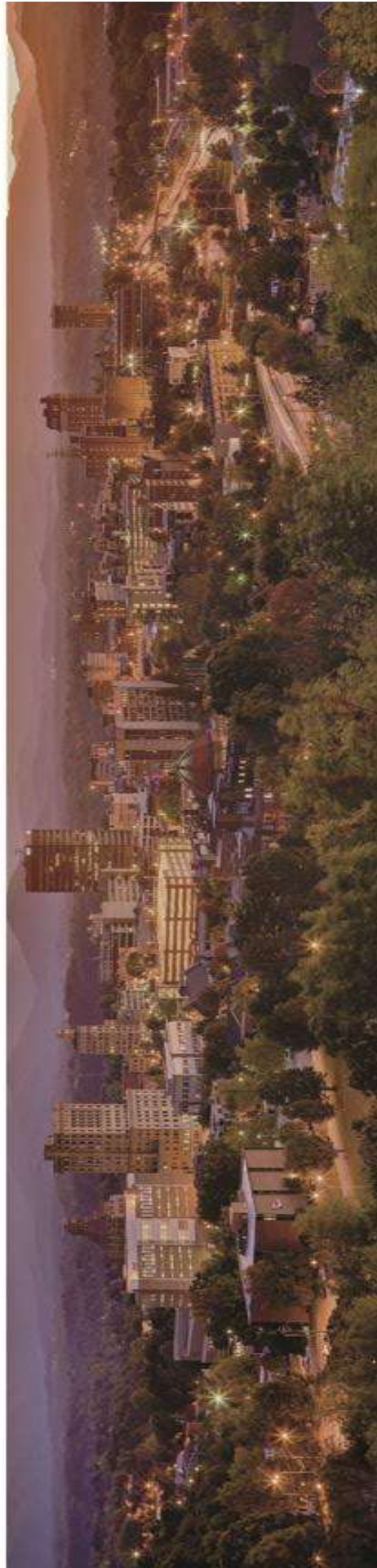




May 3, 2017 ESI

## Utility Bills: Finding Buried Treasure

*Department of Environmental Quality*



# Utility Bills 101

## Typical Electric Bills Regulated Utilities

- Energy & Demand in kWh; kW
- Billed, Actual, Contract, Excess Demand, Coincident Peak
- Time of Use; On Peak, Off Peak, Seasonal Date & Times
- Power Factor; kVA; Correction strategies
- Hidden costs in rates (Riders); find your rate schedules; OPTions
- Interval Data; how to get it, what it can do for you

## Nat Gas Billing:

- Read your bills, contracts; seasonal strategies
- Purchasing Contract Nat. Gas

## Water and Sewer

- Water billing; units, gal., 1,000 gal, CCF, sewer, stormwater fees

## Case Studies

- Municipal Electric Utility: Power Factor Penalty due to meter error
- Negative Power Factor Penalty due to Overcorrection
- Demand Response: Contract Peak Load Reduction Not Applicable
- Demand Response: Shared Savings with third party not necessary
- Rate Savings Opportunities working with Utility companies, OPTions for credits
- Third Party Billing Services: Process bills and get data
- Ratchet reset due to equipment failure
- New construction ratchet transformer changeout



# *Difference in Energy and Demand*

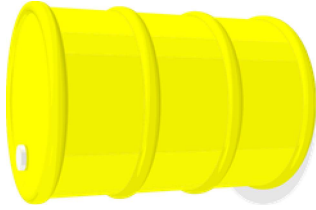
**Electricity** is like water – it flows like water in a pipe.

- Electric “Current” is flow of electrons in wires



**Demand** – How **fast** is the Flow Rate?  
Gallons per minute?(GPM).

- How many Watts turned on?
- Typically measured in kilowatts (**kW**).



