GLHN

ARCHITECTURE | MECHANICAL | ELECTRICAL | CIVIL | TECHNOLOGY

CAMPUS UTILITY METERING

30,000 – 5,000 Foot Look

RMA Webinar
August 28, 2014
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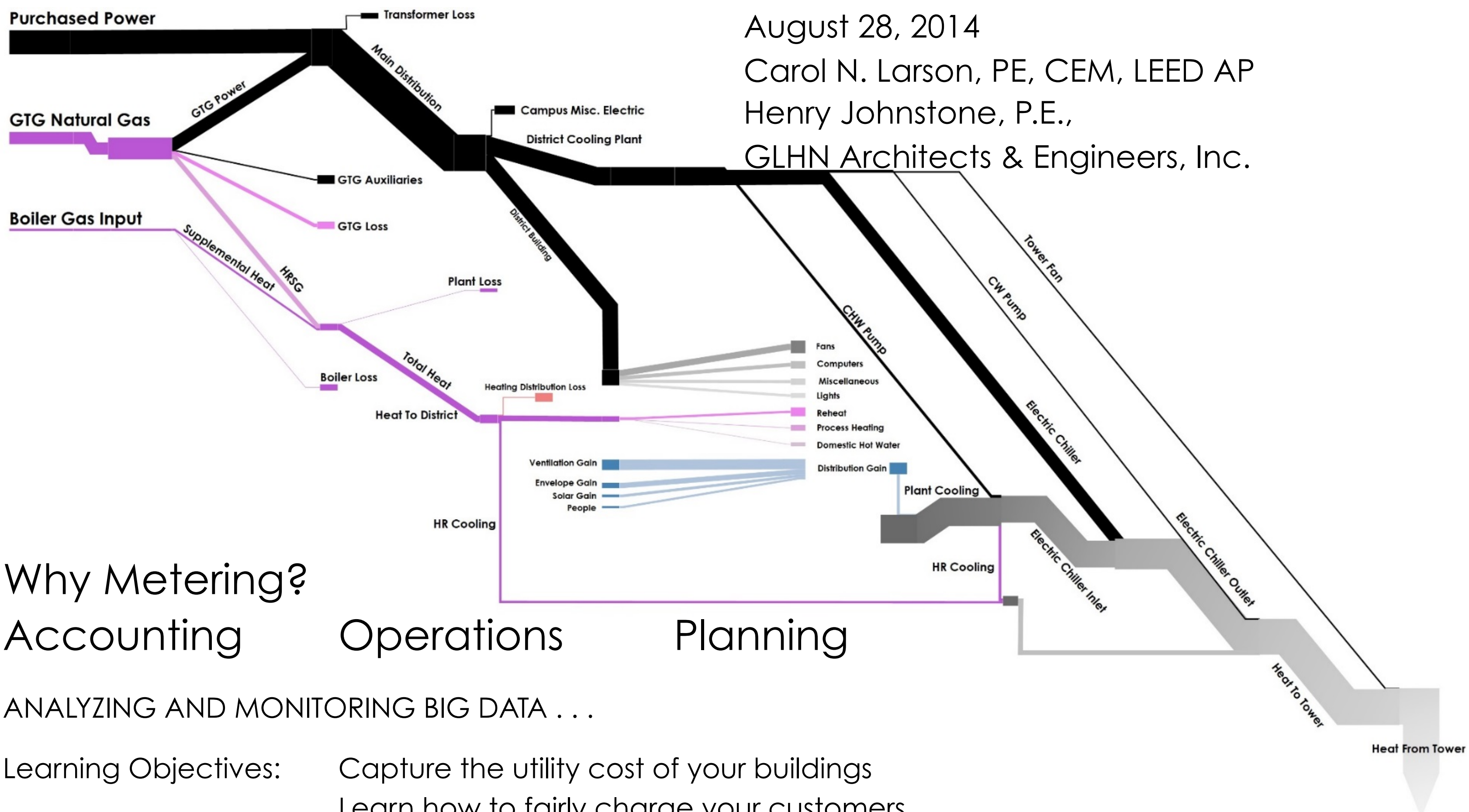
GLHN Architects & Engineers, Inc.



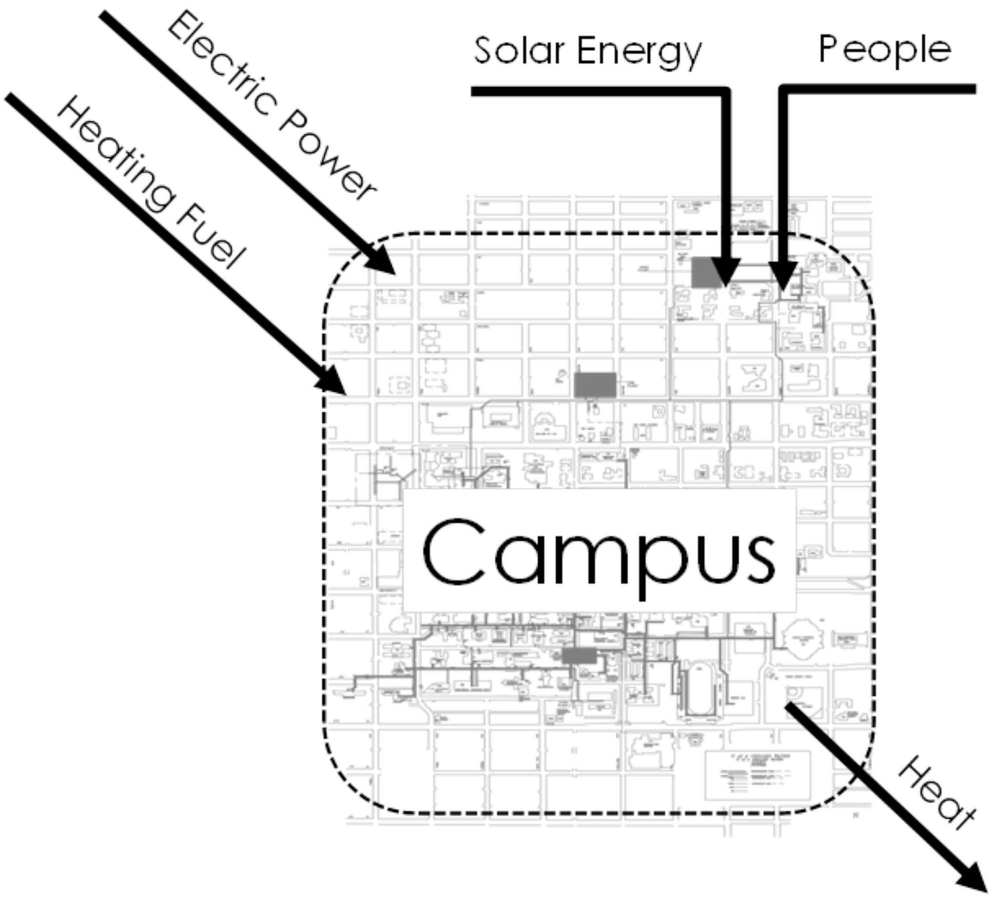
Why Metering?

Accounting Operations Planning

ANALYZING AND MONITORING BIG DATA . . .

