

Sustainable Engineering

A Method to Evaluate Production Processes for P2
Council of Industrial Boiler Owners

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Philadelphia Region
Appalachian Region



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What is Pollution?

- **Loss of raw material**
- **Loss of product**
- **Creation of pollutants from an inefficient process; products of incomplete processing (PIP)**
- **Loss of \$**

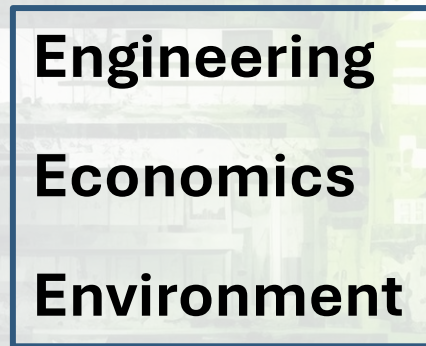
What is Sustainable Engineering?

- **Sustainable engineering is when you use engineering techniques such as: mechanical, chemical, structural, fluid mechanics, piping, thermodynamics, and materials, to do the basic design, while including additional engineering elements to achieve an environmental objective.**
- **You include: Reduce, Reuse, Recycle, and Replace techniques in your process design.**
- **You actively consider an E3 Approach:**
 - **Engineering**
 - **Economics**
 - **Environment**

Bringing the best of Engineering, Economics and Environmental considerations to your project to benefit your corporate bottom line and sustainability goals.

PROJECT DRIVERS

Regulatory Changes
Economics
Corporate Sustainability Reporting
Sustainability Strategy
Targets and Progress
Business Relationships
Customer Requirements
Lender / Shareholder Demands
Good Neighbor Expectations
Six Sigma
Incentive Programs



- Payback
- ROI
- Sustainability Metrics
- Resources

- Technology
- Productivity
- Maintenance
- Life Cycle
- Business Risk

- Pollution Prevention
- Life Cycle Assessments
- Circular Economy
- Reuse, Recycle
- Environmental Footprint

