Planning and Implementing Utility Cost Reduction Measures

NCTCOG

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Planning for Energy & Water Conservation Projects

- Initial Planning and Research
  - Goals
- Resource Allocation and Project Execution
  - Scheduling/timeline
  - Funding
  - Project Delivery Method &Procurement (Goods and services)
    - Pros & Cons
  - Implementation
  - Post implementation follow-up

Objective

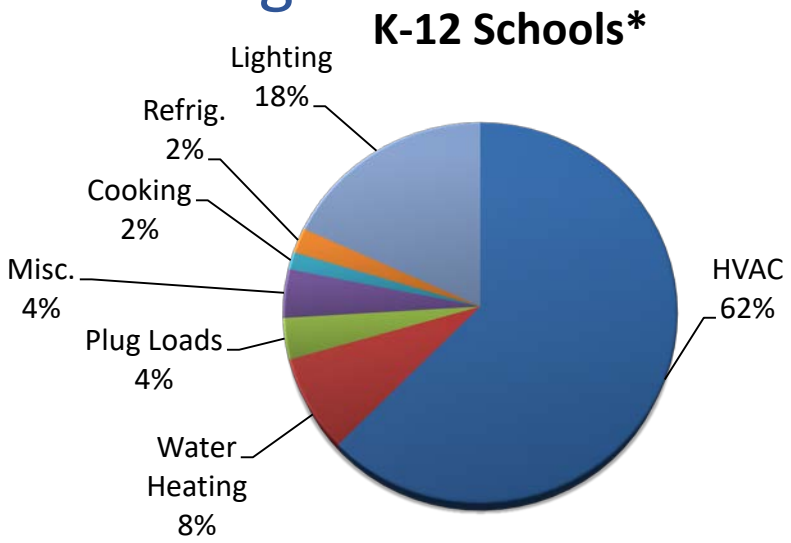
- Cost Savings
  - Measures that save $
  - Example(s): Power Factor Correction, Utility Rates, Purchase Power Agreements (PPA)
- Consumption & Cost Savings
  - Electric (kWh), Natural Gas (MCF), Water (kGal), etc.
  - Example(s): LED Lighting Retrofit, low flow plumbing fixtures
- Demand & Cost Savings
  - Electric Demand (kW) & electricity billing savings
  - Example(s): Thermal Energy Storage, Demand Response Technologies, Onsite generation

Energy Audit Types

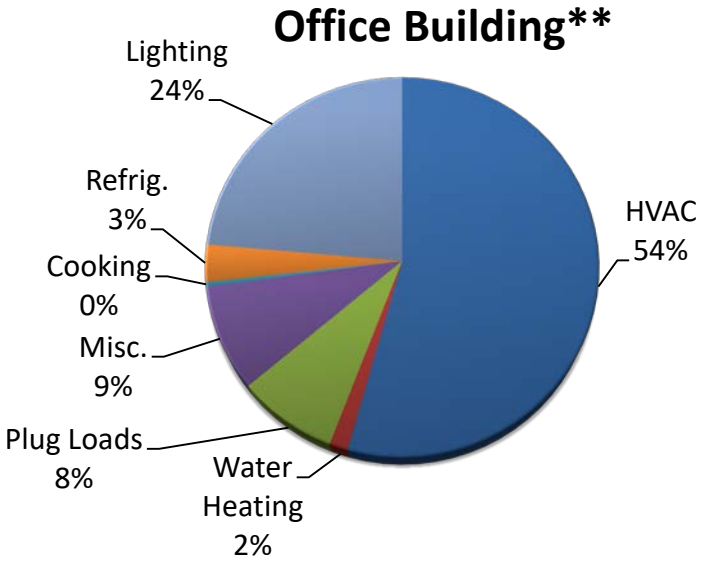
- Preliminary Energy Analysis
  - Initial Energy Audit or Survey
  - Walkthrough Survey/Assessment
  - Preliminary Energy Assessment (PEA)
- Detailed Energy Analysis (DEA)
  - Comprehensive Energy Analysis (CEA)
  - Investment Grade Audit (IGA)
  - Utility Assessment Report (UAR)
- ASHRAE categories:
  - Level I, Level II and Level III