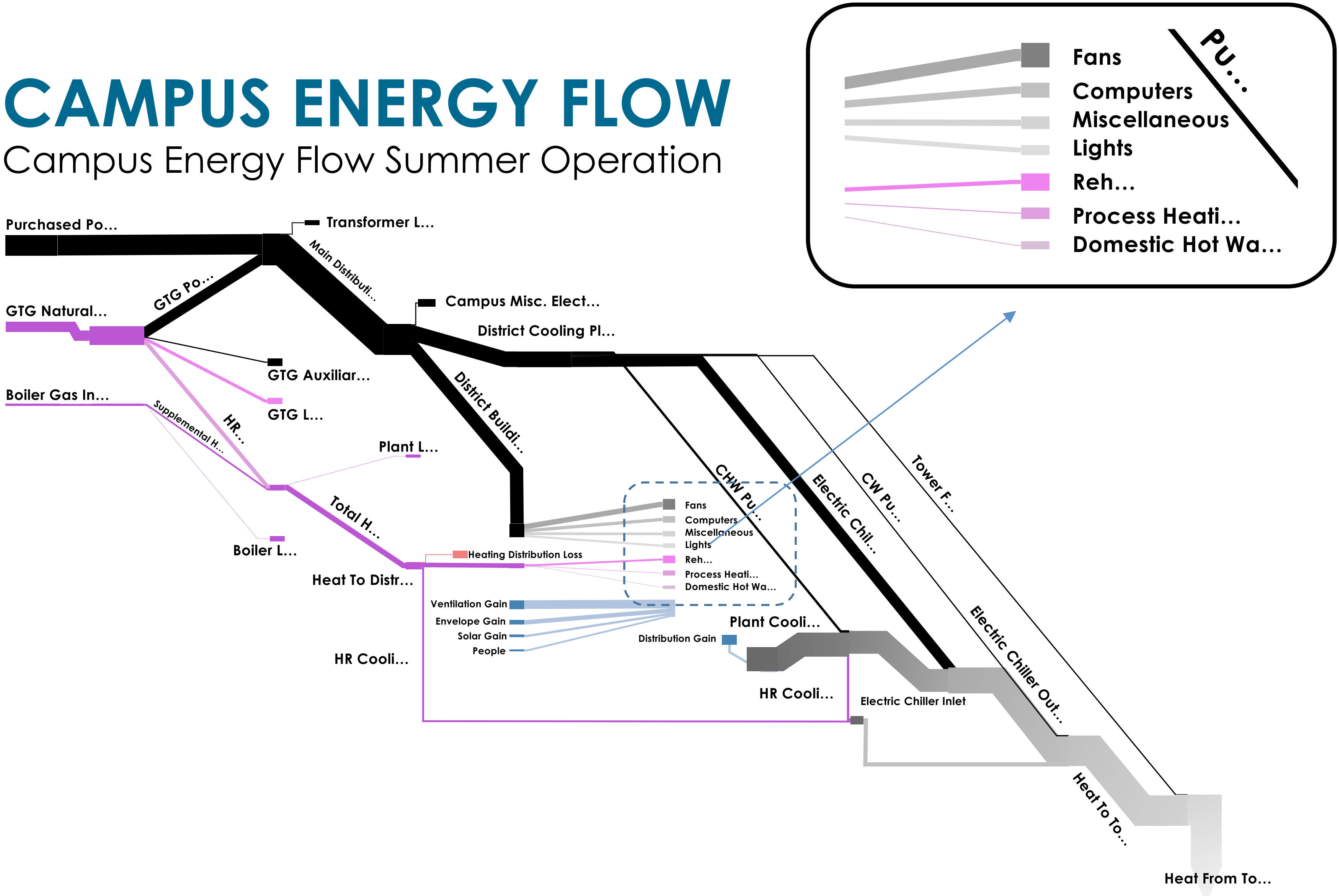
Learning Objectives:
- Capture the utility cost of your buildings
- Learn how to fairly charge your customers
- Tools to improve performance

