



Energy Management System Tools

Introduction

The purpose of the present Spreadsheet (EnMS Tools.xlsx) is two fold:

1. To reinforce and complement guidance and information provided in the narrative part of the Practical Guide;
2. To offer enterprises and organizations willing to or interested in implementing an energy management system (EnMS) a comprehensive tool to support and help in implementing an EnMS in line with ISO 50001

This Spreadsheet has been developed by international experts with extensive practical experience in the implementation of energy management systems in line with national standards, European standard (EN16001) and international energy management system standards (ISO 50001).

The Spreadsheet consists of 29 worksheets/tabs, including this one. Worksheets are related to the various parts and elements of an energy management system and the steps involved in its implementation. The tabs are colour coded and grouped to reflect the four parts of an EnMS implementation programme: commit, plan, do, check.

This Commit-Plan-Do-Check cycle is based on the Plan-Do-Check-Act (PDCA) cycle. It is felt that Commit is more relevant in the context of energy management than Act as found in quality improvement



This Spreadsheet has been developed with the objective of developing a tool that would be comprehensive, simple and flexible, open to be modified and tailored by users. Companies that already use other methods to meet the purpose of any of the tools/worksheets provided here may want and decide to delete or hide some of the tabs in the Spreadsheet. Other companies may want and decide to paste their own tools into some of these tabs or add them to the Spreadsheet. The Spreadsheet can be used also just as a reference.

The Spreadsheet is the result of several demonstrative uses within the UNIDO EnMS and ISO 50001 Capacity Building Programme and successive refinements. While considered as a proven tool, the Spreadsheet is envisaged to be regularly reviewed and updated with the objective of continually improve its effectiveness and usefulness



Practical Guide for Implementing an Energy Management System



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Energy Management System Tools

Instructions

This worksheet provides an overview of all tools/worksheets contained in the EnMS Tools Spreadsheet. For each tool/ worksheet a basic description is given.

Any User of the EnMS Tools Spreadsheet is expected to input data as well as to modify the worksheets to better suit his/her needs.

The use and modification of this Spreadsheet does require an intermediate level of knowledge of Microsoft Excel.

Cells in green are designed to have user input.

Self Assessment

This worksheet has a tool to allow you checking where you are beginning from in implementing your EnMS and perhaps highlighting areas that need particular focus.

Roles and Responsibilities

This worksheet lists all tasks associated with implementing and operating an EnMS. Each task has details of how often it occurs, where documents are filed, who is responsible and their level of authority (Lead, Participate, Inform). This is a very important part of the process of gaining commitment within the organisation. Ensure that everyone understands their own role and has enough time and priority to complete their roles and tasks.

Scope

This worksheet includes both scope and boundaries details

It should also document any items which are excluded from the scope or boundaries

Policy

Paste a copy of your energy policy in this worksheet.

NOTE: All tabs related to the energy review, baselines and energy performance indicators (EnPIs) are coloured yellow and begin with a code of the form ER#. These codes correspond with the codes on the energy review workflow diagram shown on the side for easy reference.



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ER1 Data

Data from energy meters including bills should be entered here. The data will be read into other tabs for analysis purposes. Include each energy source such as electricity, gas, oil, water, etc. Include both total monthly usage and cost for each. Try to ensure that for fuels it is usage rather than deliveries.

ER2 Trends

This worksheet will read the data from the data tab and display some trends. If additional trends are required, the user is free to add them and modify to meet his/her own requirements.

ER3 SEU list

This worksheet is a summary of all the items which make up the organisations significant energy uses (SEUs). It should ideally account for at least 80% of the energy consumption of each energy source included in the scope of the EnMS. It includes prompts for drivers, people, EnPIs, etc.

ER3 SEU - Motors

This worksheet is a list of all motors in the plant. If there is a very high number of motors consider only including those above a certain cut off size.

ER3 SEU - Heat Users

This worksheet is a list of heat using processes.

ER3 SEU - Lighting

This worksheet is a list of light fittings.

ER4 Drivers

This worksheet is to help with quantifying the effects of the drivers.

ER5 EnPIs

This worksheet includes both baselines and drivers.

ER5 Measurement Plan

This worksheet includes both meters to monitor EnPIs and other measuring instruments to monitor critical operating parameters.



ER6 Maintenance Criteria

This worksheet lists the maintenance activities for SEUs.

This worksheet will not be required if the organisation has a maintenance management system which includes these details.

ER6 Critical Operating Parameters

This worksheet is a list of the critical operating parameters for each SEU

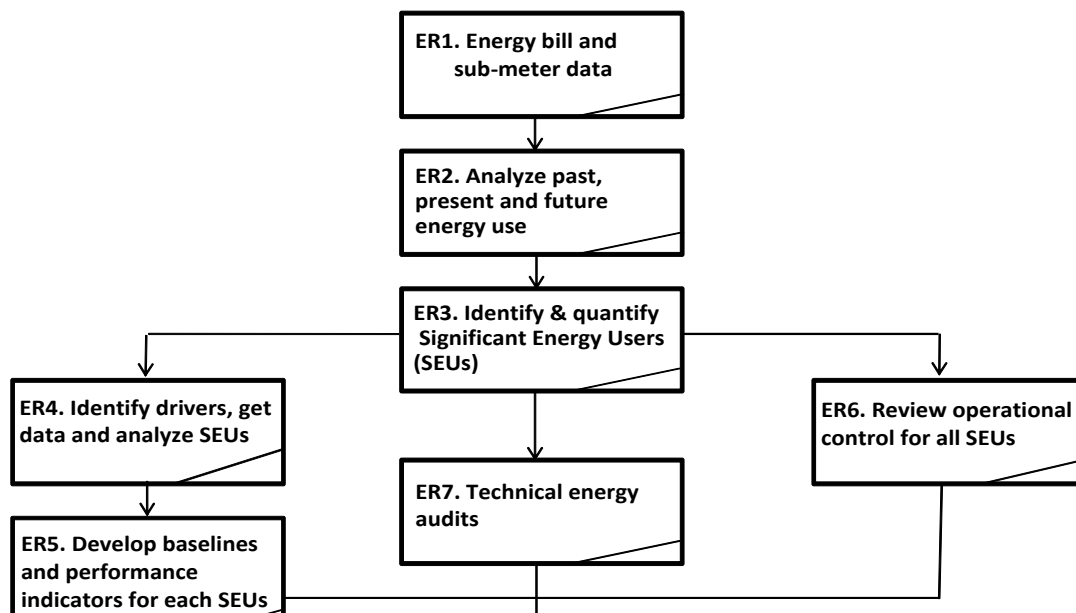
ER7 Technical Audits

This worksheet is a list of audits that have occurred. The recommendations of the audits should be included in the opportunities list.

ER8 Opportunities List

This worksheet is a list of all known opportunities to improve energy performance, including those that may be rejected. It is also the action plan of the organisation. Action plan items are those 'in progress' which have been assigned to someone.

Energy Planning Workflow Diagram

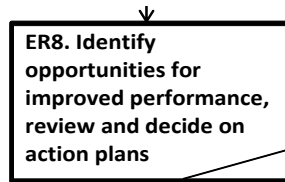




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Training

This worksheet is the training plan. It shows all training sessions and who needs each one.

Documents

This worksheet is a list of all documents associated with the organisations energy management system.

Op Cont = Operational Control

This worksheet is a list of common sources of energy waste for typical SEUs. The user can add to the list his/herself as appropriate. These items should be monitored regularly, perhaps by using this list as the basis for a check list.

