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Charting a Course to Energy Independence

Providence, RI
August 9-12, 2009

Metering all things NOT electric

- Why focus on non-electric applications?
- How do you meter these "other" applications?
- What do I do with the data?
- Case study–major auto manufacturing facility

STEAM | WATER | COMPRESSED AIR | NATURAL GAS

Why?

Growing trends

As natural resources become more costly, so does the operation of devices that use these resources.

Natural gas–4X price increase over the last 20 years; 45% increase in last five years

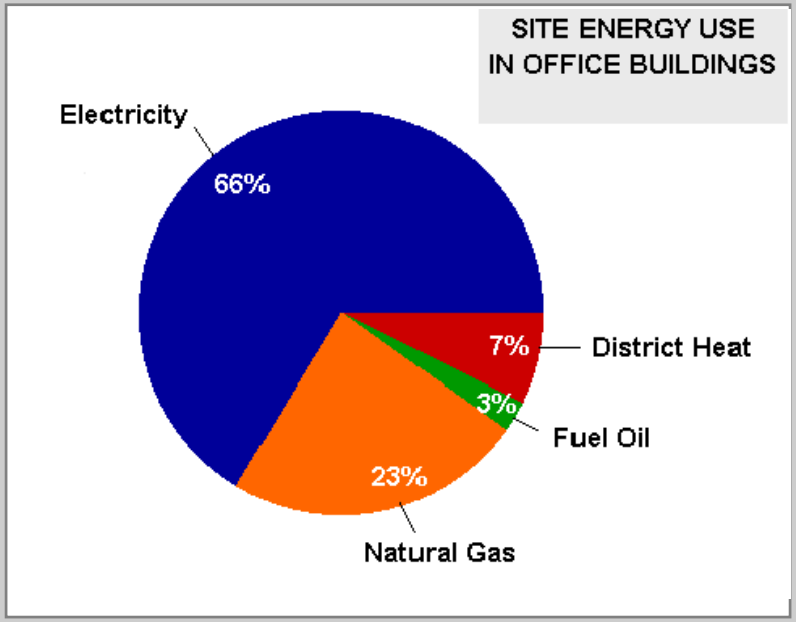
Water–severe shortages in the West and South; drought and population growth

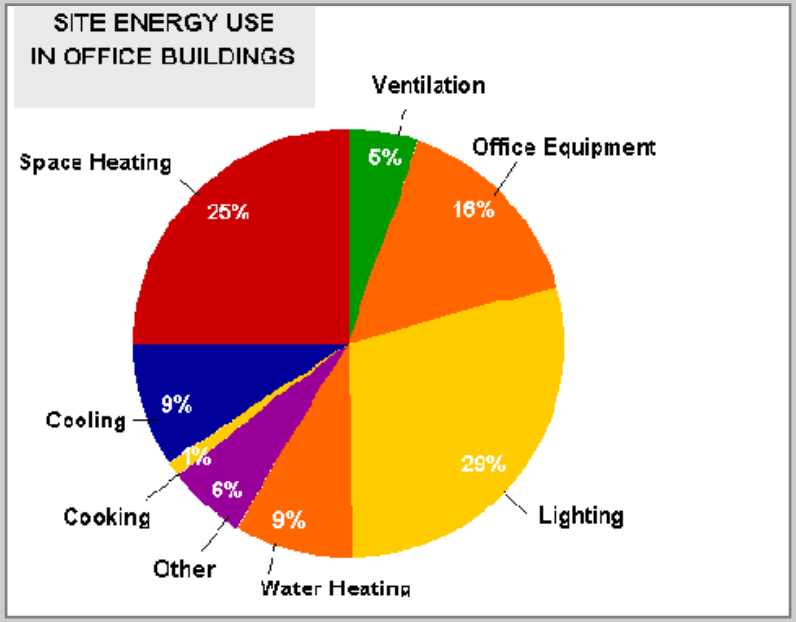
Wastewater–aging infrastructure and stretched municipal budgets

Source: Energy Information Administration

Cost avoidance

- One third of energy use is other than electric
- Space conditioning is largest consumption