**Energy** – How many **gallons** used over a period of time?

- How many Watts x run hours?
- Typically measured in kilowatt-hours(**kWh**)



# *Electric Bill Energy Costs*

**Energy** measured or billed in **kWh** (typically)

Also called **Usage** or **Consumption**

**Energy** = **Work** (to run a motor, light a bulb) over time

- How much electric **Work** did you do in a month?
- How many **kWh** did you consume?

1. **Energy = kW x hours = kWh**  
(kilowatt-hour)

OR

2. **Energy = KVA x hours = KVAh**  
(kilovolt-amp-hour)



# *KW, KVA = “Demand” for Power Electric “Power” Company*

**Power = Watts = Volts x Amps = VA = W**

Power = Work/time = Energy per hour

How fast is energy flowing? At what rate?

1000 W microwave cooks faster than 500 W.

Measured in 15 or 30 minute intervals,  
averaged over time, depends on meter

Think: How big (how many watts) is your light bulb?



1. Billed as: **Demand kW (kilowatt) = 1,000 W**

1000 W = 10 x 100 W light bulbs = 1 kW

**OR**

2. Billed as **Demand KVA (kilovolt-amp) = 1,000 x VA**

**KVA includes Power Factor Penalty! (more to come)**



# *Typical Electric Bill*

## **Monthly Facilities Charge**

- **\$12 to \$500 (based on rate “class”)**
- **Fixed monthly fee to provide electric service**
- **Based on size of equipment, transformers, 1 or 3 phases**

## **Energy Charge**

- **kWh x \$ per kWh (energy rate)**
- **~ \$ 0.10 per kWh**
- **Rate may vary based on Time of Day, Month**

## **Demand Cost**

- **kW x \$ per kW (demand rate)**
- **~ \$10 per kW**



# *Typical Electric Rates*

## *Rate Classifications*

### **General Service (GS) Rates**

- Rate “class” based on annual Peak Demand kW
  - How much load or power needed
  - More power requires more costly equipment, i.e., larger transformers
- Small (less than 30 kW)
- Medium (30 kW to 1000 kW)
- Large (over 1000 kW)
- Commercial
- Industrial
- One phase or three phase power
- Brackets (size by kW) vary by utility company



# *Typical LGS (Large General Service)*

## **MONTHLY RATE**

**I. Basic Customer Charge: \$154.85**

**II. kW Demand Charge: (Stepped)**

**\$11.23 per kW for the first 5,000 kW**

**of Billing Demand**

**\$10.26 per kW for the next 5,000 kW**

**of Billing Demand**

**\$ 9.29 per kW for all over 10,000 kW**

**of Billing Demand**

**III. kWh Energy Charge: 5.575¢ per kWh**





# *Voltage Distribution Industrial Rates*

## **Low Voltage is 480V; 3 phase power**

- Most expensive
- Utility provides & maintains step-down transformers

## **Distribution Service 2 kV to 50 kV (Varies)**

- Customer usually supplies and maintains transformers

## **Transmission Service greater than 50 kV (Varies)**

- Least expensive
- Customer supplies and maintains transformers

## **Where is meter located?**

- If meter on load side of customer transformer, rate may include transformer loss calculation



# *Types of Billing Demand*

## **CONTRACT DEMAND**

- The KW of demand specified in the “Service Agreement” (Where?)
- Estimated from Design Peak Load when new service is established.

## **ACTUAL DEMAND**

- 15 or 30 min. average KW (as measured or calculated by demand meter)
- Peak Demand = maximum measured in a month

## **BILLED DEMAND- See Rate or Tariff Definition (next page!)**

- May not be ACTUAL
- “Ratchet”



# *Billing Demand*

“The **Billing Demand** shall be the **maximum kW** registered or computed, by or from Company’s metering facilities, during any **15-minute interval** within the current billing month.