Energy Consumption Breakdown

Buildings



* DOE EIA 2003 CBECS - K-12 Schools in West South Central Region (TX, OK, AR, LA)



** DOE EIA 2003 CBECS - Offices in West South Central Region (TX, OK, AR, LA)

Water & Wastewater Treatment Plants

- WWTPs could account for up to 70% of a Local Government's energy related consumption and costs

Typical Measures and Paybacks
Building Systems

➢ Low Cost/No Cost Measures	0 to 6 months
➢ Interior & Exterior Lighting Retrofit	2.5 to 10 years
➢ Motion Sensors & Day-lighting	2 to 8 years
➢ HVAC Retrofits	7 to 25 years
➢ Insulation	8 years +
➢ Commissioning	1.5 to 5 years
➢ Water Conservation	4 to 8 years
➢ Solar Thermal Pool Heating	12 to 14 years
➢ Solar PV Arrays	15 to 25 years

Typical Measures and Paybacks
Building Systems (cont.)

➢ Cooling Tower Replacement	8 to 14 years
➢ VAV Conversion	6 to 14 years
➢ Thermal Storage	12 to 20 + years
➢ Energy Management Control Systems	4 to 12 years
➢ Solar Control (Window film, shading)	6 years +
➢ Steam Systems Improvements	3 years +
➢ Power Factor Improvements	3 to 8 years

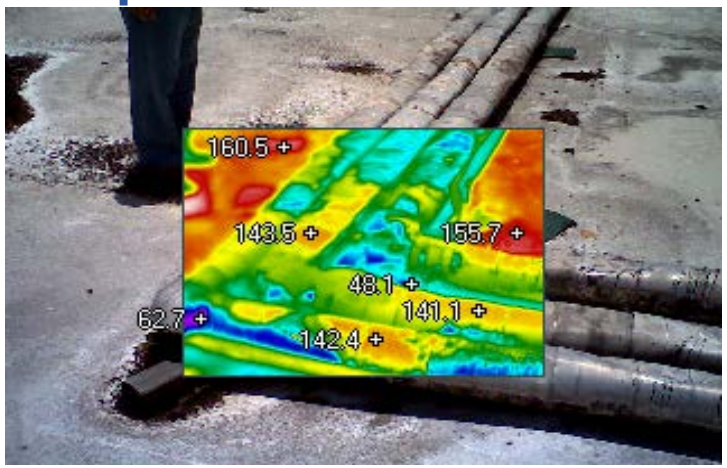
Low Cost / No Cost Measures

- Behavioral and operational practices
- Utilization of existing controls capabilities
- Maintenance & Operations (M&O)

- Payback: 0 – 6 months

Maintenance and Operations

Malfunctioning Photocells



Pipe Insulation Damage

Damaged Fins

Maintenance and Operations (cont.)

Leaking Cooling Tower

Cooling Tower Blowing Down

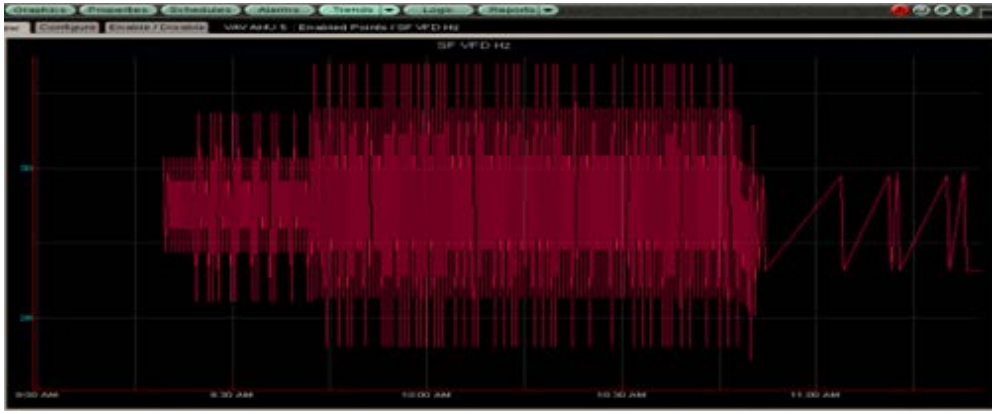
Maintenance and Operations (cont.)

