



TETRA TECH

complex world

CLEAR SOLUTIONS™

“The How and What of Audits for Sustainable Infrastructure” *The Hawaii Experience*

Donald H. King, P.E.



January 12, 2010

ALOHA! An Audit? OH MY!

AUDIT...

“ffik≠ffP_tP_t”

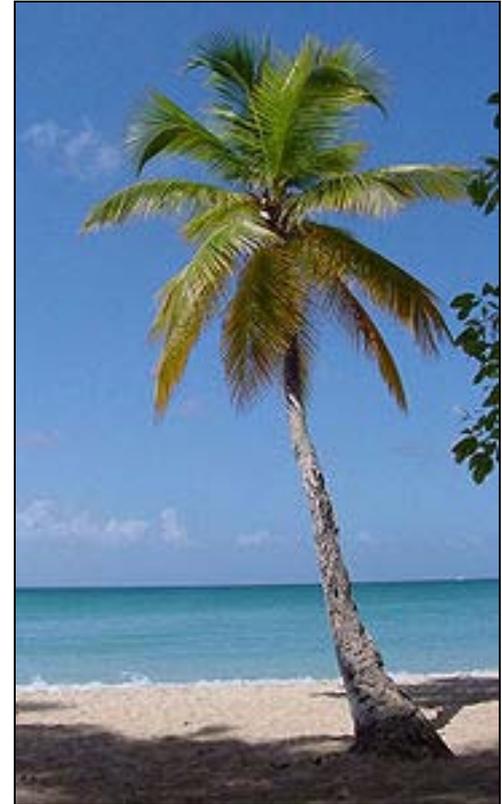
AUDIT!?

Yes, audit

A team-oriented approach with win/win results!

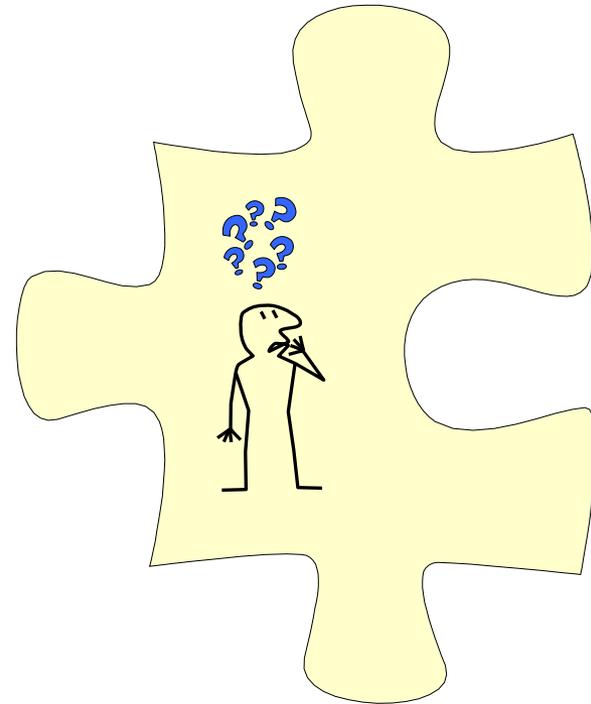
THE HAWAII STORY

- Why Conduct an Audit?
- What Information is Required?
- The Hawaii Audit Team
- Audit Steps and Best Practices
- Energy Balance - Four Plants
- Energy Conservation Opportunities
- Preliminary ECO Findings
- Conclusions



Why Complete an Energy Audit?