Source: Energy Information Administration,
1995 Commercial Buildings Energy Consumption Survey

Regulatory compliance

EISA (2007)

- Natural gas/steam metering required by 10/1/2016
- Energy intensity reduction goals–12% this year from 2003 baseline

EPACT (2005)/E.O. 13423

- 3% energy intensity reduction goals
- 2% water intensity reduction goals

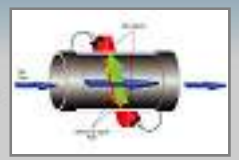
What to consider when selecting a meter

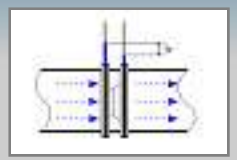
- Medium (electricity, gas, water, steam, air)
- Meter accuracy requirements
- Retrofit/new installation
- Cost of equipment
- Pipe size
- Operating temperature range (how the meter responds to variations in temperature)
- Available space for meter installation
- Environmental characteristics of location (important for areas with potentially explosive materials)
- Meter communication with energy management system

Device location—why it matters

- Impacts to operations (accuracy)
- Communications backbone
- Space constraints
- Impacts to what you're metering
- Sub metering capability/cost allocation
- Ability to optimize building efficiency

Flow meter technologies





	Ultrasonic	Coriolis	Vortex	Differential Pressure	Turbine	Magnetic
	Newer technologies			Older technologies		
Applications	Steam, gases, liquids	Gases, liquids	Steam, gases, liquids	Gases, liquids	Gases, liquids	Conductive liquids only
Pipe Sizes	Clamp-on: 0.5 to 300 inches In-line: 2 to 120 inches	0.25 to 12 inches	In-line: 0.5 to 8 inches Insertion: 3 to 24 inches	0.25 to 96 inches	1 to 20 inches	0.04 to 120 inches
Installation	In-line, clamp-on	In-line	In-line, insertion	In-line	In-line	In-line, insertion
Turndown Ratio	Liquids 400 to 1 Gases 1500 to 1	Accuracy relative to turndown ratio	Application dependent	Accuracy relative to turndown ratio	10 to 1	20 to 1
Accuracy	Clamp-on: 0.5* to 5% In-line: 0.15 to 1%	0.1 to 0.5% mass flow	0.7 to 1.5%	0.1 to 0.5%	±0.25 %	0.5 to 1%
Advantages	No pressure drop Larger pipes In-line: high accuracy, high temps/pressure	Smaller pipes High accuracy High pressure Compact Mass flow	Low pressure drop Good accuracy	Moderate accuracy Simple to install Compact	Good accuracy	No pressure drop Good accuracy
Disadvantages			Max accuracy is 0.7%	High pressure drop Recalibration	High pressure drop Viscosity dependent Mechanical wear	Erosion, corrosion and scale build up