CAMPUS ENERGY FLOW



CAMPUS ENERGY FLOW

Campus Energy Flow Summer Operation



CAMPUS METERED SYSTEMS

INPUT

- Electric Power
- Natural Gas
- Other Fossil Fuels
- Water/Sewer

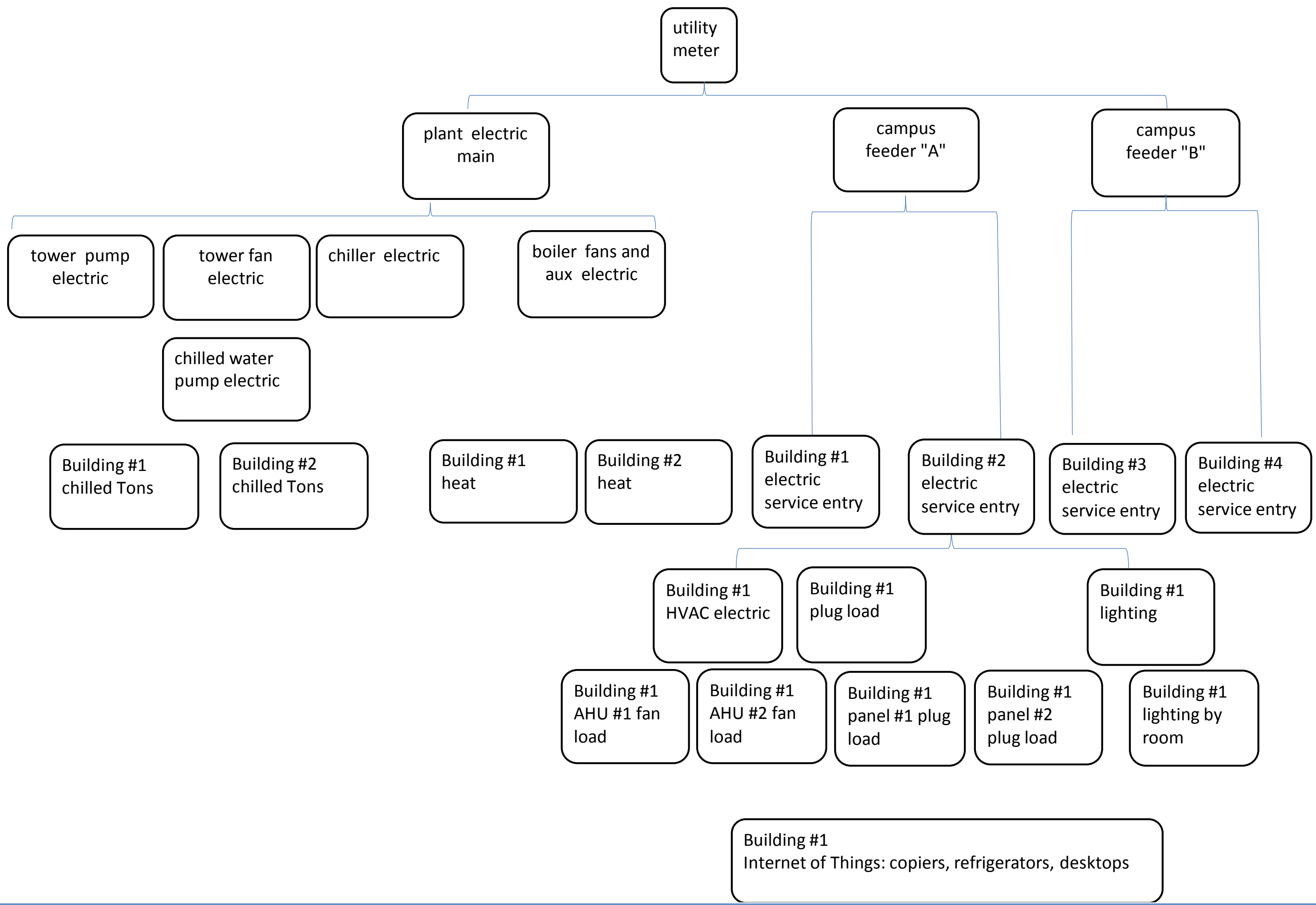
OUTPUT

- Steam/Condensate
- Heating Water
- Chilled Water
- Electric Power

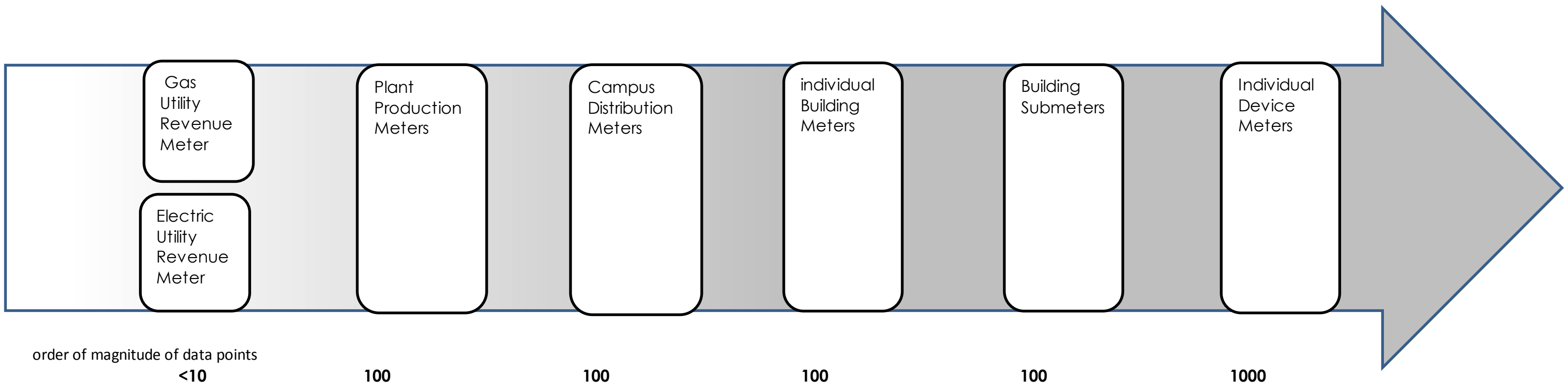
LEVELS OF METERING

- Purchased commodity (incoming meters)
- Manufactured utilities (plant production meters)
- Distribution meters (main feeders, plant flows
- Customer/Auxiliaries (Res Life, Athletics..)
- Building Meters
- Building Submeters: lighting, equip, HVAC panels
- EMCS Devices: VFDs, CTs, BTUs
- Internet of Things: copiers, refrigerators, lighting sensors

CAMPUS ELECTRICAL METERING HEIRARCHY



CAMPUS METERED POINT POTENTIAL



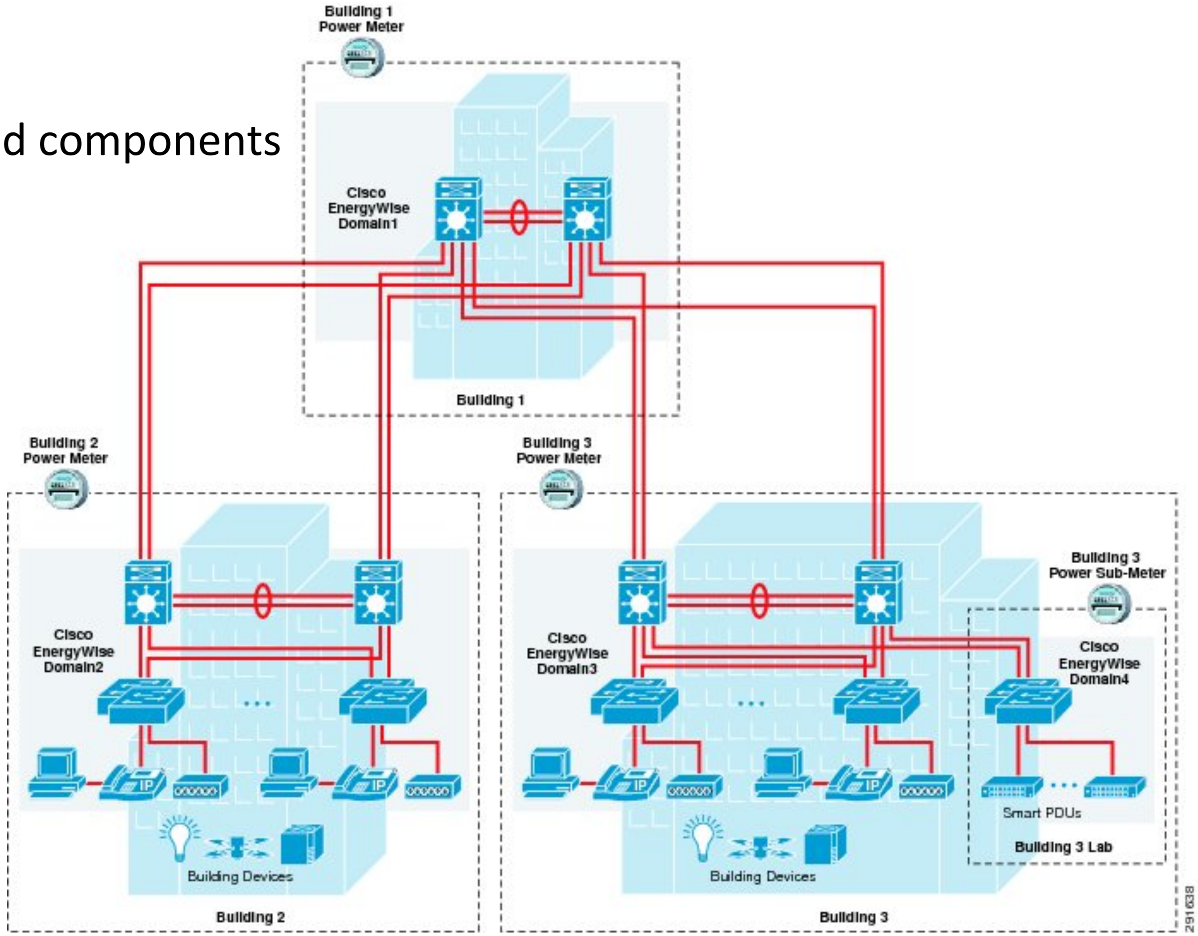
Lots of individual data points X high frequency polling = BIG data set