- Potential cost savings
- Identify improvements
- Identify fund alternatives (grants, incentives)
- Understand your energy use and costs
- Policy mandates
- It's under your control

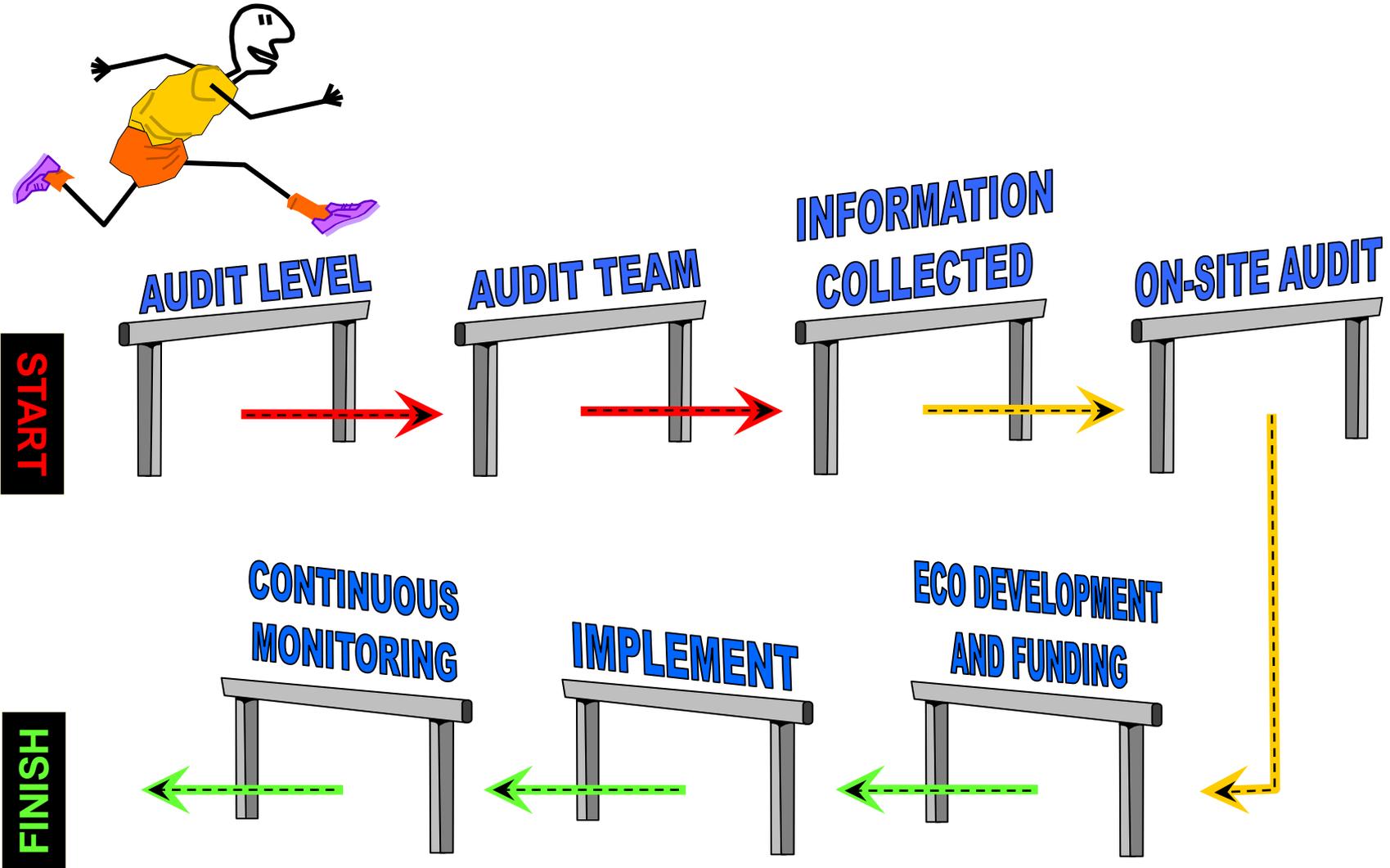


PLANT

Benefits of Energy Audit?