Procurement

This worksheet is a list of relevant procurement specifications related to each SEU.

Design

This worksheet is a list of design reviews carried out. Every time the organisation is involved in a design activity, an energy design review should be carried out and recorded here. Any recommendation should be added to the opportunities list and assigned to the appropriate person.

EnPi Monitoring

This worksheet is not used at the moment.

Non-conformities

This worksheet is for tracknig non-conformities and significant deviations and ensuring that they are closed out.

Legal

This worksheet is a list of the legal and other requirements pertaining to the organisations energy use. It is also a tool to check that the organization is complying with these requirements.



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Internal Audits

This worksheet is the internal audit plan.

Info-Finance

This worksheet is a simple non-comprehensive tool to help compare financial options



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Energy Management System Tools

Self Assessment

Instructions:

Score is 0 to 5. 0 means very poor marks and 5 full marks.

In the Evidence column examples and/or explanation of the score given should be provided.

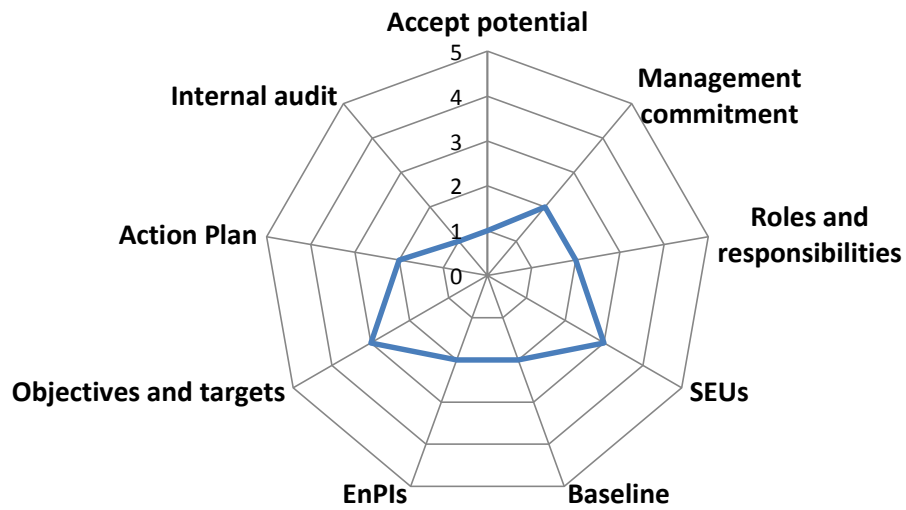
Question	Titles	Score	Evidence	Consider
Does the top management know that significant energy cost savings can be achieved by simple low cost measures without necessitating financial investment?	Accept potential	1		Has the organisation exhausted all low cost opportunities before stating to invest in capital projects?
Is the top management committed to energy cost reduction and is there an approved energy policy in place?	Management commitment	2		When a compromise is needed to reduce energy consumption, what normally takes the priority?
Have roles, responsibility and authority been identified for all persons having an influence on significant energy use and is this documented?	Roles and responsibilities	2		Are "I'm too busy" or "I have more important things to do" common excuses?
Have the significant energy uses been quantified and documented?	SEUs	3		Do you know where at least 80% of your energy is used?
Has a baseline of energy performance been established against which progress can be measured?	Baseline	2		Are you able to estimate energy use based on variables before bills arrive?
Have indicator(s) or metrics been identified to use in measuring progress against your baseline?	EnPIs	2		Do you respond pro-actively when actual consumption exceeds expected?
Have the organisation's energy objectives and targets been identified and documented?	Objectives and targets	3		Are they quantified and monitored regularly for success?
Have energy action plans been established?	Action Plan	2		Are they approved and resourced adequately and will they result in targets being met?
Is the energy management system evaluated at least once a year and are improvements made based on the results of the evaluation.	Internal audit	1		Do you have a list of improvement ideas for the mangement system (non-technical ideas)?



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Energy Management System Tools

Scope and Boundaries

Instructions:

This worksheet includes both scope and boundaries details

It should also document any items which are excluded from the scope or boundaries

Scope

Which energy sources are included in the scope of the EnMS and which are not included.

Included	Excluded
Electricity	LPG in the kitchen
Fuel Oil	transport until next year
Water	
Natural Gas	

Boundaries

Which parts of the organisation are included and excluded.

Included	Excluded
Production systems	remote warehouse facility
All buildings	
All utilities	

NOTE 1: Water is not energy but its consumption is commonly managed in the same way as energy. An organization may want to consider including water in the EnMS.

NOTE 2: Do not exclude any energy source if it has the potential to significantly impact the organisations energy performance.



Energy Management System Tools

Energy Policy

Instructions:

Insert here a copy of your energy policy.

Ensure that the policy includes the relevant requirements of ISO 50001 if certification is part of your plan.

Even if your organization is not planning to have your system certified, the ISO requirement is very useful.

Sample Energy Policy ¶

~~As an energy-intense manufacturer of xxxxx, XYZ Company strives to reduce its energy consumption and costs and promote the long-term environmental and economic sustainability of its operations. We are committed to: ¶~~

~~R~~educe energy intensity by 25% in 10 years in our manufacturing and distribution operations ¶

~~E~~nsure continual improvement in our energy performance ¶

~~D~~eploy information and resources to achieve our objectives and targets ¶

~~U~~phold legal and other requirements regarding energy ¶

~~C~~onsider energy performance improvements in design and modification of our facilities, equipment, systems and processes ¶

~~E~~ffectively procure and utilize energy-efficient products and services ¶

¶

Your Responsibilities: ¶

- Understand and conform to the ~~xxxx~~ energy policy and procedures as applicable to your role. ¶
- Suggest improvements for reducing or eliminating energy use in our activities ¶
- Support our efforts to improve our overall sustainability efforts. ¶



Energy Management System Tools

Energy Management System Tools

Data

Data

Instructions:

In this worksheet data from energy meters, including bills, should be entered.
The data entered here will be read into other worksheets for analysis purposes.
Include each energy source such as electricity, gas, oil, water, etc.
Include both total monthly usage and cost for each. Try to ensure that for fuels it is usage rather than deliveries.

Month	ELECTRICITY		GAS		FUEL		WATER	
	kWh/month	Cost/month (XX)	kWh/month	Cost/month (XX)	kWh/month	Cost/month (XX)	m3/month	Cost/month (XX)
Jan-10	1 080 392	123 157	27 854	689				
Feb-10	976 097	111 966	25 134	621				
Mar-10	1 080 828	123 032	31 500	779				
Apr-10	966 756	110 441	32 734	809				
May-10	975 233	111 418	38 804	959				
Jun-10	958 160	108 344	37 424	925				
Jul-10	971 582	111 160	39 170	968				
Aug-10	1 000 773	114 655	37 860	936				
Sep-10	951 127	109 176	34 000	840				
Oct-10	968 370	111 012	31 703	784				
Nov-10	996 576	116 732	27 118	670				
Dec-10	1 129 260	132 019	29 000	717				
Jan-11	1 141 047	131 518	36 342	863				
Feb-11	1 040 886	124 814	35 832	851				
Mar-11	1 076 357	128 187	40 000	950				
Apr-11	988 406	134 356	36 700	872				
May-11	1 016 962	138 032	48 000	1140				
Jun-11	967 156	132 292	43 000	1021				
Jul-11	1 032 814	163 867	43 670	1037				
Aug-11	1 005 262	160 494	35 052	832				
Sep-11	971 424	156 371	37 000	879				
Oct-11	979 503	158 338	31 620	751				
Nov-11	1 027 791	166 711	33 864	804				
Dec-11	1 070 024	173 305	30 036	713				
Jan-12	1 127 137	137 986	31 714	753				
Feb-12	926 579	114 629	30 089	715				
Mar-12	943 679	115 680	32 000	760				
Apr-12	888 508	63 107	28 721	682				
May-12	894 639	55 449	42 804	1017				
Jun-12	900 299	56 640	29 060	690				
Jul-12								
Aug-12								
Sep-12								
Oct-12								
Nov-12								
Dec-12								