POSSIBLE ELEMENTS OF AN ENERGY METERING SYSTEM

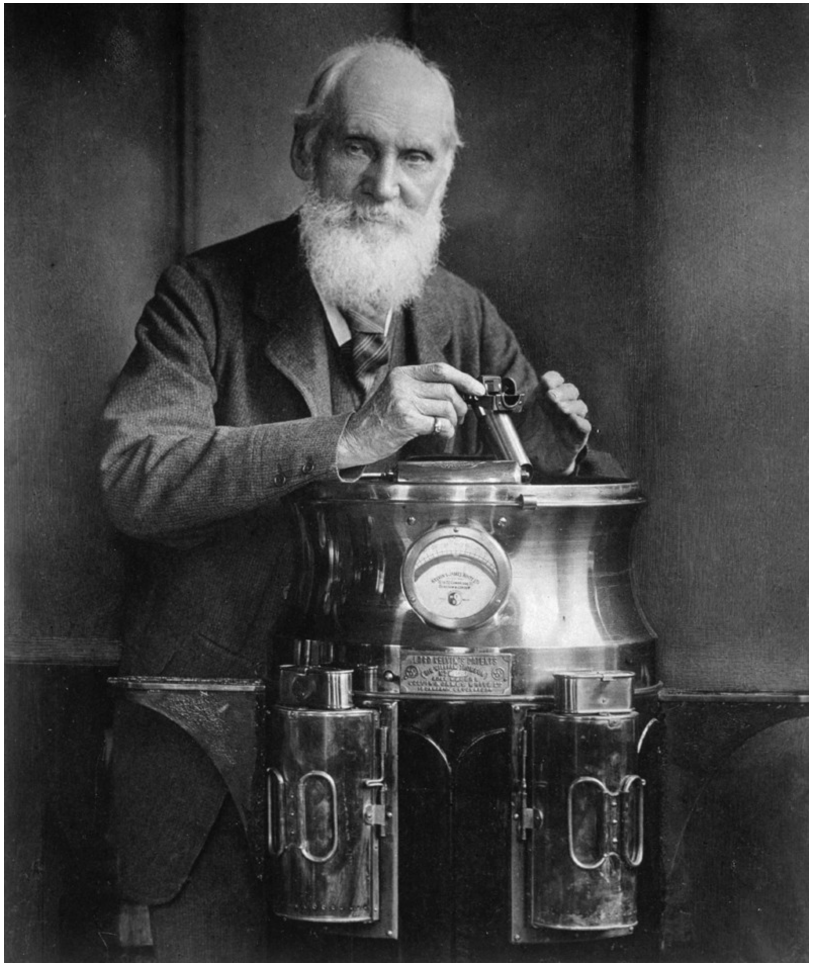
- Raw Signal Transducers: polled frequently
- Polled data converted to units of energy, cumulated
- Data communicated to central processor
- Data history stored with time stamp
- Real time data displayed to show current and recent state: alarms, flags, trends and visualization graphics
- Automated data processing in billing cycle
- Platform for analytics

WHAT IS ENERGY METERING?

Lots of inter related networked components



WHY ENERGY METERING



"If you can not measure it, you can not improve it.“

Lord Kelvin
Sir William Thomson

"The true measure of a man is what he would do if he knew he would never be caught."

WHY ENERGY METERING

THREE REASONS

1. **Accounting**
2. **Operations**
3. **Planning**

WHY ENERGY METERING

1. Accounting

Allocate energy component of overall utility cost

Set billing rates for customers and auxiliaries

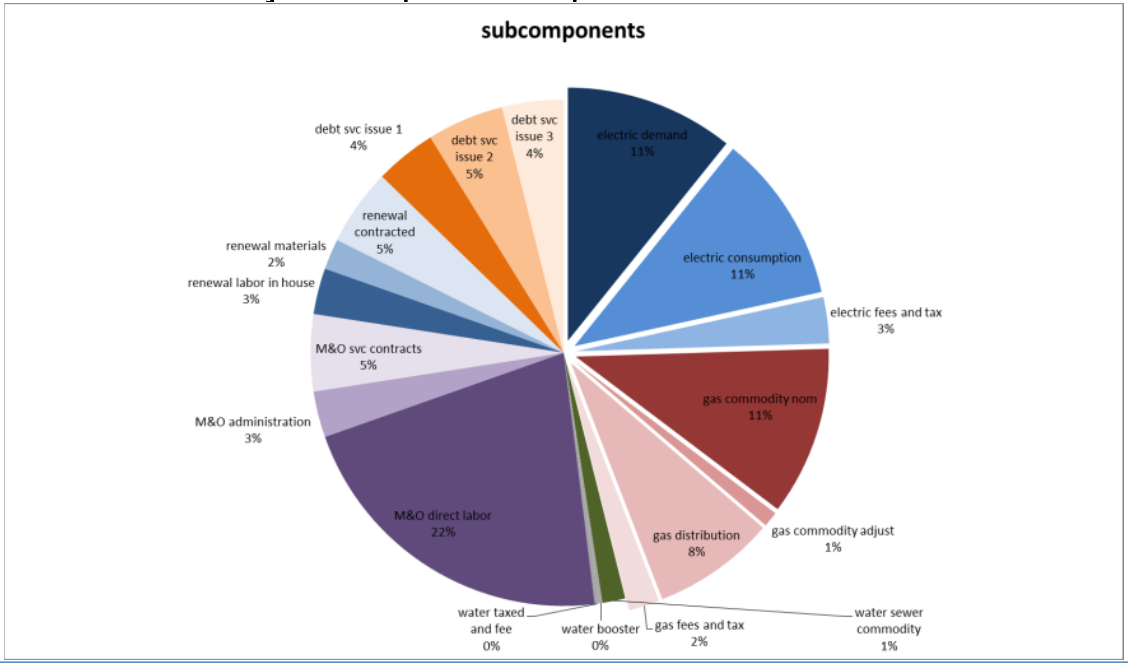
Document to take advantage of Indirect Cost recovery opportunities

Basis of a transparent, auditable, and equitable system.

Drive behavior change within student, staff, community

ACCOUNTING ALLOCATION OF ENERGY WITHIN UTILITY COST

Utility cost is built from variable energy or raw utility costs, maintenance and operations, planned renewal, and fixed debt service from major capital improvements



ACCOUNTING ESTABLISHING AND MAINTAINING BILLING RATES

- Auxiliaries and Customers
  - Monitor real time energy use behavior
    - On peak usage
    - Return water temperature
- Indirect Cost Recovery Opportunities