- Improved understanding of plant processes & energy use
- Bridge communication between energy use and utility accounting
- Gain understanding of utility bills
- Recognize your successes
- Goal development
- Reduced operating costs
- Preparation for a renewable future

Energy Audit - Road Map



Hawaii - *Four Plants, Four Stories*

- Kailua WWTP, Oahu
 - 13 MGD / Fixed Film
 - Influent & Effluent Pumping
 - Comprehensive Odor Control
 - UV disinfection
- Waimea, Kauai
 - 0.25 MGD / Aeration Basins
 - Influent & Effluent Pumping
 - New Treatment Plant Under Construction
- Kihei, Maui
 - 3.5 MGD / Aeration Basins
 - Reclaim Water & Effluent Pumping
 - UV disinfection
- Hilo, Hawaii
 - 2.5 MGD/ Fixed Film
 - NO Influent & Effluent Pumping
 - Anaerobic Digestion

Comparing “Treatment Plant Unique DNA”

ACTION	HILO	KAILUA	KIHEI	WAIMEA
<i>Influent Pumping</i>		X		X
<i>Screening/Grit Removal</i>	X	X	X	X
<i>Primary Sedimentation</i>	X	X		
<i>Fixed Film (Biotower)</i>	X	X		
<i>Aeration Basins</i>			X	X
<i>Secondary Sedimentation</i>	X	X	X	X
<i>Solids Contact</i>	X	X		
<i>Advanced Water Treatment</i>			X	
<i>Chlorine Disinfection</i>	X			X
<i>Ultraviolet</i>		X	X	
<i>Effluent Pumping</i>		X	X	X
<i>Common Outfall Pumping</i>		X		
<i>Comprehensive Odor Control</i>		X		
<i>Thickening</i>	X	X		
<i>Aerobic Digestion</i>			X	X
<i>Anaerobic Digestion</i>	X	X		
<i>Digester Gas Utilization-Heating</i>	X	X		
<i>Digester Gas-Cogeneration</i>				
<i>Dewatering-Centrifuge</i>	X	X	X	
<i>Dewatering-Solar Drying</i>				X
<i>Landfill</i>	X	X		X
<i>Composting</i>			X	
<i>Water Reuse</i>			X	
<i>FOG Program</i>			X	

Energy Audit - The Hawaii Team!

AUDITORS

Expertise in:

- Infrastructure
- Energy
- Sustainable Solutions

KEY PLANT STAFF

Managers, Accounting, & Plant Operators

- Understanding of Plant Processes
- Regulatory Requirements
- Health & Safety

Clear Focus & Goals



PLANT MANAGEMENT

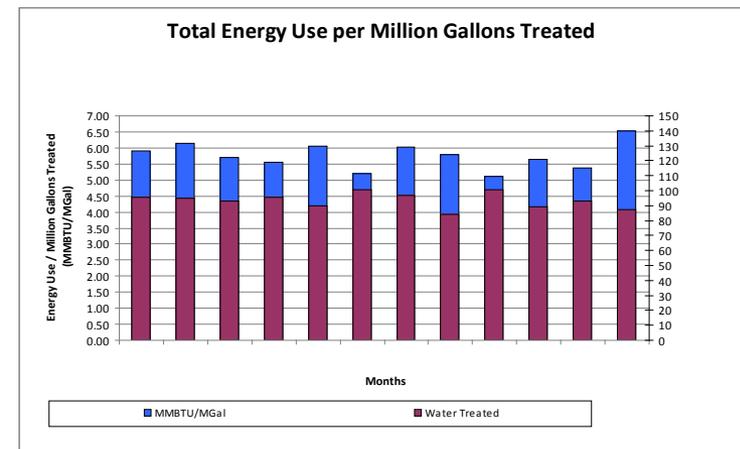
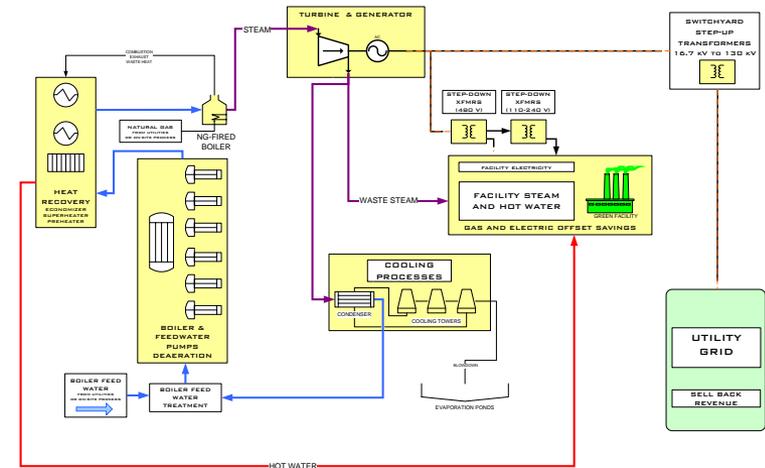
“Long-Range Vision”