Month	ELECTRICITY	GAS	FUEL	WATER
	Budget (XX/year)	Budget (XX/year)	Budget (XX/year)	Budget (XX/year)
Jan-10				
Feb-10				
Mar-10				
Apr-10				
May-10				
Jun-10				
Jul-10				
Aug-10				
Sep-10				
Oct-10				
Nov-10				
Dec-10				
Jan-11				
Feb-11				
Mar-11				
Apr-11				
May-11				
Jun-11				
Jul-11				
Aug-11				
Sep-11				
Oct-11				
Nov-11				
Dec-11				
Jan-12				
Feb-12				
Mar-12				
Apr-12				
May-12				
Jun-12				
Jul-12				
Aug-12				
Sep-12				
Oct-12				
Nov-12				
Dec-12				



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Energy Management System Tools

Trends

Instructions:

In this worksheet data entered in the ER1 Data tab are displayed in the form of trends. Possible trends related to the consumption of electricity are calculated and shown below.

The User is free to modify existing trends for electricity or add new ones, for electricity as well as for other energy sources.

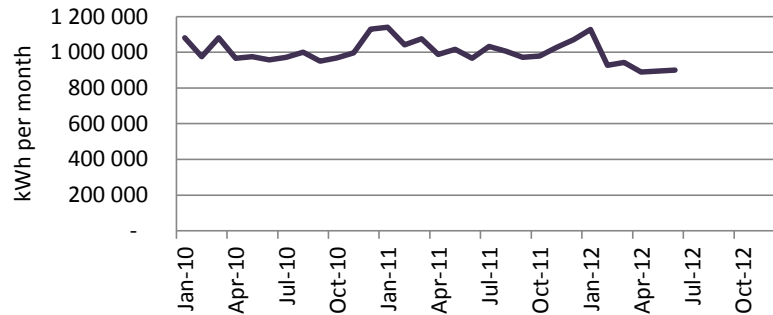
Month	ELECTRICITY				
	kWh (Annualised)	Cost (Annualised)	Budget (Annualised)	Average unit price	Target kWh 3%
Jan-10				0.114	
Feb-10				0.115	
Mar-10				0.114	
Apr-10				0.114	
May-10				0.114	
Jun-10				0.113	
Jul-10				0.114	
Aug-10				0.115	
Sep-10				0.115	
Oct-10				0.115	
Nov-10				0.117	
Dec-10	12 055 154	1 383 112	-	0.117	
Jan-11	12 115 809	1 391 473	-	0.115	
Feb-11	12 180 598	1 404 321	-	0.120	
Mar-11	12 176 127	1 409 476	-	0.119	
Apr-11	12 197 777	1 433 391	-	0.136	
May-11	12 239 506	1 460 005	-	0.136	
Jun-11	12 248 502	1 483 953	-	0.137	
Jul-11	12 309 734	1 536 660	-	0.159	
Aug-11	12 314 223	1 582 499	-	0.160	
Sep-11	12 334 520	1 629 694	-	0.161	
Oct-11	12 345 653	1 677 020	-	0.162	
Nov-11	12 376 868	1 726 999	-	0.162	
Dec-11	12 317 632	1 768 285	-	0.162	12 317 632
Jan-12	12 303 722	1 774 753	-	0.122	12 286 838
Feb-12	12 189 415	1 764 568	-	0.124	12 256 044
Mar-12	12 056 737	1 752 061	-	0.123	12 225 250
Apr-12	11 956 839	1 680 812	-	0.071	12 194 456
May-12	11 834 516	1 598 229	-	0.062	12 163 662
Jun-12	11 767 659	1 522 577	-	0.063	12 132 868
Jul-12					12 102 073
Aug-12					12 071 279
Sep-12					12 040 485
Oct-12					12 009 691



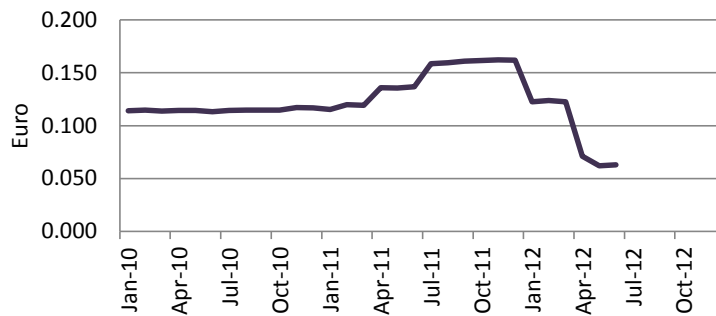
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Nov-12					11 978 897
Dec-12					11 948 103

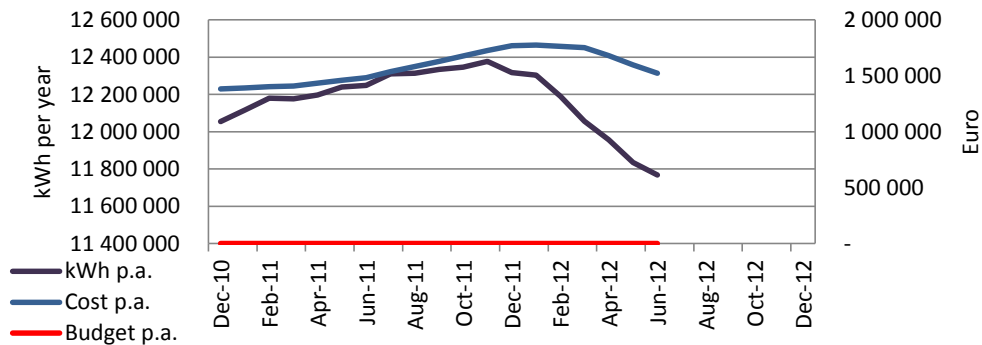
Electricity: Montly consumption (kWh)