WHY ENERGY METERING

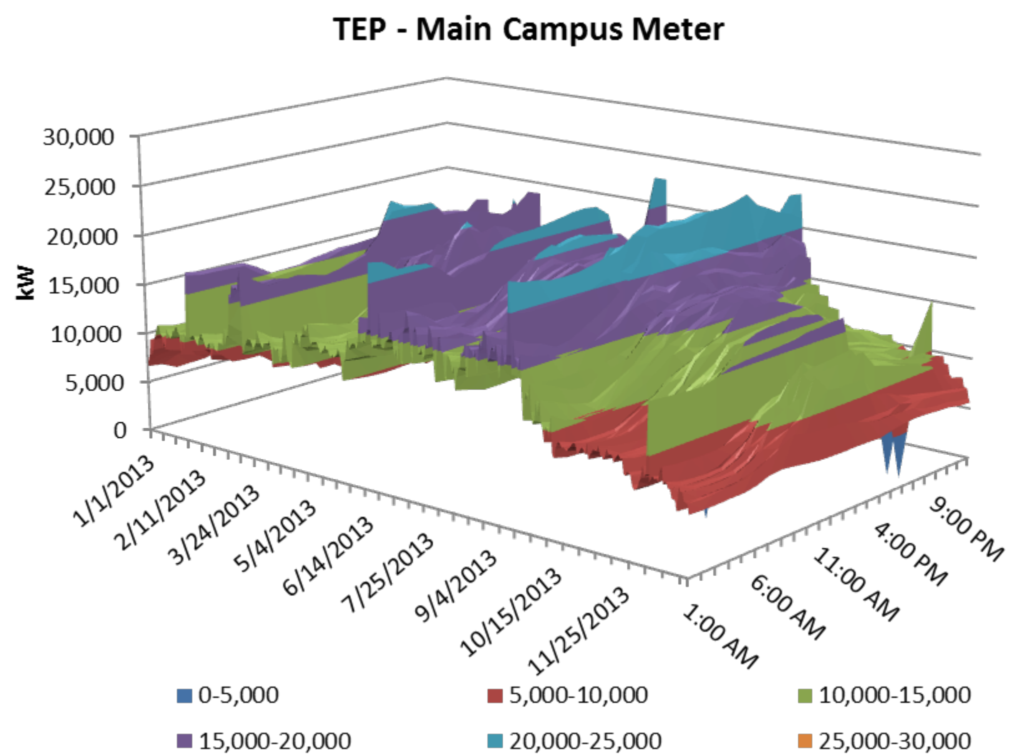
2. Operations

Early Warning, Real Time Performance Monitoring

Developing, Testing and Validating System Improvements

Participate in Real-Time, Internally and Externally Driven Energy Response. Smart Grid

OPERATIONS
DEVELOPING, TESTING AND VALIDATING



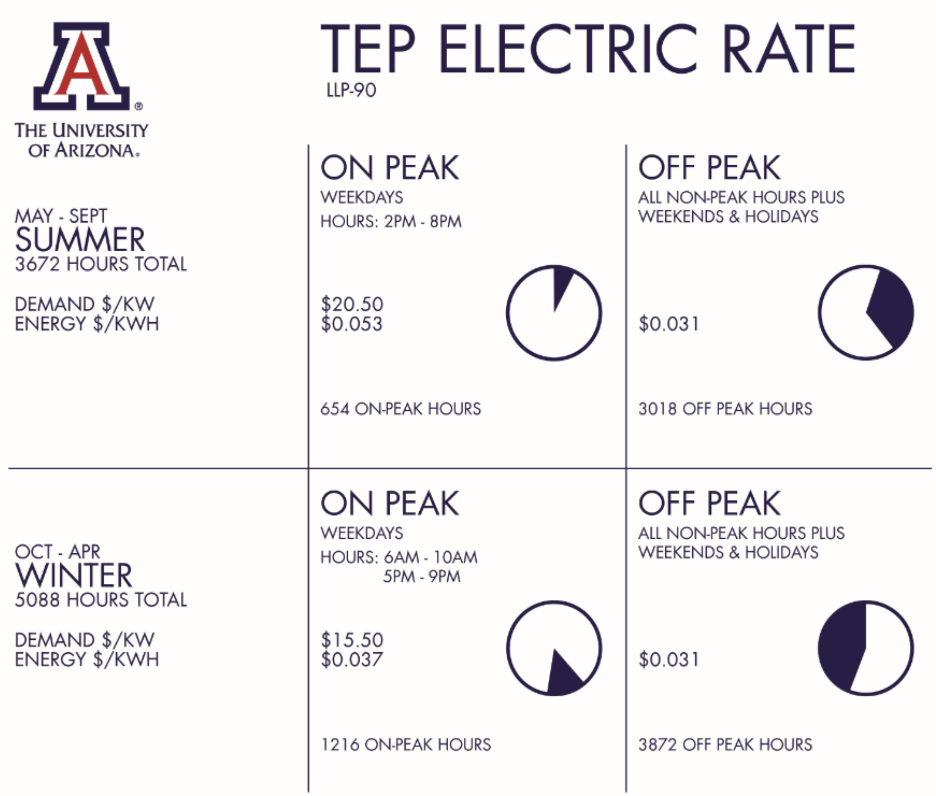
OPERATIONS EXAMPLE
REAL TIME DEMAND RESPONSE

- Electric Service Provider: **Tucson Electric Power**
- Rate Schedule: **Large Light and Power Time of Use Program (LLP-90)**
- Format: On/Off Peak **Consumption, kWh** (Energy) + **Demand, kW** (Power)

THE UNIVERSITY OF ARIZONA®

	On Peak Consumption	Off Peak Consumption	Demand
Jan	14%	36%	49%
Feb	13%	37%	50%
Mar	13%	40%	47%
Apr	13%	36%	50%
May	17%	32%	52%
Jun	15%	34%	51%
Jul	17%	34%	49%
Aug	16%	33%	51%
Sep	16%	33%	51%
Oct	16%	38%	46%
Nov	14%	37%	49%
Dec	14%	36%	50%
	15%	**35%**	**50%**

