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
Utility Cost Reduction Measures

Energy Consumption Breakdown

- **Buildings**
  - **K-12 Schools***
    - HVAC: 62%
    - Lighting: 18%
    - Refrigeration: 2%
    - Cooking: 2%
    - Miscellaneous: 4%
    - Plug Loads: 4%
    - Water Heating: 8%
  - **Office Building**
    - HVAC: 54%
    - Lighting: 24%
    - Refrigeration: 3%
    - Cooking: 0%
    - Miscellaneous: 9%
    - Plug Loads: 8%
    - Water Heating: 2%

* 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

Texas Energy Engineering Services, Inc. (www.teesi.com)
Utility Cost Reduction Measures

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
Utility Cost Reduction Measures

**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
Utility Cost Reduction Measures

Low Cost / No Cost Measures

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

Payback: 0 – 6 months
Utility Cost Reduction Measures

Maintenance and Operations

- Malfunctioning Photocells
- Damaged Fins
- Pipe Insulation Damage
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
Utility Cost Reduction Measures

Maintenance and Operations (cont.)

Equipment In “Hand” Mode

EMS Screenshots – AHU VFD Hunting
LED Lighting Retrofits

➢ Typical 2x4 fixtures with fluorescent 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.
Utility Cost Reduction Measures

**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)*

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*Texas Energy Engineering Services, Inc. (www.teesi.com)*
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
Utility Cost Reduction Measures

Solar PV Arrays

- On-site energy generation using solar photovoltaic array systems reduce peak demand and curtail total energy consumption.

- Site suitability

- 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)
Utility Cost Reduction Measures

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

<table>
<thead>
<tr>
<th>Measure</th>
<th>Payback</th>
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<tbody>
<tr>
<td>WWTP Related O&amp;M Measures</td>
<td>0 to 1 year</td>
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<tr>
<td>Dissolved Oxygen Control</td>
<td>2 to 7 years</td>
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<tr>
<td>High Efficiency Blowers</td>
<td>8 to 12 years</td>
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<tr>
<td>Variable Speed Drives</td>
<td>8 to 15 years</td>
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<tr>
<td>Optimize Aeration Design</td>
<td>5 to 10 years</td>
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<td>Power Factor Improvements</td>
<td>3 to 8 years</td>
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<tr>
<td>Smart Meter Applications</td>
<td>5 to 8 years</td>
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<tr>
<td>City Mains Leak Sensing Technology</td>
<td>1 to 6 years</td>
</tr>
<tr>
<td>WWTP Demand Response</td>
<td>*</td>
</tr>
</tbody>
</table>

*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 Cost Reduction Measures

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
Utility Cost Reduction Measures

**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/](https://comptroller.texas.gov/programs/seco/funding/)

- Texas Water Development Board
  - [http://www.twdb.texas.gov/](http://www.twdb.texas.gov/)

- US Department of Agriculture
  - [https://www.usda.gov/](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/
Utility Cost Reduction Measures

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
Utility Cost Reduction Measures

Case Study – City of San Marcos

- Implementation (SECO LoanSTAR Funding)
  - Project Costs: $1,981,037
  - Annual Savings: $221,567
  - Simple Payback: 8.9 years

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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