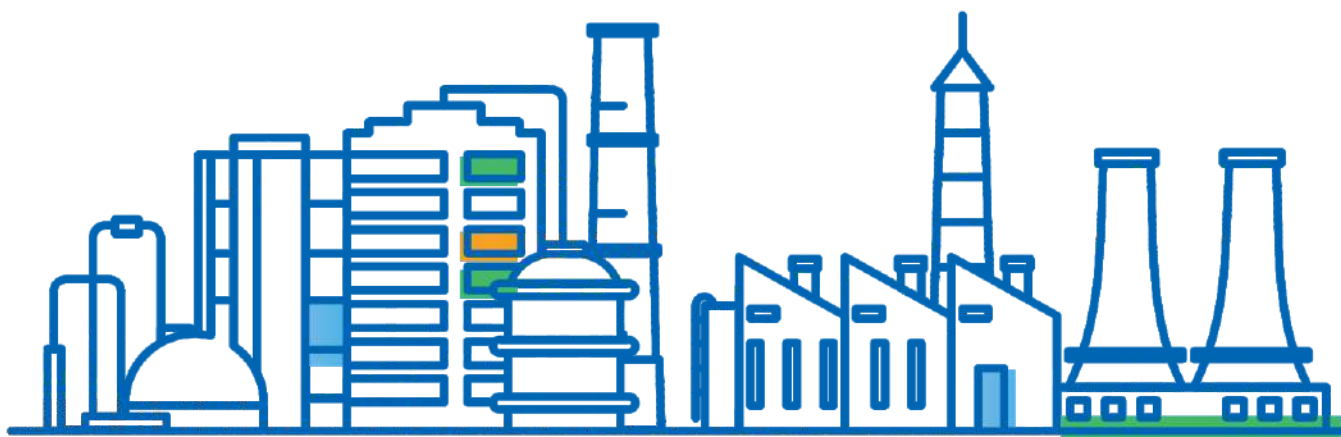


Project “Accelerating energy efficiency (EE) in large industries through energy management system, system optimisation and the promotion and adoption of EE in SMEs” (IEEP)

EXPERT TRAINING PROGRAMME

ENERGY MANAGEMENT SYSTEM IN LINE WITH ISO 50001 (MODULE 2)

Ha Noi, 01 - 03/10/2024



AGENDA

EXPERT TRAINING ON ENERGY MANAGEMENT SYSTEM IN LINE WITH ISO 50001 (MODULE 2)

From 01 to 03 October 2024

At Adonis Hotel - 55 Quang Trung Street, Hai Ba Trung District, Ha Noi

Day 1: 01/10/2024

Time	Contents	Speakers
8.00-8.30	Registration and welcome	
8.30-8.35	Participants Introduction	UNIDO Project
8.35-8.45	Opening speech	UNIDO Project
8.45-10.15	01 - REPORTING ON PROGRESS Teams report on progress of Module 1 (policy, scope, energy review, ENPI, baseline, EPO of SEU)	All expert teams
10.15-10.30	Tea break	
10.30-11.00	02 - SIGNIFICANT ENERGY USES – CONNECTIONS Emphasize SEU connections to implementation and operation	International Expert
11.00 – 11.45	03 - OPERATIONAL CONTROL	International Expert
11.45-12.45	Lunch at the Hotel	
12.45-13.30	Exercise 03: Develop Operational Criteria	International Expert
13.30-14.00	04 - PROCUREMENT	International Expert
14.00-14.30	Exercise 04: Procurement Considerations	International Expert
14.30-14.45	Tea break	
14.45-15.15	05 - DESIGN	International Expert
15.15-15.45	06 - COMPETENCY, TRAINING & AWARENESS	International Expert
15.45-16.15	Exercise 06: Develop competencies	
16.15-16.30	Daily Wrap-up	International Expert

Day 2: 02/10/2024

Time	Contents	Speakers
8.00-8.30	Registration	
8.30-9.00	07 - OBJECTIVES, TARGETS & ACTION PLAN REVIEW Review objectives & targets after discussing all the connections; revise action plans	International Expert
9.00-9.45	Exercise 07: Review & report out	International Expert
9.45-10.00	Tea break	
10.00-12.00	08 – COMMUNICATION Exercise 08A: Brainstorm session (mixed groups) Exercise 08B: Apply to company Exercise 08C: Report out communications/training	International Expert
12.00-13.00	Lunch at the Hotel	
13.00-13.20	09 - DOCUMENT CONTROL	International Expert
13.20-13.40	10 - RECORDS CONTROL	International Expert
13.40-14.10	Exercise 10: Determine documents/records	International Expert
14.10-14.30	Tea break	
14.30-15.15	11 - DEMONSTRATE WEB RESOURCES	International Expert
15.15-15.30	Daily Wrap Up	International Expert

Day 3: 03/10/2024

Time	Contents	Speakers
8.30-9.00	Registration	
9.00-9.45	12 - ENERGY PERFORMANCE, ENPI AND BASELINE REVIEW	International Expert
9.45-10.00	Exercise 12: review EnPI, modifications, system for calculating	International Expert
10.00-10.15	Tea break	
10.15-11.00	Exercise 12 (continued)	International Expert
11.00-11.45	13 MONITORING, MEASUREMENT & ANALYSIS	
11.45-12.45	Lunch at the Hotel	
12.45-14.00	Exercise 13A: Key characteristics & data analysis Exercise 13B: Develop measurement plan	International Expert
14.00-14.15	Tea break	
14.15-14.30	14 - KEEP EnMS UP TO DATE Update legal, EPOs, action plans, documents, policy; changes in energy review, baseline, documents, management review	International Expert
14.30-15.00	Exercise 14: checklist exercise for updating system	International Expert
15.00-15.15	15 - MANAGEMENT REVIEW Communication process for implementation: resources, reality check	International Expert
15.15-15.45	BACK AT THE OFFICE / NEXT STEPS	International Expert
15.45-16.00	Daily Wrap Up	International Expert

Energy Management System (EnMS) Expert Training

UNIDO International Energy Efficiency and EnMS Training

Module 2 Day 1

Delivered by: Richard Morrison, Stefan Walta

1

Housekeeping

- Emergency Exits
- Toilets
- Mobile Phones
- Breaks
- Lunch
- Please restrict email to break times
- Interact and ask questions



2

Today

Start Time	End Time	TOPIC	DURATION (min)	EXERCISE (min)
08:00	08:30	Registration	30	
08:30	08:45	Welcome and Opening Remarks	15	
08:45	10:15	01 REPORTING ON PROGRESS * Teams report on progress with policy, scope, energy review, SEU's ENPI's, baseline, EPO's		90
10:15	10:30	BREAK	15	
10:30	11:00	02 SIGNIFICANT ENERGY USES – CONNECTIONS * Emphasize SEU connections to implementation and operation	30	
11:00	11:45	03 OPERATIONAL CONTROL	45	
11:45	12:45	LUNCH	60	
12:45	1:30	* Exercise 03: Develop Operational Criteria		45
1:30	2:00	04 PROCUREMENT	30	
2:00	2:30	* Exercise 04: Procurement Considerations		30
2:30	2:45	BREAK	15	
2:45	3:15	05 DESIGN	30	
3:15	3:45	06 COMPETENCY, TRAINING & AWARENESS * Exercise 06: Develop competencies	30	30
4:15	4:30	Daily Wrap-up	15	

3

Day 2

Start Time	End Time	TOPIC	DURATION (min)	EXERCISE (min)
08:00	08:30	Continental breakfast	30	
08:30	09:00	07 OBJECTIVES, TARGETS & ACTION PLAN REVIEW * Review objectives & targets after discussing all the connections; revise action plans	30	
9:00	9:45	* Exercise 07: Review & report out		45
9:45	10:00	BREAK	15	
10:00	12:00	08 COMMUNICATION * Exercise 08A: Brainstorm session (mixed groups) * Exercise 08B: Apply to company * Exercise 08C: Report out communications/training	30	30 20 40
12:00	1:00	LUNCH	60	
1:00	1:20	09 DOCUMENT CONTROL	20	
1:20	1:40	10 RECORDS CONTROL	20	
1:40	2:10	* Exercise 10: Determine documents/records		30
2:10	2:30	BREAK	20	
2:30	3:15	11 DEMONSTRATE WEB RESOURCES	45	
3:15	3:30	Daily Wrap Up	15	

4

Day 3

Start Time	End Time	TOPIC	DURATION (min)	EXERCISE (min)
08:30	09:00	Continental Breakfast	30	
9:00	9:45	12 ENERGY PERFORMANCE, EnPI AND BASELINE REVIEW	45	
9:45	10:00	* Exercise 12: review EnPI, modifications, system for calculating		60
10:00	10:15	BREAK	15	
10:15	11:00	* Exercise 12 continued		45
11:00	11:45	13 MONITORING, MEASUREMENT & ANALYSIS	45	
11:45	12:45	LUNCH	60	
12:45	2:00	* Exercise 13A: Key characteristics & data analysis		45
		* Exercise 13B: Develop measurement plan		30
2:00	2:15	BREAK	15	
2:15	2:30	14 KEEP EnMS UP TO DATE	15	
		* Update legal, EPOs, action plans, documents, policy; changes in energy review, baseline, documents, mgt. review		
2:30	3:00	* Exercise 14: checklist exercise for updating system		30
3:00	3:15	15 MANAGEMENT REVIEW	15	
		* Communication process for implementation: resources, reality check		
3:15	3:45	BACK AT THE OFFICE / NEXT STEPS	30	
3:45	4:00	Daily Wrap Up	15	

5

Today

Start Time	End Time	TOPIC	DURATION (min)	EXERCISE (min)
08:00	08:30	Registration	30	
08:30	08:45	Welcome and Opening Remarks	15	
08:45	10:15	01 REPORTING ON PROGRESS		90
		* Teams report on progress with policy, scope, energy review, SEU's ENPI's, baseline, EPO's		
10:15	10:30	BREAK	15	
10:30	11:00	02 SIGNIFICANT ENERGY USES – CONNECTIONS	30	
		* Emphasize SEU connections to implementation and operation		
11:00	11:45	03 OPERATIONAL CONTROL	45	
11:45	12:45	LUNCH	60	
12:45	1:30	* Exercise 03: Develop Operational Criteria		45
1:30	2:00	04 PROCUREMENT	30	
2:00	2:30	* Exercise 04: Procurement Considerations		30
2:30	2:45	BREAK	15	
2:45	3:15	05 DESIGN	30	
3:15	3:45	06 COMPETENCY, TRAINING & AWARENESS	30	
		* Exercise 06: Develop competencies		30
4:15	4:30	Daily Wrap-up	15	

6

01 Reporting on Progress

7

Report Out Exercise

Please prepare a 15-20 minute presentation (typically 8-12 slides) for your colleagues participating in the energy management demonstration. Please cover the following topics:

- ❖ Who are your team members?
- ❖ Describe your progress in the demonstration so far:
 - ✓ Context, stakeholder, issues
 - ✓ Energy Policy
 - ✓ Scope and boundaries
 - ✓ Legal and Other
 - ✓ Energy Review
 - ✓ EnPIs and baseline
 - ✓ Energy Performance Opportunities
- ❖ What successes have you experienced so far?
- ❖ What has been the most challenging aspect for your team?
- ❖ What has been most beneficial for your team and your organization so far?
- ❖ What implementation ideas or best practices can you share with the other teams participating in the demonstration?

8

See you in 15 minutes!

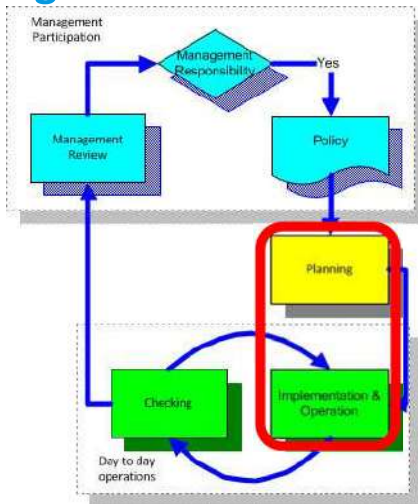


9

02 Significant Energy Uses - Connections

10

Planning & Do



- How much energy am I using?
- Where am I using it?
- What Legal requirements are related to my energy use?
- What Other requirements are related to my energy use?
- Which are significant users?
- What is driving it?
- Who is influencing its use?
- Do I need to have an energy audit?
- System Optimization
- Renewable energy options
- Are there legal or other requirements?
- Develop baseline & indicators
- Set objectives and targets
- Action Plans

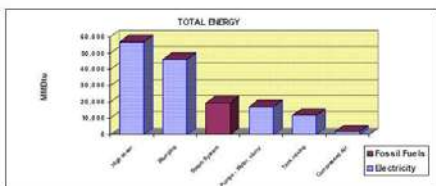
Significant Energy Uses



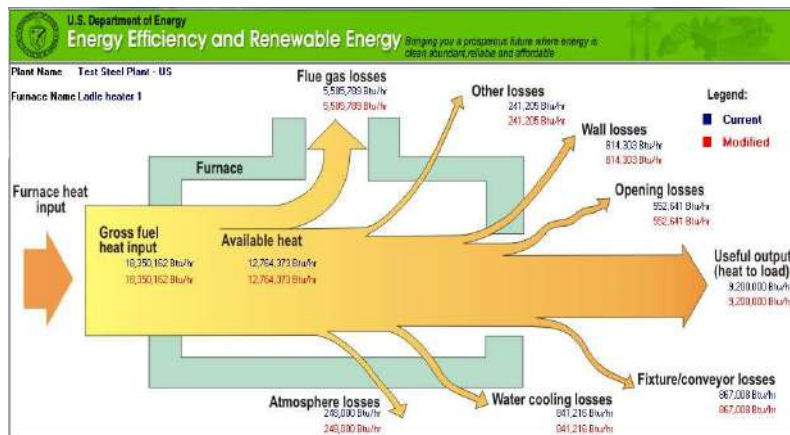
ENERGY BALANCE REPORT

Mine

SYSTEM	ELECTRICITY MMBTU		FOSSIL FUEL MMBTU		TOTAL MMBTU	
Blunging	46,205	30.6%	0	0.0%	46,205	27.1%
Compressed Air	1,935	1.3%	0	0.0%	1,935	1.1%
Steam System	181	0.1%	19,356	97.6%	19,537	11.4%
Tank mixing	11,768	7.8%	0	0.0%	11,768	6.9%
High shear	58,905	37.7%				
Pumps - Water, sl	17,057	11.3%				
Other	10,034	11.2%				
TOTAL	150,885					

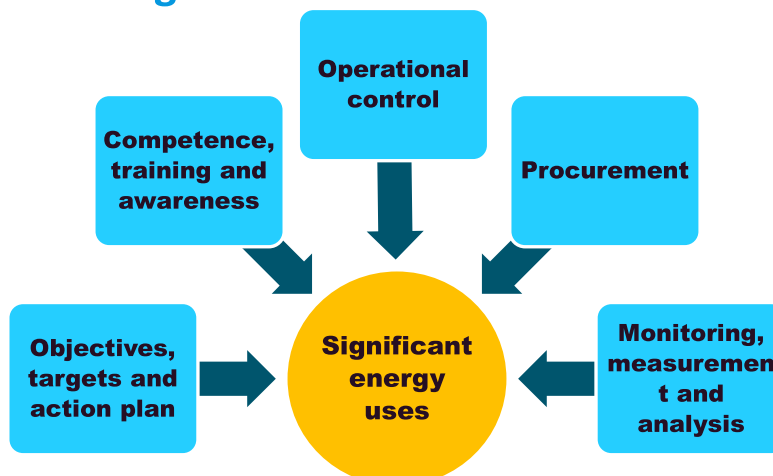


SEU Sankey Diagram



13

Connections to Significance



14

Significant Energy Uses-Connections

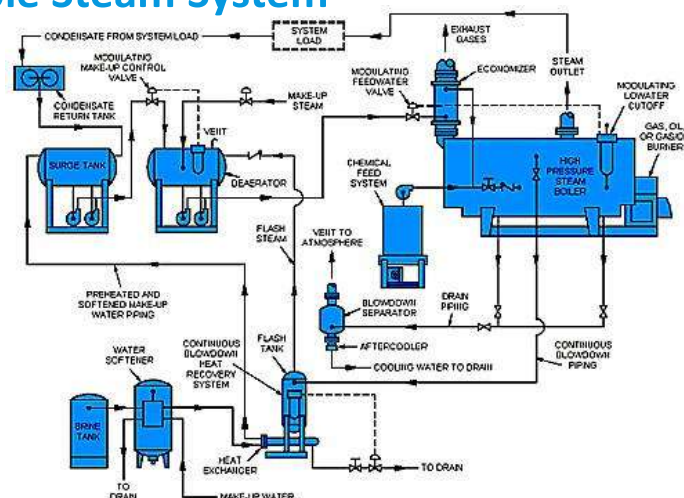
What does this mean to me?

- Designation of an energy use as *Significant* will have profound effects on the implementation and operation of an Energy Management System
- Connections to significance exist throughout the EnMS and must be addressed. Specific requirements include operator competence and training, procurement, operational controls, monitoring, measuring and analysis and objectives, targets, and action plans.



15

Recall: Simple Steam System



16

Steam System Performance

A profile of losses operating a 500 hp boiler with NG at 60% firing rate (annual fuel bill = \$800,000)

Boiler Losses		
Stack Losses	18%	\$144,000
Blowdown Losses	4%	\$32,000
Surface Losses	3%	\$24,000
	25%	
Distribution System Losses		
Insulation Losses	7%	\$56,000
Steam Leaks	6%	\$48,000
Blowing Traps	5%	\$40,000
Flash Losses	11%	\$88,000
Return Losses	9%	\$72,000
	38%	\$304,000
Combined Losses	63%	\$504,000
System Efficiency	37%	\$296,000

17

Steam System Connections-Example

- Operator competence and associated training

Competency	Training
General knowledge of boiler operation	Complete 2 day-Boiler Operation, Maintenance & Safety course
Ability to understand and follow startup and shutdown procedures	1 week on-the-job training with experienced boiler operator
Ability to test boiler water and make necessary adjustments	1 day on-site training with water treatment chemical tech rep
Ability to test burner performance, calculate combustion efficiency and adjust combustion controls as needed	Complete 1 day-Combustion Analysis and Fuel Efficiency course and pass HVAC Excellence Combustion Analysis exam

18

Steam System Connections-Example

Procurement of services, products and equipment associated with steam system - Procedures

- Notify potential suppliers of steam system equipment and products that evaluation of their offerings are partly dependent upon energy performance (e.g. includes products like water treatment chemicals or steam traps and equipment like deaerators, feed pumps or stack economizers).
- Assess energy use over lifetime: Inform purchasing that large capital items (> \$20,000) will have a lifecycle cost evaluation prepared that includes at a minimum initial cost, annual maintenance, energy cost savings and salvage cost based on expected lifetime.