FGD System Evaporation – Full Load

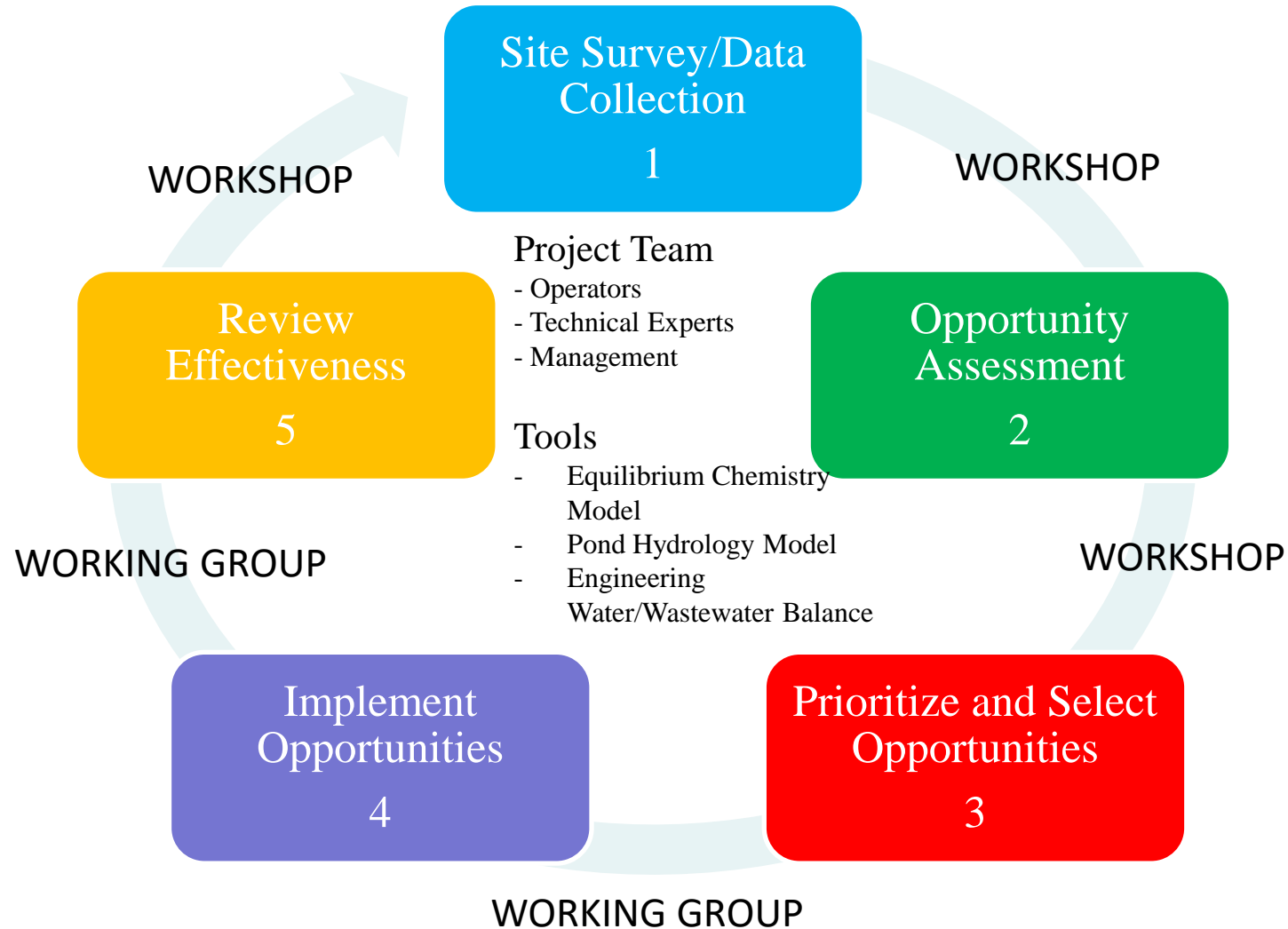


ZLD Plant - Takes Blowdown from Coal Units 1&2 & Gas Turbines A & B



Approach – Five Steps to Success

(Power Plant Example)



Site Survey - Step 1

- **Two, or Three, day focused site-survey**
- **Opening meeting and preliminary review of process and goals**
- **“Walk-about” for data collection and interviews with operators**
- **Close-out meeting to present survey findings to project team**
- **Review Data, create tools, develop findings**

Site Survey Results - Step 1

- **Tools Developed from Step 1 – Examples:**
 - **Engineering Water/Wastewater Balance**
 - **Equilibrium Chemistry Model for Identified Key Processes (Cooling towers, demineralizers, MVC, etc.)**
 - **Pond volume flow model – probability of overflow**
 - **Energy Use**
 - **Greenhouse Gas Inventory**

Opportunities Assessment & Prioritization – Steps 2 and 3

Develop & Prioritize Alternatives to Meet the Stated Project Objectives

Based on:

- **Technical Feasibility**
- **Impact on problem**
- **Operational Feasibility**
- **Cost – CapEx/OpEx**
- **Impact on Meeting Objective**
- **Workshops to discuss, select and prioritize**
- **Spreadsheet approach to catalogue opportunities**

Opportunities Selected for Detailed Study

- Opportunities are prioritized by the project team in to three categories: high, medium, low
- Fall into four main technical categories:
 - Operational change
 - Mechanical change
 - Chemical change
 - Civil change
- Solutions are often combinations of these

Opportunities Selected for Detailed Study

(EXAMPLE: Specific Outcome for a coal fired power plant)

- Re-route demineralizer wastewater to cooling towers – 26 gpm
- Boiler blowdown to cooling towers – 150 gpm (discuss issues with oil/water separator)
- ZLD plant capacity available to treat cooling tower and recycle basin – 200 gpm
- Seal pump water – 40 gpm
- Replace demineralizer with RO – 150,000 gpd
- Limestone ball chute washwater replacement - 20 gpm
- Reduce Contact water & misc. drains – 300 gpm

Implementing Opportunities –Step 4

- **Implementing Opportunities is a Reiterative and Collaborative Process that incorporates E3 principles – Engineering, Economics, Environment**
- **Key Lessons Learned:**
 - 1) Importance of Working Groups to Process**
 - 2) Continue to review data and question assumptions: it yields new opportunities**
 - 3) Don't throw away opportunities**

Economics of Implementing Opportunities

- Risk/reward
- Economics
- \$/gal for treating with brine plant
- \$ to investigate sending small amount to cooling towers – pilot study went from expected 100k to \$1M to avoid risk to the ZLD plant and condensate tubes cooling towers
- \$/gallon for treating with RO system on site

Results Review and Status – Step 5

- **Adjust the plan as needed**
- **Strategize how you will track progress**
- **Install Flow meters, electric meters, fuel meters on selected processes**
- **Training, data collection, evaluation and follow-up**

Next Steps

- **Document your work to review later**
- **Repeat the 5-Step Opportunity Assessment process in 2 years to see if any opportunities originally identified but not implemented are now viable**

Questions?