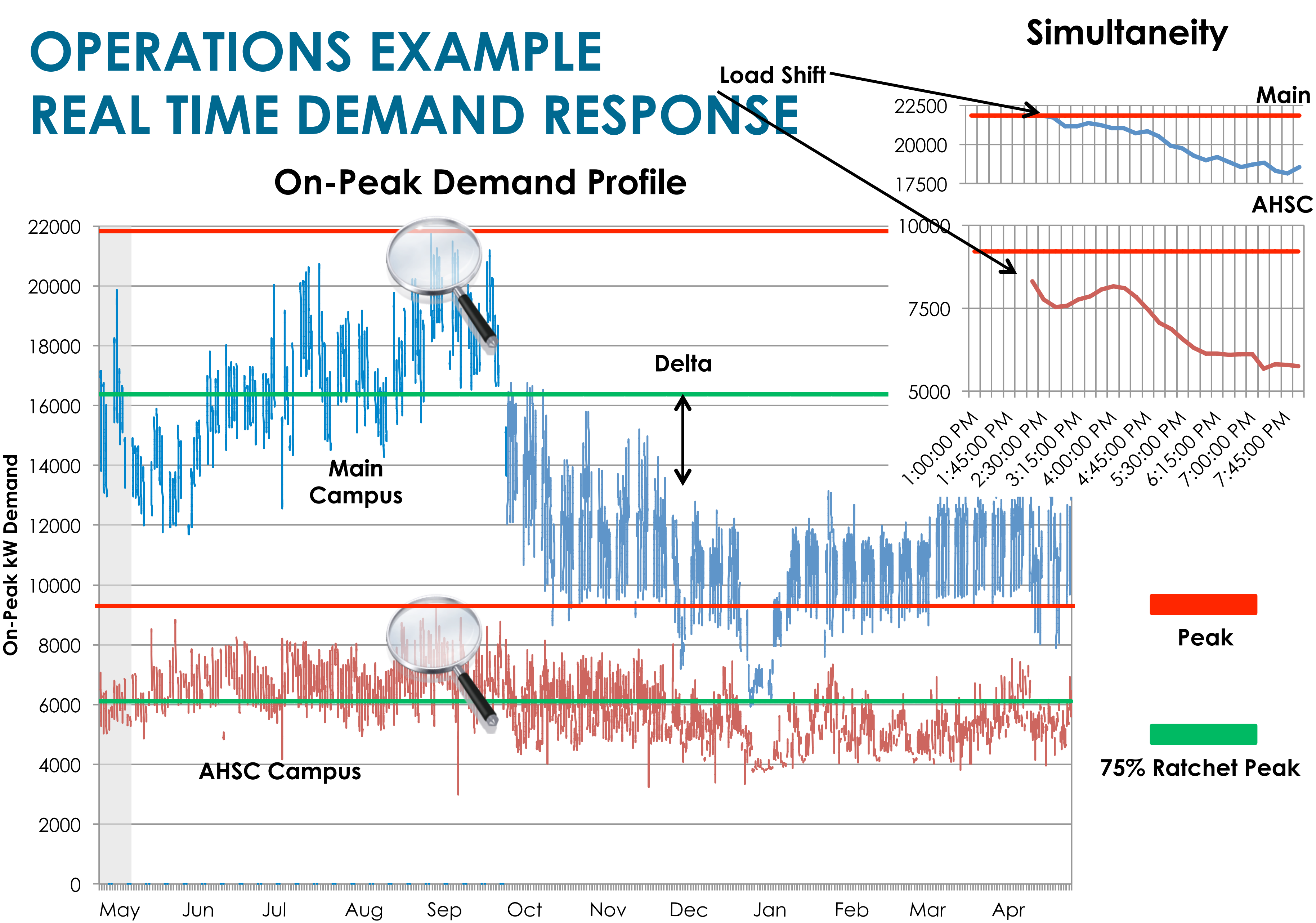
OPERATIONS EXAMPLE
REAL TIME DEMAND RESPONSE



Ratchet Cost:

“75% of the maximum on-peak period billing demand used for billing purposes in the preceding 11 months”

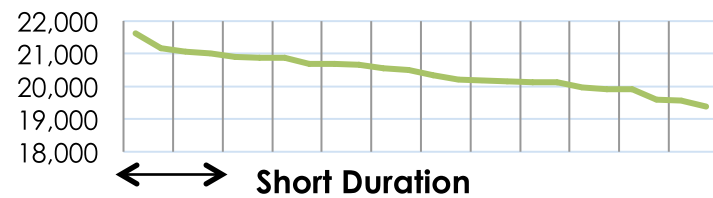
OPERATIONS EXAMPLE
REAL TIME DEMAND RESPONSE

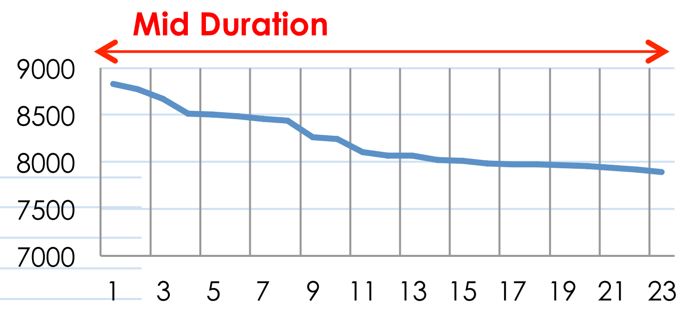


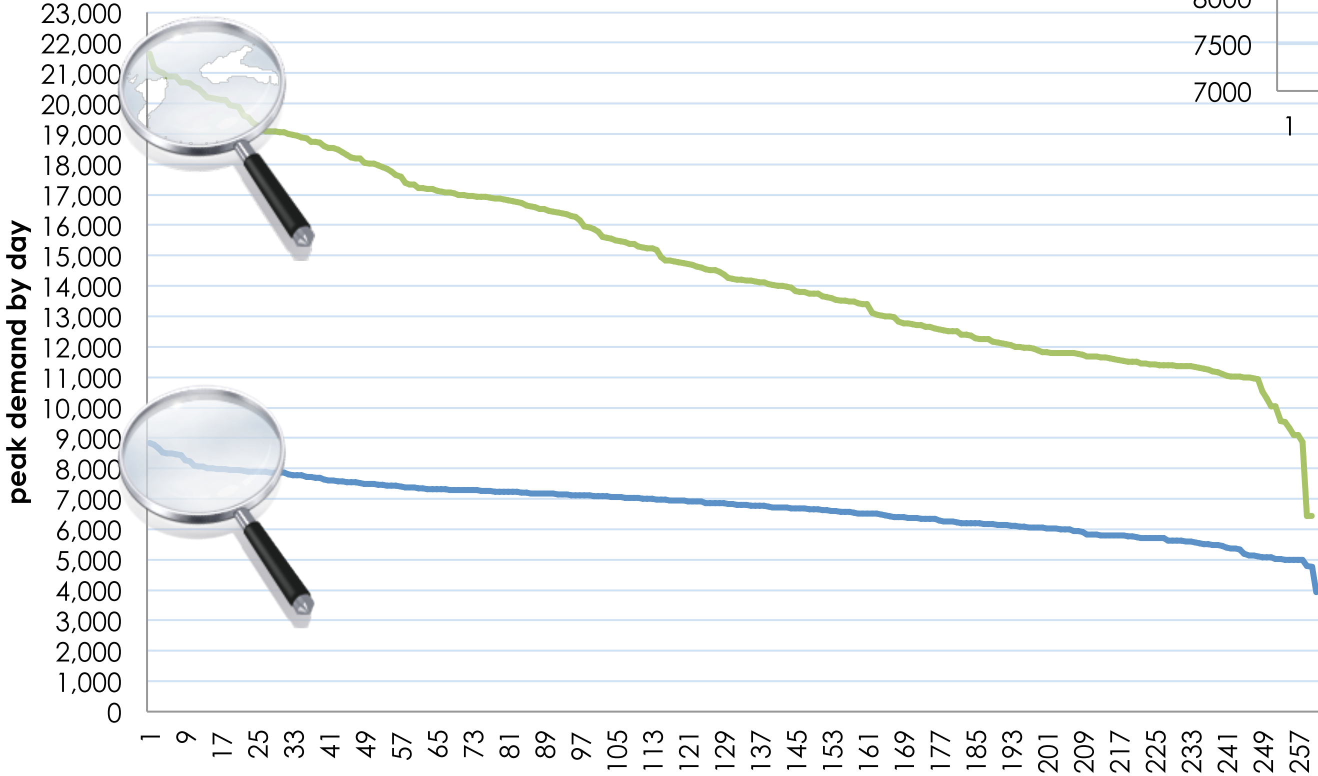
OPERATIONS EXAMPLE
REAL TIME DEMAND RESPONSE

Only a few hours where demand is above 20,000 kW

Peak Daily Demand Duration







- **Operate plants in close parallel**
- **Ride out short duration peaks**
- **Activate standby gensets through mid duration peaks**
- **Enhance TES Operation**