Steam System Connections-Example

Operating control topic	Control method
General boiler operation	Attend boiler operator training course
Boiler startup/shutdown	On-the-job training on how to follow procedures
Emergency conditions	Safety covered in operator training course
Steam trap inspection	Traps are tested monthly with ultrasonic meter and losses tracked. Trap replaced or repaired when loss >\$2.5K/yr
Boiler tune-up	Boiler performance monitored weekly and tune-up is completed when efficiency decreases by 3%
Steam leak inspection/repair	Boiler operating procedure requires weekly inspection and write-up of visible leaks by operators that are then assigned to maintenance for repair

Steam System Connections-Example

Monitoring & measurement practice

- Maintenance procedure: monthly test of exhaust stack excess oxygen and temperature to determine combustion efficiency
- Record feedwater flow rate from water meter daily
- Measure feedwater and boiler water solids concentration daily, use ratio of concentrations to calculate blowdown rate
- Record natural gas flowrate daily from gas meter
- Boiler performance determination:
 1. Steam production - Subtract blowdown rate from feedwater rate
 2. Calculate energy in steam – enthalpy difference of steam and feedwater
 3. Boiler efficiency - steam energy divided by fuel input
 4. Compare calculated boiler efficiency with measured combustion efficiency

21

Connections-Meeting Expectations

What would an auditor look for?

- **Operator competence and associated training**
 - Operating procedures
 - Testing procedures
 - Start-up/shutdown procedures
 - Controls & Alarm details
 - Maintenance procedures
- **Procurement of services, products and equipment associated with steam system**
 - Notify suppliers that evaluation is partly dependent upon energy performance
 - Assess energy use over lifetime

22

Connections-Meeting Expectations

What would an auditor look for? (Continued)

Controls

- **Operating controls**
 - Boiler operations criteria
 - Start-up/shut down procedures
 - Blowdown procedures
 - Analysis and response guidance
- **Maintenance controls**
 - Steam trap survey and repair / replacement
 - Insulation inspection and repair / replacement
 - Boiler tube cleaning, water-side, fire-side
 - Steam leak survey and repair
 - Combustion tune-up
 - Calibration

23

Connections-Meeting Expectations

What would an auditor look for ? (Continued)

- **Monitoring & measurement**
 - Regular combustion, flue gas analysis
 - Make-up water meter volumes
 - Fuel input volumes
 - Water quality
 - De-aerator temperature / pressure

24



Barriers associated with SEUs

- Incomplete equipment lists and inadequate consumption data for energy uses
- Relying on part of the organization when determining significance criteria
- Deciding that everything is significant – instead of keeping it manageable!
- Ignoring required connections when developing SEU methodology
- Lack of metering to adequately monitor and measure SEU performance

25

The Expert's Role

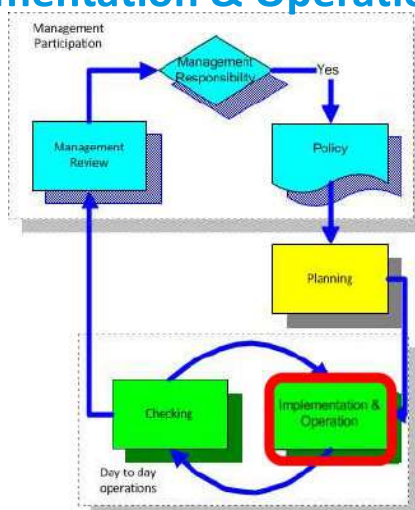
- Assist with development of SEU selection criteria and methodology
- Ensure that chosen significant energy uses are appropriate for organization's resources
- Identify connections to SEUs and help organization to fill gaps with training, procedures, and processes
- Determine data and information needed to monitor and measure SEU performance

26

Operational Control

27

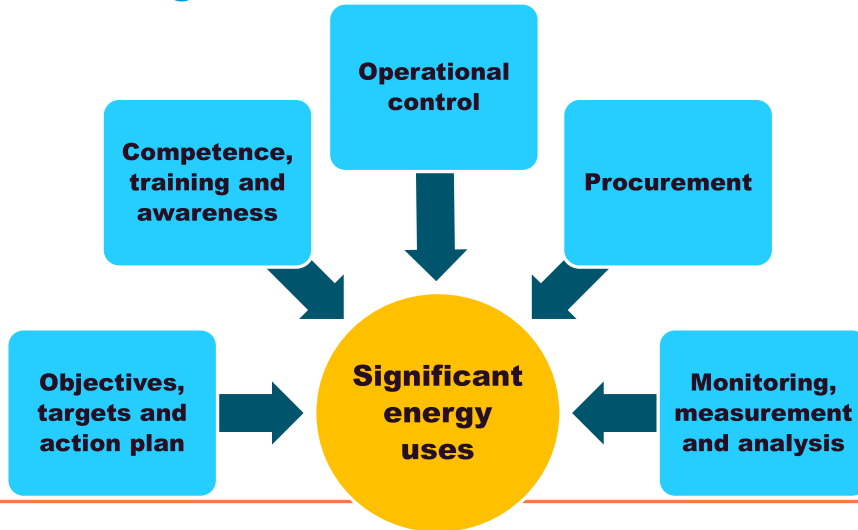
Implementation & Operation



- Competence, training and awareness
- Documentation
- Operational control
 - Key Area
 - Operation and Maintenance
 - Service Contractors
 - Training
- Communication
- Design
 - Energy Efficient Design (EED)
- Purchasing energy, services, goods
- Action Plan

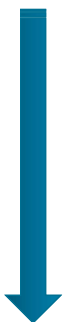
28

Connections to Significance



29

What is Required by the EnMS?



- Determine and plan operations associated with significant energy uses
- Set criteria for operation and maintenance of significant energy uses
- Communicate to the appropriate personnel
- Operate and maintain according to criteria
- NOTE: May include energy performance consideration in contingency planning

30

Operational Control: A critical element of the EnMS for energy savings

Steps in achieving effective operational control:

1. Determine and establish maintenance and operational criteria
2. Communicate operational controls
3. Operate according to the criteria

Leads to,

**SIGNIFICANT ENERGY SAVINGS & BENEFITS
WITHOUT CAPITAL EXPENDITURE!**

31

Developing Criteria

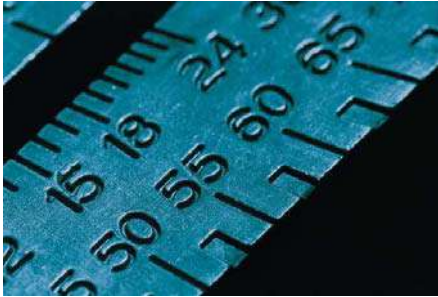
Sources of Criteria

- Manufacturers recommendations
- System operational manuals, including automated controls
- Service personnel suggested operating settings
- Service personnel suggested maintenance practices
- Internal expert's suggestions
- Guidance from energy system experts
- Benchmarking performance of similar equipment
- Past issues or problems



32

Operational Criteria



Operating criteria

- Temperature
- Pressure
- Residence time
- Humidity
- Control schemes
- Others

Critical operating parameters – for each SEU:

- What are the parameters you need to control to maintain maximum efficiency?
- What is the unit of measure for each, e.g. Bar, degC, ppm, etc.
- What is the normal setting? E.g. 5 bar
- What is the maximum value where action should be initiated? E.g. 5.5 bar.
- What is the minimum value where action should be initiated? E.g. 4.5 bar.
- There are not always both max and min
- How is the measuring instrument identified and how often is its accuracy checked?
- Who needs to know these values and what to do in the event of a deviation?
- Who needs to know if there is a deviation?

Critical operating parameters

Critical Operating Parameters										
SEU (Inc use)	Parameter	Eng. Units	Normal set point or value	Upper Limit	Lower Limit	Measuring Instrument Designation	Accuracy/Calibration Frequency	Who needs to be informed of these values?	Who needs to be informed of deviations?	Note
Steam system	Total Dissolved Solids	ppm	3500	3800	3400	TDS001	3 months	operators	supervisor	
Steam system	Boiler Pressure	bar	9.5	10	9	PT123	12 months	operators	supervisor	
Steam system	Exhaust Oxygen	% O ₂	3	3.5	2	Portable 123	6 months	operators	supervisor	
Steam system	Stack Temperature	DegC	N.A.	300	N.A.	TT124	12 months	operators	supervisor	Varies with firing rate
Pump 28	Differential pressure	bar	3	3.3	2.7	P28	24 months	Refrigeration	supervisor	
Refrigeration	Temperature Lift	DegC	25+/-10	35	15	T12 and T16	12 months	operators	supervisor	Varies with the ambient wet bulb temperature
Refrigeration	Condenser approach temperature	DegC	5	6	N.A.	T12	12 months	operators	supervisor	
Refrigeration	Evaporator approach temperature	DegC	5	6	N.A.	T12	12 months	operators	supervisor	
Compressed Air	Compressor discharge pressure	bar	6	6.4	6	PT124	12 months	operators	supervisor	
Compressed Air	Compressor vs system pressure difference	bar	0.5	0.7	N.A.	PT127	12 months	operators	supervisor	

35

Maintenance-Definitions

- The primary purpose of maintenance has traditionally been to maintain reliability and availability.
- If equipment is properly maintained it is more likely to be energy efficient also.
- Reactive maintenance will undoubtedly waste energy
- The cost of the energy will often be more than the cost of the maintenance (also a different budget!)
- All significant energy users need to be maintained correctly
- Applies equally to external service contracts as internal maintenance staff

36

Maintenance options

- Preventive maintenance
 - Predictive maintenance
 - Reliability centred maintenance (RCM)
 - Overall equipment effectiveness (OEE)
 - Total productive maintenance (TPM)
-
- Note: reactive maintenance may be appropriate for items that are relatively unimportant in terms of reliability and energy use

37

Maintenance Criteria & Factors

- **Maintenance criteria**
 - Filters
 - Lubrication
 - Tune-ups, adjustments
- **Maintenance factors**
 - Operating schedules
 - Inspection methods and intervals
 - Start up & shut down frequency
 - Severity of service



38

Document Criteria

Significant Energy Uses Operational Criteria Specifications					
Significant Energy Use and Associated Operation	Operating Criteria Associated with Significant Energy Use	Defined Operational Set Point	Maintenance Criteria Associated with Significant Energy Use	Required Maintenance interval	Who needs to be informed of operational and maintenance criteria?
	<input type="checkbox"/> Dwell (Cycle) time		<input type="checkbox"/> Lubrication		
	<input type="checkbox"/> Temperature set-point		<input type="checkbox"/> Tune-up		
	<input type="checkbox"/> Pressure set-point		<input type="checkbox"/> Oil & filter change		
	<input type="checkbox"/> Differential pressure		<input type="checkbox"/> Clean or flush		
	<input type="checkbox"/> Humidity set-point		<input type="checkbox"/> Air filter change		
	<input type="checkbox"/> Liquid level		<input type="checkbox"/> Adjust/tighten		
	<input type="checkbox"/> Solution concentration		<input type="checkbox"/> Recharge		
	<input type="checkbox"/> Other:		<input type="checkbox"/> Other:		

Document Criteria: Completed Example

SEU	Parameter	Eng Units	Upper Limit	Lower Limit	Measuring Instrument	Routine Calibration	Note
Boilers	Total Dissolved Solids	ppm	3800	3400	TDS001	Y	
Boilers	Boiler Pressure	bar	10	9	PT123	Y	
Boilers	Exhaust Oxygen	% O2	3.5	2	Portable 123	Y	
Boilers	Stack Temperature	Deg C	300	N.A.	TT124	Y	Varies with firing rate

Communication of Criteria

- On-the-job training
- Work instructions or operating procedures
- Classroom training
- Posted list of specified settings
- Logbooks



41

Implementation of Criteria = Controls

Procedures Based

- Procedures or work instructions
- Equipment logbooks
- PM Schedule

Training Based

- Maintenance training
- Operations training
- Contractor training

Technology Based

- Control systems
- Alarm/alert systems
- Computer automated activities
- Preventive maintenance system

May already have many operational controls in place!

42

Operating Controls-Best Practice

Operational Controls - Best Practice



Clearly define requirements



Conduct training for operations and maintenance people



Keep documentation current



Remember, even technology-based controls require some training and documented procedures



Ensure recommended practices are being followed & significant deviations handled

Contingency, Emergency or Disaster Situations

Contingency, Emergency or Disaster Situations



May consider operational control requirements for energy performance during contingency situations

To plan contingent operational control, first define contingency to isolate potential effect on SEU

After contingency is defined, determine necessary changes to criteria and establish controls

Contingency Situation Example

Dual-fuel boiler operating normally on interruptible natural gas. An extended cold-snap will necessitate operation on #2 fuel oil during a gas interruption. What operational changes are anticipated?

1. To ensure efficient combustion, the excess oxygen must be increased from the present 3% to 4% to avoid smoking and carbon monoxide formation.
2. Since fuel oil contains approximately 1% sulfur, the stack economizer dampers must be closed to by-pass the economizer and prevent corrosive condensation on the economizer coils. Boiler efficiency will decrease, but the economizer will be preserved for operation on natural gas

45

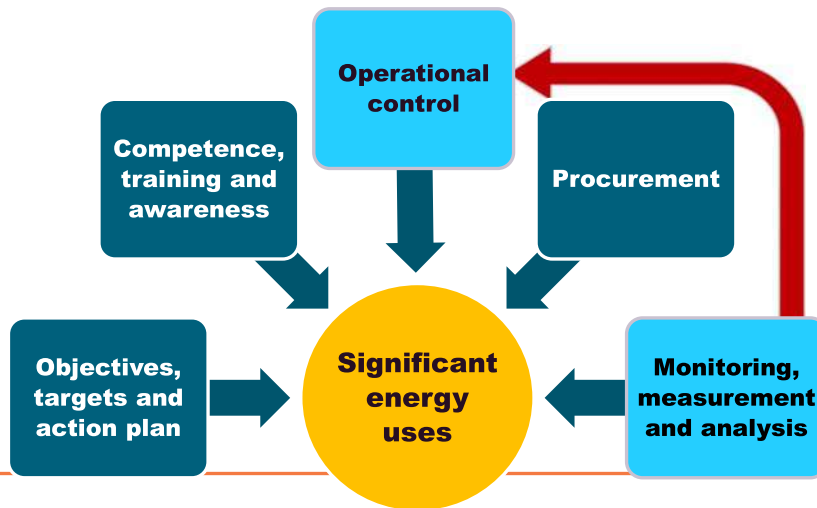
Contingency Situation Example Operational Control Implementation

How will operational controls for a natural gas curtailment be implemented?

- A clear description of who will make the operational changes, when they should be made and how to make them will be included in the boiler operating instructions located in the boiler control room. (Procedure based)
- To ensure that all boiler operators understand changes necessary during gas interruptions, the operating procedures will be presented during new operator training and annual reviews for existing operators. On-the-job role playing will be employed that allows operators to demonstrate that they understand how to implement the required changes. (Training based)

46

Connections to Significance



47

Operational Controls & Monitoring and Measuring



Measure & Monitor

Measure = passive data acquisition: utility meters, panel meters

Monitor = active data collection: sub-meters, data loggers



Energy Performance

Use M&M data to determine SEU performance

EnPIs



Operational Control

Is energy performance as expected?

Are controls working?

How can they be improved?

48

Operational control checks

Operational control checks					
ID	SEU	Check	Method	Expectations	Corrective Action
1	Steam	Uninsulated pipes, valves, fittings, boiler fittings	Infra red thermometer, thermal imaging camera, surface temperature probe, your hand (don't touch hot surfaces!)	It should be possible to keep your hand on all insulated surfaces without pain	Repair, replace, upgrade insulation
2	Steam	Condensate return rate	Compare make up water flow rate with steam rate. Steam rate can be estimated from fuel flow rate if a steam meter is not available	Dependent on the process conditions. If steam is not lost to the process e.g. by sparging, humidification, etc. then over 80% condensate return is achievable	Check condensate return units, flash steam (are there visible steam plumes), repair traps, are there condensate or steam leaks, open drains, ???

49

Barriers to effective operational controls

- Implementing controls that are not easy to use, understand or communicate (controls not user-friendly)
- Forgetting to include maintenance criteria in addition to operating criteria
- Infrequent communication of operational controls
- Not checking control effectiveness regularly
- Failing to improve ineffective controls



50

Value to the Organization

- ✓ Promotes efficient, uninterrupted operation of critical equipment
 - ✓ Criteria for efficient operation can help identify actions that will support targets and objectives
 - ✓ Implementation of controls or refinement of existing controls can result in significant savings with no capital cost
 - ✓ Control energy spend by controlling highest cost uses
 - ✓ Improves uniformity of process
 - ✓ Provides continuity of processes during personnel changes
 - ✓ Allows operators to help with energy savings
-

51

The Expert's Role

- Assist in defining appropriate operating and maintenance criteria for SEUs
 - Review existing operational controls to ensure they meet requirements for efficient operations
 - Determine maintenance requirements for significant energy uses
 - Determine and develop communications plan for changes to operational controls
-

52

See you in 60 min 😊



53

Exercise 03

Determine what operational and maintenance criteria it takes to run and maintain one of your SEUs in an efficient manner, and record these criteria on the Operational Criteria Specification Worksheet.

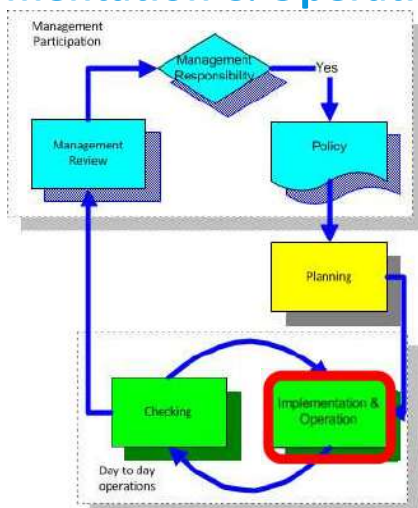


54

Procurement

55

Implementation & Operation



- Competence, training and awareness
- Documentation
- Operational control
 - Key Area
 - Operation and Maintenance
 - Service Contractors
 - Training
- Communication
- Design
 - Energy Efficient Design (EED)
- **Purchasing energy, services, goods**
- **Action Plan**

56

Procurement

- Can have a significant impact on your energy performance
- You need to be able to assess the energy performance and impact of items that you purchase
- Inform all vendors that you have an EnMS that requires energy impact to be assessed as appropriate
- Need to move towards Life Cycle Costing (LCC)

57

Procurement of Energy Services, Products and Equipment

- If purchases affect significant energy use (singular) notify suppliers evaluation partly based on energy performance
- Designate how energy use over the lifetime of the product, equipment or service will be assessed for purchases that have significant impact on energy performance
 - Significant energy use
 - Objectives and targets
 - Past improvement efforts
 - Maintenance of energy system

58

Purchasing goods

- Many purchased items can impact energy performance
 - Air compressors, motors, boilers, pumps, etc.
 - IT equipment, PCs, printers, photocopiers, etc.
 - Light bulbs
 - Maintenance materials, insulation, gaskets, bearings, lubricants, etc.
- Establish criteria for assessing energy use, consumption and efficiency
- Develop purchasing specifications for these items
- Need an analysis that incorporate life cycle costing
 - Include NEBs as relevant

59

Purchasing services

- Energy service providers who will affect energy performance need to be evaluated
 - Maintenance service contractors for SEUs
 - Project engineers/managers/architects
 - Energy consultants
- Informed procurement partly based on energy performance
- Develop criteria for assessment
- Major component of assessment is competency
 - Education
 - Training
 - Skills
 - Experience of previous similar services

60

Purchasing services

- Any service provider who will affect your significant energy uses needs to be competent
- They include:
 - Maintenance service contractors for SEUs
 - Project engineers/managers
 - Architects
 - Energy consultants
- You need to be able to judge competence
 - Education
 - Experience of previous similar services
 - References
 - Curriculum vitae (CV) or resume

61

Supplier Notification

- Notify suppliers that evaluation will be partially based on energy performance
 - Letter
 - PO
 - Specification
 - Training
 - Supplier open house
 - Email



62

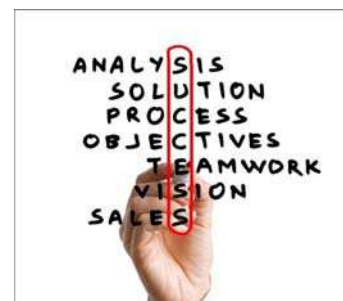
What about purchasing energy saving technologies?

