2,240.34	$4.35	$9.04	$11.04			1.014	1.014	0.043	$0.60	$0.80	0.000		3.060	2.434

"Obfuscation" continued from page 15

The incident shown as occurring on 8/2/18, turns out, it was the exercising of the plant's standby generator. When the generator is started, the plant staff wanted to reduce the load on the generator and they shut down a series of motors to ease the load. When the generator was shut down, all of the processes were demanding to be operated—in unison—and the demand soared!

Obviously, now that the plant is enlightened by the printout of the occurrence, that will not repeat at the same level. Yet, the tracking of the power is by the power provider and not by the user! So, what to do? Well, simply install your own power monitor on your end! Above is one example of a vendor and there are others. These will soon be found at plants ubiquitously. They will pay for themselves in a matter of a few months!

Example of a dashboard and related hardware for the monitoring of peak demand in a typical plant. Equipment shown is from www.theenergydetective.com

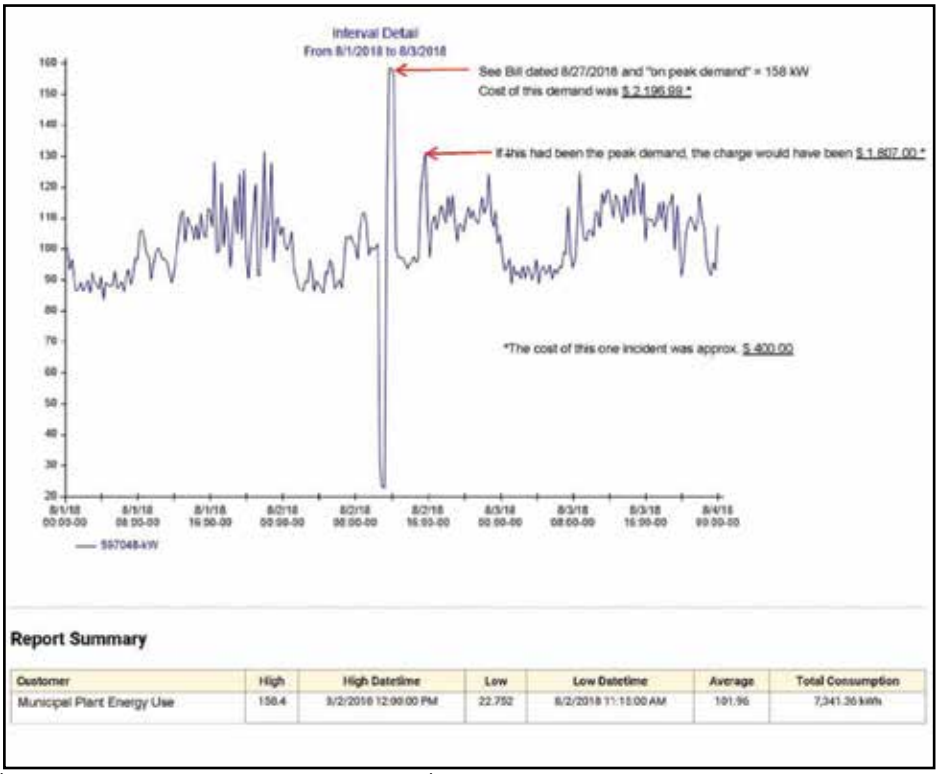
Customer Name Municipal Water Treatment Plant
Service Address

Activity Since Last Bill

Previous Balance 07/26/2018	$5,620.66
Payment Received 08/13/2018	-$5,620.66
Balance	$0.00
Total Current Charges	$5,658.70
Total Current Balance	$5,658.70

Elec 3m Comi & Ind TOU Secondary
Cg-20

	Interval Reading 08/24/2018	15376
	Interval Reading 07/25/2018	-14929
		447
	Meter Constant	x 160.0000
	Master Meter Total Use (KWH)	71520
Daily Fixed Charge	30 Days at $3.05750	$91.73
Demand Charges/Credits		
Customer Demand 09/12/2017 12:15	226 KW at $1.68900	$381.71 Highest demand in past 12 months
On-Peak	158 KW at $13.90500	$2,196.99
Off-Peak	149 KW at $0	$0.00 Highest demand in this month
Energy Charges/Credits		
On-Peak	23,120 KWH at $0.06458	$1,493.09
Off-Peak	48,400 KWH at $0.03945	$1,909.38
Fuel Cost Adjustment	71,520 KWH at $0.00003	$2.15
Fuel Cost Adjustment - Prior Year	54,860 KWH at -$0.00030	-$16.46
Other Service Charges/Credits		
2017 Tax Cut Credit	54,860 KWH at -$0.00157	-$86.13



Report Summary

Customer	High	High Datetime	Low	Low Datetime	Average	Total Consumption
Municipal Plant Energy Use	158.4	8/2/2018 12:00:00 PM	22.752	8/2/2018 11:15:00 AM	101.96	7,341.36 kWh

Bottom line, we, as designing/implementing engineers, need to be cognizant of the value of energy monitoring. We need to seek out online costs and online monitoring, where available. And, be ever aware of newly available options to our customers and/or users of power. Less diligence is at best unprofessional, in a time and day when environmentalism and system responsibility should be a watchword/phrase.

About the Author:

Don Voigt is an energy cost reduction engineer working in tandem with owners and/or other engineering consultants. His company—Engineered Equipment Integration LLC—has its main offices in Fort Myers, FL.

Don is current Chair of the Energy Committee of Florida's Engineering Society (FES). He is licensed as a CEM worldwide and as a Professional Engineer in multiple states. He can be reached through email or phone at don@equipintegration.com and (414) 940-9281.