UTILITY PROVIDERS

Kauai and Maui
Account Representative

Energy Audit – Pre Audit Information Gathering

- Process Flow Diagram
- Site Plan
- Electrical One-Line Diagram
- Detailed Equipment List
- All Utility Bills
- Utility Contract Schedules



Energy Audit – Onsite Audit Activities

- Introduction of participants
- Review collected materials
- Virtual operations review by plant staff
- Conduct site walk
 - Observe and Record Current Conditions
 - Taking Meter Readings
 - Inspect and verify equipment information
 - Photographic documentation



Energy Audit – Onsite Information Gathering

- Equipment load verification “Demand Impact”
- Equipment operation “Consumption over Time”
- Regulatory permits or operational prohibitions
- Plant metrics
- Metering and monitoring

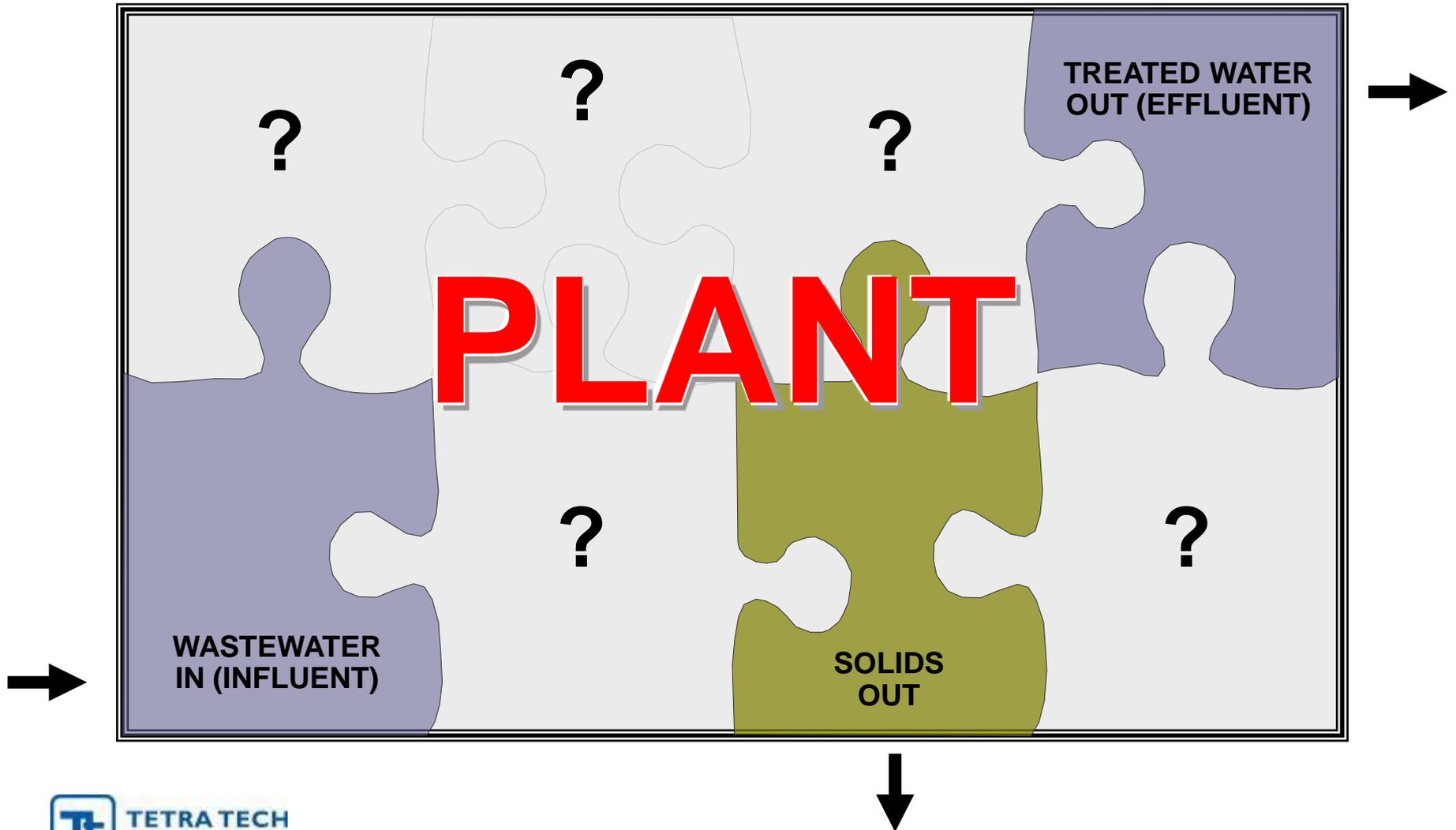


Energy Audit – Onsite Audit Activities

- Interview operators
 - Gain better understanding of unique plant dynamics
 - Operational schedule
 - Control philosophy
- Review historical and seasonal events
- Conduct exit meeting & thank all participants



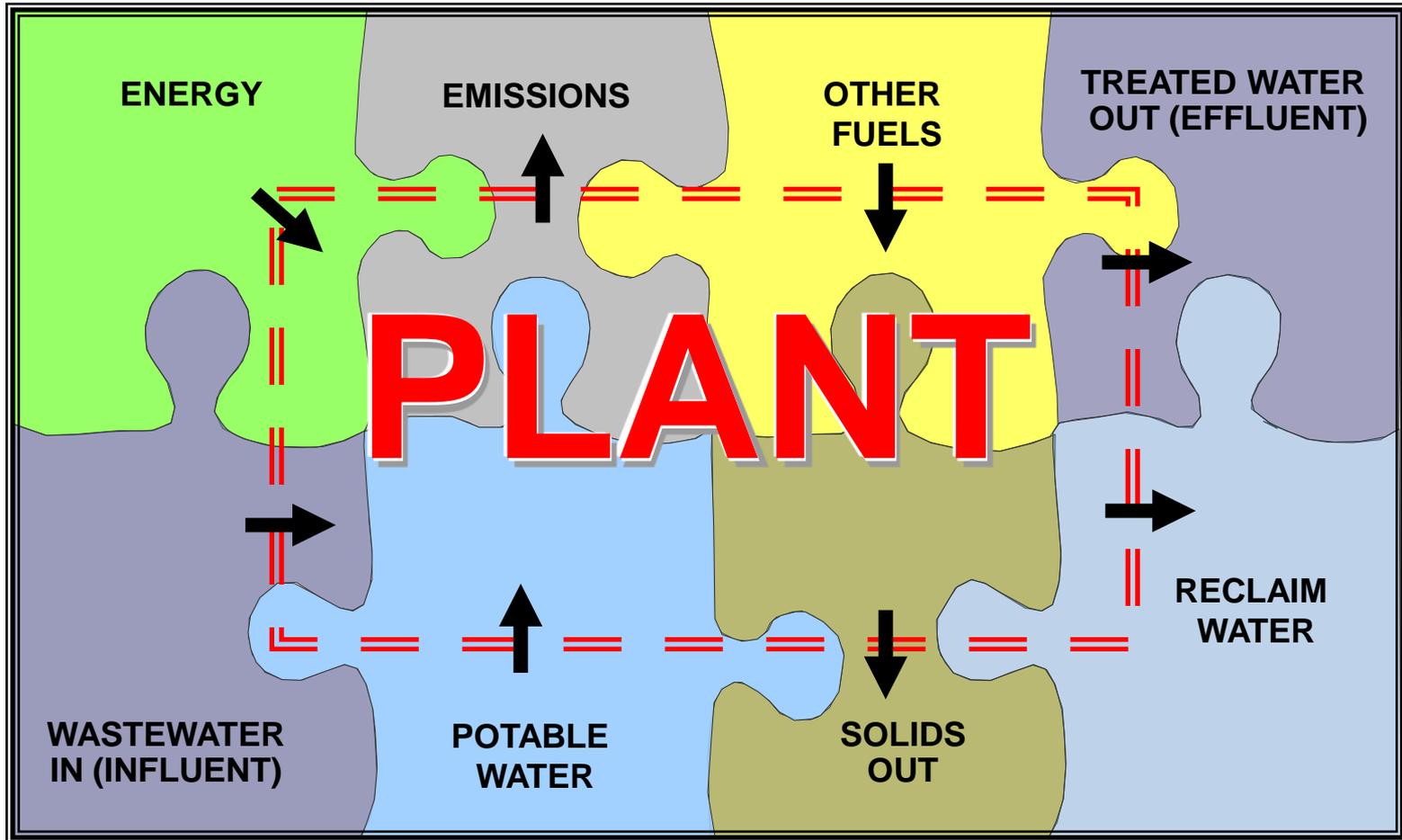
Energy Audit – What Energy Balance?