- There are many vendors of energy saving technologies
- You need to be able to judge real saving potential from what the sales person says.
- Try a sample as a test
- How do you verify savings?
- Nobody admits to buying the wrong thing
- Some good technologies are only good in the right application, e.g. variable speed drives

63

Life Cycle Analysis

- Upfront expense
- Incremental cost
- Energy cost
- Maintenance cost
- Expected lifetime
- Disposal cost/Salvage value



64

Example

Example Lighting Lifecycle Cost Assessment Worksheet								
Energy Cost: <u>\$0.07/kwh</u>			Maintenance Labor Cost: <u>\$20/hr</u>			Bulb Replacement Time: <u>10 min. or 0.167hr</u>		
Options	Energy Consumption (Annual)	Initial Cost	Number of Bulbs Needed Per Year	Annualized Maintenance and Repair Cost	Annual Energy Cost	Operating Life	Annual Replacement Cost	Lifecycle cost
100W Incandescent	440 kWh	\$0.79	4.4	\$14.70	\$30.80	1,000	\$3.48	\$48.98
23W Compact Fluorescent	101 kWh	\$6.00	.44	\$1.47	\$7.07	10,000	\$2.64	\$11.18

65

Example

Example Pump Life Cycle Cost Worksheet						
Energy Cost: <u>\$0.07/kwh</u>			Maintenance Labor Cost: <u>\$20/hr</u>			Net Discount Rate: 5%
Options	Energy Consumption (Annual)	Initial Cost	Annualized Maintenance Cost	Annual Energy Cost	Operating Life	Lifecycle cost
Fixed Speed Pump with control valve	100,000 kWh	\$5,000	\$85	\$7,000	15 years	\$78,540
Variable speed pump	42,860 kWh	\$8,000	\$115	\$3,000	15 years	\$40,333

66

Life Cycle Costing - info finance worksheet

Life Cycle Costing (LCC)				
Project				
Date				
Engineering company				
Discount rate	10%			
Inflation	6%			
Cost kWh (€)	0.15			
Estimated lifetime (years)	10			
	CURRENT SOLUTION	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3
Description	Current system	Description 1	Description 2	Description 3
	Cashflow	Cashflow	Cashflow	Cashflow
Initial investment	0.00 €	-2,520.00 €	-7,000.00 €	-3,500.00 €
Annual preventive maintenance	-300.00 €	-300.00 €	-300.00 €	-300.00 €
Annual corrective maintenance	-600.00 €	-12.50 €	-12.50 €	-12.50 €
Annual consumption	-413.91 €	-137.97 €	-137.97 €	-137.97 €
Other factors or other NEBs	-56.00 €			
Observations				
LCC	-9,637.65 €	-5,460.07 €	-9,532.80 €	-6,350.98 €
NPV		4,177.57 €	104.85 €	3,286.67 €
IRR		40%	10%	28%
PAYBACK		2.74	7.61	3.81

67

What if Procurement is a Centralized Activity?

Is the purchase of the service, product, or equipment related to a significant energy use?

- Inform corporate that energy performance is important in decision
- Request energy be a criteria in evaluation
- Request that corporate notify suppliers that energy performance will be taken into consideration
- Develop a working relationship with central procurement people

68

Communication Ideas

If procurement is a corporate function:

- Is there information that the facility can provide corporate purchasing to make their buying decisions more effective, for equipment or energy supply?
- Is there energy supply price signal information that corporate can provide to the facility that might impact operational decisions?



69

Procurement of Energy Supply

- Defined and documented energy purchasing specifications



70

Purchasing energy

- Increasingly complex area with competition
- Need to know who are the potential suppliers
- Need understanding of available tariffs
- Need understanding of specification of energy requirements
- If significant energy savings are achieved through EE this may affect best tariff structure
- Need each supplier to quote for the same thing and same basis, need to be able to compare quotes

71

Energy Supply Specifications

- Quality
 - Moisture
 - Composition
 - Energy Content
 - Voltage
 - Amperage
 - Power Factor
- Quantity
 - Amount supplied
 - Delivery period
 - Interruptible?
- Reliability
 - Allowable variation in quality
 - Allowable variation in supply
- Cost Factors
 - Cost per unit
 - Cost for non-interruption
 - Cost for demand
 - Cost for delivery

72

Expert's Role in Procurement of Energy Services, Products, Equipment and Energy

- Help determine which energy services, products and equipment can have an impact on significant energy use.
- Identify the suppliers that provide these energy services, products and equipment.
- If procurement is a corporate function help organization with identifying information/plan to inform corporate:
 - How energy performance is important in purchasing decisions
 - Energy is an important criteria in evaluation
 - Suppliers should be notified that energy performance will be taken into consideration

73

Expert's Role in Procurement of Energy Services, Products, Equipment and Energy

- If procurement is a facility function, help the facility determine a method for notifying suppliers that procurement evaluation is partly based on energy performance, if purchase may affect significant energy use.
 - Letter, PO, specification, training, supplier open house, email
- Determine the best way to include the standard requirements into the routine procurement processes.

74

Typical Barriers

- Lack of communication between operations and procurement
- Excluding procurement in energy related activities or meetings
- Excluding energy considerations from regular procurement activities
- Not reviewing and analyzing energy requirements on a regular basis



75

Value to the organization

- Helps ensure the availability of sufficient quantity, acceptable quality, and competitive price for energy in the selected application
- Better management of energy costs
- Help sustain energy savings from past projects



76

Documents & Records

Documents

- Develop procurement criteria for assessing energy use of services, products and equipment over the planned operational period
- Develop procurement specifications for energy supply

Records

- Record of notification to suppliers regarding evaluation criteria

77

Tools

- Significant Energy Uses Procurement Worksheet
- Lifecycle Resource List
- Example Lifecycle Cost Assessment Worksheet
- Purchasing Specification for Energy Supply Guidance Tool



78

Deliverables

- Identify any changes necessary for the design and procurement processes
- Implement any identified changes to the design and procurement processes
- Develop procurement criteria for assessing energy use of services, products and equipment over the planned operational period
- Develop procurement specifications for energy supply



79

Exercise 04

Consider the procurement policies and procedures in your organization. Using the Procurement Checklist determine the gaps in your procurement procedures and the actions needed to fill those gaps.



80

See you in 15 minutes!

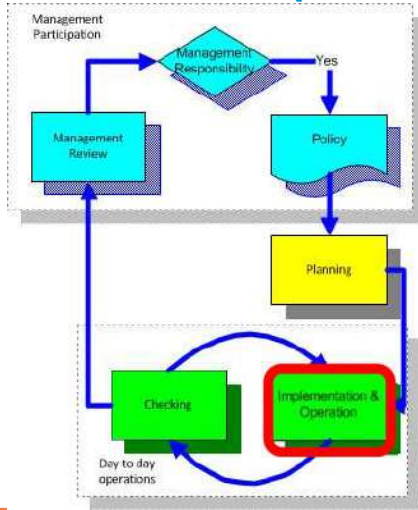


81

Design

82

Implementation & Operation



- Competence, training and awareness
- Documentation
- Operational control
 - Key Area
 - Operation and Maintenance
 - Service Contractors
 - Training
- Communication
- **Design**
 - Energy Efficient Design (EED)
- Purchasing energy, services, goods
- Action Plan

83

Design – Energy Efficient Design (EED)

- Major opportunity to improve
- Technical Changes
 - Expansion, refurbishment, replacement
 - Facilities, equipment, systems and processes
- Energy Efficient Design
 - Challenge user specification, use, distribution, generation
- Consider the operating life time of the equipment

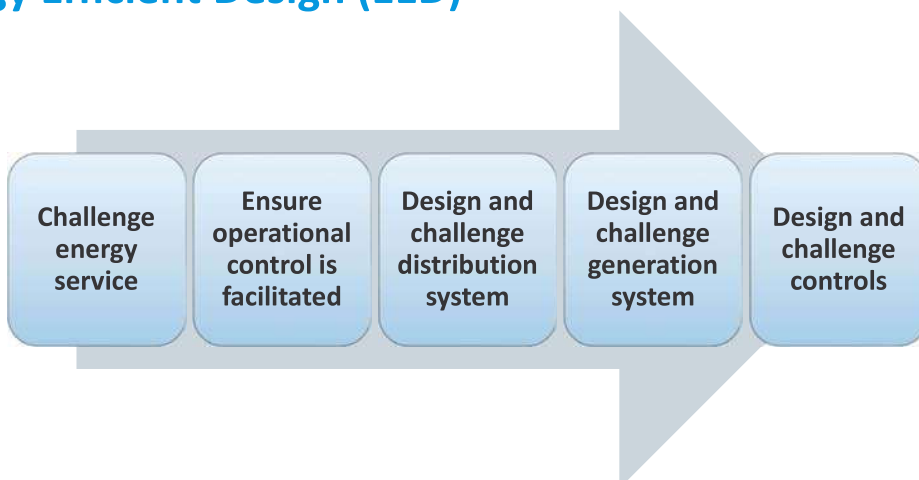
84

When Does Design Occur?

- Design may occur as a part of an action plan
- Design may occur as a part of a preventive or corrective action
- Design may occur as a part of a process change
 - To improve energy performance
 - New product introduction
 - New technologies
 - Energy supplies
 - Change in materials, regulations, customers
 - For some other reason
- Design within the EnMS versus design as part of operations....

85

Energy Efficient Design (EED)



86

Considerations

- What is the right energy source?
- What specific items or operations can be changed to improve the consumption of energy?
- What technology options are available?



87

Design Process

- Determine what types of new or modified equipment, systems, facilities or processes can have a major impact on energy performance
- Ensure design review includes appropriate stakeholders from the very beginning - including operators from any affected areas
- Consider developing procedures, checklists and/or forms to ensure that the design process consistently considers energy improvement opportunities

88

Design Process

- Consider building energy performance evaluation and opportunity consideration into the existing design and review process.
- Ensure the loop is closed between design and procurement.
- If the existing design and review process does not ensure appropriate design records are being kept, modify the process.



89

Expert's Role in Design

- Help determine what new or modified equipment, systems, facilities or processes can have a major impact on energy performance
- Help determine how planned new or modified equipment, systems, facilities or processes have a major impact on energy performance
 - Energy performance of the significant energy use
 - EnPIs
 - Effectiveness in meeting objectives and targets through action plans

90

Expert's Role in Design

- If a strong design and review process is in place, help the facility build energy performance evaluation, opportunity consideration, and operational controls into the existing process.
- If the current design and review process is not effective, help the facility develop procedures, checklists and/or forms to ensure the process consistently considers energy improvement opportunities and operational controls.
- Ensure the existing design and review process maintains appropriate design records.
- Ensure the loop is closed between design and procurement.

91

Typical Barriers

- Developing a design review process that is not consistent in ensuring energy performance and potential improvement opportunities are always considered.
- Developing a separate process for this requirement and not incorporating energy considerations into the existing design process.



92

Value to the organization

- Better management of energy costs
- Much less expensive to plan energy efficiency improvements up front, rather than as a retrofit



93

Documents & Records

Records

- Design activity records (including the inclusion of the energy performance evaluation in the design, specification, and procurement)

94

Deliverables

- Identify any changes necessary for the design and procurement processes
- Implement any identified changes to the design and procurement processes



95

The importance of commissioning

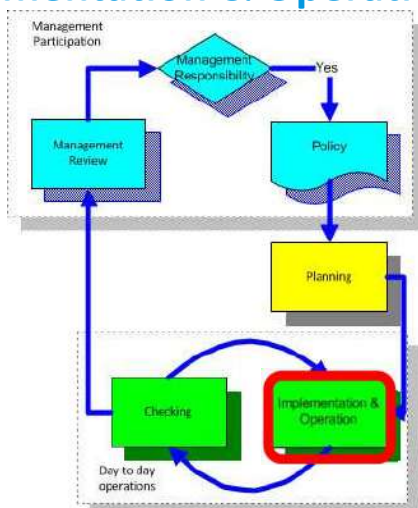
- It is common to find well designed buildings and processes that are not energy efficient in operation
- The commissioning team need the following:
 - Understanding of the design intent of energy saving features
 - They need the expertise to be able to commission properly
 - They need the time to be able to do it properly (the lowest bidder may not have enough time)
 - The project schedule needs to allow enough time for correct commissioning
- The design intent and commissioning learnings need to be communicated to the operational team (training)

96

Competence, Training and Awareness

97

Implementation & Operation



Competence, training and awareness

- Documentation
- Operational control
 - Key Area
 - Operation and Maintenance
 - Service Contractors
 - Training
- Communication
- Design
 - Energy Efficient Design (EED)
- Purchasing energy, services, goods
- Action Plan

98

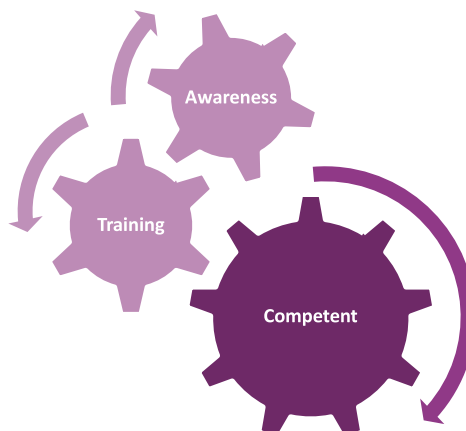
Competence, Training & Awareness

- Ensure those related to significant energy uses are competent.
- Identify training needs related to the control of its SEUs.
- Provide training or take other actions.
- Maintain records of training.



99

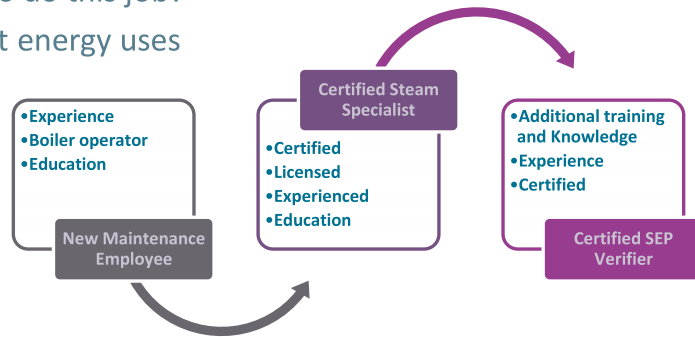
Three Cogs



100

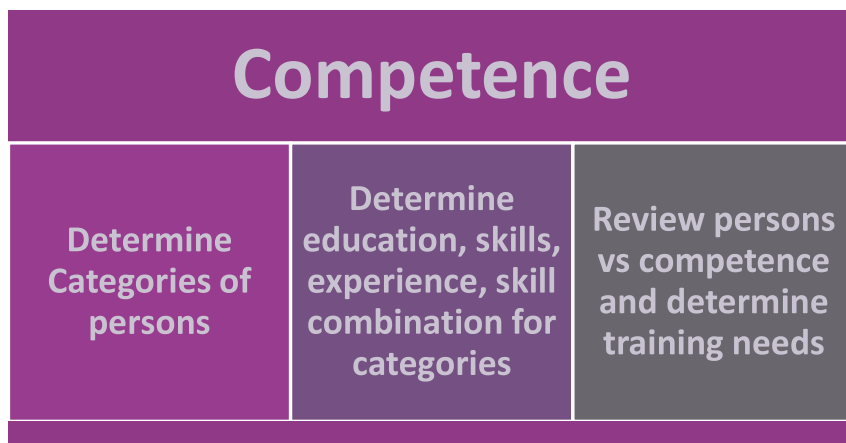
Competence

- Education, training, skills, or experience
- Records
- How am I qualified to do this job?
- Related to significant energy uses



101

Competence Process



102

Types of competence

MANAGEMENT	TECHNICAL
Change management	Operational control
Competence building	Metering and measurement
Financial analysis	Data collection
Leadership	Data analysis
Communication	Energy Efficient Design
Organisation	Energy efficient procurement
	Communication

103

STEP 1: List Energy TASK		
turn off equipment when not in use		
boiler operator		
STEP 2 Energy Task	And Category	
turn off equipment when not in use	Basic	
boiler operator	Advanced energy skills	
Step 3 Energy Task	And Category	Competency definition
turn off equipment when not in use	Basic	Energy awareness training
boiler operator	Advanced energy skills	<ul style="list-style-type: none"> • Certification training for boiler operators • Education of high school or equivalent • 3 years experience

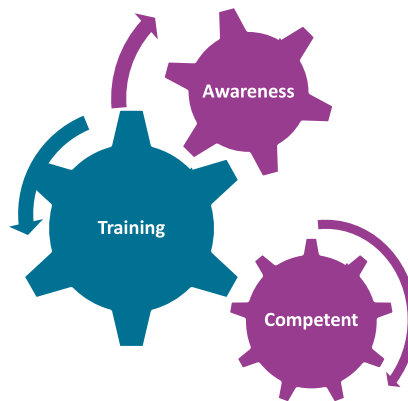
104

Competency Record	
Name:	
Position:	Competence Category:
Department:	
Competency Requirements	
Description	Initial and Date When Completed

The GAP



Three Cogs



107

Training Needs

- Competency defines what is needed
- Training needs define what is missing or has changed
- Records of the training provided are required

Other Options

- ✓ Reassign to another activity
- ✓ Provide additional training
- ✓ Assign a mentor
- ✓ Increase the training opportunities
- ✓ Remove from the situation

108

Training Needs

- Classroom training
- On-the-Job training
- Certification program
- Work with a mentor
- Work with a supplier or contractor
- Web-based training
- Time in a job



109

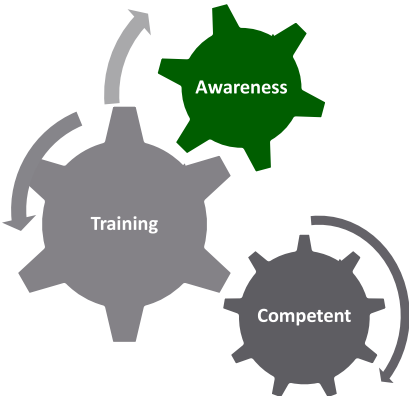
Training Plan

Name	Job Title/Function	Category	Introduction to EnMS	RnR	Efficient design	Efficient purchasing	EnPIs	LCC	Cooling, heating and HVAC	How to detect saving opportunities
Oscar Wilde	Managing director	Influencer	17/10/16	23/9/16						
Agatha Christie	Energy management representative	Influencer	17/10/16	23/9/16			20/11/16	15/2/17		
Charles Dickens	Energy manager	Influencer	17/10/16	23/9/16						24/11/16
Jane Austen	Maintenance	Influencer	17/10/16	23/9/16						
Ernest Hemingway	Production	Influencer	17/10/16	23/9/16	25/10/16					
Virginia Wolf	Projects	Influencer	17/10/16	23/9/16		25/10/16		15/2/17		
William Shakespeare	Facilities	Influencer	17/10/16	23/9/16						
Mary Shelley	Purchasing	Influencer	17/10/16	23/9/16				15/2/17		
Umberto Eco	Environment	Direct							30/2/17	24/11/16
J.K Rowling	Finance	Direct							30/2/17	24/11/16

110

WHAT TRAINING IS NEEDED?	WHO NEEDS TRAINING?	WHAT INFORMATION IS NEEDED? WHAT EnMS DOCUMENTS (if any) ARE INVOLVED?	WHO IS RESPONSIBLE FOR CONDUCTING THE TRAINING? (Position)	HOW/WHERE WILL THE TRAINING BE DONE?	WHEN WILL THE TRAINING BE DONE?	WHAT WILL BE THE TRAINING RECORD ?
General EnMS Awareness	All employees New hires On-site contractors	Energy Policy Basic EnMS Awareness PPT Presentation	Energy Management Representative	Management meetings Shift meetings New Hire Orientation Contractor Orientation	Annually New Hire Orientation Monthly Contractor Orientation	Signature sheets Signature cards for contractors

Three Cogs



Awareness

The organization shall ensure that persons working for or on its behalf are aware of:

- Energy policy
 - Importance
- Procedures
- Roles, responsibilities and authorities
- Benefits of improved energy performance
- Impact actual or potential, respect to energy use and consumption,
- How their actions contribute to achievement of energy objectives and targets
- Potential consequences of departure from procedures

113

Awareness – Behaviour Change – Social Norms

- ✓ Safety Belts in Cars
- ✓ Smoking in public places
- ✓ Smoking while Pregnant
- ✓ Safety glasses
- ✓ Etc
- ✓ Etc
- ✓ Energy Waste?