Vending Machines Running 24/7

Unoccupied Room with Lights and Computers Left On

Maintenance and Operations (cont.)

Equipment In "Hand" Mode



EMS Screenshots – AHU VFD Hunting

LED Lighting Retrofits

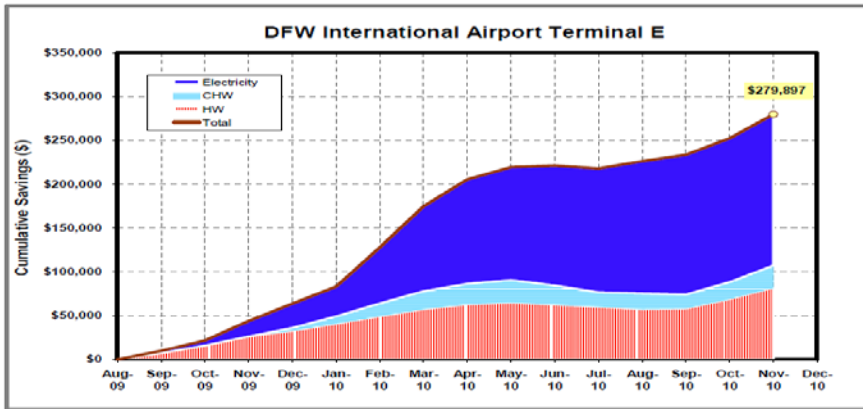
- Typical 2x4 fixtures with florescent lamps
  - Type A – "Plug & Play" LED tubes
    - Utilize existing fixture and electronic ballast
  - Type B – Ballast Bypass LED tubes
    - Remove bypass, "direct-wire"
  - Type C – Dedicated Driver & LED lamps
    - Replace existing ballast with LED driver
  - Fixture Changeout

HVAC Retrofits

- Forecasting replacements vs replace on burnout
- Split-DX, Rooftop Units, Chillers, Boilers, etc.
- Payback Considerations
  - First cost vs operating cost
    - Efficiency (EER, SEER, COP, etc.)
  - HVAC Unit replacements
    - R-22 phase out
- Construction considerations
  - Roofing, structural, etc.

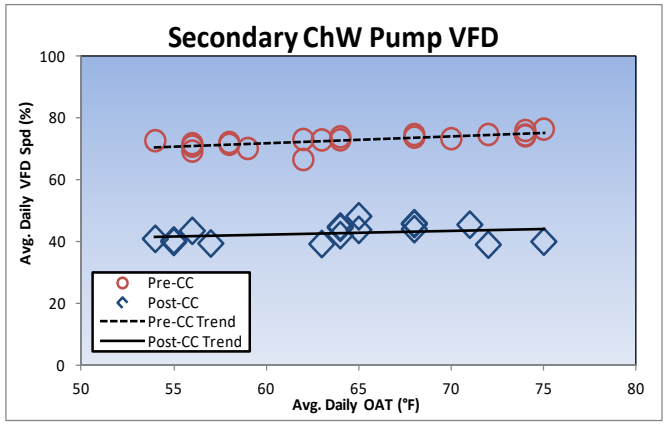
Commissioning (Cx)

