



# Energy Efficiency (EE) Where the Rubber Hits the Road

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# Abstract

- This presentation will review energy efficiency technology applied in
  - residential and light commercial construction and retrofit
  - farm buildings and operations
  - water and wastewater treatment
- And construction contractor and crew member training programs available.

# MU EE Programs



- Industrial EE Internships – 2 ea
- Ag EE audit & implementation funding – MAESTRO
- MU Facility Management Energy Management Program
- Facility design & retrofit – HES Arch. Studies, UExt
- Business Development – SBTDC
- EE in Water & Wastewater Systems
- Numerous current courses in several Colleges
- Energy Economic studies
- CELDI, Transportation Engineering
- On-line EE courses under development

# Saving \$\$ Will Cost \$\$



- What you can accomplish & what to expect
  - Energy costs will continue to increase
  - A few low or no cost activities
  - Expect to borrow \$\$ to make major savings
  - Need to consider return on investment (ROI)
  - Can reduce \$\$ & increase ROI with rebates & tax credits
  - Technology is advancing rapidly; improvements in efficiency and cost anticipated



# EE Technology

- Energy Audits identify alternatives
- Cost & ROI Analysis yield recommendations
- Financing
- Implementation – Construction & Retrofit
- Facility O&M Manuals
- Evaluation, Measurement & Verification (EM&V)
- Facility Operations

# Residential, Light Commercial Construction & Retrofit



- Green construction codes
- Building location & orientation
- Stormwater management
- Landscaping
- Building envelope
  - Foundation & basement
  - Walls, Structural Insulated Panels (SIPs)
  - Roof
  - Overhangs & awnings
  - Windows & doors
  - Insulation

# Residential, Light Commercial Construction & Retrofit, cont'd



- HVAC incl. geothermal
- Water heating
- Waste heat recovery & reuse
- Appliances
- Climate control
- Motion detection control
- Office
- Monitoring & control
- Building O&M Manual
- Building operations

# Animal Agriculture



- Lighting
- Ventilation
- Building envelope
- Motors & VFDs
- Water heating
- Space heating
- Stock watering
- Waste heat recovery & reuse
- Solar, wind, biomass uses
- Milk pumps, pre-coolers, refr. Compressors
- Monitoring & control

# Crop Agriculture



- Motors, VFDs
- Irrigation
- GPS auto-steer
- Grain drying motors, heaters, control by moisture, temp.
- Conveyor motors
- Grain wagon sizing
- Motor connections to driven equipment
- Fuel storage tank color, cover
- Monitoring & control

# Water Supply, Wastewater



- MU developed an “EE in water & wastewater systems” process for small utilities.
- Used Pollution Prevention (P2) student interns to test water procedures in 2010.
- Have review committee of organizations.
- Working with Crowder College and other organizations to advance program.
- One of several, we’re studying others.
- Focusing on EE improvements for equipment and facilities.

# Water Supply, Wastewater



- Technologies:
  - Utility cost management
  - Motors, starters, VFDs, connections to eqpt
  - Eqpt size, age, maintenance, selection for EE
    - Pumps & mixers
    - Air supply & end use (compressors, blowers, diffusers, aerators)
    - Liquid level control
    - Metering
    - Water storage
  - Process & equipment monitoring & control
  - Operations & maintenance travel
  - Building envelope, lighting, HVAC, etc.
  - Water loss

# Remote Sensing & Control



- 5 usual applications
  - Security
  - Equipment operations
  - Energy monitoring
  - Sub-metering
  - Equipment predictive maintenance
- Now available in one equipment package

# Summer 2010 Results



- **NOTE: We've learned more since these 3 were done.**
- Small water treatment plant serving less than 3000 residents.
- Constructed at the 1950s.
- Energy Consumption 550,000 kWh.
- Cost of Energy 2009 \$34,000.

# Summer 2010 Results



	Project	Implementation Cost	Annual Energy Savings (kWh)	Net Annual Cost Savings	Expected Payback Period (years)
Capital Investment	Lighting	\$3,205	7000	\$510	6.28
	Air Compressors	\$0	1,833	\$253	Immediate
Low Cost	Programmable Thermostat	\$200	6,707	\$402	0.5
	Belts	\$6	242	\$14	0.4
	Backwash Pump	\$0	n/a	\$1,043	Immediate
	High Service Pumps	\$0	2850	\$137	Immediate
	Vending Machine	\$179	1,586	\$95	1.9
	<b>Total</b>		<b>\$3,590</b>	<b>20,218</b>	<b>\$3,640</b>



# Summer 2010 Results

Energy Consumption in 2009: 568,000 kWh

Cost of Energy in 2009: \$40,000

Water Source: Lake

	Project	Implementation Cost	Annual Energy Savings (kWh)	Net Annual Cost Savings	CO <sub>2</sub> Reduction (metric tons CO <sub>2</sub> equivalent)	Expected Payback Period (years)
Capital Improvement	Lighting	\$2,620	7,729	\$540	6.6	4.8
Low Cost	Programmable Thermostat	\$200	10,090	\$706	8.7	0.28
	Dehumidifier	\$100	n/a	\$1,000	n/a	0.10
	<b>Total</b>	<b>\$2,920</b>	<b>17,819</b>	<b>\$2,246</b>	<b>15.3</b>	<b>1.3</b>

# Summer 2010 Results



Energy Consumption in 2009:

545,000 kWh

Cost of Energy in 2009: \$39,000

Water Source: Wells

	Project	Implementation Cost	Annual Energy Savings (kWh)	Net Annual Cost Savings	CO <sub>2</sub> Reduction (metric tons CO <sub>2</sub> equivalent)	Expected Payback Period (years)
Capital Improvement	Meter Replacement (8% increase in accuracy)	\$278,400	n/a	\$58,326	n/a	4.8
	Reduction in Water Loss (50%)	n/a	59,000	\$3,540	50.6	n/a
Low Cost	Faulty Valves	\$84	7,430	\$446	6.38	0.14
	<b>Total</b>	<b>\$278,484</b>	<b>66,430</b>	<b>\$62,312</b>	<b>57</b>	<b>4.5</b>

# EM&V



- Follows implementation decisions
- Pre & post energy consumption monitoring
- At least at sub-metering level
- Consider energy use patterns (day, month, seasonal, annual, uses, business level, etc.
- Compare field data to savings projections
- Modify standard savings projections
- Publish results

# Contractor, Worker Training



- Several auditor training programs
- Construction & retrofit workforce training also needed
- Providers
  - National Assoc. of Homebuilders (NAHB)
  - Green Building Institute (GBI)
  - Green Globes
  - US Green Building Council (USGBC) – LEED
  - Various colleges & universities

# Oct. 2010 Conference



**October 19-20, 2010  
Capitol Plaza Hotel  
Jefferson City, MO**

**<http://muconf.missouri.edu/gmcc>**