114

Benefits

- Increased energy awareness
- Better decision making capability of staff
- Improved energy performance
- Improved qualifications of staff
- Increased understanding of processes and energy relationships



115

Connections



116

Success factors

- Many organizations produce competency requirements for each role in the organization.
 - If you choose not to do this, then determine which roles in your organization (or those working on behalf of your organization) perform work related to significant energy uses.
 - Don't forget about contractors or temporary workers.
- Utilize a well-defined system for identifying who needs what training and when it is required to be completed
- Keep training needs and training records organized!



117

Documents & Records

Documents

- Competency requirements
- Training needs

Records

- Competency records
- Training records



118

Tools

- Competency Tool
- EnMS Training Needs Planning Matrix
- Employee Training Record



119

Exercise 06

- Consider one of the SEUs that you have identified and the operational criteria required to operate the SEU in an efficient manner.
- List those personnel who operate and maintain the SEU (don't forget external contractors).
- Use the 3 step process in the Competency Tool to identify the competencies required to operate the SEU.
- Review with the team different ideas on types of competencies that may be necessary and examples of how this is currently managed.

120

Deliverables

- Define competency requirements for persons working with significant energy uses
- Identify energy training needs for energy
- Complete competency records for persons working with significant energy uses
- Update energy training records for energy



121

Day 1 End
Thank You

122

Energy Management System (EnMS) Expert Training

UNIDO International Energy Efficiency and EnMS Training

Module 2 Day 2

Delivered by: Richard Morrison, Stefan Walta

1

TODAY

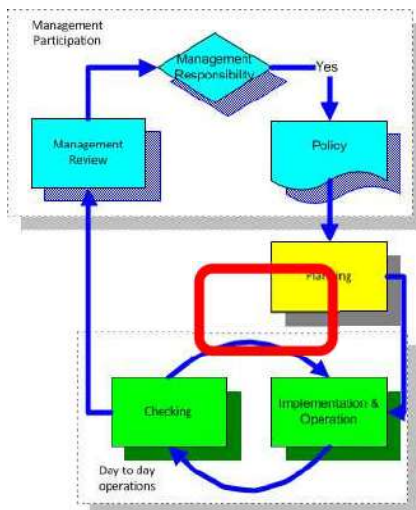
Start Time	End Time	TOPIC	DURATION (min)	EXERCISE (min)
08:00	08:30	Continental breakfast	30	
08:30	09:00	07 OBJECTIVES, TARGETS & ACTION PLAN REVIEW	30	
		* Review objectives & targets after discussing all the connections; revise action plans		
9:00	9:45	* Exercise 07: Review & report out		45
9:45	10:00	BREAK	15	
10:00	12:00	08 COMMUNICATION	30	
		* Exercise 08A: Brainstorm session (mixed groups)		30
		* Exercise 08B: Apply to company		20
		* Exercise 08C: Report out communications/training		40
12:00	1:00	LUNCH	60	
1:00	1:20	09 DOCUMENT CONTROL	20	
1:20	1:40	10 RECORDS CONTROL	20	
1:40	2:10	* Exercise 10: Determine documents/records		30
2:10	2:30	BREAK	20	
2:30	3:15	11 DEMONSTRATE WEB RESOURCES	45	
3:15	3:30	Daily Wrap Up	15	

2

Objectives, Targets and Action Plans Review

3

Planning



- How much energy am I using?
- Where am I using it?
- Which are significant users?
- What is driving it?
- Who is influencing its use?
- Do I need to have an energy audit?
- What are the best opportunities?
- System Optimization
- Renewable energy options
- Are there legal or other requirements?
- Develop baseline & indicators
- **Set objectives and targets**
- **Action Plans**

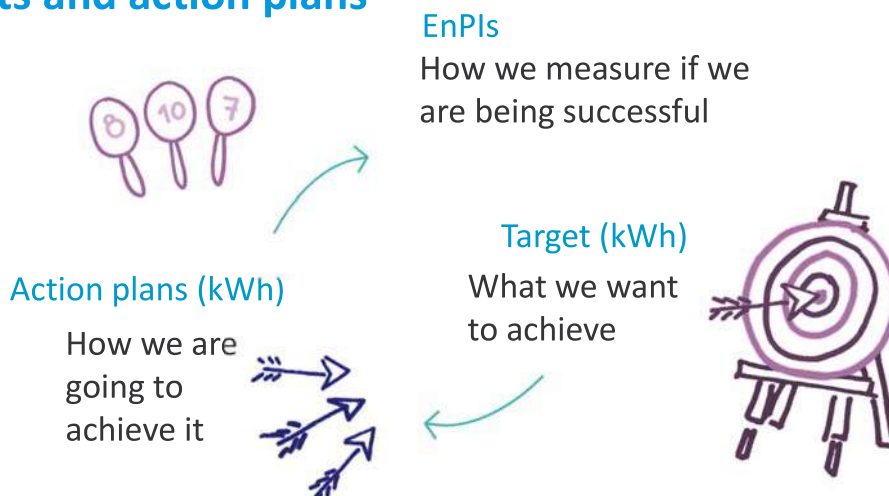
4

Purpose:

- Review Objectives and Targets
- Review Action Plans
- Incorporate EnMS Implementation and Operation considerations into Action Plans

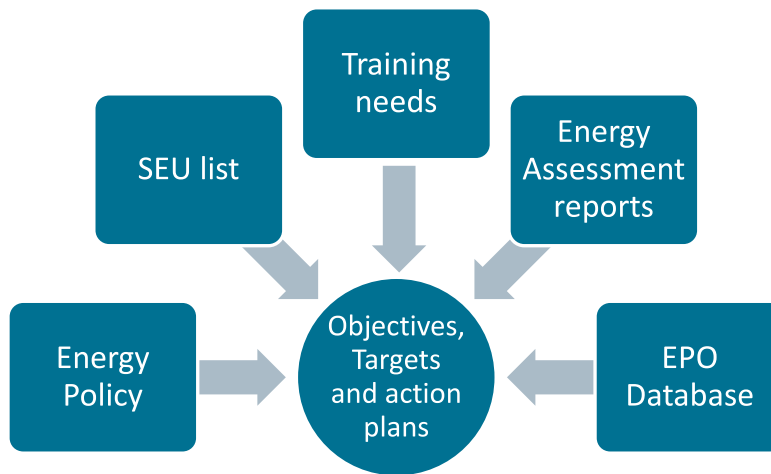
5

Targets and action plans



6

Objectives, Targets and action plan



7

Relationship



8

Three classes of “target”

1. Aspirational

- “Top down” possibly corporate
- Aggregate *e.g.* site-wide
- May be arbitrary
- Deliberately “stretching” ??

2. Bottom up based on action plans

- Based on what can actually be achieved
- Revised continuously
- Agreed with interested parties

3. Based on previous best performance

- CUSUM



In all cases should be “tough but fair”

9

1. Aspirational targets

- Top down: to challenge and drive improvement
 - Corporate target, *e.g.* 5%
 - Based on national targets *e.g.* EU2020
- Should be reflected in budgets
 - Padded budgets are a licence to waste energy
- Should be reflected in performance monitoring
 - *i.e.* reduce expected consumption by x%

10

2. Bottom up approach

- Identify all opportunities
 - Decide which you will action
 - The total of these is the target savings
 - Consider the effect of operational control
 - And reaction to deviations
 - Subtract from expected consumption
 - This is the method suggested in ISO 50001
-

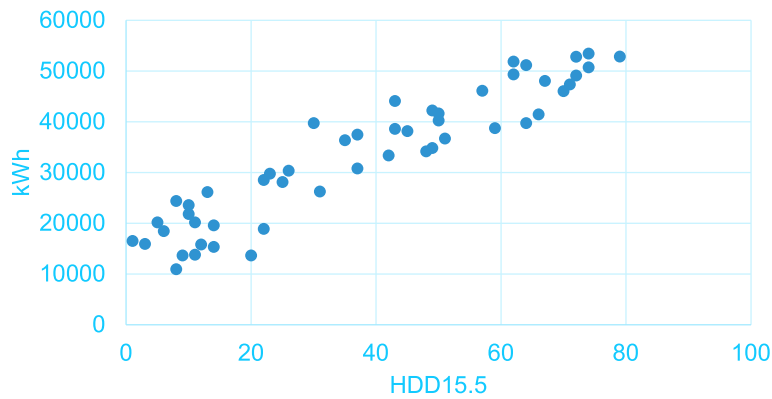
11

3. Previous best performance

- Previous best performance based on regression model(s)
 - Not necessarily best possible performance
 - Has been achieved with existing equipment and people
 - No investment required
-

12

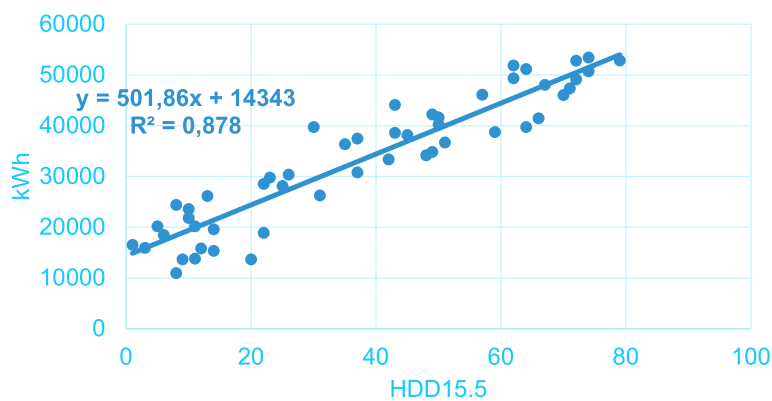
Setting an “aggressive but achievable” target



Raw data

13

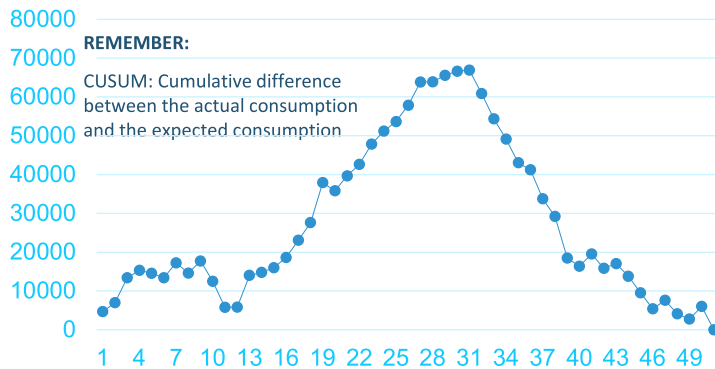
Setting an “aggressive but achievable” target



Regression line

14

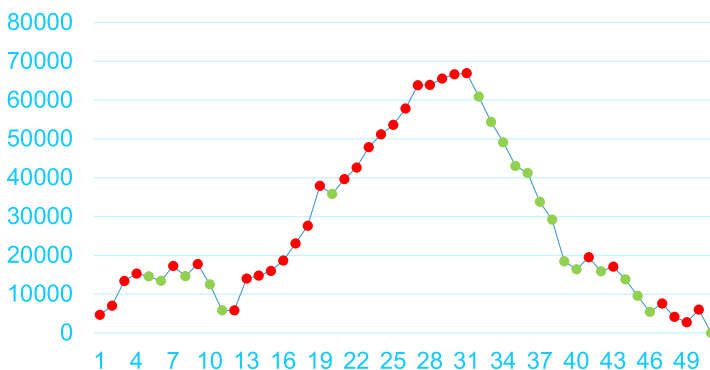
Setting an “aggressive but achievable” target



Initial CUSUM

15

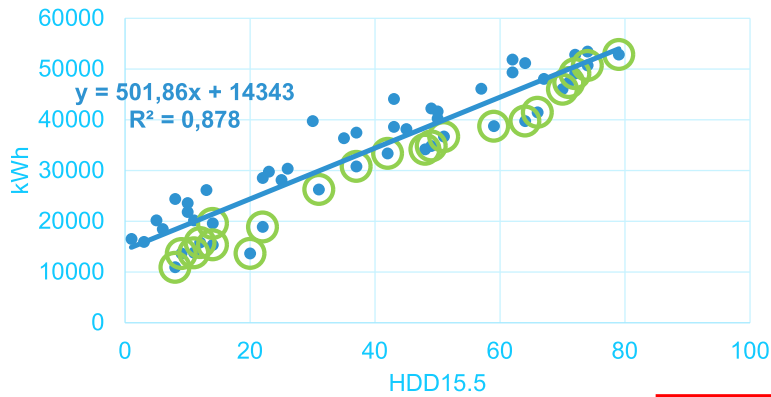
Setting an “aggressive but achievable” target



Period of best performance identified in Green

16

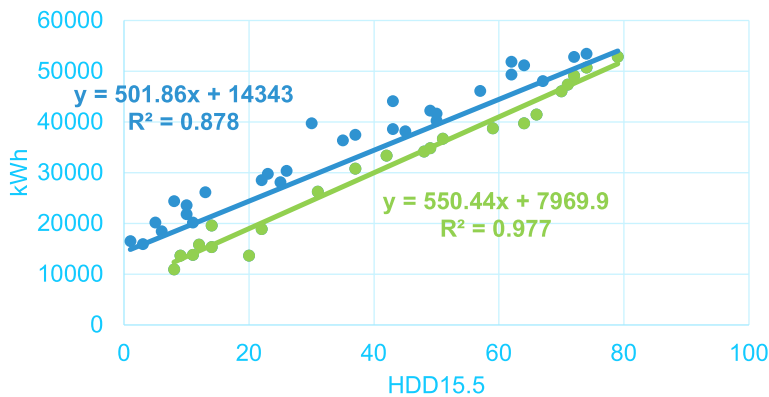
Setting an “aggressive but achievable” target



Raw data

17

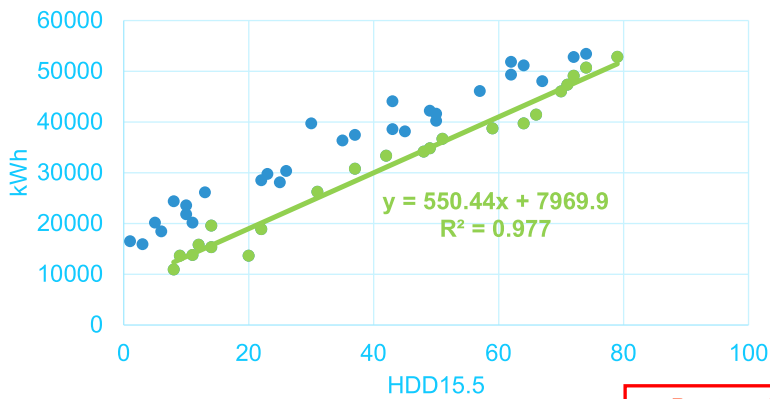
Setting an “aggressive but achievable” target



Regression of best performance period only

18

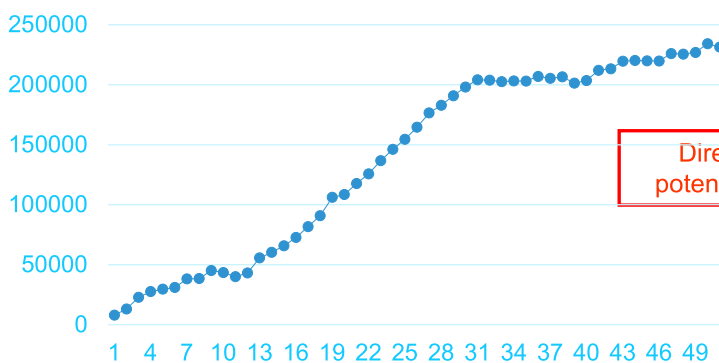
Setting an “aggressive but achievable” target



Best performance adopted as target

19

Setting an “aggressive but achievable” target



Directly read potential savings

CUSUM relative to best performance

20

Targets

Specific

- What is the task to be done, use action words
- What are the details?

Measurable

- How will we know if the task is complete and how well?

Achievable

- Is it possible and fair?
- Is training or personal development required?

Relevant

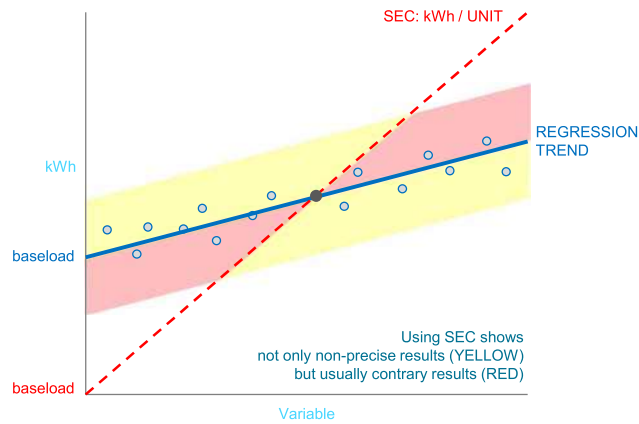
- Which objective is it supporting?
- In what way is it improving our energy performance?

Timed

- When will it be completed or how often?
- Does it need sub steps and are these SMART?