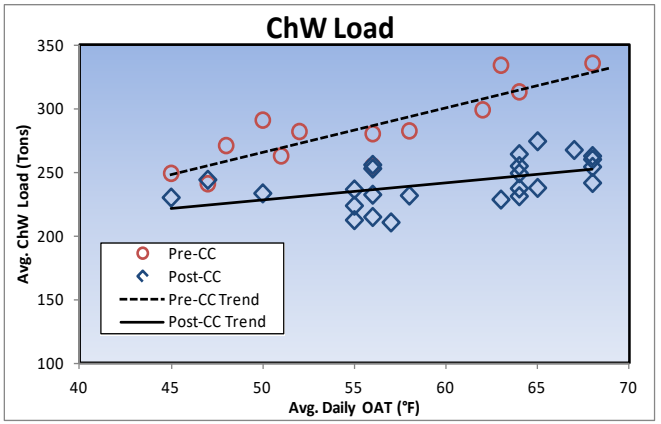
- Operate per design intent & energy savings
  - New Construction, Renovation, or Retro-Commissioning (RCx)
- Existing Continuous Commissioning ®(CC®)
  - Energy savings & comfort improvement
  - Calculate savings, implement CC® and document
  - Payback: 1 – 5 years (typical)

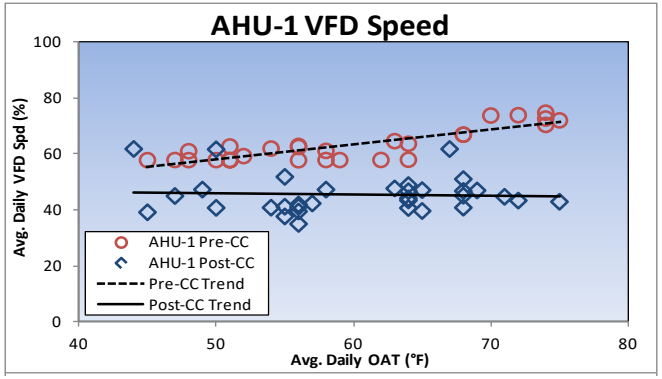


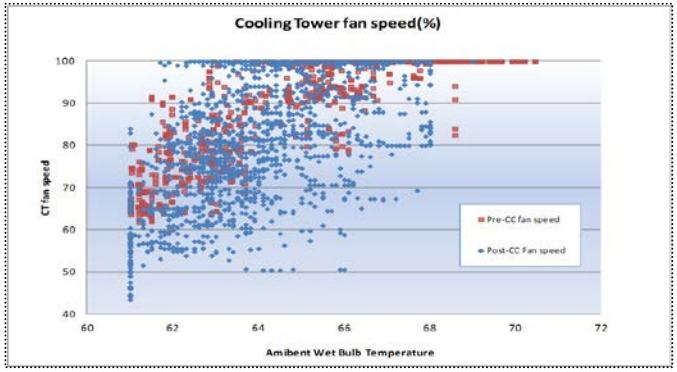
® Trademark Texas A&M Engineering Experiment Station's Energy Systems Laboratory (ESL)

Commissioning (cont.)









Domestic Water Conservation

- Low flow faucet aerators and flush valves reduce the amount of water used in lavatories, urinals, and toilets
- Faucet aerators – 0.5 GPM (gallons per minute)
- flush valves – 0.5-1.0 GPF (gallons per flush)
- Irrigation systems upgrades
- Payback: 3 – 8 years