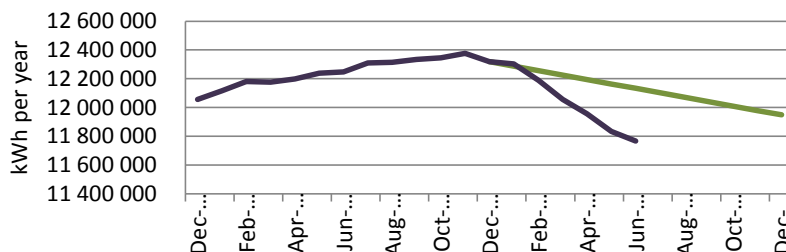
Electricity: Unit price



Electricity: Annualised consumption, cost and budget



Electricity: Actual consumption VS Target consumption





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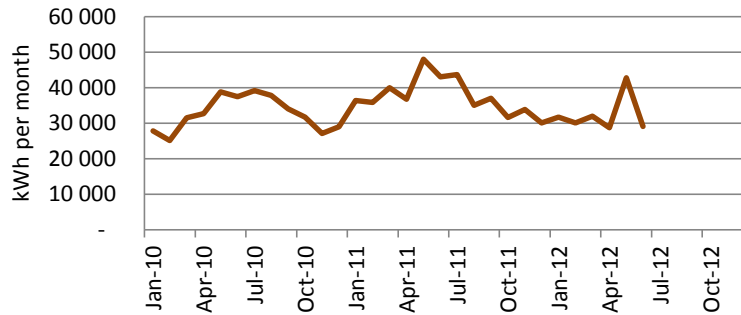
Month	GAS				Target kWh 3%
	kWh (Annualised)	Cost (Annualised)	Budget (Annualised)	Average unit price	
Jan-10				0.025	
Feb-10				0.025	
Mar-10				0.025	
Apr-10				0.025	
May-10				0.025	
Jun-10				0.025	
Jul-10				0.025	
Aug-10				0.025	
Sep-10				0.025	
Oct-10				0.025	
Nov-10				0.025	
Dec-10	392 301	9 698	-	0.025	
Jan-11	400 789	9 872	-	0.024	
Feb-11	411 487	10 102	-	0.024	
Mar-11	419 987	10 273	-	0.024	
Apr-11	423 953	10 336	-	0.024	
May-11	433 149	10 516	-	0.024	
Jun-11	438 725	10 613	-	0.024	
Jul-11	443 225	10 681	-	0.024	
Aug-11	440 417	10 578	-	0.024	
Sep-11	443 417	10 616	-	0.024	
Oct-11	443 334	10 584	-	0.024	
Nov-11	450 080	10 718	-	0.024	
Dec-11	451 116	10 714	-	0.024	451 116
Jan-12	446 488	10 604	-	0.024	449 988
Feb-12	440 745	10 468	-	0.024	448 860
Mar-12	432 745	10 278	-	0.024	447 733
Apr-12	424 766	10 088	-	0.024	446 605
May-12	419 570	9 965	-	0.024	445 477
Jun-12	405 630	9 634	-	0.024	444 349
Jul-12					443 221
Aug-12					442 094
Sep-12					440 966
Oct-12					439 838



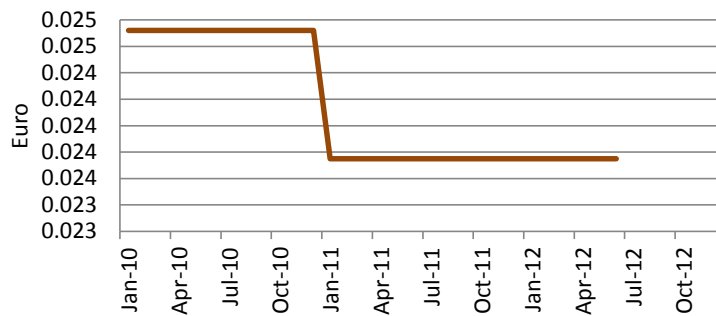
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Nov-12					438 710
Dec-12					437 583

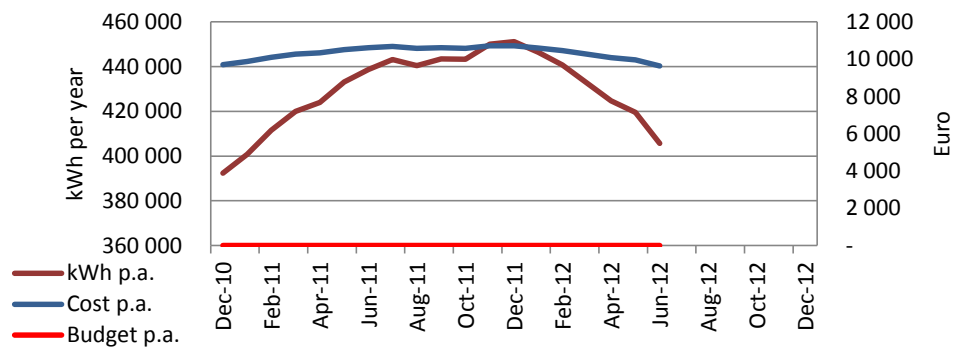
Gas: Montly consumption (kWh)



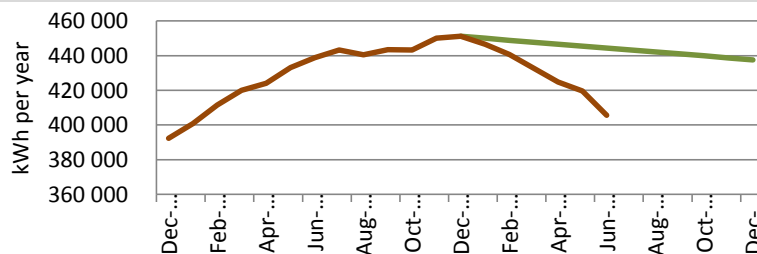
Gas: Unit price



Gas: Annualised consumption, cost and budget



Gas: Actual consumption VS Target consumption





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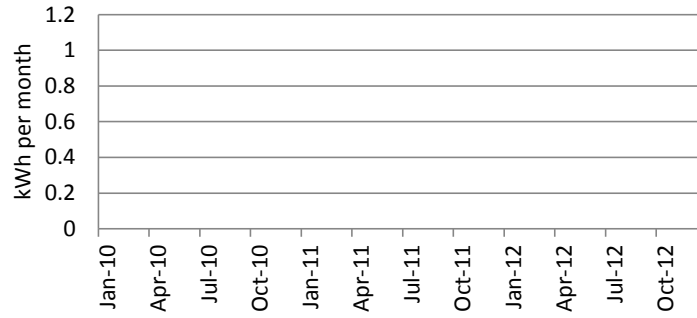
Month	FUEL				Target kWh
	kWh (Annualised)	Cost (Annualised)	Budget (Annualised)	Average unit price	3%
Jan-10				#DIV/0!	
Feb-10				#DIV/0!	
Mar-10				#DIV/0!	
Apr-10				#DIV/0!	
May-10				#DIV/0!	
Jun-10				#DIV/0!	
Jul-10				#DIV/0!	
Aug-10				#DIV/0!	
Sep-10				#DIV/0!	
Oct-10				#DIV/0!	
Nov-10				#DIV/0!	
Dec-10	-	-	-	#DIV/0!	
Jan-11	-	-	-	#DIV/0!	
Feb-11	-	-	-	#DIV/0!	
Mar-11	-	-	-	#DIV/0!	
Apr-11	-	-	-	#DIV/0!	
May-11	-	-	-	#DIV/0!	
Jun-11	-	-	-	#DIV/0!	
Jul-11	-	-	-	#DIV/0!	
Aug-11	-	-	-	#DIV/0!	
Sep-11	-	-	-	#DIV/0!	
Oct-11	-	-	-	#DIV/0!	
Nov-11	-	-	-	#DIV/0!	
Dec-11	-	-	-	#DIV/0!	-
Jan-12	-	-	-	#DIV/0!	-
Feb-12	-	-	-	#DIV/0!	-
Mar-12	-	-	-	#DIV/0!	-
Apr-12	-	-	-	#DIV/0!	-
May-12	-	-	-	#DIV/0!	-
Jun-12	-	-	-	#DIV/0!	-
Jul-12					-
Aug-12					-
Sep-12					-
Oct-12					-



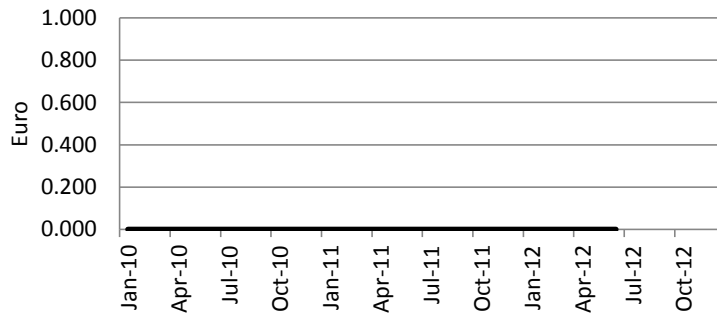
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Nov-12					-
Dec-12					-