* Depends on installation

Source: GE internal

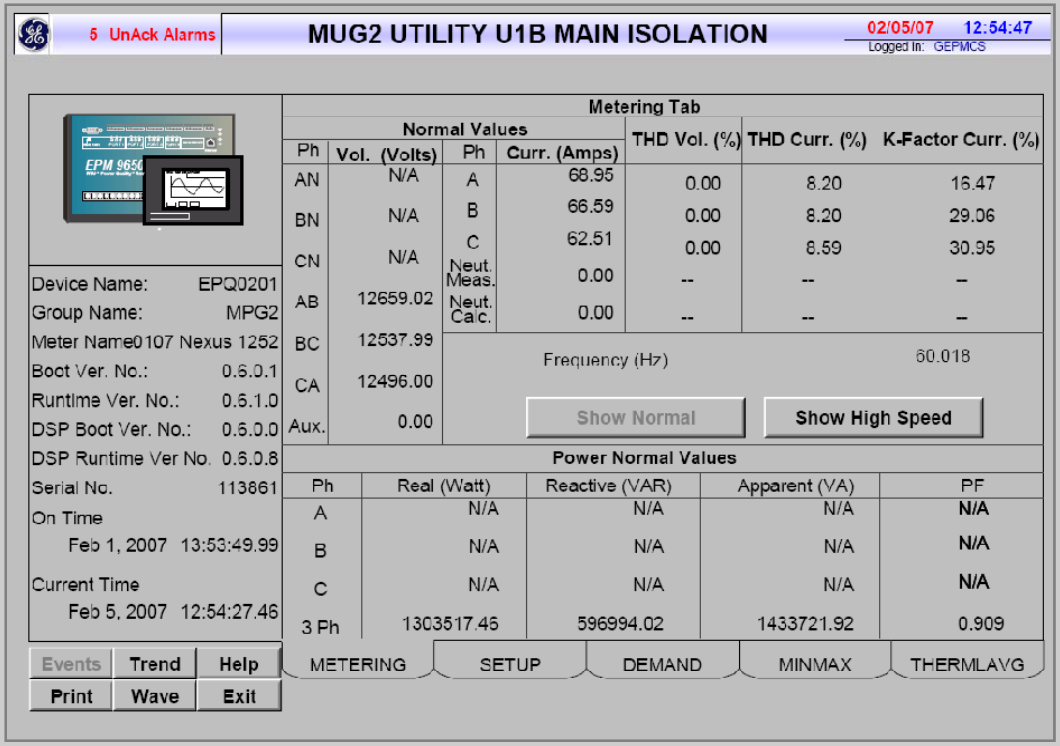
What do I do with the data???

Energy management systems

Energy management systems will reduce the cost of energy to a customer by optimizing the methods used to control both processes and equipment to utilize energy more economically and efficiently.

Performance validation

- Accurate baseline
- Performance contract validation (ESPCs)
- Tracking of energy
- Intensity reduction mandates