**However**, the Billing Demand **shall not be less than the greater of:**

- (1) **80%** of the maximum monthly 15-minute demand during the billing months of **July through October** of the preceding 11 billing months (Summer Peaking)
- (2) **60%** of the maximum monthly 15-minute demand during the billing months of **November through June** of the preceding 11 billing months (Winter Peaking)
- (3) **75%** of the **Contract Demand** until such time as the Billing Demand first equals or exceeds the effective Contract Demand, or
- (4) **1,000 kW.**”

Courtesy Duke Energy Progress LGS Rate

**Billing Demand is your Minimum Demand Billing**

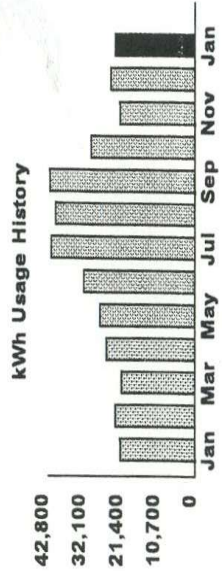


# Find kWh Usage, \$ and KW Demand, \$

## Customer Bill

Account number **9860**  
**Total due \$1,904.39**  
**Current charges past due after Feb 4**  
 Thank you for your payment Jan 2 \$2,113.30  
 Usage period Dec 18 - Jan 20  
 This bill was mailed on January 21, 2004

00045858 1 AV 0.278 00 \*\*AUTO \*\*C004  
 Customer Name  
 Address  
 ASHEVILLE NC 28801-3271



**Usage**  
 Meter number TA3536  
 Readings: Jan 20 9787  
 Dec 18 9588  
 Meter constant X 120  
**kWh usage 23880**  
 Days in period 33 Average kWh per day 724  
**Actual kW Demand 80.40**

Billing MGS rate	33 Days
Basic customer charge	12.00
Energy charge	23,880 kwh x \$0.05132
Demand charge (80% of 132.00 kw (09/03))	1,225.5216
Three phase service charge	105.60 kw x \$4.89000
	516.3840
	9.00

ALS rate	33 Days
Metal halide light, 160 kwh, 40000 lumens, flood	
Area lighting	1 Light x \$25.63
Wood pole charge	1 Pole x \$2.16
	2.16
	33 Days
High Pressure Sodium light, 46 kwh, 9500 lumens, flood	
Area lighting	1 Light x \$11.15
	11.15
	33 Days
High Pressure Sodium lights, 109 kwh, 28500 lumens, flood	
Area lighting	3 Lights x \$15.69
	47.07
3% North Carolina sales tax	55.47
<b>Total due</b>	<b>\$1,904.39</b>

Please detach here. Turn over for helpful phone numbers and customer service tips. PIN:

# *Coincident Peak*

- **Customers of Municipal Power Companies or other utilities who buy wholesale power, or Deregulated utilities (other states)**
- **Coincident peak is your demand kW measured when the hourly IOU system monthly peak occurs**
- **Highest costs for kW during generation company peak demand for the system total as set by their customers**
- **Up to \$35 per kW during coincident peak**
- **Some municipal utilities install peaking generation**
- **Demand-side Management (DSM) programs pay \$**
- **Load shedding, shaving or curtailment**
- **Notification programs when Peak is to occur**
- **Weather dependent; can be winter peak for heat pumps**
- **ERCOT (TX) or PJM (Northeast) deregulated markets have historical data online; typically 4 to 5 pm**
- **Shut down early in summer; work 3am to noon Alabama**



# *Time of Use (TOU) Rates*

Higher rates during “peak” times

- Summer afternoons, Winter mornings

Lower rates charged “off-peak” to encourage:

- peak shifting (scheduling)
- peak shaving (turn some things off)

Some utilities have very long duration summer “peaks”

6 am to 4 pm; 10 am to 10 pm; 6 am to 12 am

- Read the rates and watch for seasonal changes, especially if occurring over the weekend
- Need to reset manual timers or digital controls setpoints unless Astronomical Time Clock w/DST



# *Load Factor*

What percentage of maximum possible

energy (kWh) did you use in a month?