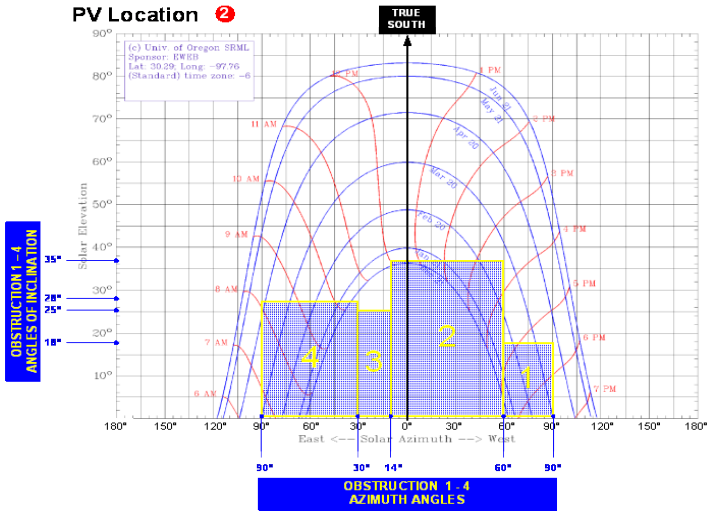
Solar Thermal Pool Heating

- Pool water can be heated by pumping the water through a solar tube array.
  - Traditional method of heating (Boiler) will be back-up
- Payback: 12 – 14 years

Solar Thermal Pool Heating

Solar PV Arrays

- On-site energy generation using solar photo-voltaic array systems reduce peak demand and curtail total energy consumption.
- Site suitability



Site Solar Survey

- Payback: 15 – 25 years

Thermal Energy Storage

- HVAC Application
- Two popular systems
  - Water based
  - Ice based
- Full Storage & Partial Storage
  - No chiller running during on-peak time (Full load shift)
  - Some chiller running during on-peak time (Partial load shift)

Power Factor Improvements

- $ Savings (Utility rate w/ power factor penalty)
- Installation of capacitors bank at main service entrance or end use equipment (motors etc.)
- Payback: 3 – 10 years

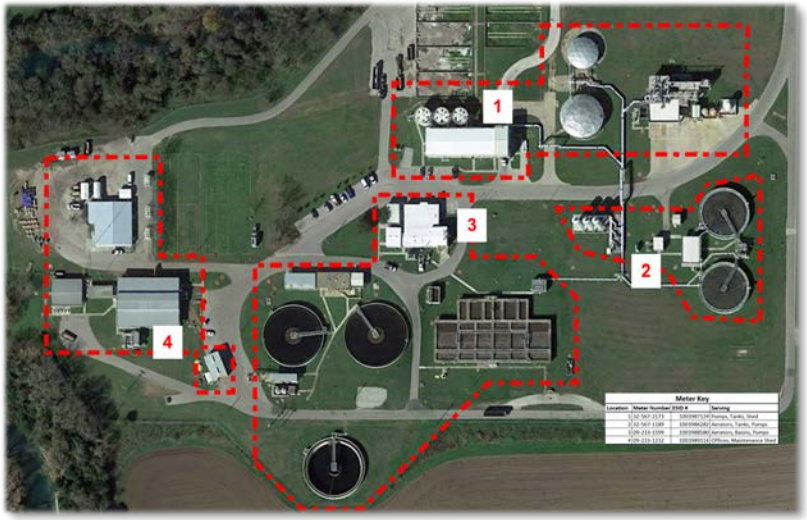
Typical Measures and Paybacks Water Treatment Plant (WTP) and Wastewater Treatment Plant (WWTP)

➢ WWTP Related O&M Measures	0 to 1 year
➢ Dissolved Oxygen Control	2 to 7 years
➢ High Efficiency Blowers	8 to 12 years
➢ Variable Speed Drives	8 to 15 years
➢ Optimize Aeration Design	5 to 10 years
➢ Power Factor Improvements	3 to 8 years
➢ Smart Meter Applications	5 to 8 years
➢ City Mains Leak Sensing Technology	1 to 6 years
➢ WWTP Demand Response	*

*Dependent on existing load profile and capital used for automation

Survey Plant

- Benchmarking WWTP plants
  - Energy use tied permitting requirement
- Identification & process power use
- May have one or multiple meters similar to buildings