Energy Audit – Energy Balance Part 1

- Draw boundary (BOX) around plant
- Determine all materials and energy entering and exiting the BOX
 - Influent flow into and through plant
 - Energy and fuel into plant
 - Potable water into plant
 - Effluent flow out of plant
 - Solids out of plant
 - Self-generated energy out of plant

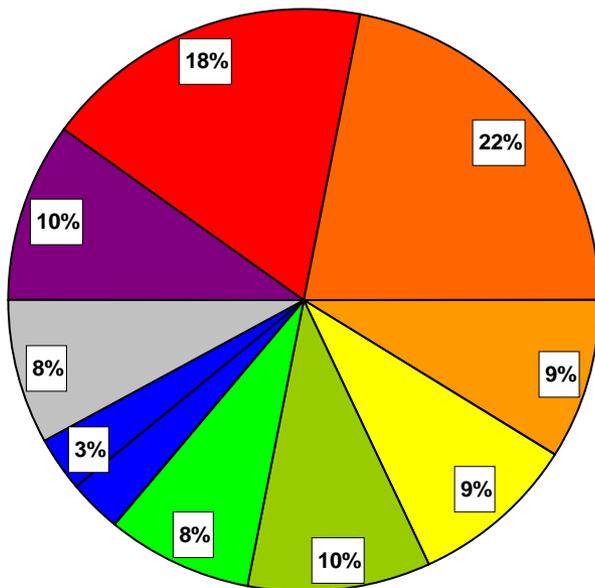
Energy Audit – Your Energy Balance!