- Maximum hours in a month:  
24hr x 30d = 720 hrs per month
  - Max kWh = Monthly Peak Demand (kW) x hrs
  - 500 KW Peak x 720 hours = 36,000 kWhs
  - If monthly metered usage = 20,000 kWhs
- ➔ Load Factor =  $20,000/36,000 = 0.56$  LF

Load Factor less than 40%: one shift operations

Load Factor greater than 70%: 3 shifts

Electric Utilities prefer higher load factors

High LF with 1 shift = opportunity to turn things off

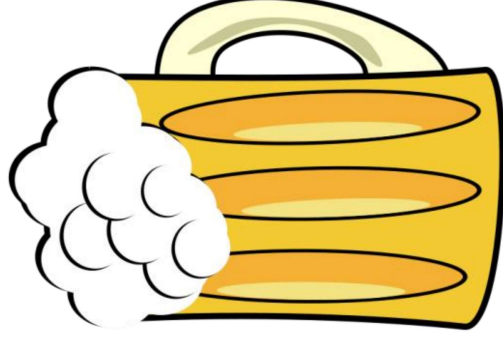
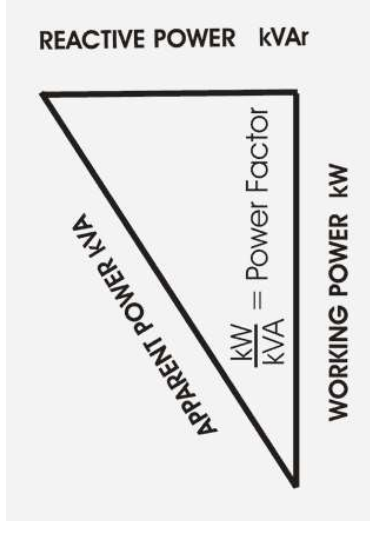


# Power Factor Penalty

- kVA = Utility delivered power to meter
- kW = power used by customer to do work
- kVA x Power Factor = kW or  $PF = kW/kVA$
- Power Factor = Reactive losses in motors, magnetic windings
  - Power factor reduces “usable” power
  - Losses measured in KVAR (kilovolt-amps reactive)
  - Electric Resistance heat has  $PF = 1.0$  (No losses)
- Utilities set PF targets = 80-90% w/penalties if below target
- Example: Penalty for PF below 90%; actual PF = 82%
  - KW billed = KW actual x 90/actual PF
  - KW billed = 200 KW x 90/82 = 220 KW; added 20 KW

Do I have a Power Factor Penalty?

- If billed in KVA; includes PF penalty built in!
- If billed in KW, may have a line item for PF Penalty
  - Easiest to spot!
- If little or no penalty, don't need PF Correction!





# Power Factor Penalties

## SAMPLE POWER FACTOR ADJUSTMENT CLAUSE

“ When the power factor in the current billing month is less than **85%**, the monthly bill will be increased by a sum equal to \$0.34 multiplied by the difference between the maximum reactive kilovolt-amperes (kVAR) registered by a demand meter suitable for measuring the demands used during a 15-minute interval and 62% of the maximum kW demand registered in the current billing month.”  
Duke Energy Progress

- Penalties usually greatest for municipal power companies who buy wholesale power
- Low power factor increases current, heat, maintenance, I<sup>2</sup>R losses
- Low power factor means more kVA power required to be generated

## Solutions?: Power Factor Correction

- Line Capacitors installed by Utilities; request assistance
- Stepped Capacitor Banks correctly sized by power quality measurements at the equipment Motor Control Center or at Transformer
- Watch for harmonics



# *Other Monthly Charges*

## **Fuel Cost Adjustment- usually in Rate or Rider**

- Passed through as allowed by utility commissions
- Natural gas yields credits from fuel switching