Selecting appropriate EnB(s)

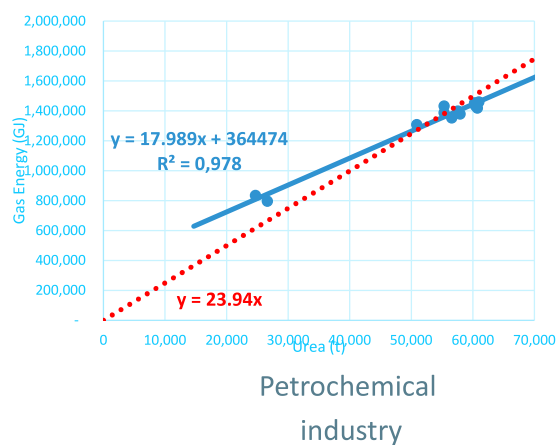
Regression vs SEC



23

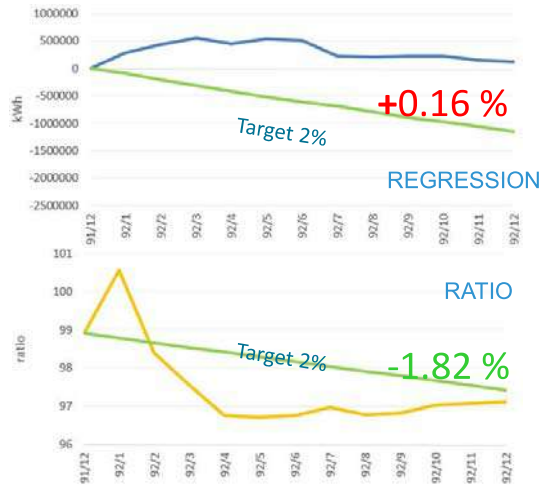
Regression vs SEC

Date	Driver Urea (Ton)	Gas Energy (GJ)	Ratio	
92-1	60,975	1,459,756	23.94	
92-2	60,439	1,433,852	23.72	
92-3	60,714	1,419,236	23.38	
92-4	55,317	1,387,274	25.08	
92-5	50,877	1,308,811	25.73	
92-6	60,266	1,453,399	24.12	
92-7	56,554	1,353,021	23.92	
92-8	57,929	1,379,231	23.81	
92-9	55,308	1,431,928	25.89	
92-10	26,606	796,450	29.93	average
92-11	24,672	835,078	33.85	
92-12	57,553	1,398,561	24.30	23.94



24

Regression vs SEC



Cement industry

25

Regression vs SEC



Cement industry

26

EnB process

1. Collect energy consumption data
 - The interval frequency (weekly or monthly) will decide frequency of analysis typically.
2. Consider (brainstorm) relevant variables and their data
 - Need full range of variables, e.g. hot and cold weather, high and low production. This could be 6 months or more up to a year typically.
3. Statistical tests
 - If SEC is accurate enough you can use it
 1. R2 and P-value
 2. Negligible baseload AND only one variable
4. Otherwise multivariable analysis is required.

27

Exercise

Consider your action plans, targets and EnBs
Are they adequate?
What corrective action will you take?

30 minutes

28

See you in 15 minutes!

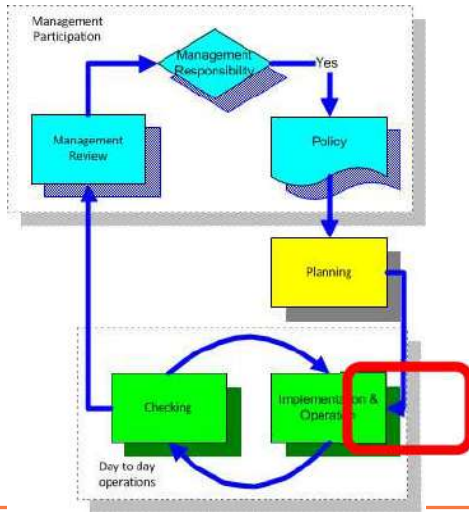


29

Communication

30

Implementation & Operation



- Competence, training and awareness
- Documentation
- Operational control
 - Key Area
 - Operation and Maintenance
 - Service Contractors
 - Training
- **Communication**
 - Design
 - Energy Efficient Design (EED)
 - Purchasing energy, services, goods
 - Action Plan

31

Communication

Internal Communication

- EnMS
- Energy performance
- Commitment, awareness, and understanding
- Process for comments or suggestions

External Communication

- Plant decision
- Must be recorded
- Plan for communication developed



32

Types of Communication

- Internal
 - Inside the facility
 - Between different levels, functions, shifts
 - Written procedures, newsletters, bulletin boards, intranet, emails, communication screens, universal screen savers
- External
 - Outside of the facility
 - Regulators, media, community members, etc.
 - Community meetings, newspaper, television, website

33

Internal Communication



- Policy
- Significant energy uses
- Objectives, targets, action plans
- Energy performance
- Responsibilities
- Suggestion process

34

Suggestion Process

- Anyone can make suggestions
 - Employees
 - Temporary Workers
 - Contractors
- Need a means to collect suggestions
- Need a means to direct them to the correct person(s) for evaluation
- Need a means to respond and implement where appropriate
- Need evidence it is working



Suggestion/Request: _____

Suggestion submitted by: _____

Date of Suggestion: _____

Request Directed to: _____

Response to your request—

👍 thumbs up! 🤔 We're checking into it.

👎 Hmm, we need more information.

Additional Comments: _____

External Communication

Decision

- Needed
- Recorded

If Yes:

- Plan
- Responsibilities and authorities

Communicate

- Energy performance
- EnMS
- Energy policy
- Others

Stakeholders

- Regulators
- Community
- Board
- Others



Develop External Communication Method

- Receive
 - Who will receive the request for information regarding the EnMS?
- Document
 - Where is the request for information recorded?
- Respond
 - Who is responsible for responding to requests regarding the EnMS?



37

External Communication Records

- External communication can be recorded on a log
 - Receiving information – name, organization, date, contact information, and details of the request
 - Responding information – date, summary of response, name of responder
- Or, a separate record form can be completed for each external communication

38

Typical Barriers

- Ignoring existing communication mechanisms
- Not engaging facility personnel and contractors in the suggestion process
- Showing bias in considering ideas
- Providing feedback slowly



39

Value to the organization

- Employees will understand energy is a priority to the organization
- Employees and contractors will be more aware of energy consumption and their impact
- Employees will take more ownership of energy performance and the EnMS
- Another avenue for identifying issues or opportunities



40

Documents & Records

Documents

- Plan for external communication, if applicable

Records

- Decision to communicate externally
- Internal communication records
- Suggestions from employees and contractors
- External communication records

41

Tools

- Suggestion Form
- Internal Communication Planning Worksheet
- External Communication Planning Worksheet
- External Communication Record
- External Communications Log



42

Deliverables

- Determine and record if the organization will communicate externally about the EnMS
- Develop a comment or suggestion process for the EnMS



43

Exercise 08-A

- Split random in groups
- Consider the EnMS and discuss the following communication needs:
 - What energy related information is important and to whom should it be provided?
 - What energy awareness topics should be communicated?
 - What are some techniques for providing appropriate EnMS and awareness information? (In addition to “standard” communication methods, think outside the box of unique ways for providing relevant EnMS information.)
 - What are some techniques for providing/receiving suggestions and comments?

44

Exercise 08-B

- Select a spokesperson
- Summarize the ideas from each of the four items from the brainstorming session of Exercise 6-1.



45

Exercise 08-C

- Reorganize teams by company
- Review ideas recorded on the flip charts
- Discuss the ideas and consider the information topics currently addressed and the communication systems currently utilized in your organization.
- What potential gaps exist in your information flow and what new or revised techniques may be appropriate for communication? Layout a few basic steps of what you will do for addressing internal and external communication when you return to your organization.
- Select a spokesperson for a brief report out of specific communication ideas you will address in your organization.

46

See you in 60 minutes!



47

Document Control

48

Document Control – Value to the organization

- Ensures correct information is available where needed
- Manages external information and obsolete information



51

Typical Barriers

- Overly complex formats
- Excessive controls
- Too many levels of approval
- Document managers/coordinators
- Lack of ownership



52

Expert's Role in Document Control

- Check for and understand existing document controls and systems and facilitate leveraging or integrating with what's already in place.
- Make suggestions for simple controls that can get the job done.
- Ensure that responsibilities and authorities for controlling documents are clearly defined and communicated.
- Test the system to ensure that users can access the documents they need and know that they are the correct and current versions



53

Success Factors

- Don't make the process cumbersome
- Align or integrate with existing document control processes as appropriate
- Allow stand-alone (but controlled!) documents



54

Deliverables

Develop document control procedures for energy management

Tools:

- Document Control Index
- Checklist of Document Control Basics

55

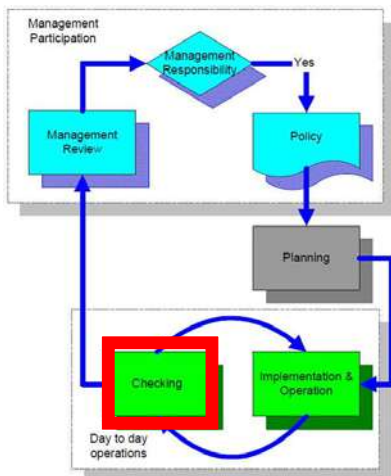
Questions for Discussion

- Did you use the Checklist of Document Control Basics to review and evaluate the company's existing system(s) for controlling information?
- Are there any features of the existing system(s) that need to be modified to accommodate control of EnMS documents?
- Who else needs to be involved in helping the energy team establish control of EnMS documents?

56

Records Control

57



Records

- Records support the CHECKING processes by providing evidence that you are doing what you said you would do.
- Controlling records means controlling the data and other evidence that your system is implemented and effective.

58

Records

- provide evidence of activities performed
- state results achieved



59

What records are needed?

- Records that demonstrate
 - Conformity to EnMS requirements
 - Energy performance results achieved of performance
- Some specific records are required, for example
 - Energy review
 - Baseline
 - Measuring and monitoring results
 - Management reviews



60

What record controls are needed?

- Define and implement controls for
 - Identification
 - Retrieval
 - Retention
- Ensure records are legible, identifiable and traceable (and stay that way)



61

Records control - Value to the organization

- Ensures that you can tell what the recorded data or information is related to
- Ensures that records can be located and retrieved
- Expectations for retention of data and information are clear



62

Consider

- using a records table or index
- assigning record owners (by responsible position)
- legal requirements in setting retention times



Record Owner (Responsible Position)	Identification	Maintenance (Responsible Position)	Storage Location	Retrieval	Minimum Retention Time
EnMS Mgt Rep	Internal Audit Reports	Quality Mgr	K:\MS\records\AuditRepts	Date	2 years
EnMS Mgt Rep	Management Review Minutes	EnMS Mgt Rep	K:\Energy\Records\MgtReview	Date	2 years

Expert's Role in Record Controls

- Don't make the process cumbersome
- Help the company align or integrate with existing records policies as appropriate
 - Corporate records policies
 - Other management systems
 - Legal and other requirements
- Clearly define responsibilities
- Ensure ease of retrieval



65

Tools

- EnMS Document/Records Index

66

Deliverables

- Develop a mechanism for controlling records

67

Exercise 10: Documents and Records

During your Phase 1 implementation efforts, what documents and records have you generated?

How are you controlling your energy data to ensure that it is identifiable, retrievable and kept for a specified period of time?

Based on your discussions with your team members, are there any “back at the office” actions you need to address to ensure both control of records and control of documents?

68

Demonstrate Web Resources

69

Tools List

There are many tools available to provide guidance and implementation techniques. Here are just a few:

- BESS (European Union), Benchmarking and Energy management Schemes in SMEs, <https://wayback.archive-it.org/12090/20210201143503/https://ec.europa.eu/energy/intelligent/projects/>
- And <https://www.lei.lt/en/projektas/bess/>
- SEAI, Sustainable Energy Authority of Ireland, <http://www.seai.ie/>
- U.S. Department of Energy, <https://www.energy.gov/eere/office-energy-efficiency-renewable-energy>
- Superior Energy Performance (US), <https://www.energy.gov/eere/iedo/superior-energy-performance>
- Measure, online tool DOE: <https://measur.ornl.gov/>

70

**Day 2 End
Thank You**

Energy Management System (EnMS) Expert Training

UNIDO International Energy Efficiency and EnMS Training

Module 2 Day 3

Delivered by: Richard Morrison, Stefan Walta

1

Today

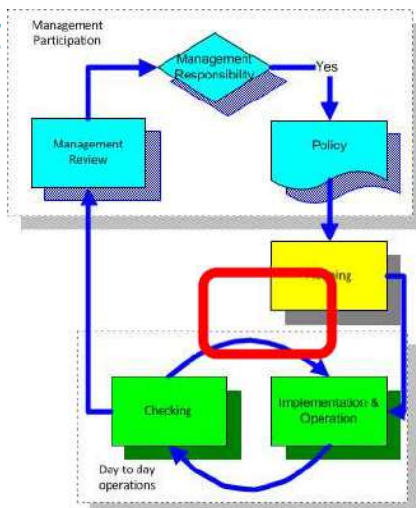
Start Time	End Time	TOPIC	DURATION (min)	EXERCISE (min)
08:30	09:00	Continental Breakfast	30	
9:00	9:45	12 ENERGY PERFORMANCE, EnPI AND BASELINE REVIEW	45	
9:45	10:00	* Exercise 12: review EnPI, modifications, system for calculating		60
10:00	10:15	BREAK	15	
10:15	11:00	* Exercise 12 continued		45
11:00	11:45	13 MONITORING, MEASUREMENT & ANALYSIS	45	
11:45	12:45	LUNCH	60	
12:45	2:00	* Exercise 13A: Key characteristics & data analysis		45
		* Exercise 13B: Develop measurement plan		30
2:00	2:15	BREAK	15	
2:15	2:30	14 KEEP EnMS UP TO DATE	15	
		* Update legal, EPOs, action plans, documents, policy; changes in energy review, baseline, documents, mgt. review		
2:30	3:00	* Exercise 14: checklist exercise for updating system		30
3:00	3:15	15 MANAGEMENT REVIEW	15	
		* Communication process for implementation: resources, reality check		
3:15	3:45	BACK AT THE OFFICE / NEXT STEPS	30	
3:45	4:00	Daily Wrap Up	15	

2

Energy Performance, EnPI and Baseline Review

3

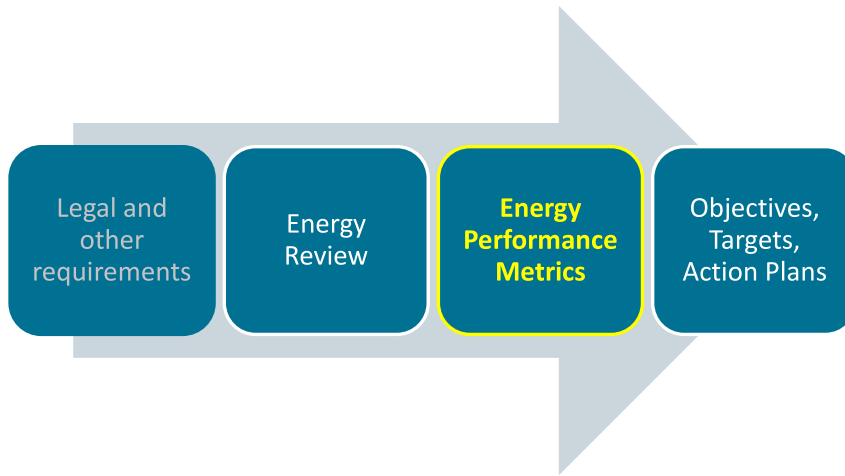
Planning



- How much energy am I using?
- Where am I using it?
- What Legal requirements are related to my energy use?
- What Other requirements are related to my energy use?
- Which are significant users?
- What is driving it?
- Who is influencing its use?
- Are there opportunities for improvement?
- What is my future energy picture?
- System Optimization
- Renewable energy options
- Are there legal or other requirements?
- **Develop baseline & indicators**
- Set objectives and targets
- Action Plan

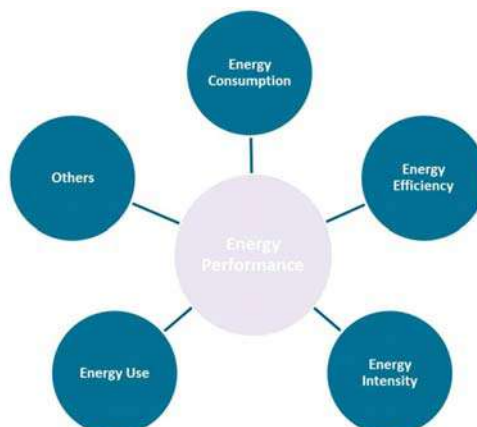
4

Energy Planning



5

It's all about improving energy performance



6

Energy Performance

EnPIs & Baseline

- EnPIs are used to measure energy performance
- Baselines are established to provide a reference or starting point for measuring energy performance

Measurement & Verification (M&V) protocols provide guidance on how to calculate energy savings.