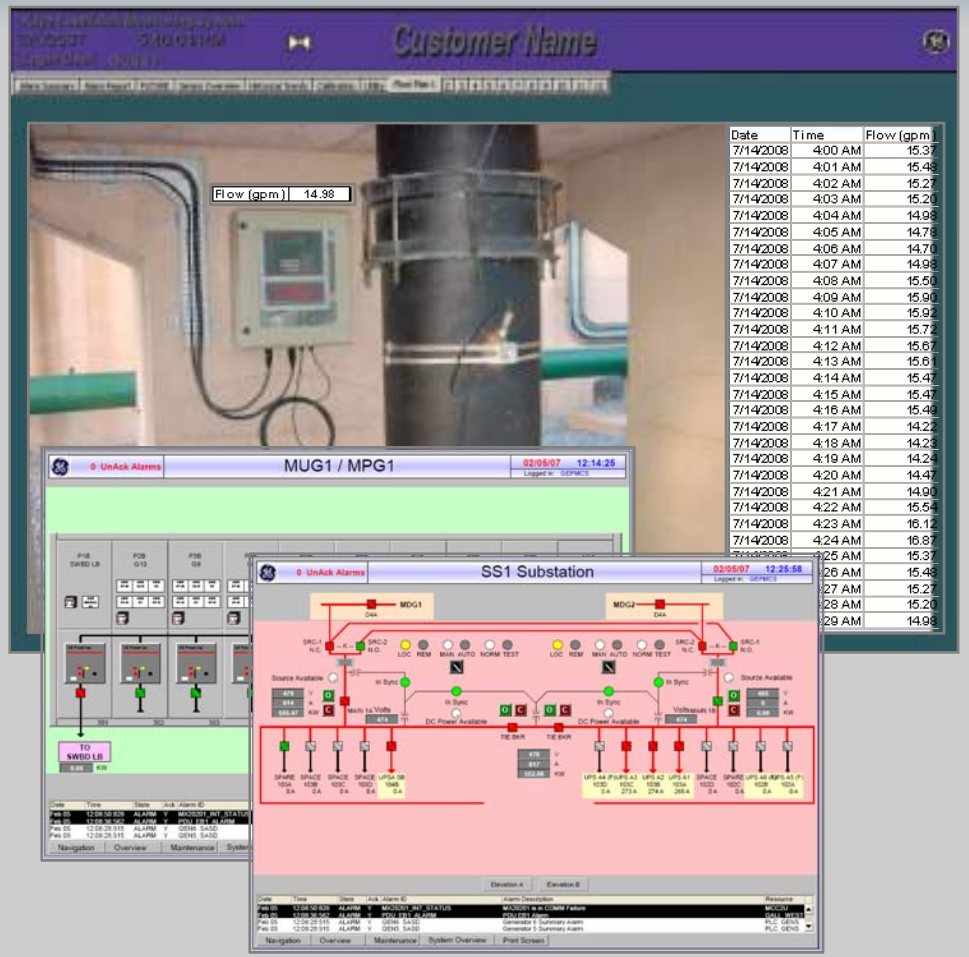


Scoreboard for success

Mitchell Meier and David Leslie

Decision analysis

- Automated optimization
- Event analysis
- ROI calculations
- Real time Monte Carlo scenarios–project creation



Controlled solutions

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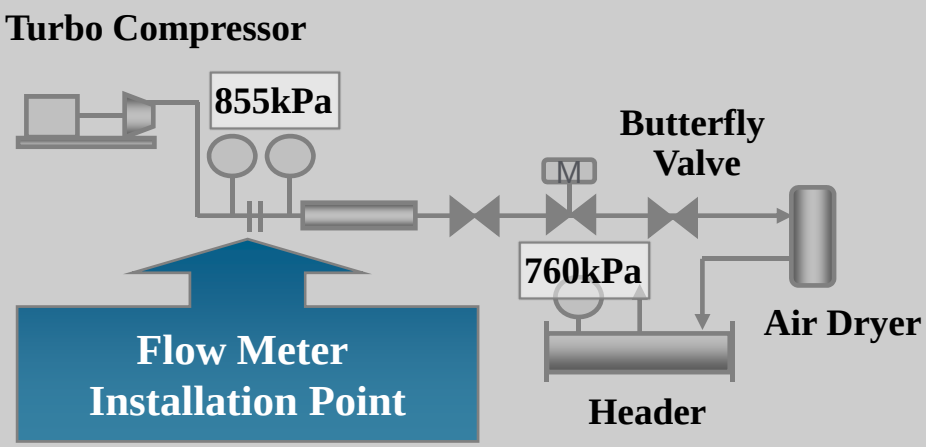
Case study

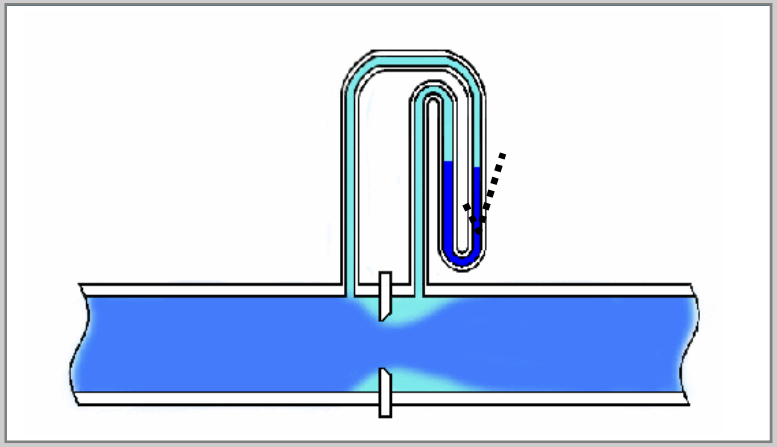
- Large automotive plant using differential pressure (DP) flow meters
- Using air compressors for tools, etc.
- Air compressors' running cost: 37,591MWh/year (~$3.8MM/year)
- 14% of plant's total energy consumption



Source: customer data

Our proposal

Replace 30 conventional DP flow meters with GE's DigitalFlow™ GM868.