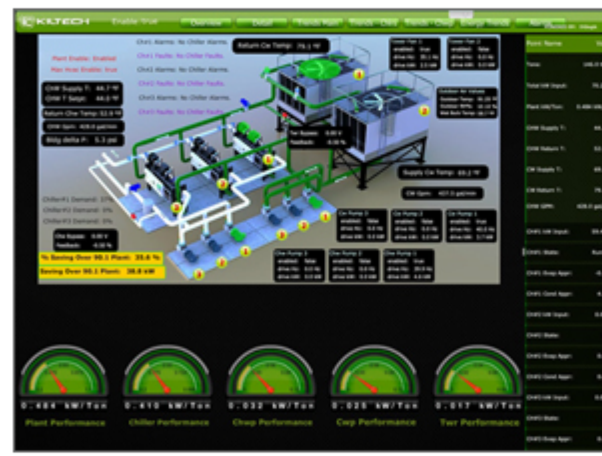
OPERATIONS: SMART GRID

RELIABILITY
BI-DIRECTIONALITY
EFFICIENCY
LOAD BALANCE
PEAK CURTAILMENT
TIME OF USE
INTEGRATION OF RENEWABLE
ENERGY STORAGE
DEMAND RESPONSE SUPPORT

OPERATIONS: PLANT OPTIMIZATION

CPECS Achieves Optimal and Predictive Central Plant Energy Performance (kW/ton) While Maintaining Cooling Needs and Respecting Equipment Limitations

CPECS utilizes Continual Feedback Loops and Advanced control algorithms to provide real time and predictive data processing that analyzes the historical data, load profiles of the building, climate data and the manufacture's equipment performance models to provide automatic modulation of control levels to all VFD's. CPECS logic provides the maximum level of system performance while respecting chiller, tower, building flow and temperature limits.



CAMPUS ENERGY FLOW

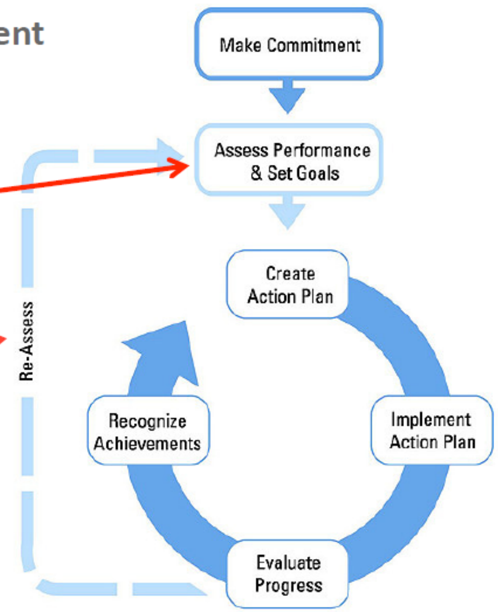
3. Planning

- Establish Baseline at all levels
  - Compare campus to similar situations : internal/ external (CBECS, Sightlines)
  - Ground Plane for Internal pay-from-savings or External Energy Performance Contracting projects
  - Basis of Building Energy Improvement process
  - Essential to long term Rcx Persistence
- Evaluate Alternative Energy Investments
  - Test financial consequences of renewables, CHP, TES, Smart Grid
  - Evaluate alternative utility tariffs and procurement strategies
- Quantify available capacity and performance
- Establish long term utility strategies based on granular, time dependent understanding

PLANNING

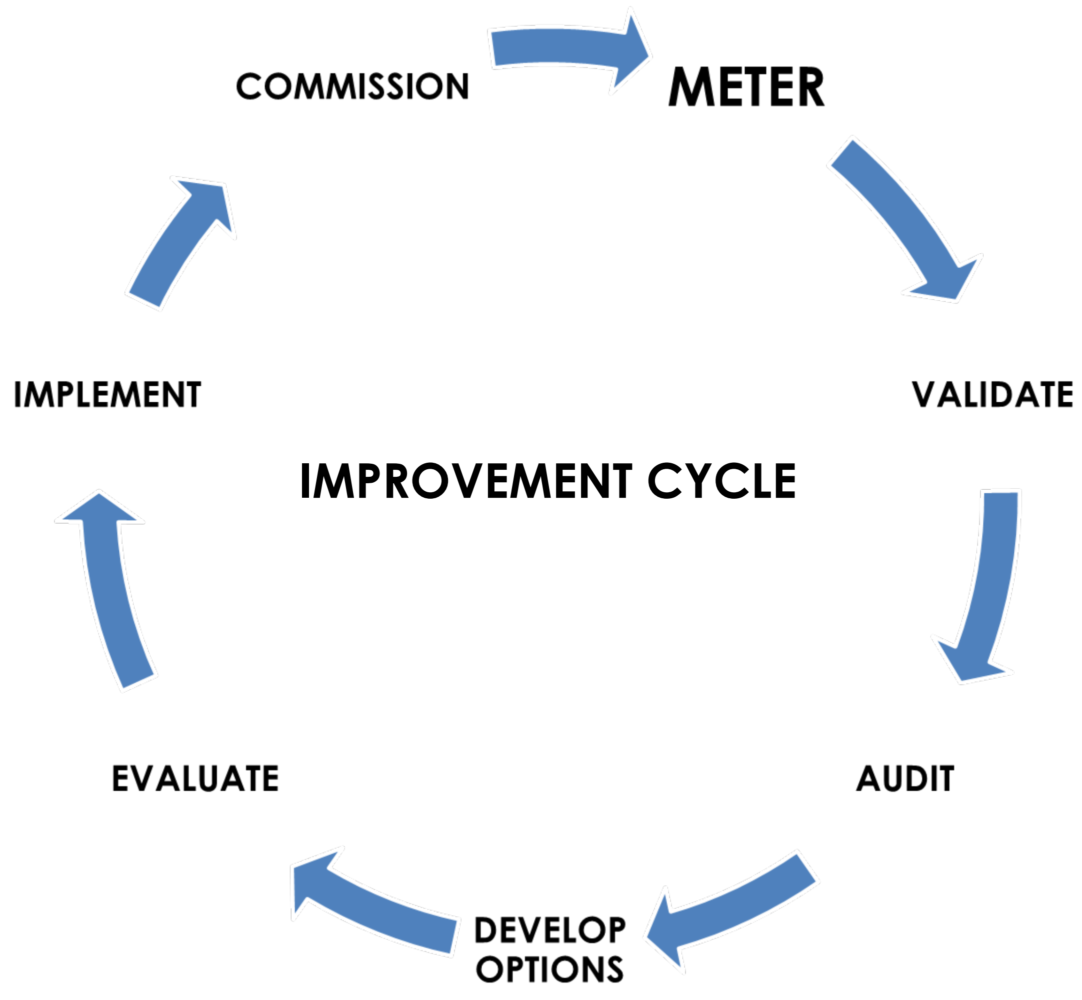
Assessing Performance for Smart Energy Management

- **Guidelines for Energy Management**
  - Developed by the EPA
  - Outlines an effective strategy for smart energy management
  - Assessing performance is essential and precedes the creation and implementation of an Action Plan
  - Continuous re-assessment informs future goals and improvements to the Action Plan
  - **Sub-metering enables you to assess the performance of individual buildings**