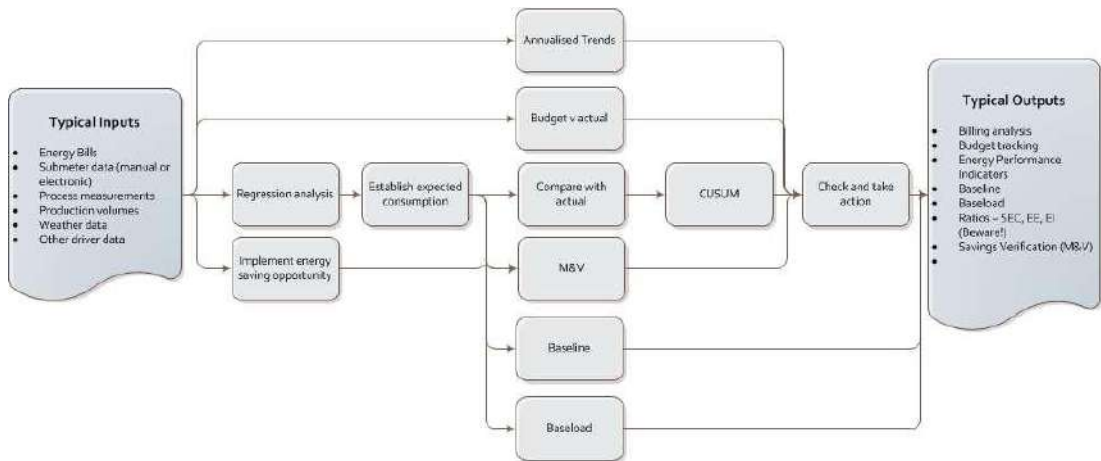
7

Purpose of energy metrics

- Objective support for decision making
 - Often subjective reasons
- We need to know how much energy we are using
- We need to know if performance is improving or not
- We need to know if we are meeting targets
- We need to be able to verify savings of improvements
- We need to establish the following:
 - Baseline
 - Baseload
 - Performance indicators (EnPIs)
- Numerical basis

8

Overview of metrics



9

Example Performance Indicators

- Facility-wide EnPIs
- Process-unit level
 - Product specific
 - Process specific
- Energy System level
 - Compressed Air – kW / m³/sec
 - Steam systems – kWh / kg/hr
 - Furnace – kWh / unit

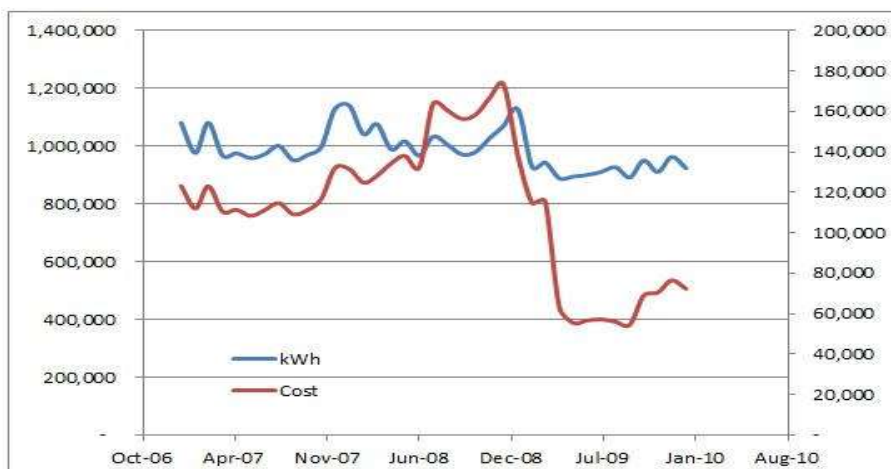
10

Energy Metrics

- Various levels of complexity
- Simple:
 - Simple: consumption last month v same month last year
 - Simple: compare actual consumption with budget
 - Simple: annualised trend of cost and consumption
- More complex
 - Energy use per unit output
 - Cooling energy per cooling degree day
 - Specific energy consumption (SEC)
- Same principles apply to EnPIs and verification of savings

11

Electricity Use and cost (monthly)



12

Simple EnPI

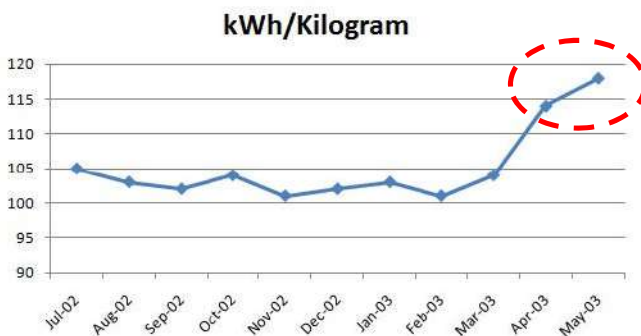
$$\text{EnPI (simple)} = \frac{\text{Annual Energy Consumption (kWh/year)}}{\text{Annual Production (e.g. KG/yr, units/yr)}}$$

- Easiest to use and calculate
- Sufficient if other variables don't impact energy consumption
- KISS rule: keep EnPI as simple as possible
- Watch out!

13

kWh/Kilogram

What Caused Increase in Energy Intensity (kWh/Kilogram)?



- Did the plant start using energy more inefficiently?
- Or, did other variables impact energy consumption?

14

Complicating Factors

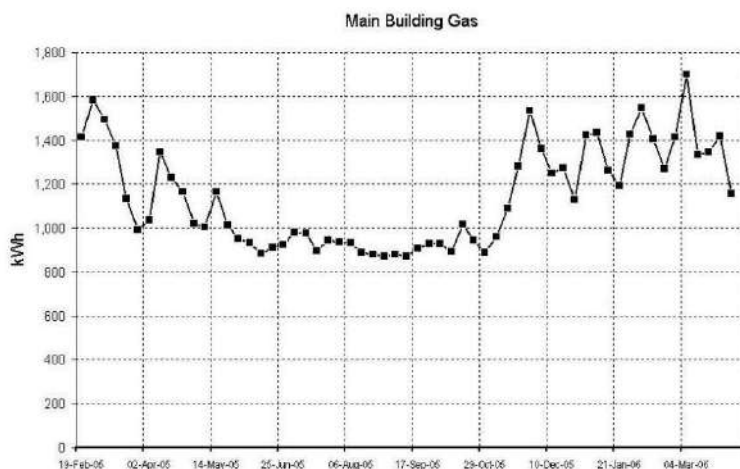
To answer these questions, we need to understand what variables impact energy intensity. Often there are complicating factors in 3 broad areas:

- Production
- Energy types/uses
- Other



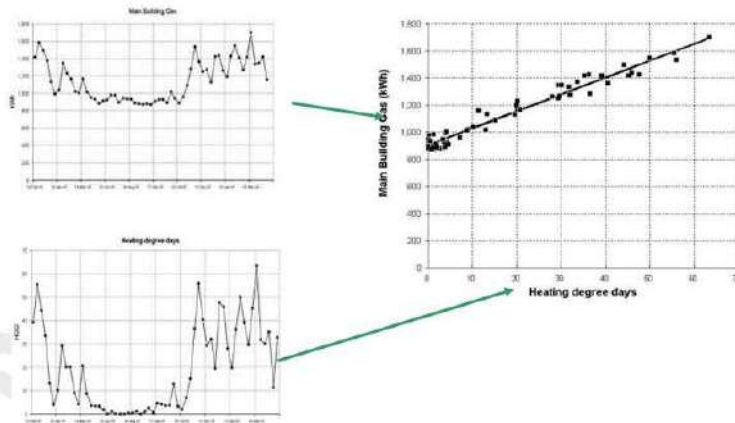
15

Example: Dryers



16

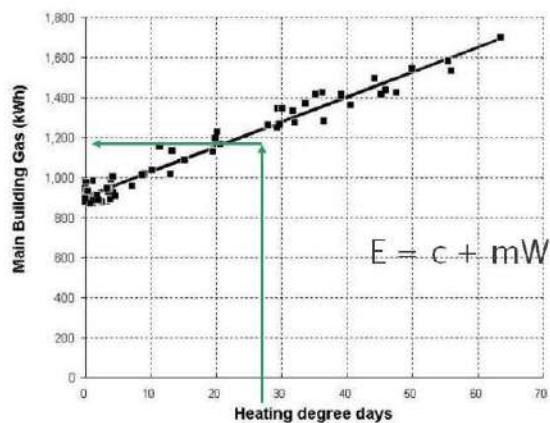
Example: Determine drivers



Gas consumption plotted against degree days

17

Scatter plot



Gas consumption plotted against degree days

18

Other models

Multivariate linear regression:

$$Y = b + m_1X_1 + m_2X_2$$

Polynomial linear regression:

$$Y = b + m_1X_1 + m_2(X_2)^2$$

Nonlinear regression (energy use in cement industry):

$$E_i = \beta_0 + \beta_1 \ln(\text{capacity}) + \beta_2 \ln(\text{labor hours}) + \beta_3 \ln(\text{total cement production}) \\ + \beta_4 \ln(\text{number of kilns}) + \beta_5 (\% \text{ masonry}) + \beta_6 (\% \text{ 4 or other}) \\ + \beta_7 (\% \text{ wet}) + \varepsilon_i$$

Courtesy of Argonne National Laboratory and EPA, ANL/DIS-06-3

19

Modeling Energy Consumption

- In order to determine the variables that impact energy consumption, use energy review to assess/understand how energy is used.
- Use the EnPI (KPI) Tool to assess variables impact on energy consumption.
- The EnPI (KPI) Tool implements statistical methods to help determine what variables impact energy consumption (multivariable linear regression).
- Those relevant variables (e.g. production, ambient temperature, etc.) are used to model energy consumption and develop an energy intensity.

20

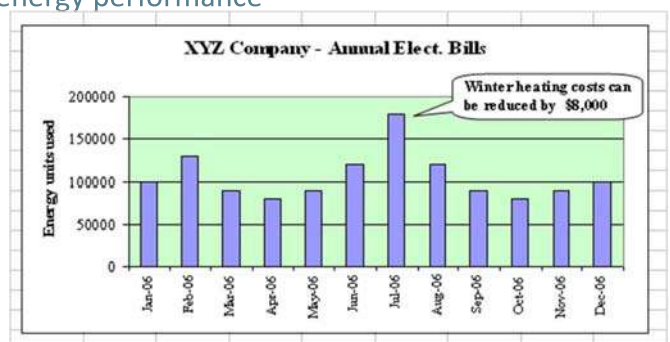
Typical Barriers for EnPI & Energy Metrics

- Not identifying all energy sources from the very beginning
- Neglecting any significant changes that have occurred during the baseline development period and since that time
- Not identifying driving factors
- Dedicating resources to EnPI development who are not familiar with processes or understand EnPIs
- Not using the EnPI to report improvement to management

21

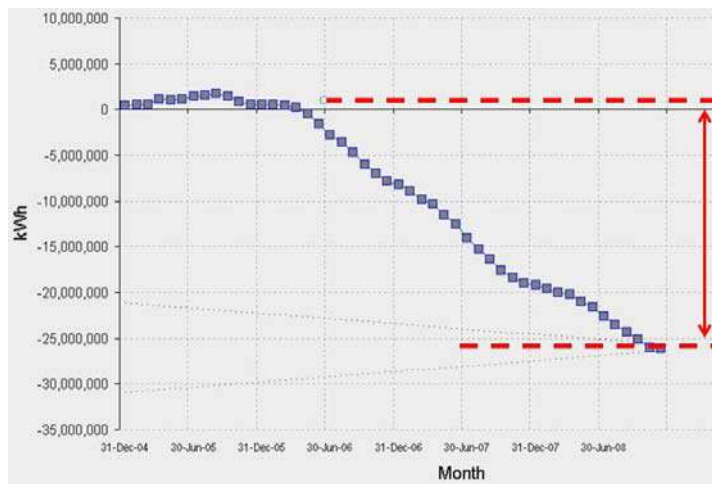
Energy Baseline (EnB)

- Basis of comparison for evaluating energy performance
 - Facility wide
 - System
 - Equipment
 - Significant energy uses
- Uses pieces of initial energy review
 - Energy use data
 - Energy consumption data
- Facility-determined time period
 - Point in time
 - Period of time
- Measure energy performance improvement against the baseline



22

Cumulative savings can be tracked



23

CUSUM

CUmulative **SUM** of deviation from expected consumption

➤ Equals the sum of the residuals

• Key technique for...

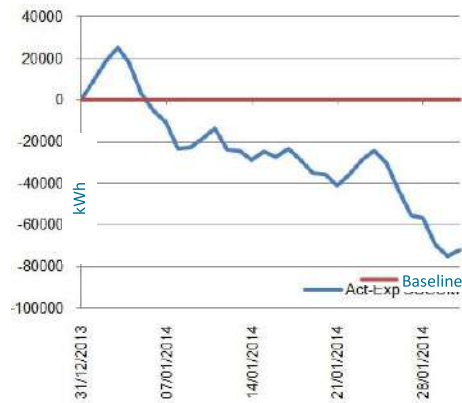
- Target-setting
- Diagnosing changes in performance
- Tracking savings achieved

	A	B	C	D	E
1				Act. – Exp.	
2		Expected	Actual	Difference	Cusum
3					
4		442	449	7	7
5		341	338	-3	4
6		261	274	13	17
7		136	137	1	18
8		81	83	2	20
9		120	115	-5	15
10		120	120	0	15

24

Cumulative sum of the difference between actual and expected consumption

Day	KWh	Expected	Act-Exp	Act-Exp CUSUM	LnPC
31/12/2013		0	0	0	0
01/01/2014	107428	95375	12053	12053	1.09
02/01/2014	78548	6925	71623	83676	1.13
03/01/2014	82165	58042	24123	107799	1.12
04/01/2014	69589	75803	-7214	100585	0.90
05/01/2014	68019	82903	-14884	85701	0.82
06/01/2014	72558	83875	-11317	74384	0.90
07/01/2014	80609	86417	-5808	68576	0.94
08/01/2014	57674	94189	-36515	32061	0.87
09/01/2014	101411	107077	-5666	26395	1.00
10/01/2014	103003	104394	-1391	25004	1.04
11/01/2014	105008	107094	-2086	22918	1.05
12/01/2014	100170	103332	-3162	19756	0.91
13/01/2014	100970	101215	-2245	17511	1.00
14/01/2014	104885	103333	1552	19063	0.96
15/01/2014	97125	93507	3618	22681	1.04
16/01/2014	94610	97057	-2447	20234	0.97
17/01/2014	124637	133395	-8758	11476	1.04
18/01/2014	126703	134234	-7531	3945	0.96
19/01/2014	131501	12785	118616	118616	0.94
20/01/2014	171753	102595	69158	187774	0.99
21/01/2014	107193	102635	4558	192332	0.95
22/01/2014	107817	102175	5642	197974	1.06
23/01/2014	12193	105400	-93207	108667	1.06
24/01/2014	104543	100085	4458	113125	1.04
25/01/2014	90623	104637	-14014	99111	0.94
26/01/2014	105335	103637	1699	100810	0.89
27/01/2014	115323	127085	-11762	89048	0.91
28/01/2014	115232	117815	-2583	86465	0.99
29/01/2014	125488	137532	-12044	74421	0.91
30/01/2014	141070	145680	-4610	69811	0.96
31/01/2014	124369	122034	2334	72145	1.02

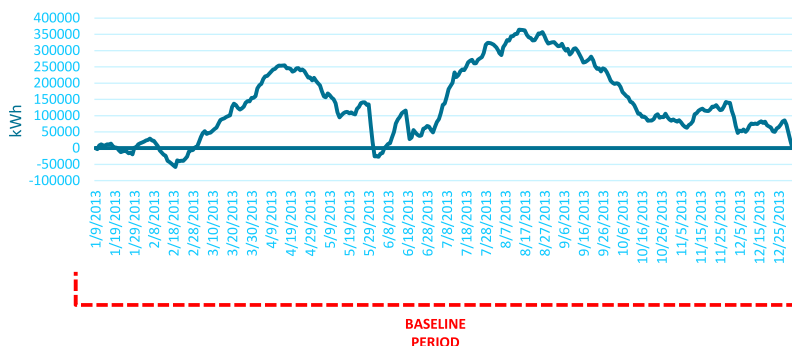


Drink industry

25 25

Why does CUSUM end at zero in the baseline period?

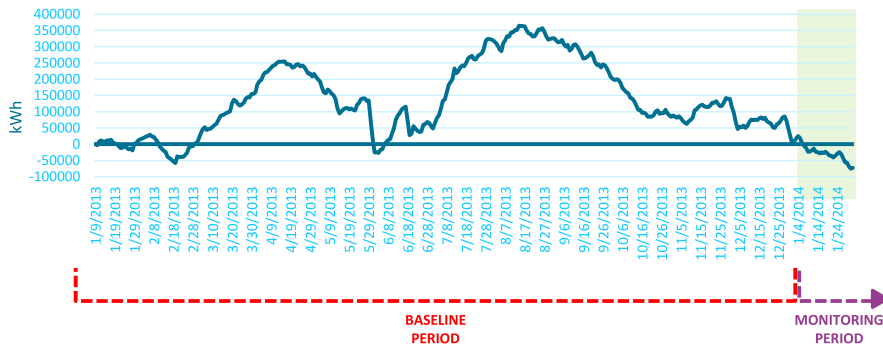
CUSUM always starts at zero and ends at zero when you compare actual and expected consumption in the baseline period



26

Monitoring period

In the monitoring period, CUSUM always starts at zero. The value at the end of the line represents the total savings (if negative) or excess of consumption (if positive).



27

Monitoring and Reporting

SERVICE	TARGET	ACTUAL	SAVINGS		COST		AVERAGE	
	7 days	7 days	YTD	7 days	YTD	7 days	7 days	
Chilled Water	38,960 kWh	24,273 kWh	36%	€ 10,188	-€ 1,788	€ 38,730	€ 2,593	144 kW
Compressed Air	60,962 kWh	68,206 kWh	6%	€ 12,829	€ 431	€ 215,368	€ 7,285	406 kW
Cold Glycol	57,645 kWh	66,901 kWh	-5%	-€ 13,019	€ 665	€ 238,002	€ 7,146	398 kW
Steam	31,668 Nm ³	32,874 Nm ³	0%	€ 684	-€ 49	€ 709,889	€ 3,512	196 Nm ³ /h
Utility Electricity			2%	€ 9,999	-€ 692	€ 492,100		
Utility Gas			0%	€ 684	-€ 49	€ 709,889		

- The three things are **compatible**
- **Reporting** is essential to **get support and to trigger action**
- The **objective is to improve**, not to write reports
- It can be **automated**, reducing time spent. **Be focused on action**

28

Adjust Energy Baseline (EnB)

- Major process changes
- Major operational changes
- Major energy system changes
- When EnPIs no longer reflect organizational use
- As determined by the organization (predetermined method)

29

Typical Barriers for Baseline

- Failure to collect appropriate data for baseline
- Identifying inappropriate baseline for energy performance measurement
- Failure to identify appropriate time frame
- Failure to identify baseline during initial energy review
- Failure to record baseline(s)
- Failure to adjust baseline(s) based on changes



30

Expert's Role with EnPI & Baseline

- Help organization to understand how to measure energy performance of SEUs
- Assist with determining drivers
- Help determine appropriate EnPI for SEUs and for measuring performance of entire EnMS
- Determine data needs for performance evaluation
- Help the facility determine baseline from the initial energy review
- Help the facility organize and record the baseline(s)

31

Documents & Records

Documents

- Identified Energy Performance Indicators (EnPIs)
- Method for determining and updating EnPIs
- Energy management baseline

Records

- Baseline (data pieces of initial energy review)
- Review and comparison of EnPIs to baseline

32

Exercise 12

- Review your organization's EnPIs and SEUs.
- How are you measuring energy performance of SEUs?
- How are you measuring energy performance of the entire EnMS?
- Do you need additional data or metering?
- What are the limitations of your EnPIs?
- Do you need to modify them?

33

Deliverables

- Develop Energy Performance Indicators (EnPIs)
- Document method for determining and updating EnPIs
- Determine Baseline (data pieces of initial energy review)
- Methodology for baseline development recorded



34

Different aspects of performance measurement

35

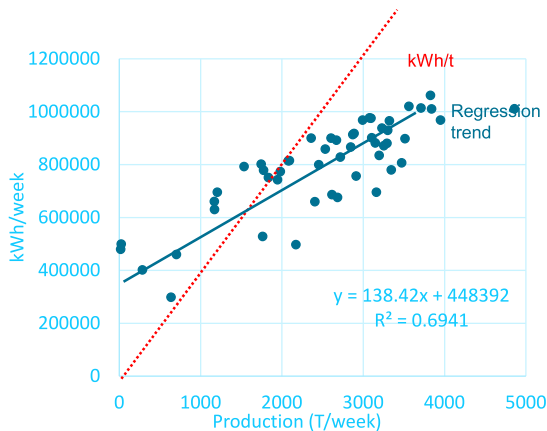
Section	Common application
Legal and other requirements	In some countries there is a legal requirement to measure and report specific energy consumption (SEC). The same applies in some organisations. If this requirement exists, it must be conformed with. This a not substitute for monitoring the energy performance of the organisation itself as required in the planning and checking parts of an EnMS.
Planning	Part of the planning process is to develop energy baselines and energy performance indicators. These will be used to monitor the energy performance of the organisation. In order to be effective these need to be normalised for any relevant variables that affect energy consumption.
Awareness and training	The effectiveness of awareness campaigns could be measured by comparing behaviour before and after the training. For example one could count the number of personal computers left on when not in use before and after an awareness campaign.
Operational control	In developing operational controls for SEUs critical operating parameters will be established. Monitoring these parameters is a form of energy performance measurement.