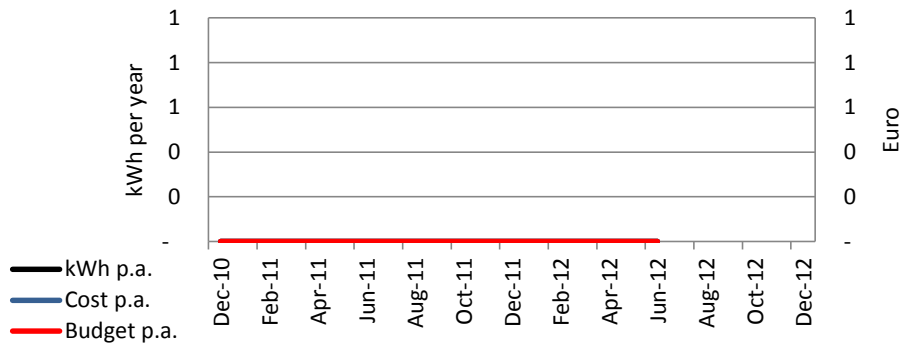
Fuel: Montly consumption (kWh)



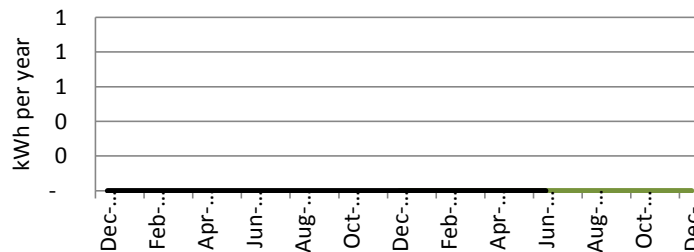
Fuel: Unit price



Fuel: Annualised consumption, cost and budget



Fuel: Actual consumption VS Target consumption





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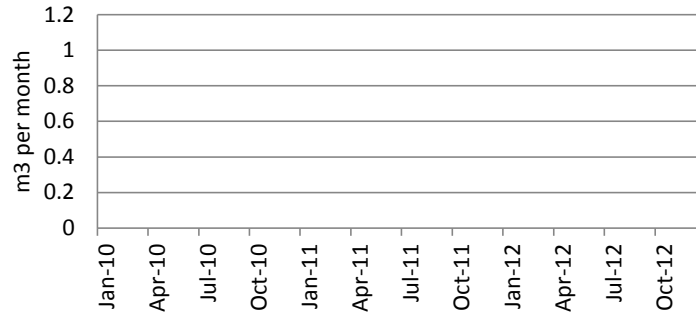
Month	WATER				Target kWh
	kWh (Annualised)	Cost (Annualised)	Budget (Annualised)	Average unit price	3%
Jan-10				#DIV/0!	
Feb-10				#DIV/0!	
Mar-10				#DIV/0!	
Apr-10				#DIV/0!	
May-10				#DIV/0!	
Jun-10				#DIV/0!	
Jul-10				#DIV/0!	
Aug-10				#DIV/0!	
Sep-10				#DIV/0!	
Oct-10				#DIV/0!	
Nov-10				#DIV/0!	
Dec-10	-	-	-	#DIV/0!	
Jan-11	-	-	-	#DIV/0!	
Feb-11	-	-	-	#DIV/0!	
Mar-11	-	-	-	#DIV/0!	
Apr-11	-	-	-	#DIV/0!	
May-11	-	-	-	#DIV/0!	
Jun-11	-	-	-	#DIV/0!	
Jul-11	-	-	-	#DIV/0!	
Aug-11	-	-	-	#DIV/0!	
Sep-11	-	-	-	#DIV/0!	
Oct-11	-	-	-	#DIV/0!	
Nov-11	-	-	-	#DIV/0!	
Dec-11	-	-	-	#DIV/0!	-
Jan-12	-	-	-	#DIV/0!	-
Feb-12	-	-	-	#DIV/0!	-
Mar-12	-	-	-	#DIV/0!	-
Apr-12	-	-	-	#DIV/0!	-
May-12	-	-	-	#DIV/0!	-
Jun-12	-	-	-	#DIV/0!	-
Jul-12					-
Aug-12					-
Sep-12					-
Oct-12					-



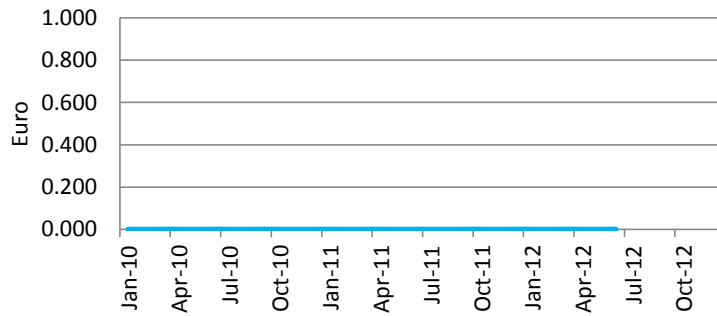
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Nov-12					-
Dec-12					-

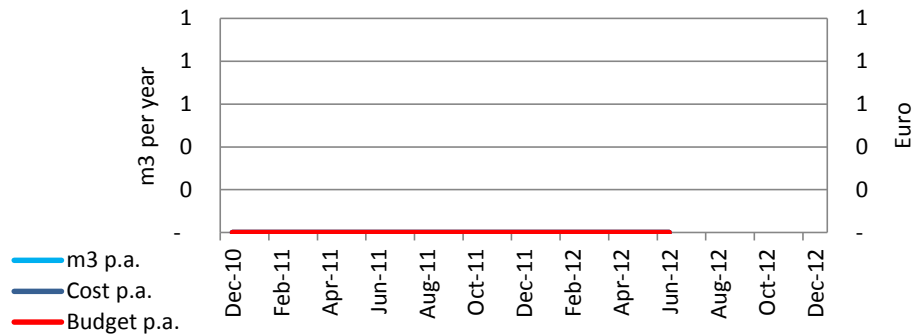
Water: Montly consumption (m³)



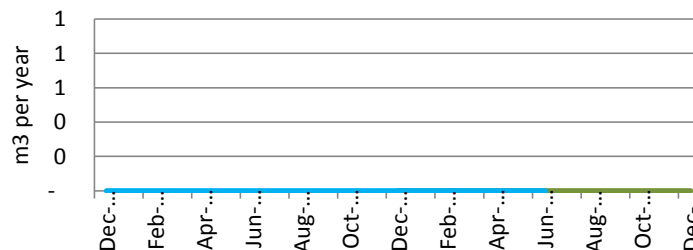
Water: Unit price



Water: Annualised consumption, cost and budget



Water: Actual consumption VS Target consumption





Energy Management System Tools

Energy Management System Tools

Significant Energy Uses (SEU) List

Significant Energy Uses (SEU) List

Instructions:

This worksheet is a summary of all the items which make up the organisations significant energy uses (SEUs). It includes prompts for drivers, people, EnPIs, etc. It should ideally account for at least 80% of the energy consumption of each energy source included in the scope of the EnMS. It should include any items that offer significant opportunity to reduce energy consumption or improve performance. The User may want to use a pie chart, Sankey Diagram or other graphic/visual aid to represent the SEU. An example of pie chart for the Electricity SEUs is provided below.