## **Renewable Energy &/or Demand Side Management program charges- usually in Rate or Rider**

- May be opt out provision; check rate schedules
- Ask utility account manager

## **Lighting: Area lights leased monthly by type and pole**

- Pole audit; only pay for poles on your property
- Are your poles metered (pay for kWh)? Change to LED

## **Taxes**

- State, Municipal, Gross Receipts; Varies by State
- Based on meter location; check for exemptions

## **Additional Facilities (do you know what this is for?)**

**Municipal Utility Bills may include all utilities; water, wastewater, waste management, telecom, etc.**



# *Large Utilities: Many Rates*

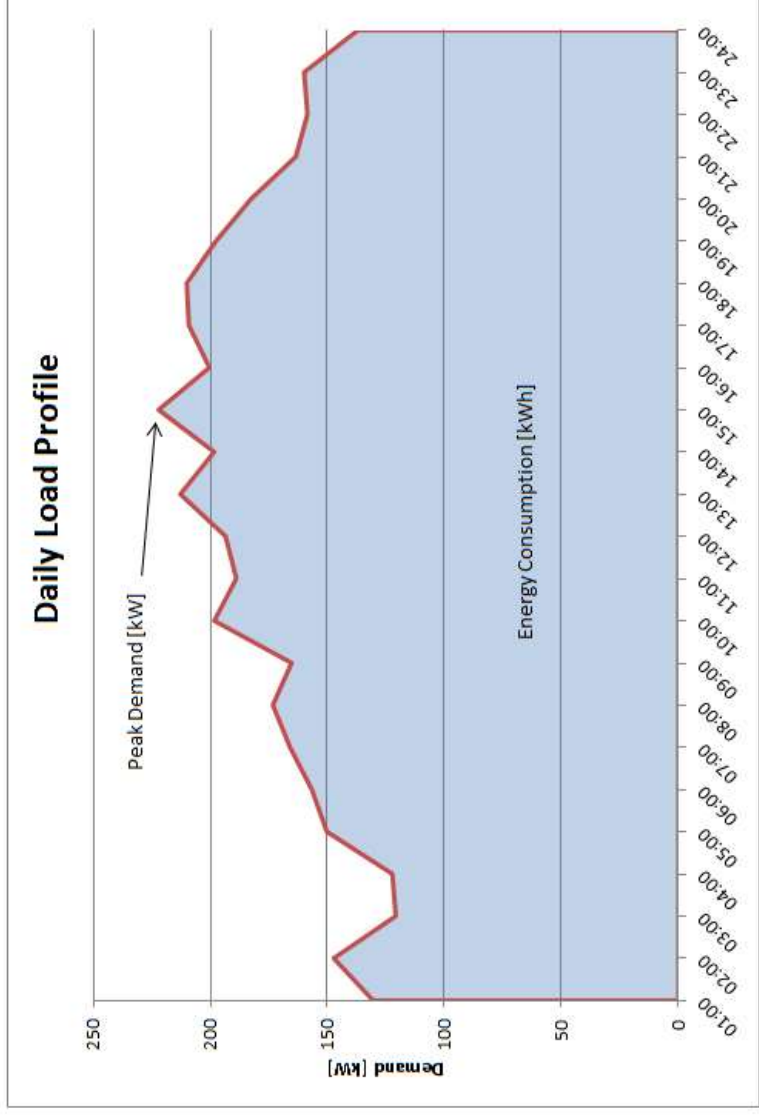
- Riders/Billing Adjustment (RE, EE & DSM programs)
- All Electric
- Churches
- Seasonal (sports lighting)
- Mining
- Real-Time Pricing
- Interruptible (Demand-side Management)
- Co-generation, Thermal Storage
- Renewable/Solar
- Experimental
- Economic Development
- Special Requests! Negotiate with utility
- **RATES CHANGE FREQUENTLY!**



# Interval Meter Data: Load Profile

How many Intervals in a month? 15 min. interval meter is most common  
4 avg. kW/hour x 24 hours = 96 intervals/day  
96 intervals x 30 days = **2,880** readings per mo.