Utility Meter Mapping

Wastewater Plant - Coarse Bubble to Fine Bubble Aeration Conversion

Coarse Bubble Aeration

Fine Bubble Aeration

Bubble Types

Fine Bubble

Coarse Bubble

High Efficiency Turbo Blowers

- High Efficiency, variable speed turbo blowers with integral VFD and air bearings
  - Typical blower system efficiency = 55% (approx.)
  - Turbo blower system efficiency = 75% (approx.)
- Control system to vary aerator airflow to maintain dissolved oxygen (DO) concentration at optimal value
- System upgrade (blower, VFD, fine bubble, DO sensor) for best results
  - Payback: 8 – 12 years

Wastewater Treatment – Control Dissolved Oxygen

- TCEQ Criteria : 2.0 mg/l of D.O.
- Process Requirements : 0.5 – 1.0 mg/l
- General Statement:

  "Anything over 1.0 mg/l is wasting power"

Advanced Infrastructure Upgrades (Water)

- Water Leak Detection
  - City wide distribution piping mains
- Automated Meter Reading (AMR)
- Reduces “Unaccounted for” water loss

Funding

- State Energy Conservation Office (SECO)
  - Texas LoanSTAR Program (low interest revolving loan)
  - Funding source for energy & water conservation projects
  - Notice of Loan Fund Availability (NOLFA)
  - https://comptroller.texas.gov/programs/seco/funding/
- Texas Water Development Board
  - http://www.twdb.texas.gov/
- US Department of Agriculture
  - https://www.usda.gov/
- Other
  - Bond, M&O, Third-party, ESPC etc.

SECO Resources

- SECO – Local Government & Schools Energy Technical Assistance Program
  - Cities, Counties, K-12 & Colleges
  - https://comptroller.texas.gov/programs/seco/programs/local/
  - https://comptroller.texas.gov/programs/seco/programs/schools/
- SECO - LoanSTAR Program
  - Funding open to all public entities
  - https://comptroller.texas.gov/programs/seco/funding/loanstar/
- Texas Building Energy Code
  - https://comptroller.texas.gov/programs/seco/code/
- SECO Website
  - https://comptroller.texas.gov/programs/seco/

Case Study – New Braunfels Utilities

Cost & Savings Summary for Identified UCRMs

(Preliminary Energy Analysis i.e. ***PEA by SECO****. WWTP Measures: Coarse to Fine Bubble Diffusion, Install WWTP Dissolved Oxygen Sensors, Install High Efficiency Variable Speed Turbo Blowers, City-Wide 5/8" Water Meter Changeout)*

Approximately 75-80% water meter changeout completed

Case Study – City of San Marcos

- Implementation (**SECO LoanSTAR Funding**)

➢Project Costs:	$1,981,037
➢Annual Savings:	$221,567
➢Simple Payback:	8.9 years

(Project Delivery – Traditional Design Bid & Build. Lighting Retrofit w/Motion Sensors, HVAC Replacement, Controls Upgrades/Retrofits, Solar Thermal Heating, Water Conservation Measures, WWTP – replace blower & automate aeration airflow)

Case Study – DFW

➢City of Dallas (2014-2018)

Energy Project Costs:	$17,400,000 (approx.)
Annual Savings:	$2,300,000
Simple Payback:	7.6 years

The City has completed several ESPC projects **SECO LoanSTAR funded*

➢City of Fort Worth (2003 -2013)

Energy Project Costs:	$67,547,559
Annual Savings:	$5,939,183
Simple Payback:	11.4 years

** Approx. $10 Million of projects funded through **SECO LoanSTAR** program, ESPC project*

Case Study – City of Laredo

- Preliminary Energy Assessment (2017)

Project Costs:	$7,500,000
Annual Savings:	$1,776,200
Simple Payback:	4.2 years

- Detailed Energy Assessment (2019) & Implementation* (**SECO LoanSTAR** Funding)

Project Costs:	$1,033,588
Annual Savings:	$159,420
Simple Payback:	6.5 years

** Traditional Design-Bid-Build - High Service Pump VFDs & Power Factor Correction. Currently in implementation phase*

Questions?

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