Instructions:

This worksheet is a summary of all the items which make up the organisations significant energy uses (SEUs). It includes prompts for drivers, people, EnPIs, etc. It should ideally account for at least 80% of the energy consumption of each energy source included in the scope of the EnMS. It should include any items that offer significant opportunity to reduce energy consumption or improve performance. The User may want to use a pie chart, Sankey Diagram or other graphic/visual aid to represent the SEU. An example of pie chart for the Electricity SEUs is provided below.

Electricity									
ID	Name of SEU	What are the main drivers?	Is the SEU metered? Auto/Manual	kWh p.a.	% of Overall Usage	Who influences the energy use?	Objectives	Targets kWh	EnPI
1	Building Cooling	Weather and occupancy	No	4 000	20%	Facility operator	Reduce consumption by 5% in 2012		
2	Process Cooling	Production	Auto	6 000	30%	Production supervisor	Reduce consumption by 10% in 2012		
3	Compressed air	Leaks and waste	Manual	5 000	25%	Facility operator	Reduce consumption by 20% in 2012		
4	Lighting	Daylight	No	3 000	15%	Everyone	Reduce consumption by 10% in 2012		
5									

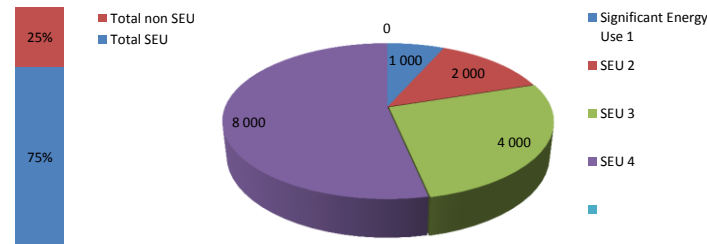
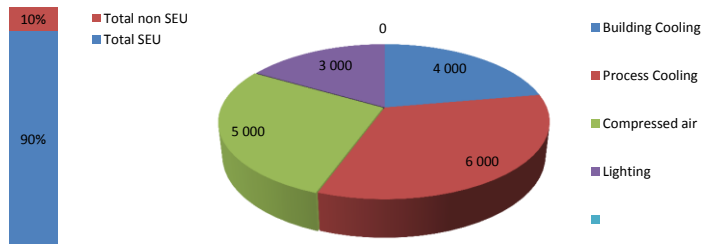
Thermal Energy									
ID	Name of SEU	What are the main drivers?	Is the SEU metered? Auto/Manual	kWh p.a.	% of Overall Usage	Who influences the energy use?	Objectives	Targets kWh	EnPI
1	Significant Energy Use 1			1 000	5%				
2	SEU 2			2 000	10%				
3	SEU 3			4 000	20%				
4	SEU 4			8 000	40%				
5									

Total SEU	18000	90%
Total non SEU	2000	10%
Total consumption	20 000	100%

Total SEU	15000	75%
Total non SEU	5000	25%
Total consumption	20 000	100%

Note: This total should be the same as the annual data from tab ER1

Note: This total should be the same as the annual data from tab ER1





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Energy Management System Tools

SEU - Motors

Instructions:

This worksheet is a list of all motors in the plant.

If in your plant there is a very high number of motors consider only including those above a certain cut off size.

ID	Purpose	Name plate (kW)	Hours per year	Ave VSD speed (100% if fixed)	% name plate load	Actual Power (kW)	Annual Power (kWh)	Note	When can this be switched off?	% of total	How were estimates made?	Opportunities for improvement	SEU
1	Cooling Water Pump #1	20	4200	0.5	0.9	4.5	18 900	shares load with #2		0.0189	Hours run meter reading, estimate of speed, estimate of nameplate %	insert ref nos from opp list	Cooling water
2	Cooling Water Pump #2	20	4200	1	0.9	18	75 600			0.0756	Hours run meter reading, estimate of speed, estimate of nameplate %		Cooling water
3	Hydraulic pack drive	100	250	1	0.9	90	22 500	used intermittently		0.0225	Hours run meter reading, estimate of speed, estimate of nameplate %		Production
4	Seal cooler pump	1	8400	1	0.9	0.9	7 560		almost always	0.00756	review of operator logs, estimate of speed, estimate of nameplate %		Production
5	AHU 1 Fan	10	8400	0.8	0.9	5.76	48 384		night and weekend	0.048384	review of BEMS data, other items estimated		HVAC
6				1	0.9	0	-			0			
7				1	0.9	0	-			0			
8				1	0.9	0	-			0			
9				1	0.9	0	-			0			
	Total						172 944			17%			
	Total electricity consumption						1 000 000 kWh per year						



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Energy Management System Tools

Drivers

Instructions:

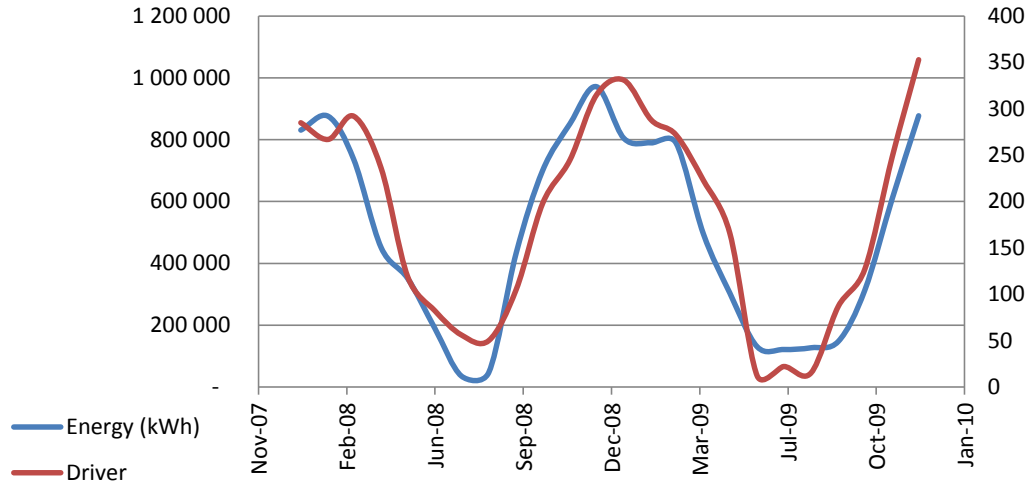
This worksheet is to help with quantifying the effects of the drivers. Driver data may be production, weather and other variable which is expected to cause the energy consumption to vary.