*Graph it* = Demand Profile KW vs. Time  
Utilities offer as fee service: monthly, daily, real time  
May provide historical data annually at no cost



# *How to Estimate Energy Savings for Projects?*

1. Average cost per kWh for time period
  - Total cost/total kWh = avg. \$/kWh
  - Blended rate includes demand “savings”
  - Project may not impact demand
  - Not typically the most accurate
2. Billed cost savings per rate schedule
  - Project demand savings x kW rate
  - Project energy savings x kWh rate
  - Time of Use Rates? Operating time of day?
  - Parking lot lighting only at night
  - Include monthly facilities charges x 12 for total \$



# Natural Gas

## Units of billing and conversions:

- Therms (th) = 100,000 BTUs
- Dekatherm (dt) = 10 x therms = 1,000,000 BTUs
- CF = cubic feet = approx. 1000 BTUs
- CCF = 100 cubic feet = 1 therm
- BTU x Heat Rate Factor = therms
- BTUs British Thermal Unit
- 1 MMBTU = 1,000,000 BTUs

LDC Local Distribution Company delivers gas to end-users

PSNC, Piedmont (bought by Duke Energy)

Metered in CF; converted to therms

Transport Gas = Pipeline Gas; for large users (see LDC rates)

less \$\$ than from LDC

State Contract with Texican

You may receive two bills, so don't double count units!



# Water-Sewer Bill Tips

**Units of Consumption:** May or may not be on the bill

- Gallons, 1,000 gallons, CF, CCF, “units”
- Go to Utility Website: Municipal utilities

**Sewer charges usually same utility; don’t double count usage!**

**Rates!**

- Sewer usually double water rate
- City Limits? Are you in or out? May be higher rates OS (outside!)
- Sewer deduct for water tower evaporation; add meter to makeup
- Sewer deduct for irrigation
- Fixed monthly fee based on meter size; can request smaller meters

**Monitor monthly bills:**

- Spikes = leaks, toilets running, broken line
- Zero consumption? Broken meter or no usage
- Request account to be closed, save on monthly fee

**Stormwater fee = property tax?! Cost per sf impermeable area**

# *Lessons Learned*

## **Power Factor Penalty \$5,000 +**

- **Installed 1000 KVAR Capacitor Banks \$\$\$**
- **No change to Power Factor Penalty**
- **Utility changed demand meter**
- **PF went from 0.62 to 0.85**
- **Reviewed daily demand meter data provided in spreadsheet from utility for 15 min. KW, KVAR**
- **Old PF meter programmed taking average every 15 min. instead of peak; very low PF at low loads at night**

## **Power Factor Penalty for PF greater than 1**

- **approximately \$500 per month for years**
- **Utility Company installed PF correction on incoming distribution lines**
- **Capacitors oversized; loads changed?**
- **PF over-corrected to Leading PF (vs. Lagging)**
- **Customer unable to fix; requested assistance from utility**





# Lessons Learned

DIFF		RATCHETS/ADDED COST	
RATCHET	New Bill	RATCHETS/ADDED COST	
SEP PK	80% PK Demand BILLING @ \$11.88		
3858	3086.4	3086.4	470 \$ 5,578.85

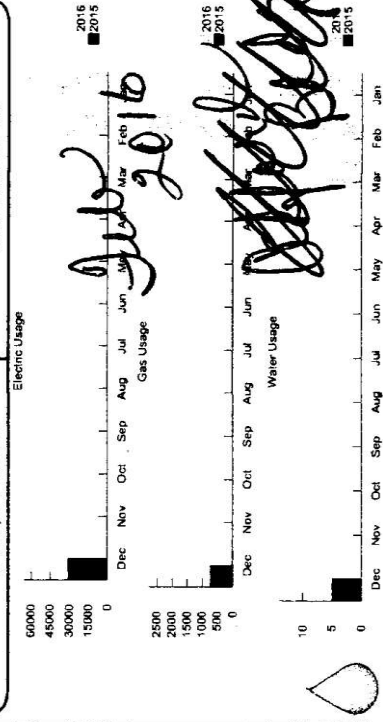
KW DEMAND



\$28,000 billing adjustment (refund) for broken equipment in July; reset peak to September (historical) and reduced ratchet and # months on ratchet