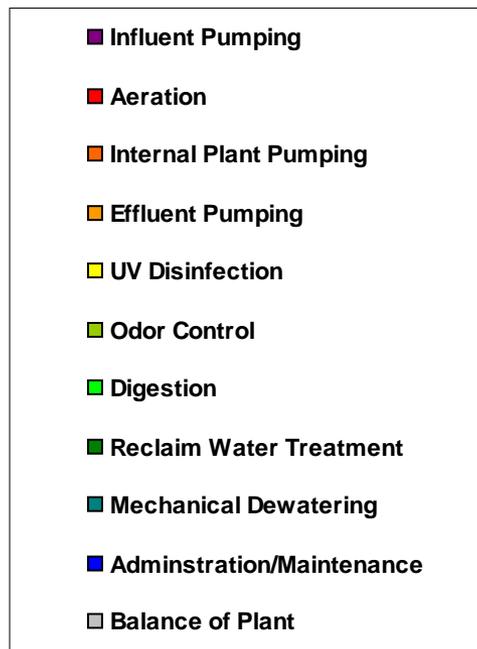
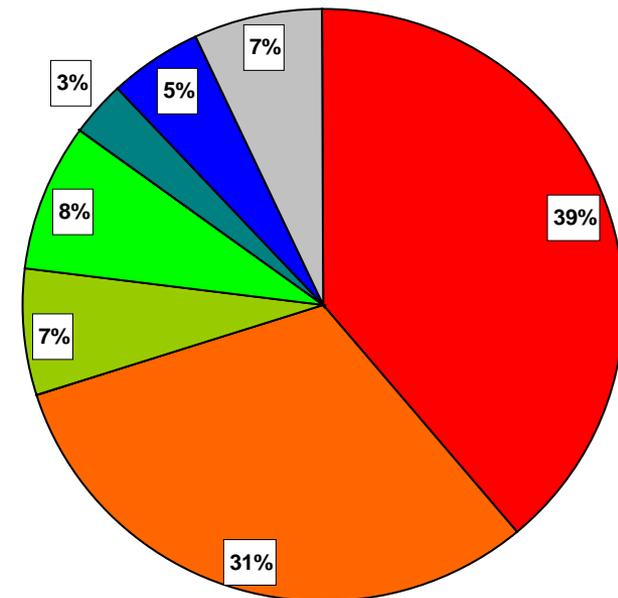
Energy Audit – Energy Balance Part 2

- Develop baseline metrics (e.g. MMBTU_{eq} per MG)
- Analyze energy use for each process type (chart)