Date	Driver	Energy (kWh)	Expected demand	Energy Intensity Index (EII)	Difference (excess)	CUSUM
Jan-08	285	831 092				
Feb-08	267	875 958				
Mar-08	292	735 809				
Apr-08	236	450 972				
May-08	119	351 244				
Jun-08	82	188 689				
Jul-08	56	34 984				
Aug-08	50	46 967				
Sep-08	105	433 268				
Oct-08	198	700 476				
Nov-08	245	851 995				
Dec-08	315	971 613				
Jan-09	331	804 673				
Feb-09	288	789 939				
Mar-09	272	789 939				
Apr-09	223	495 983				
May-09	166	304 111				
Jun-09	12	130 154				
Jul-09	22	121 042				
Aug-09	15	126 626				
Sep-09	87	147 314				
Oct-09	127	313 066				
Nov-09	248	608 835				
Dec-09	353	877 607				
Jan-10	390	905 000	958 483	0.94	- 53 483	- 53 483
Feb-10	340	833 586	840 334	0.99	- 6 748	- 60 232
Mar-10	310	745 725	769 445	0.97	- 23 720	- 83 952
Apr-10	217	536 482	549 688	0.98	- 13 206	- 97 158
May-10	163	351 350	422 087	0.83	- 70 737	- 167 895
Jun-10	54	180 000	164 523	1.09	15 477	- 152 418
Jul-10	50	160 000	155 071	1.03	4 929	- 147 489
Aug-10	58	165 000	173 975	0.95	- 8 975	- 156 464
Sep-10	78	215 000	221 234	0.97	- 6 234	- 162 699
Oct-10	166	359 000	429 176	0.84	- 70 176	- 232 875
Nov-10	303	593 176	752 904	0.79	- 159 728	- 392 603
Dec-10						

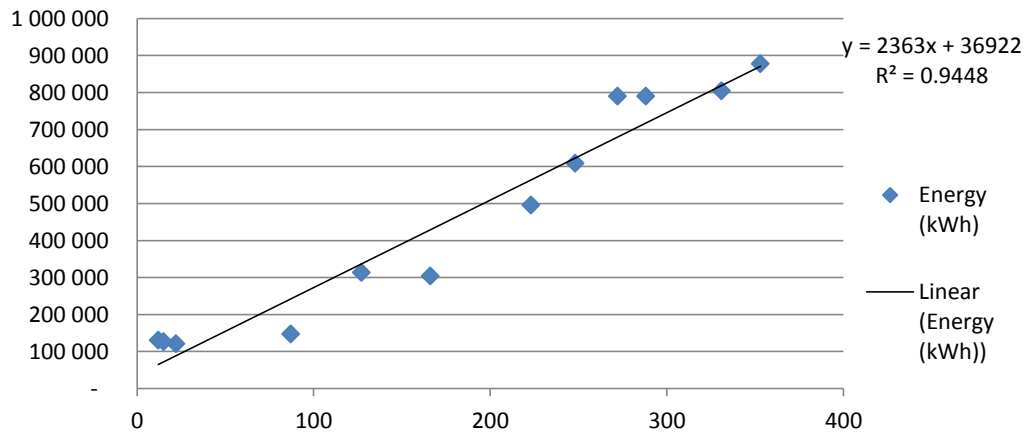


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Monthly energy consumption VS Driver



Monthly energy consumption VS Driver. Regression analysis



Base Year is in blue starting in cell A14

Slope	2362.97716
Baseload (intercept)	36922.1635
R2	0.94477427



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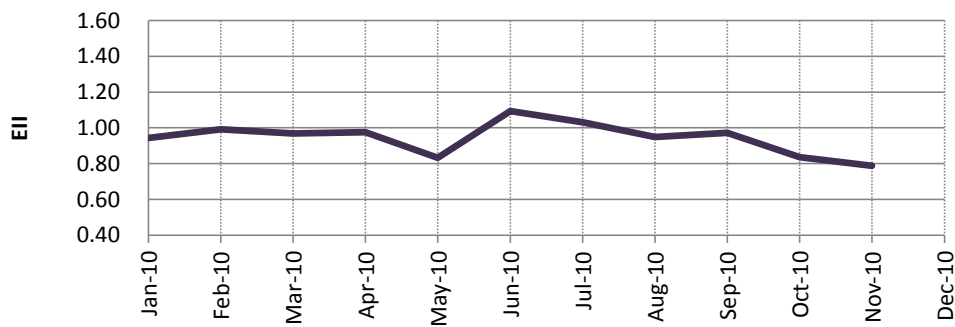
Energy Management System Tools

Energy Performance Indicators (EnPIs)

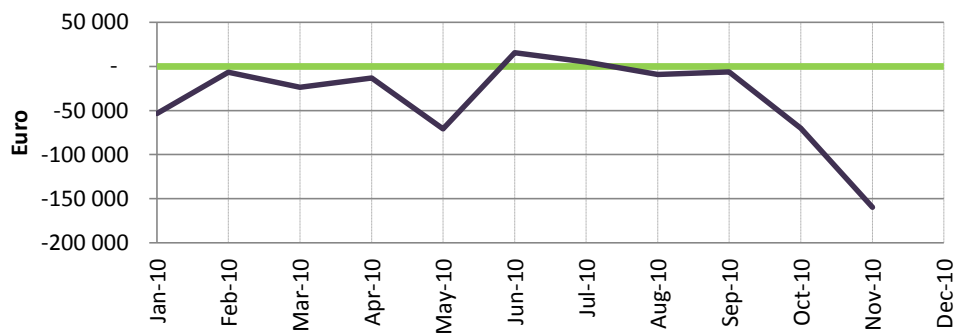
Instructions:

This worksheet includes both baselines and drivers. In the Energy Intensity Index chart the baseline is the horizontal line through 1.0. In the second chart the baseline is 0.0 (green line) and in the CUSUM the baseline is also 0.0 (also green line). If the baseline is adjusted to become a target this needs to be taken into account, e.g. the coefficients for the regression formula will be reduced by amounts corresponding with the targeted improvement in performance.

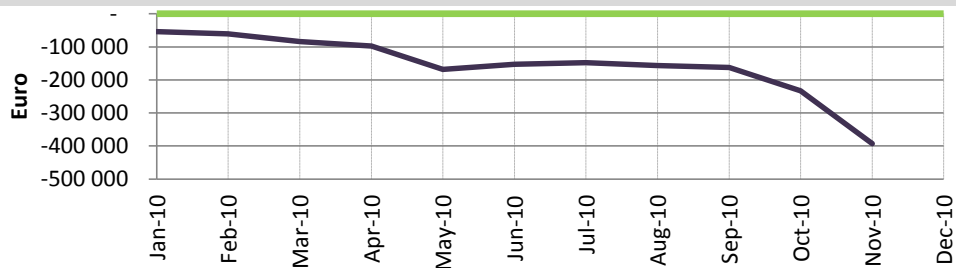
Energy Intensity Index



Difference between actual and expected



CUSUM





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Energy Management System Tools

Measurement Plan

Instructions:

This worksheet includes both meters to monitor EnPIs and other measuring instruments to monitor critical operating parameters.

Significant Energy User	EnPi	Energy Drivers	Ideal means of measurement	Instrumentation currently in place	Gap from ideal instrumentation for operation and performance monitoring	Meter Plan
Air Compressor	Compressed air flow v compressor electricity	Compressed air flow	Electricity meter Compressed air flow meter	electricity meter	flow meter	cost too high
Air Compressor	Loaded hours percentage	Production activity	daily reading of loaded vs unloaded hours	hourmeters	none	n.a.
Building heating	heat load vs HDD and occupancy	HDD and occupancy	heat meter, HDD and occupancy	gas meter, HDD from web	occupancy	get security records

Significant Energy User	Critical operating parameters	Energy Drivers	Ideal means of measurement	Instrumentation currently in place	Gap from ideal instrumentation for operation and performance monitoring	Meter Plan
Air Compressor	Filter differential pressure	flowrate and filter cleanliness	differential pressure gauge	none	differential pressure gauge	differential pressure gauge
Boilers						



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Energy Management System Tools

Critical Operating Parameters

Instructions:

This worksheet shall list the critical operating parameters for each SEU.

The worksheet provides a non-exhaustive list of critical operating parameters for some typical significant energy uses. Please note that the numerical values provided are typical values, but which may and will vary depending on User's plant, equipment, etc.

The User shall review and/or add critical operating parameters for those equipments, systems, processes, etc. that constitute its SEUs.