36

Section	Common application
Design and Procurement	When selecting equipment and designs that will affect energy consumption or performance take account of the efficiency of the equipment and systems. This includes such factors as boiler efficiency, pump and motor efficiency, coefficient of performance of refrigeration systems, etc. These and other performance indicators should be used in combination with the cost of ownership over the life of the equipment and system.
Action plans	Completed action plan items need to have their actual savings measured and verified. This M&V activity is a form of energy performance measurement. It is a valid method where regression models are not possible.
Budgets and forecasting	Trends in absolute energy consumption are required to develop financial budgets and to monitor actual spending compared to budget.
Checking	All of the above need to be checked and compared with expected results

37

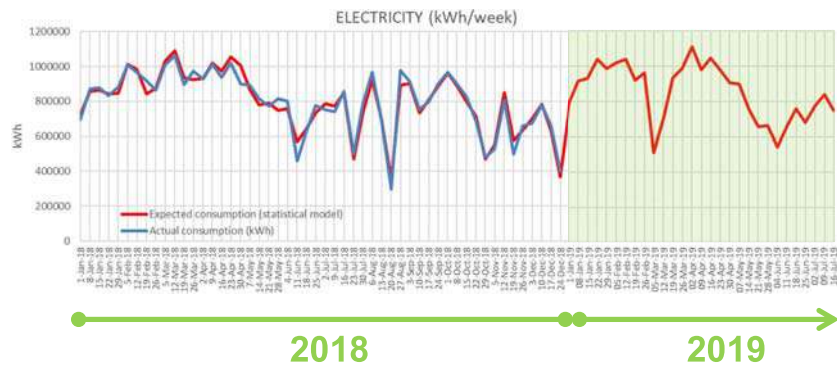
What do we see here?



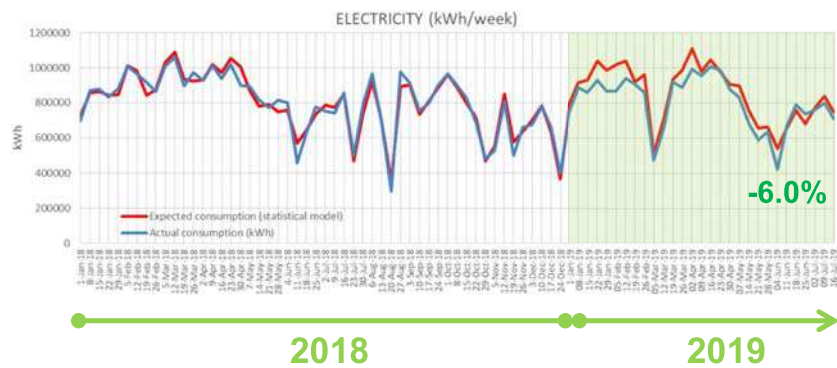
- SEC line is far from best fit line
 - Baseload
- Why large dispersion?
 - Data?
 - Other variables?

38

ELECTRICITY: Using the model to predict values in 2019



ELECTRICITY: Calculating real savings



ELECTRICITY: Showing the results



41

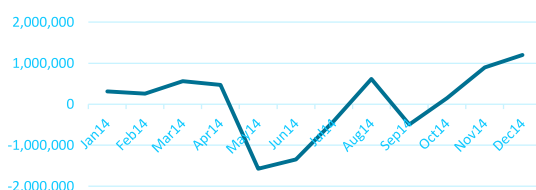
Updating Baselines

- Different results depending on which year is selected as baseline
- Using 2012 baseline 2014 looks good
- Using 2013 baseline 2014 is not good
- Select based on which is the most representative,

CuSUM Energy Savings 2013-14 kWh (2012 Baseline)



CuSUM Energy Savings 2014 kWh (2013 Baseline)



42

Discussion

Can you demonstrate energy performance improvement if you can't build good EnBs?

10 mins

43

See you in 15 minutes!



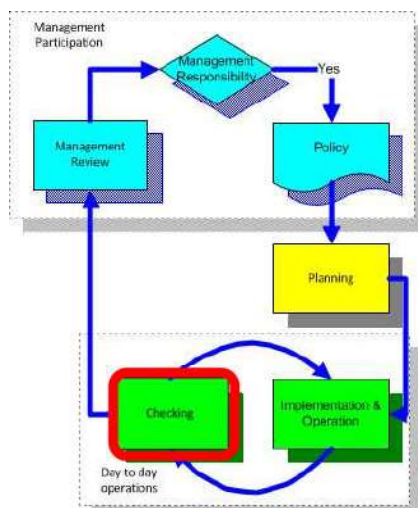
44

Monitoring, Measurement and Analysis

45

45

Checking



- Check Operations
 - Check operator records
 - Check maintenance records
 - Equipment checking
- Check the system
 - Is everyone doing what is required?
- Check Performance
 - Check EnPIs
 - Check trends and costs
- Check progress
 - Against plans

46

Definitions

- Monitoring
 - Passive, periodic, or intermittent
 - Monthly utility bills, periodic check of a continuous monitor
- Measurement
 - Active, point reading
 - Stack analyzer readings
- Analysis
 - Make use of the data
 - Determine performance
 - Identify issues

47

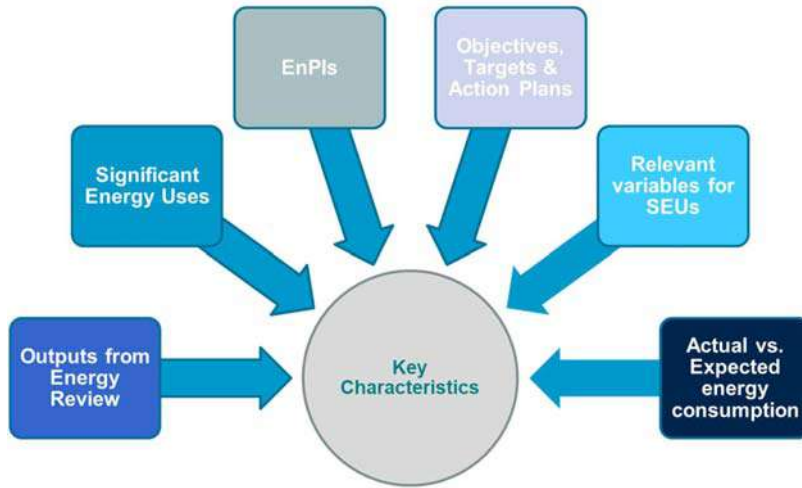
Monitor, measure and analyze key characteristics

- Identify key characteristics – Factors that determine an organization's energy performance
 - Confirm operation at peak efficiency
 - Detect performance degradation
 - Verify effect of improvement activities
- Determine appropriate intervals
- Record results
- Energy review data helpful



48

Key Characteristics



49

What are the Key Characteristics?

- Significant energy uses
- Significant energy use relevant variables
- EnPIs
- Other outputs from energy review
 - Energy sources, uses and consumption
 - Future energy use
 - Energy improvement opportunities
- Progress toward meeting objectives and targets
- Expected vs. actual energy consumption evaluation



50

Data Collection Sources

- Significant energy uses
 - Primary metering
 - Sub-metered data
 - Spot measurements
 - Equipment meter data
 - Portable measuring equipment data
- Significant energy use relevant variables
 - Relevant variable impacting energy consumption (pressure, temperature, etc.)
 - Monitoring of the variables utilized to ensure the relationship is still valid



51

Data Collection Sources

- EnPIs
 - Input variable data
 - Utility billing meter data
 - Sub-metered data
 - Equipment meter data
- Energy use and consumption
 - Utility billing meter data
 - Sub-metered data
 - Operating hours, load factors, duty factors
 - Energy assessments
 - Equipment meter data



52

Data Collection Sources

- Future energy use – Monitor assumptions used to calculate future energy use
 - Production forecasts
 - Equipment purchase plans
 - Weather
 - New technologies
 - Process changes
 - Economic forecasts
- Energy improvement opportunities
 - Sub-metered data
 - Criteria for becoming an action plan (how do you move up or off the list?)



53

Data Collection Sources

- Progress toward meeting targets and objectives
 - Comparison of before and after energy use
 - Utility billing meter data
 - Sub-metered data
 - M&V measurements
 - Action item completion
- Expected vs. actual energy consumption evaluation
 - Utility billing meter data
 - Sub-metered data
 - Direct comparison of data
 - Calculation of energy savings.



54

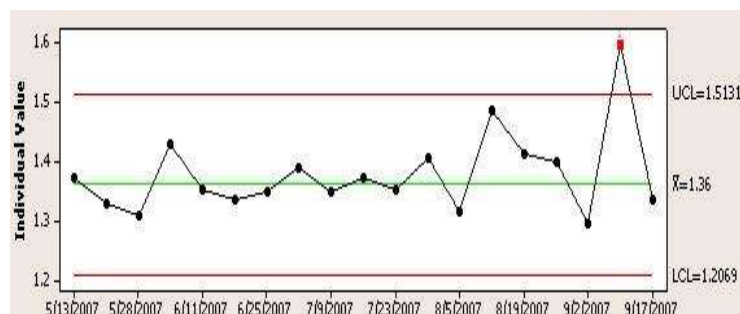
Data Collection Considerations

- What key characteristic data will be collected?
- Are there instruments/meters in place to collect the appropriate data?
- What actions are required to keep the instruments/meters operating properly?
- What type of maintenance records are going to be kept?
- Who will collect the key characteristic data?
- How often will key characteristic data be collected?
- How and where will the information be stored?

55

Analysis of Key Characteristics

- What type of data analysis method will be used?
 - Absolute analysis
 - Control limit analysis
 - Trend analysis
 - Benchmarking



56

Analysis of Key Characteristics

- What are important analysis questions ?
 - Has your energy performance improved?
 - Has the energy balance changed?
 - Are significant uses changing?
 - How effective is the system in meeting energy objectives and targets?
- How often will data analysis be completed?
- How will data and analysis results be recorded?

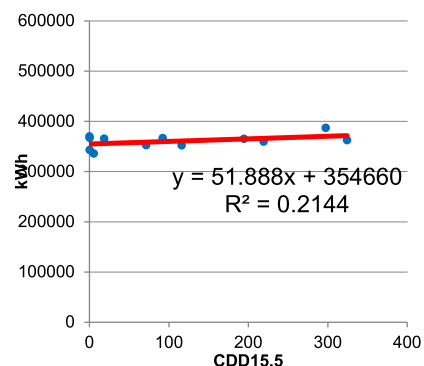


57

For Example how much could we save here?

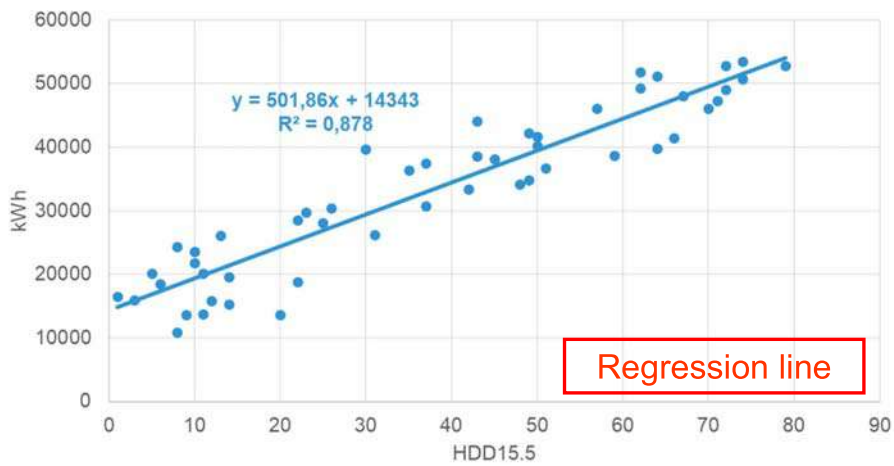
Electricity data taken from an office building in Spain.

- Main variable must be CDD.
- Regression shows low R².
- We would have expected high R².
- **Saving opportunities in operational control.** It consumes the same in winter and in summer.



58

For Example how much could we save here?



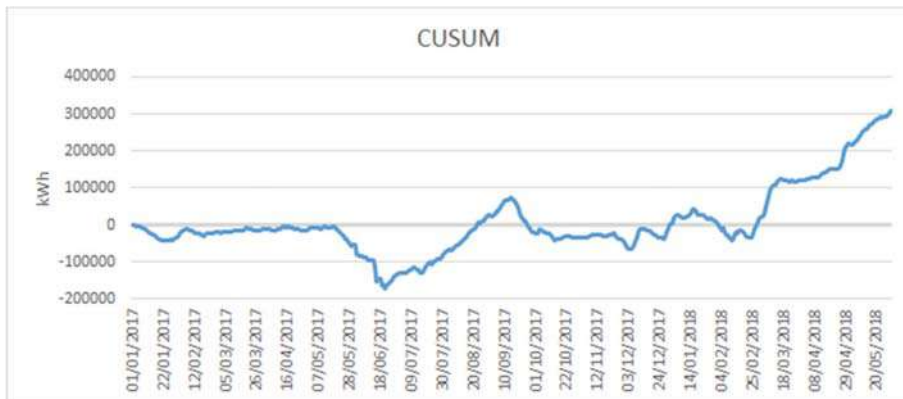
59

For Example how much could we save here?



60

Boiler CUSUM (3 boilers) – saving opportunities



61

And remember...

✓ Low R2 can show you opportunities to improve

BUT:

✓ High R2 does **NOT** mean good performance

✓ High R2 does **NOT** mean lack of low cost saving potential

✓ High R2 **JUST** shows a strong correlation.

62

Define measurement needs

- What must be measured/monitored?
- What degree of accuracy is required?
- What is required to provide this accuracy?
- What is already in place?
- What are the calibration requirements?
- How often should the measurement needs be reviewed?



63

Identify Significant Deviations

- What will be considered a significant deviation?
 - Trend identified
 - Outside of control limits
 - Higher or lower than designated value
 - Percentage different from what is expected
- Find out what happened
- Take appropriate action
- Keep a record

You determine what will be
considered a significant deviation!



64

Investigation of Significant Deviations

- How will significant deviations be handled?
- Will significant deviations be placed into the corrective action system?
- What methods will be employed during the investigation?
 - 5 whys
 - IS/IS NOT
 - Fishbone
 - Other root cause analysis methods
- What records will be kept?



65

Calibration

- Ensures accuracy and repeatability of data
- Allows data to be compared over time
- Is required for equipment used in key characteristic measurements
- Typically a calibration form or record is used



66

Energy Measurement Plan

What has to be done

- A measurement plan is developed.
- The plan is implemented.
- Used to manage the monitoring and measurement of the key characteristics

Ways it might be done

- Maintenance software
- Checklist
- Work Instructions
- Schedules
- Charts
- Others

67

Energy Measurement Plan

- Key characteristics
- Monitoring and measurement method
- System/process/equipment
- Data collected and frequency
- Data records and storage
- Responsibilities
- Operation requirements
- Maintenance/calibration requirements
- Data analysis method
- Significant deviation definition



68

Energy Measurement Plan

- Legal reporting requirements can be specified
- What meters and measurements are required to deliver these reports?
- Manual vs. automated
- List what new instruments are required
 - Each new instrument should be able to justify its cost
 - Don't forget installation cost
 - Electricity and liquid flow meters can be good value
 - Gas flow meters tend to be expensive (steam, compressed air, etc)

69

Expert's Role in Monitoring, Measurement and Analysis of Key Characteristics

- Assist the facility in identifying key characteristics
- Assist in identifying data recording needs
- Provide guidance on energy measurement plan
- Help determine significant deviation criteria
- Ensure measurement needs are defined and reviewed
- Ensure calibration system in place

70

Typical Barriers

- Inadequate data for key characteristics
- Selecting key characteristics with minimal impact on energy performance
- Inadequate or lack of instrument calibration
- Not using data for performance analysis
- Unclear plan for measurement or performance analysis
- Unclear guidelines about significant deviations.



71

Value to the organization

- Key characteristic identification allows a facility to focus monitoring and measurement on the most critical areas.
- Frequent monitoring allows quick problem identification.
- Facility performance should track the key characteristics.
- Proper investigation of energy performance issues will lead to solutions that impact the root cause and therefore prevent future similar issues.
- Help demonstrate EnMS effectiveness
 - Operational controls
 - Action plans
 - Training
 - Maintenance



72

Documents & Records

Documents

- List of measurement needs
- Energy measurement plan

Records

- Results from monitoring and measurement
- Evidence that measurement needs are reviewed
- Records of calibration or other evidence that measurement equipment is providing accurate and repeatable data
- Record of investigation and response to significant deviation (including results)

73

Tools

- Energy Measurement Plan Worksheet



74

Deliverables

- Develop key characteristics
- Finalize key characteristics
- Evaluate current monitoring, measurement and analysis of key characteristics
- Determine measurement and calibration/maintenance needs for key characteristics
- Implement identified changes to monitoring, measurement and analysis
- Determine significant deviation criteria
- Define investigation process for significant deviation



75

See you in 60 minutes!



76

Exercise 13

Select one of the key characteristics/SEU Consider what will be required to ensure that appropriate data is collected to adequately monitor energy performance.



77

See you in 15 minutes!



78

Keeping the EnMS Up to Date

79

79

Building connections to maintain the EnMS

- Systematic management of energy and continual improvement in performance depends on maintenance of the EnMS
- Tracking energy performance requires up to date information and data
- Keeping the EnMS up to date and relevant is critical to embedding energy management into business processes

80

Maintaining the EnMS is built into the EnMS implementation process

- The EnMS is not just established, documented and implemented, but also
 - maintained, and
 - continually improved
- In addition, various elements of the EnMS have specific requirements related to:
 - Regular or periodic reviews
 - Regular review and updating as needed
 - Updating at planned intervals
 - Conducting at planned intervals

81

Updating the EnMS—Value to the Organization

- Maintains alignment with organizational priorities
- Demonstrates management commitment
- Furthers integration of energy management into business processes
- Ensures currency of information and data
 - supports informed decision-making
 - status of performance is known
 - expectations for employees are clear

82

Updating the EnMS—Value to the Organization

- Maintains alignment with organizational priorities
- Demonstrates management commitment
- Furthers integration of energy management into business processes
- Ensures currency of information and data
 - supports informed decision-making
 - status of performance is known
 - expectations for employees are clear

83

What specific updating is needed?

- Energy policy
- Applicable legal requirements
- Applicable other requirements subscribed to
- Energy review
- Action plans
- EnPIs
- Documents



84

What provides the foundation for updating?

- Clearly defined intervals for routine reviews
- Clearly assigned roles and responsibilities
- Effective change management
- Effective management reviews



85

Changes mean taking action!