Kailua, Oahu



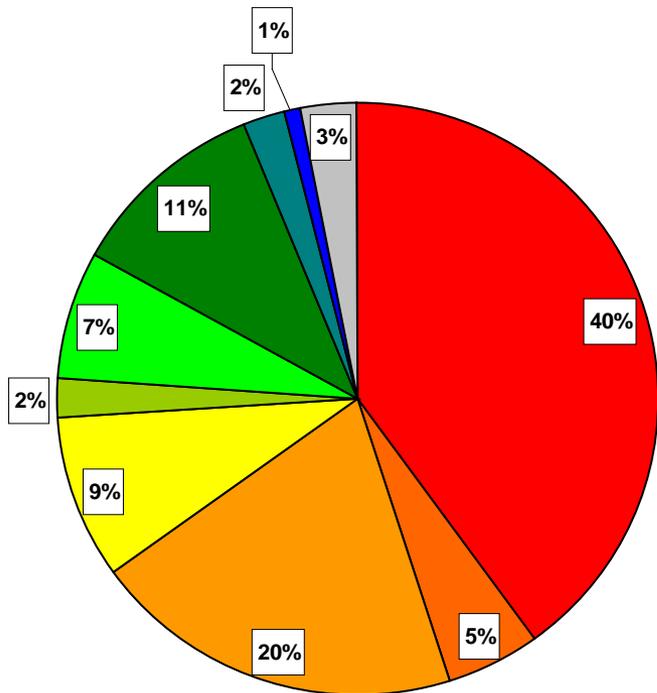
Hilo, Hawaii



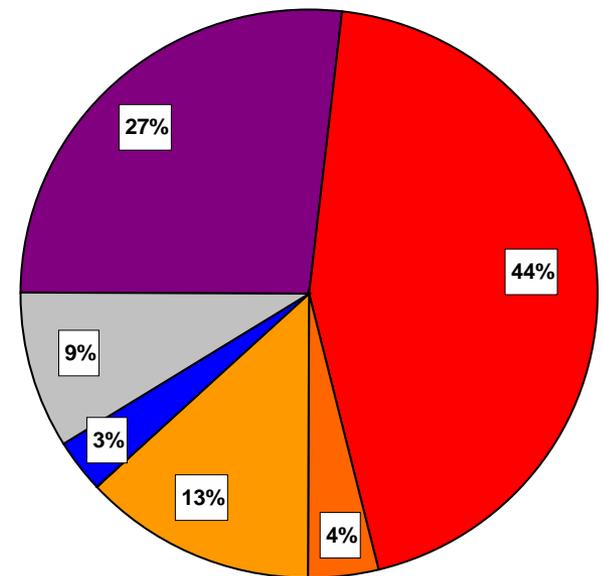
Energy Audit – Energy Balance Part 2

- Analyze energy use for each process type (chart)

Kihei, Maui



Waimea, Kauai



Energy Analysis – ECO Development Process

- What's an ECO?
- ECO = Energy Conservation Opportunity
- Definition:
“The systematic means, technologies or applications for improvement of specific processes that meets certain cost effectiveness”
- Commonly referred to alternatives:
 - FIM = Facility Improvement Measures
 - ECM = Energy Conservation Measures
 - EEO = Energy Efficiency Opportunity
 - AR = Assessment Recommendation

Energy Analysis – ECO Development Process

Further evaluate findings from the Audit Phase through...

WHAT is happening Inside the BOX!

- Ask the investigative questions!
 - Who? What? Where? When? Why? How?
- Typically start with the larger energy use areas first “80/20 rule”
- Select potential list of ECO’s

Energy Analysis – ECO Development Process

Examples of “Investigative” ECO questions:

- “Why are blowers operating 24/7?”
- “Why are UV and chlorine disinfection required prior to discharge?”
- “Why are four primary tanks in service when influent flow only requires two?”
- “How often does sludge dewatering occur?”
- “How efficient is a constant pressure pumping system with variable demands?”
- “If odor control is needed only 30 hours per week, why is the odor control system in operation 24/7?”



Energy Analysis – ECO Screening Process

- List all ECO's
- Estimate of energy savings
- Estimate of capital improvement requirements
- Review ECO viability (non-energy factors)
- Select ECO's for further development

Preliminary ECO's!

Waimea

- Effluent Pumping VFD modifications
- Aeration Blower System Modifications

Estimated Savings: 8-13%

Kihei

- Reclaim Water Storage and Pumping Improvement
- Aeration Blower Upgrade (Recently Installed)
- UV Replacement Project
- Plant Air Upgrade

Estimated Savings: 28-38%

Preliminary ECO's!

Kailua, Oahu

- Replace existing UV with high-efficiency system
- Improve Plant Electrical Grid
- Install New Digester Gas Boilers
- Install biogas cogeneration (500 kW)

Estimated Savings: 15-33%

Hilo, Hawaii

- No. 2 & No. 3 Water System Modifications
- Modify Operation Schedule of Dewatering Odor Control System
- Modify # of primary clarifiers units on line
- Complete Collection System Repairs (I&I Reduction)

Estimated Savings: 13-22%

Do the “Cents” Really Make Sense?

- Economic viability?
- Consistent with health & safety?
- Consistent with regulatory requirements?
- Consistent with plant reliability requirements?
- Consistent with long-term strategic planning?
- Is funding available?

Energy Audit – Do's and Don'ts

- Three key's to effective auditing:
“Information, *information*, & information!”
- Enlist team concept with plant personnel actively engaged in auditing
- Look beyond the numbers
- Understand local requirements and prohibitions
- Confirm assumptions
- Evaluate “aggressively” but “keep it real”
- Make the auditing process a learning experience for *all participants*

Conclusions!

Good Information + Right Audit Team
=
Enhanced Energy Utilization
Operational Process Understanding
\$\$\$ Savings

***Save a couple of “cents” along the
audit journey!***



TETRA TECH

complex world

CLEAR SOLUTIONS™

Contact Information:

Donald H. King, P.E.

Tetra Tech

(760) 310-8544

don.king@tetrattech.com