NOTE: It is likely that the User may need the assistance of external experts, equipment vendors and technology suppliers to fully and correctly populate this worksheet.

SEU (inc use)	Parameter	Eng Units	Normal set point or value	Upper Limit	Lower Limit	Measuring Instrument Designation	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	% O2	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



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Energy Management System Tools

Documents

ID	Description	Location	Revision	Revision Date
1	Energy Manual	Energy Manager Office	2	01/10/2010
2	Energy Bills	Finance Office	N.A.	N.A.
3	Boiler Operating Manual	Boiler control room	N.A.	23/04/2004
4	Planning Spreadsheet	S:/energy/records	N.A.	01/12/2010
5	Checking Spreadsheet	S:/energy/records	N.A.	N.A.
6	Energy Policy	S:/energy/documents	1	01/12/2010
7	Energy Audit reports - hard copies	Energy Manager Office	N.A.	N.A.
8	Energy Audit reports - electronic copies	S:/energy/reports	N.A.	N.A.
9	Training plans	Operating Spreadsheet	N.A.	N.A.
10	SEU Operator logs	relevant control room	N.A.	N.A.
11	Management review minutes	S:/energy/records	N.A.	N.A.
12	Minutes of energy team meetings	S:/energy/records	N.A.	N.A.
13	Maintenance records	Maintenance management system		
14	SEU Process diagrams			
15	SEU operating procedures			
16	SEU maintenance procedures			
17				
18				
19				
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21				
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23				
24				
25				
26				



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Energy Management System Tools

Operational control

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, ???
3	Steam	Steam leaks	Usually very visible and noisy	There should be none	Repair, check gaskets and seal materials for suitability, warm steam lines slowly
4	Steam	Excessive boiler blowdown	check total dissolved solids	They should be close to the maximum allowed for the boiler type and operating conditions	

WARNING:

All the checks on this list are intended as an aid to trained personnel. If you do not fully understand the potential consequences of any of the items then check with a competent person before implementing any of the ideas. There are safety and reliability issues associated with incorrect understanding of many of these items. UNIDO and the authors accept no responsibility for misinterpretation of these ideas.



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5	Steam	Excess oxygen in combustion	Test exhaust gases for O2 content	It should be close to the manufactures guide values.	Tune the boiler. It may be beneficial to tune to close to normal operating output rather than maxumin outout.
6	Steam				
7	Steam				
8	Steam				
9	Steam				
10	Steam				
11	Compressed Air	Audible leaks	Listen, especially during times of low noise from other sources	All audible leaks should be repaired,	Repair ASAP
12	Compressed Air	Excessive pressure drops		The compressor discharge pressure should be as close a spossilbe to the end user pressure	Replace filters, replace poorly designed pipe fittings,
13	Compressed Air	Excess air compressor pressure	Challenge required pressure, is there a small user drivinig the total system prerssure upwards	The compressor discharge pressure should be as close a spossilbe to the end user pressure	
14	Compressed Air	Warm air entering the compressor(s)			
15	Compressed Air				
16	Compressed Air				
17	Compressed Air				
18	Compressed Air				
19	Compressed Air				

WARNING:



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20	Compressed Air				
21	Refrigeration	Chiller delivery temperature too low	Compare with recorded temperature range	greater than or equal to the upper limit	Increase setpoint, check other issues
22	Refrigeration	Condensing temperature too high	Compare with recorded temperature range	less than or equal to the lower limit allowing for ambient temperature conditions	Reduce setpoint, check condenser condition, etc.
23	Refrigeration	Excess parasitic loads including pumping and fans	Compare parasitic loads with optimum	not exceeding normal for current conditions and loads	reduce parasitic loads
24	Refrigeration	poor part load efficiency	Monitor COP under current conditions	not exceeding normal for current conditions and loads	identify and rectify
25	Refrigeration				
26	Refrigeration				
27	Refrigeration				
28	Refrigeration				
29	Refrigeration				
30	Refrigeration				
31	Pumping	Throttled pump discharge valves	Check positions of valves	Throttled valves waste energy, can they be opened	Reduce pump speed, variable speed drive, pulley ratios, trim impellor
32	Pumping	Excess pumping pressure	compare actual pump discharge pressure with required system pressure	they should be similar	eliminate pressure drops including throtted valves, etc
33	Pumping	Excess pressure drops	pump pressure higher than system pressure at users	small pressure drops, compare with design	eliminate pressure drops including throtted valves, etc
34	Pumping				

WARNING:



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35	Pumping				
36	Fans	Throttled air handling unit outlet dampers	Check positions of dampers	Throttled dampers waste energy, can they be opened	Reduce fan speed, variable speed drive, pulley ratios, trim impellor or smaller impellor
37	Fans	Excessive pressure drops	Fan pressure higher than system pressure at users	small pressure drops, compare with design	eliminate pressure drops including throtted dampers, etc
38	Fans				
39	Fans				
40	Fans				
41	Lighting	External lights on when not required	Check ambient light levels	Lights not on during the day or when area unoccupied	Switch them off!
42	Lighting	Internal lights on when not required	Check ambient light levels, occupancy and light levels	Lights not on when daylight available or when area unoccupied	Switch them off!
43	Lighting	Excess light levels for the purpose of the space	Compare lux levels with required lux levels	Actual to be slightly higher than required	Remove lamps or fittings or starters or disconnect or change switching arrangement
44	Lighting				
45	Lighting				
46	HVAC	Simultaneous heating and cooling	Check valve positions, consider ambient conditions	no simultaneous heating and cooling	
47	HVAC	Excess heating or cooling	check room temperatures against required	should be as high as possible during cooling times and as low as possible during heating times	change setpoints, calibrations, leaking valves, etc.
48	HVAC				
49	HVAC				
50	HVAC				

WARNING:



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Energy Management System Tools

Procurement

SEU	Equipment Procurement Specifications	Services procurement Specifications	Next Review	Responsible
Steam				
Refrigeration				
Lighting				
Pumping				
Motors				
Computers				
Printers				

This tab is not used at this time
Its intent is to help with monitoring of performanc indicators



Energy Management System Tools

Financial Analysis

Instructions:

See notes below the tables

Financial Benefits of an investment

Year 0	- 50 000	Discount Rate	10%
Year 1	8 000	Savings Inflation	3%
Year 2	8 240		
Year 3	8 487		
Year 4	8 742		
Year 5	9 004	NPV	€4 609.05
Year 6	9 274	IRR	12%
Year 7	9 552		
Year 8	9 839		
Year 9	10 134		
Year 10	10 438		

Enter Project Cost in cell B13, cost will be negative

Enter Annual savings in Cell C14

You may insert or delete rows for projects with different useful lives

You will then need to adjust the various formulae in column E

Life Cycle Costing (LCC)

	Option 1	Option 2		
Cost	- 50 000.00	- 75 000.00	Discount Rate	10%
Year 1	- 8 000.00	- 4 000.00	Savings Inflation	3%
Year 2	- 8 240.00	- 4 120.00		
Year 3	- 8 487.20	- 4 243.60		
Year 4	- 8 741.82	- 4 370.91		
Year 5	- 9 004.07	- 4 502.04		
Year 6	- 9 274.19	- 4 637.10		
Year 7	- 9 552.42	- 4 776.21		
Year 8	- 9 838.99	- 4 919.50		
Year 9	- 10 134.16	- 5 067.08		
Year 10	- 10 438.19	- 5 219.09		
LCC	-€95 518.14	-€93 213.61		

All values are negative

The lowest LCC is the least negative of the 2