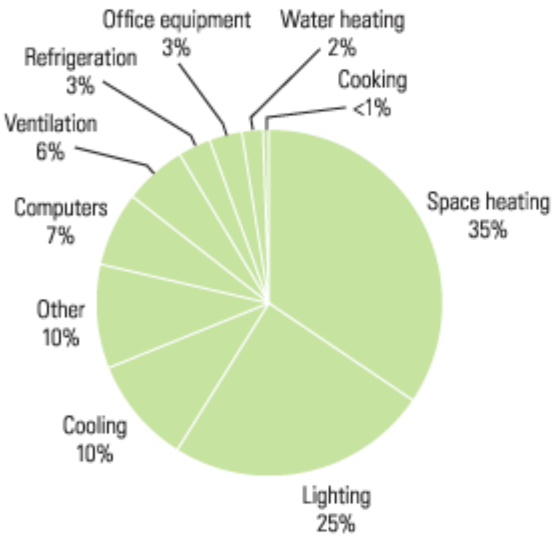


EPA

PLANNING: BASIS OF IMPROVEMENT

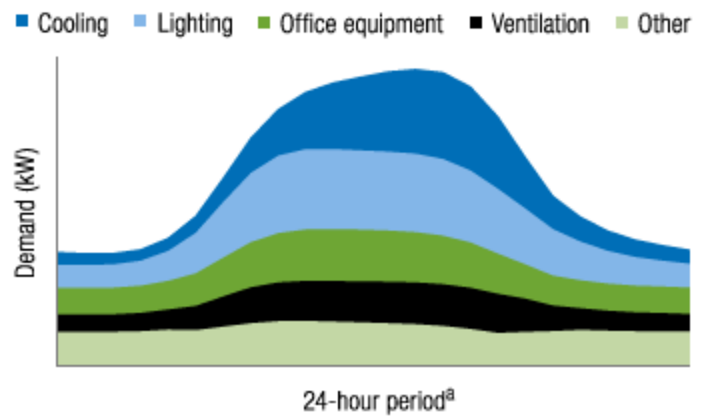


PLANNING SEGMENTING ENERGY USE



Notes: Insufficient data was available for the Cooking category; percentages may not add up to 100% due to rounding.

© E SOURCE; data from the U.S. Energy Information Administration (2003)

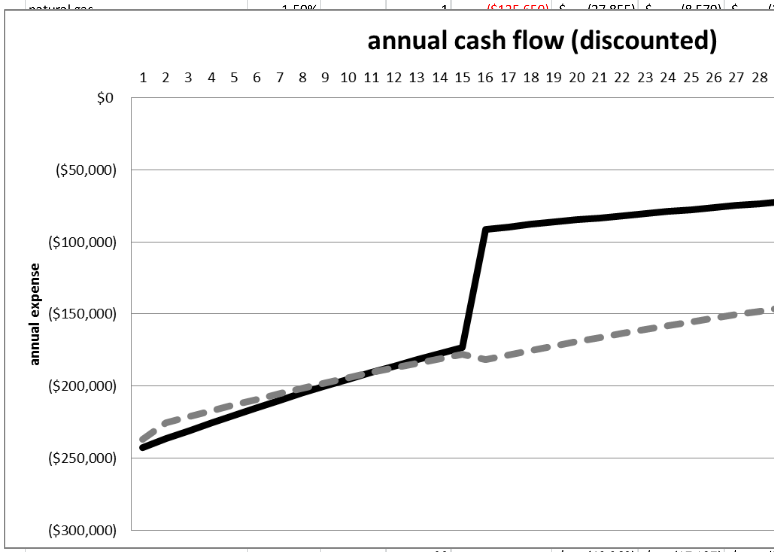


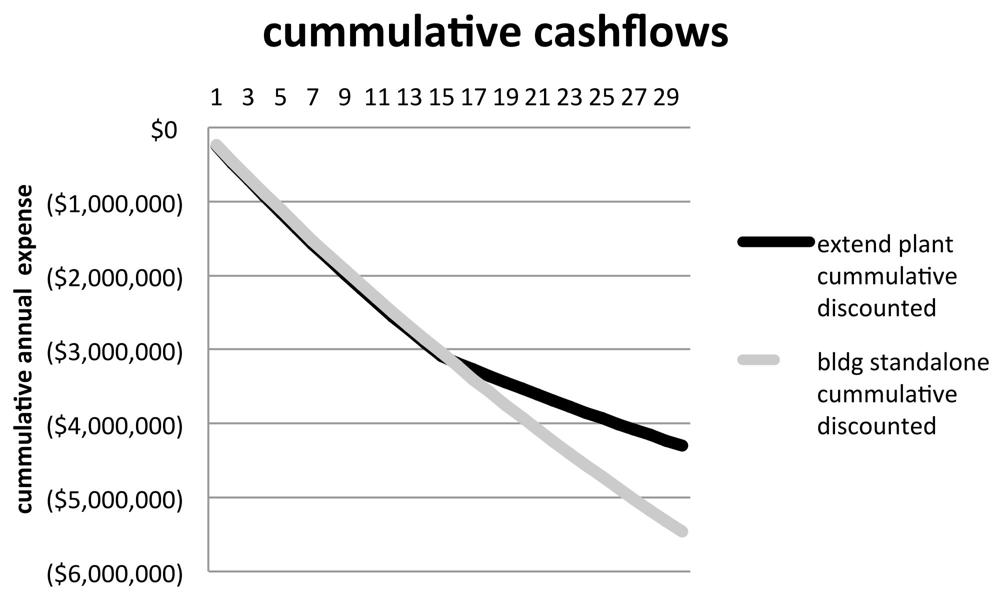
Notes: kW = kilowatt.
a. 24-hour period = midnight to midnight.

© E Source; data from ITRON

PLANNING: EVALUATE ALTERNATIVE ENERGY STRATEGIES

				cap ex	op ex												
escalation				distribution									VRF premium	VRF renewal			
				$ 1,500,000	chilled water								$ 1,500,000	$ 1,500,000			
				extend piping principal and interest	*natural gas expense*	*purchased electric expense*	*water/sewer expense*	*nse*	*ant debt*	*x + op ex*			*al*	*um*	*electric expense*	*tract expense*	*nse*
general	1.00%		0	3%	1.50%	2.50%	2										





			29		$ (42,262)	$ (17,127)	$ (5,883)	$ (82,043)	$ (22,646)	($169,961)		127%	($143,241)		$ (117,091)	$ (83,007)	($343,339)
			30		$ (42,896)	$ (17,556)	$ (6,030)	$ (82,864)	$ (22,646)	($171,990)		128%	($143,241)		$ (120,604)	$ (84,252)	($348,097)
				($1,884,748)					cummulative	**($6,275,639)**			($2,148,613)	($1,884,748)	($2,434,803)	($2,141,986)	**($8,610,150)**
									NPV	($4,298,757)							($5,456,423)
					$ (1,045,626)	$ (376,630)	$ (129,359)	$ (2,159,905)	$ (679,371)								
												delta c	**($2,334,511)**		21.22%		
												delta NPV	**($1,157,666)**				

SUMMARY: INVESTMENT IN METERING

PLAN

CONCEIVE END-IN-MIND

ROADMAP

EXISTING COMPONENTS, SYSTEMS, NETWORKS, INFRASTRUCTURE

IMPLEMENT

EVALUATE ALTERNATIVES

NEW METERING COMPONENT HARDWARE: OFTEN REVENUE GRADE

DATA MANAGEMENT SOFTWARE

INTEGRATION, IMPLEMENTATION, VALIDATION

MAINTAIN

HARDWARE

CALIBRATION

SOFTWARE

ACTIVE INTERACTION AND OVERSIGHT

LONG TERM MANAGEMENT COMMITMENT