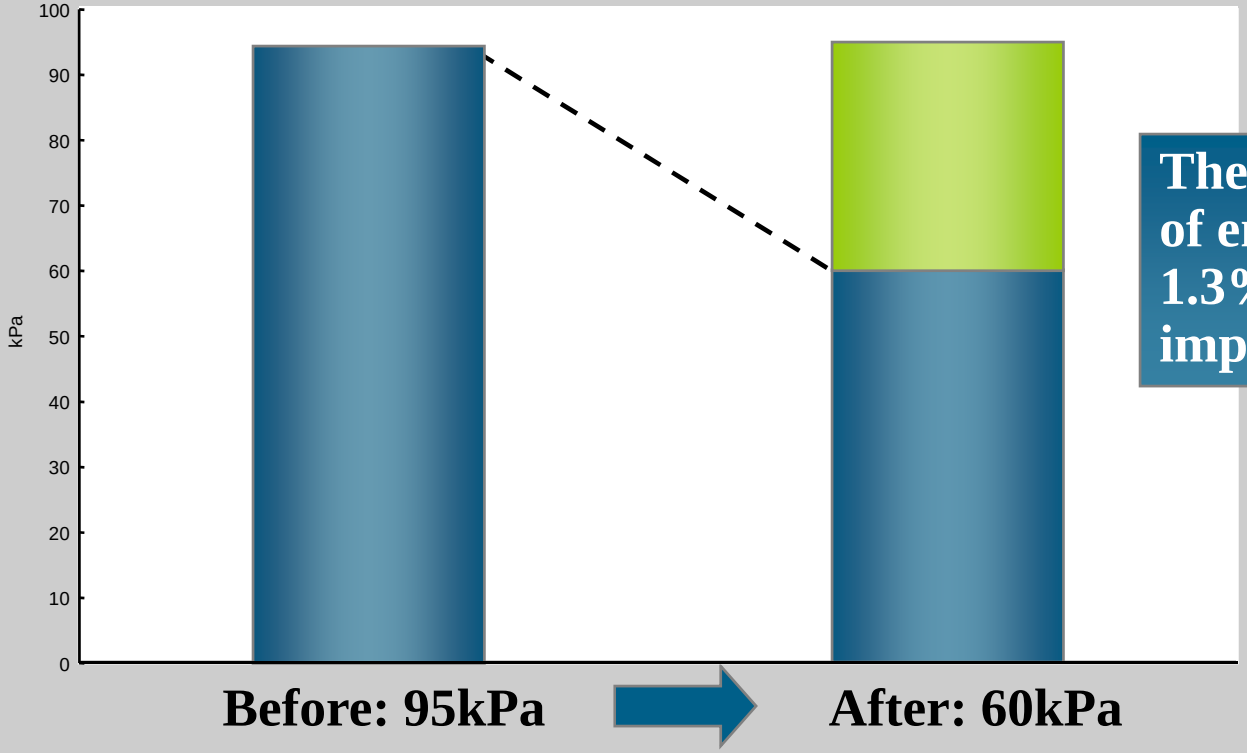


Generates *unwanted* pressure loss

No pressure loss and high rangeability

Pressure loss reduced

Pressure loss between compressor and header

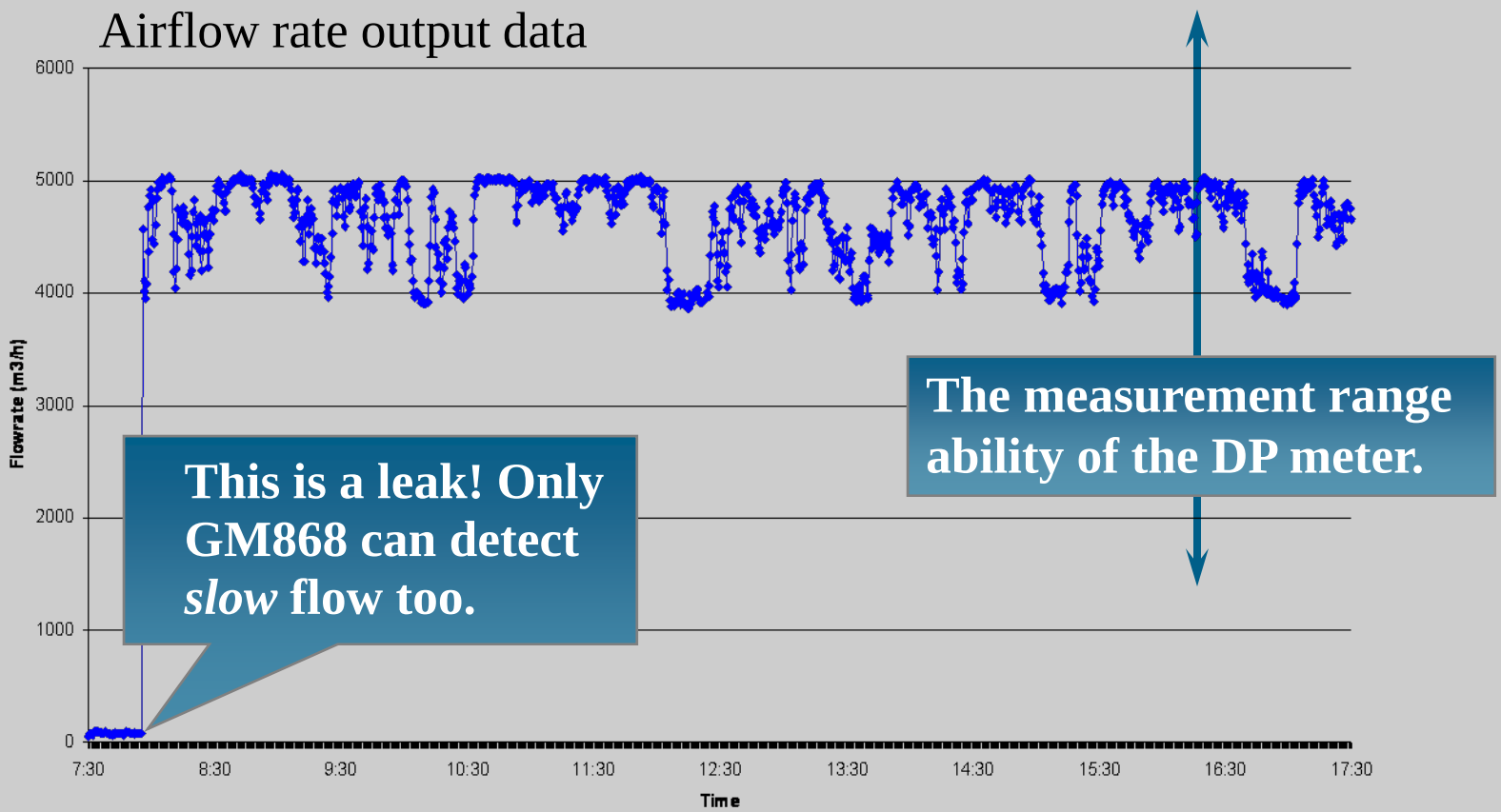


The unit cost of energy: 1.3% improved

Energy reduction: $48,869/year

Mitchell Meier and David Leslie

Air leakage detected



Detect extra 1.8% airflow loss: $67,663/year

Return on investment

Investment	Return
Meters cost $300,000	Press loss reduction $48,869
	Airflow loss reduction $67, 663
	Total $116,532

- **Reduction of CO_2 emissions/year**
  - ✓ **96 ton/year**
- **Following initial pilot, 400+ units were installed at other plants**
  - ✓ **1280 ton/year CO_2 reduction**
  - ✓ **25% of customers target CO_2 reduction**

Payback in 2.6 years

Installations

Customer	Steam/ HT Hot Water	Chilled Water	Conden-sate	City Water	Comp-ressed Air	Natural Gas
Yale University	✓	✓	✓			✓
Brown University	✓	✓				
Cornell University		✓				
Harvard Medical School	✓					
Dartmouth College	✓					
Georgetown University		✓		✓		
University of Connecticut	✓	✓		✓		
University of Maryland		✓				
University of New Hampshire		✓				
University of Southern Connecticut	✓	✓				
Architect of the Capital	✓	✓				
IBM		✓			✓	
Texas Instruments	✓	✓				