# Lessons Learned

<p>Electric Sales Tax Electric Water Wastewater Gas Gas Sales Tax Total New Charges:</p>	<p>Charges \$11,277.30 \$22.25 \$29.52 \$1,458.77 \$102.11 \$13,679.36</p>	<p>Total Due \$13,679.36</p> <p>Due Date 03/30/2016</p>
<p>Past Due Charges <i>Subject to Disconnection</i> \$0.00</p> <p>Total Due \$13,679.36</p>		



Service	Meter #	Read Dates		Days Billed	Current	Previous	Reading		Multiplier/ Factor	Billed	Units	Charges
		Current	Previous				Current	Previous				
Electric	E43105	02/29/2016	01/31/2016	29	488	326.2	200	32366	200	KWH	\$2,579.80	
KVAR	E43105	02/29/2016	01/31/2016	29	69	50.6	200	69	200	KVAR	\$20.70	
KW	E43105	02/29/2016	01/31/2016	29	118	0	200	118	200	KW	\$8,676.80	
Gas	G32513	02/29/2016	01/31/2016	29	4316	3114	1.040600	1389	1	THM	\$1,458.77	
Water	W66451	03/01/2016	02/01/2016	29	84	77	1	7	1	CCF	\$22.25	

- Large contract demand 638 KW, rate MGS signed March 2015
- Rate changed to LGS for transformer size > 500 kW September 2015
- Cost per kw \$11 to \$17
- Utility changed transformer; new bill for 200 kW = \$1,924



# *Lessons Learned Data Mgmt*

## **3<sup>rd</sup> Party Bill Management Services**

- **Fixed fee per bill per month**
- **All billing data captured in database**
- **Bills routed to 3<sup>rd</sup> party**
- **Web-based reporting, graphs**
- **Bill Payment optional (can upload payment data)**
- **Exception reporting automated to spot errors, water leaks, controls issues**
- **Upload site data for KPIs (number students, widgets, prisoners)**

**Manual tracking of billed data in spreadsheets time-consuming plus possible data entry errors**

**Do-it-yourself: Portfolio Manager is FREE DOE tool**  
upload spreadsheets, weather normalization option,  
soon to include kW tracking

**Packaged Energy Management software; some with data-entry options**

**“Enterprise” accounting software- IT added field for Units**



# *Steps to Success*

- Read the bills; review all data and charges
- Meet with your Utility Account Manager
- Sign up for Utility websites for services, rates, tools, newsletters
- 1 to 2 year billing history by account; download or copy and paste
- Request rate reviews from utility annually
- Read the Rates and Tariffs for specifics on:
  - Demand kW tiers, Billing Demand, Ratchets,
  - Time-of-Use seasonal dates and times,
  - Power Factor calculations, Riders, etc.
- Request and read your utility contracts for service agreement, contract demand, voltage,
  - Transformer sizes, renewal and expiration dates
- Caught on Ratchet? Need to lower contract kW?
- Track the data and graph monthly to spot opportunities
- Typically 1-2% Savings from Utility Bill and Rate Reviews
- More savings with Demand Response programs!



*“If you don’t ask, you don’t get!”*

*Questions?*

**Kathleen Stahl, P.E., C.E.M., L.C.**

**Energy Engine**

**Utility Savings Initiative**

**Environmental Assistance and**

**Customer Service**

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**919-707-9256**

**THANK YOU!**