- Update energy review regularly and in response to major changes
- Measure changes in energy performance against the baseline
- Adjust baseline under specific conditions



86

Changes mean taking action! (cont'd)

- Legal and other requirements frequently change
- Changes may trigger revisions to documents
- Corrective and preventive actions lead to changes
- Management review actions lead to changes



87

Expert's Role



Ensure decisions on how that part of the system will be maintained are made throughout EnMS implementation.

- Help company leverage existing change management and data collection and analysis processes
- Ensure roles and responsibilities are defined and communicated
- Reality-check the system connections for reviews and updating

88

Typical Barriers

- Inefficient /ineffective communication processes
- Haphazard or limited change management processes
- Inexperience with regular data collection and analysis



89

Success Factors

- Currency and relevance of energy data and other information
- Up to date action plans
- Changes needed as a result of corrective and preventive actions are implemented and effective
- Follow through on management review decisions and actions related to needed changes



90

Exercise 14: Updating the EnMS

Review the items on the Checklist for Updating the System to determine what decisions on updating have been made.

Complete the checklist by filling in the blanks (How often? How? Who?).

What are your plans for completing items that have not been addressed?

91

Management Review

Communicating with Management

- Visual
- Short
- Value to the organization
- Resources needed
- Expected outcomes for those resources
- Next update



93

Challenge: What quote can your team come up with to describe your success?

- Obstacles are those frightful things you see when you take your eyes off your goal.
~Henry Ford
- Some of the world's greatest feats were accomplished by people not smart enough to know they were impossible. ~Doug Larson

Goals are dreams with deadlines. ~Diana Scharf Hunt

- The best angle from which to approach any problem is the try-angle. ~Author Unknown

94

Review of Success

Items Completed

- Is Top Management committed?
- Has a policy been developed
- Who is the management representative
- Who is on the energy management team
- Where is the scope and boundaries defined?

Value to Management

- Resources ensure that the energy objectives are achieved.
- Policy provides direction and helps the public image.
- Management representative helps ensure progress and effective use of resources
- Energy team helps ensure that the knowledge and skills are developed throughout the organization
- Scope and boundaries ensure a focus

Review of Success

Items Completed

- Draft of policy completed?
- Training on policy started or planned?
- Defined the planning process?
- Identified legal and other requirements

Value to the Organization

- Provides direction and public commitment
- Ensures support from everyone in the organization
- Proper planning ensure great results – lack of planning ensures failure
- Understanding legal and other requirements reduces risk of noncompliance

Review of Success

Items Completed

- Determined operational issues for legal and other requirements
- Data collection for past, present energy data
- Criteria for SEUs
- Calculation of Future energy use

Value to Management

- Operational controls balance efficiency with commitment
- Data becomes information – and information is a power advantage in decisions
- Significant Energy Uses means appropriate focus on the items that matter
- Understanding Future energy use means – knowing where things are heading

97

Review of Success

Items Completed

- List of opportunities
- Criteria for prioritized opportunities
- Developed Objectives, Targets, and action plans
- Reviewed M&V protocols

Value to the Organization

- Opportunities provide ideas and savings opportunities
- Priorities help ensure effort is spent where it matters
- Objectives, targets and action plans demonstrate planned improvement
- M&V protocol provide a recognized means to validate energy savings

98

Review of Success

Items Completed

- Scheduled discussions on how to verify the planned improvements (action plans)
- Developed EnPIs
- Developed Baseline(s)

Value to the Organization

- External coaches ensure proactive action plans that lead to improvement.
- EnPIs ensure appropriate direction and “sign-posts” along the action pathway.
- Baselines ensure an accurate comparative point that shows actual improvement

Review of Success

Items Completed

- Developed a document control process
- Developed a management review process

Value to the Organization

- Clear expectations provide improved performance
- Routine reviews of the program ensures it remains in alignment with the organizational priorities and needs.

Where are we?



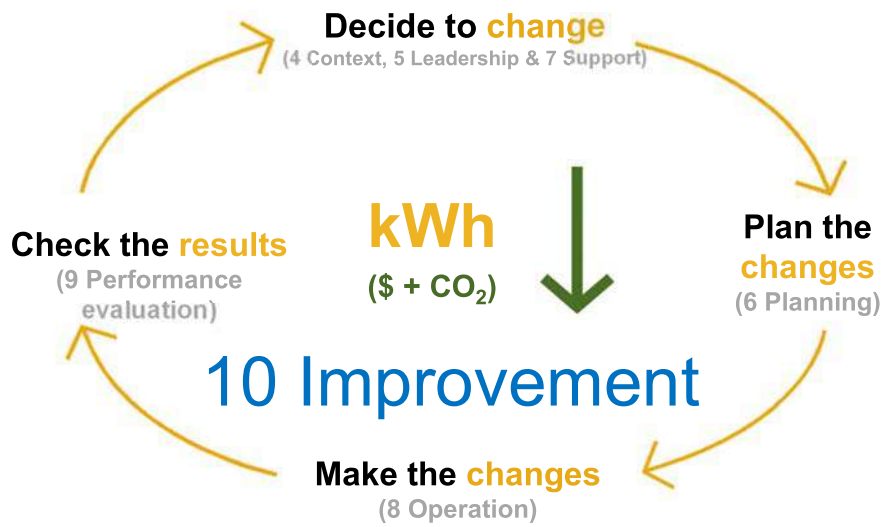
- Deliverables are providing great results
- We can expect to continue to improve
- We can expect more information that helps us with energy decisions.

101

Making connections

How all the EnMS parts fit together

102



103

Day 3 End
Thank You

104

UNIDO EXPERT TRAINING

Exercise 03: Develop Operational Criteria

1. In your teams, determine what operational and maintenance criteria it takes to run and maintain one of your SEUs in an efficient manner, and record these criteria on the Operational Criteria Specification Worksheet.
2. Discussion with the larger group (10-15 minutes).

Each of the groups will,

- Appoint a spokesman,
- Describe the SEU chosen,
- Discuss the operational and maintenance criteria for the SEU,
- Get feedback from the larger group on criteria chosen.

NOTES for Instructor

- If there is enough time, have each group fill out the forms in electronic format and display on the screen for the entire group to see.
- If the experts are not working with an organization to implement the EnMS, then choose an energy system, like steam and/or compressed air that each of the groups can discuss and determine operational criteria for.

UNIDO Expert Training

Significant Energy Uses Operational Criteria Worksheet

[illegible]

UNIDO EXPERT TRAINING

Exercise 04: Procurement Considerations

1. In your small group, review the Procurement Checklist. Think about the procurement policies at your own organization. Determine the gaps in your procurement procedures and determine what additional steps are required to bring your procurement procedures into line with your EnMS. (20 minutes).

2. Discussion with the larger group (10 minutes).

Each of the groups will,

- Appoint a spokesman,
- Describe gaps in procurement procedures,
- Describe actions needed to fill the gaps.

04 Procurement Checklist

Use this checklist to review your organization's current purchasing process for products, equipment and energy services that can significantly impact energy performance. Note any needed modifications to the existing system under Actions Needed.

	Yes	No	Actions Needed
1) Do personnel who affect purchasing consider the following?			
a) Significant energy uses and their related controls?			
b) Energy objectives, targets, and related action plans?			
c) Overall energy performance which you should know through your EnPIs?			
d) Sustaining the improvements of past energy projects?			
e) Maintenance of energy systems (e.g., compressed air, steam, etc.)?			
f) Life cycle costs?			
2) Has criteria for assessing energy use, consumption and efficiency over the lifetime of the product, equipment or service been established and implemented?			
3) Have the following been communicated to personnel who affect procurement?			
a) The outputs of energy planning such as the significant energy uses and related controls; energy objectives, targets, and related action plans; EnPIs)			
b) Operational controls to sustain the improvement results of past energy projects?			
c) Key maintenance items related to the organization's energy systems (e.g., compressed air, steam, etc.)?			
3. Do specifications for items being purchased clearly identify any energy performance related requirements?			
4. Have energy performance related requirements been communicated to suppliers?			
5. Have suppliers been made aware that energy performance is part of the evaluation criteria?			

UNIDO EXPERT TRAINING

Exercise 06: Develop Competencies

1. In your small group, review the Competency Tool. Consider one of the SEUs that you have identified and the operational criteria required to operate the SEU in an efficient manner. List those personnel who operate and maintain the SEU (don't forget external contractors). Use the 3 step process in the Competency Tool to identify the competencies required to operate the SEU. (20 minutes)

2. Discussion with the larger group (10 minutes).

Each of the groups will,

- Appoint a spokesman,
- Describe the SEU and the operational criteria,
- Describe significant people that operate the SEU and competencies developed.

Competency Tool (for exercise 06)

STEP 1: List Energy Task		
STEP 2 Energy Task	And Category	
STEP 3 Energy Task	And Category	Competency definition

Competency Record	
Name:	
Position:	Competence Category:
Department:	
Competency Requirements	
Description	Initial and Date When Completed

ENMS TRAINING NEEDS PLANNING MATRIX

Location: _____

Date: _____

Completed by: _____

WHAT TRAINING IS NEEDED?	WHO NEEDS TRAINING?	WHAT INFORMATION IS NEEDED? WHAT EnMS DOCUMENTS (if any) ARE INVOLVED?	WHO IS RESPONSIBLE FOR CONDUCTING THE TRAINING? (Position)	HOW/WHERE WILL THE TRAINING BE DONE?	WHEN WILL THE TRAINING BE DONE?	WHAT WILL BE THE TRAINING RECORD ?
<i>General EnMS Awareness</i>	<ul style="list-style-type: none"> • All employees • New hires • On-site contractors 	<ul style="list-style-type: none"> • Energy Policy • Basic EnMS Awareness PPT Presentation 	<ul style="list-style-type: none"> • Energy Management Representative 	<ul style="list-style-type: none"> • Management meetings • Shift meetings • New Hire Orientation • Contractor Orientation 	<ul style="list-style-type: none"> • Annually • New Hire Orientation • Monthly Contractor Orientation 	<ul style="list-style-type: none"> • Signature sheets • Signature cards for contractors
<i>!POWER DOWN! Office Electrical Energy Conservation Program</i>	<ul style="list-style-type: none"> • All Office Personnel • New office staff hires 	<ul style="list-style-type: none"> • !POWER DOWN! Tip Sheets and Checklist 	<ul style="list-style-type: none"> • HR Manager 	<ul style="list-style-type: none"> • Monthly staff meeting 	<ul style="list-style-type: none"> • Quarterly 	<ul style="list-style-type: none"> • !POWER DOWN! Training Certificates
<i>Departmental-Specific EnMS and SEU Awareness*</i> <i>*based on current version of the SEU Control Chart = Boiler and Ovens</i>	BOILERS <ul style="list-style-type: none"> • Boiler operators • Maintenance personnel Ovens <ul style="list-style-type: none"> • Oven Operators • Maintenance Personnel 	<ul style="list-style-type: none"> • Impacts of their activities on energy consumption • Actual/potential energy consequences of not following procedures • Applicable operational controls 	<ul style="list-style-type: none"> • Maintenance Manager 	<ul style="list-style-type: none"> • Training meetings 	<ul style="list-style-type: none"> • Weekly as needed 	<ul style="list-style-type: none"> • Departmental training record

WHAT TRAINING IS NEEDED?	WHO NEEDS TRAINING?	WHAT INFORMATION IS NEEDED? WHAT EnMS DOCUMENTS (if any) ARE INVOLVED?	WHO IS RESPONSIBLE FOR CONDUCTING THE TRAINING? (Position)	HOW/WHERE WILL THE TRAINING BE DONE?	WHEN WILL THE TRAINING BE DONE?	WHAT WILL BE THE TRAINING RECORD ?
<i>Significant Energy Uses Awareness</i>	<ul style="list-style-type: none"> • <i>Onsite contractors</i> 	<ul style="list-style-type: none"> • <i>Actual and potential impacts of their activities on energy consumption</i> • <i>Energy consequences of not following procedures</i> • <i>Relevant operational controls</i> • <i>Contractor Energy Awareness Brochure</i> 	<ul style="list-style-type: none"> • <i>Maintenance Manager</i> • <i>Departmental Managers</i> 	<ul style="list-style-type: none"> • <i>Contractor Energy Awareness Video & Briefing Session</i> 	<ul style="list-style-type: none"> • <i>Monthly Contractor Orientation and as needed</i> 	<ul style="list-style-type: none"> • <i>Signature cards</i>
<i>ISO 50001 EnMS Lead Auditor Training</i>	<ul style="list-style-type: none"> • <i>Energy Management Representative</i> • <i>Maintenance Supervisor</i> 	<ul style="list-style-type: none"> • <i>ISO 50001 Standard</i> 	<ul style="list-style-type: none"> • <i>RABQSA-Accredited Training Provider (External)</i> 	<ul style="list-style-type: none"> • <i>Publicly Available ISO 50001 Lead Auditor Training Course</i> 	<ul style="list-style-type: none"> • <i>Initial Training November 201X, then as needed</i> 	<ul style="list-style-type: none"> • <i>Certificates of Course Completion & Competency</i>
<i>ISO 50001 EnMS Internal Auditor Training</i>	<ul style="list-style-type: none"> • <i>Internal Auditors</i> 	<ul style="list-style-type: none"> • <i>ISO 50001 Standard</i> • <i>Internal Audit Procedures</i> 	<ul style="list-style-type: none"> • <i>Energy Management Representative</i> 	<ul style="list-style-type: none"> • <i>Classroom training</i> 	<ul style="list-style-type: none"> • <i>Quarterly</i> 	<ul style="list-style-type: none"> • <i>Training Certificates</i>

UNIDO EXPERT TRAINING

Exercise 08: Communication Innovation

- A. Brainstorming Session (20 min) – split in random groups - Consider the EnMS and discuss the following communication needs:
 - a. What energy related information is important and to whom should it be provided?
 - b. What energy awareness topics should be communicated?
 - c. What are some techniques for providing appropriate EnMS and awareness information? (In addition to “standard” communication methods, think outside the box of unique ways for providing relevant EnMS information)
 - d. What are some techniques for providing/receiving suggestions and comments?

- B. Reporting (20 min) - Select a spokesperson. Summarize the ideas from each of the four items from the brainstorming session above. Record the ideas on the flip chart.

- C. Apply to Company (40 min) - Reorganize teams by company. Review ideas recorded on the flip charts.
 - a. Discuss the ideas and consider the information topics addressed and the communication systems currently utilized in your organization. What potential gaps exist in your information flow and what new or revised techniques may be appropriate for communication?
 - b. Layout a few basic steps of what you will do for addressing internal and external communication when you return to your organization.
 - c. Select a spokesperson for a brief report out of specific communication ideas you will address in your organization.

UNIDO EXPERT TRAINING

Exercise 10: Determine Documents and Records

1. Review the Exercise 10 Worksheet. Use this tool to identify and record the documents and records you generated during phase 1 implementation of the EnMS.
2. Discuss in your group any methods or techniques you are using for controlling your energy data to ensure that it is identifiable, retrievable and kept for a specified period of time?
3. Based on your discussions with your team members, list any “back at the office” actions you need to address to ensure both control of records and control of documents?

Exercise 10: Worksheet for Documents and Records

During your Phase 1 implementation efforts, what documents and records have you generated?

	Documents	Records
Management responsibility		
Context of organisation		
Energy policy		
Energy planning		
<ul style="list-style-type: none">• Risk and opportunities		
<ul style="list-style-type: none">• Legal and other requirements		
<ul style="list-style-type: none">• Energy review		
<ul style="list-style-type: none">• Energy baseline		
<ul style="list-style-type: none">• EnPIs		
<ul style="list-style-type: none">• Energy objectives and targets		
<ul style="list-style-type: none">• Action plans		

How are you controlling your energy data to ensure that it is identifiable, retrievable and kept for a specified period of time?

--

Based on your discussions with your team members, are there any “back at the office” actions you need to address to ensure both control of records and control of documents?

--

--

UNIDO EXPERT TRAINING

Exercise 12: Review EnPIs

1. In your groups, review your organization's EnPIs and SEUs. (30 min)
 - a. How are you measuring energy performance of SEUs?
 - b. How are you measuring energy performance of the entire EnMS?
 - c. Do you need additional data or metering?
 - d. What are the limitations of your EnPIs?
 - e. Do you need to modify them?

2. Present your EnPIs to the international experts / instructors and get input from them on the adequacy and effectiveness of the EnPIs to measure energy performance. (30 min)

Exercise 13: Energy Measurement Plan Worksheet

Using the output from the planning worksheet complete the following worksheet to develop your Measurement Plan

[illegible]

UNIDO EXPERT TRAINING

Exercise 14: Updating the EnMS

1. In your group, review the items on the Checklist for Updating the System to determine what decisions on updating have been made.
2. Complete the checklist by filling in the blanks (How often? How? Who?).
3. What are your plans for completing items that have not been addressed?

Exercise 14: Checklist for Updating the System

UPDATING THE SYSTEM				
	What?	How often?	How?	Who?
<input type="checkbox"/>	Context		Context analysis stakeholders	
<input type="checkbox"/>	Energy policy (as needed)		Management review	
<input type="checkbox"/>	Legal requirements (defined intervals)			
<input type="checkbox"/>	Other energy requirements subscribed to (defined intervals)			
<input type="checkbox"/>	Energy review (defined intervals)			
<input type="checkbox"/>	– Energy sources			
<input type="checkbox"/>	– Energy use and consumption (past and present)			
<input type="checkbox"/>	– SEUs			
<input type="checkbox"/>	– Opportunities			
<input type="checkbox"/>	Energy baseline	<ul style="list-style-type: none"> – EnPIs no longer reflect energy use and consumption – Major changes to processes, operational patterns, energy systems – Pre-determined method 		
<input type="checkbox"/>	EnPIs			
<input type="checkbox"/>	Review of methodology for determining and updating EnPIs			
<input type="checkbox"/>	Objectives and targets		Management review	
<input type="checkbox"/>	Action plans (defined intervals)			
<input type="checkbox"/>	Training needs			
<input type="checkbox"/>	Awareness			
<input type="checkbox"/>	Communication (internal)			

UPDATING THE SYSTEM				
	What?	How often?	How?	Who?
<input type="checkbox"/>	Communication (external)			
<input type="checkbox"/>	Documentation			
<input type="checkbox"/>	Operational control			
<input type="checkbox"/>	Design			
<input type="checkbox"/>	Procurement			
<input type="checkbox"/>	Monitoring, measurement and analysis (planned intervals)			
<input type="checkbox"/>	Measurement needs (periodic review)			
<input type="checkbox"/>	Evaluation of compliance (planned intervals)			
<input type="checkbox"/>	Internal audit schedule	– Changes in status or importance		
<input type="checkbox"/>	Necessary changes resulting from corrective and preventive actions			
<input type="checkbox"/>	Record controls			
<input type="checkbox"/>	Conduct management reviews (planned intervals)			
<input type="checkbox"/>	Mgt review inputs			
<input type="checkbox"/>	Mgt review outputs			

DISCLAIMER

This document was developed within the framework of the project “Accelerating energy efficiency in large industries through energy management systems, system optimization and the promotion and adoption of energy efficiency in small and medium-sized enterprises (IEEP)”, funded by the European Union (EU), managed by the Ministry of Industry and Trade (MOIT), and implemented by the United Nations Industrial Development Organization (UNIDO). The content of this document is the sole responsibility of the Project and does not necessarily reflect the views of any individual or organization.