Energy Management System (EnMS) Implementation Training

Insert Trainer Names

UNIDO International Energy Efficiency Experts

Day 1 - Morning

Based on the contents of the UNIDO EnMS Student Training Manual

Insert Venue
Insert Dates

Housekeeping

Emergency Exits

Restrooms

Mobile Phones

Breaks

Lunch

Please restrict email to break times

Today

Topic	Duration (hours)	Break duration	Start Time	End Time
Registration		0.25	08:00	08:15
Introductions	0.25		08:15	08:30
Why are we here?	0.5		08:30	09:00
Overview of whole system	0.5		09:00	09:30
Project management - EnMS implementation	0.5		09:30	10:00
Break		0.25	10:00	10:15
Management committment	0.25		10:15	10:30
Policy	0.25		10:30	10:45
Develop energy information and plans inc tools	1.75		10:45	12:30
Lunch		0.75	12:30	13:15
Q&A - planning	0.25		13:15	13:30
Interactive session - energy information and plans	1		13:30	14:30
Energy Metrics	0.75		14:30	15:15
Break		0.25	15:15	15:30
Financial appraisal of opportunities inc tool	0.5		15:30	16:00
Day to day operations - part 1	0.75		16:00	16:45

Preview of Tomorrow

Day to day operations - part 2 and tool demo	1.25		08:00	09:15
Q&A - operations	0.25		09:15	09:30
Checking - part 1	0.5		09:30	10:00
Break		0.25	10:00	10:15
Checking - part 2 inc tools	1.25		10:15	11:30
Q&A - checking	0.25		11:30	11:45
Management Review	0.5		11:45	12:15
Lunch		0.75	12:15	13:00
Integration with other MSs	0.25		13:00	13:15
Workshop - planning, operating and checking	1.5		13:15	14:45
Break		0.25	14:45	15:00
Review workshop results	0.75		15:00	15:45
Close out inc feedback form	0.5		15:45	16:15
Next Steps	0.5		16:15	16:45
Day 2 End			16:45	

Introductions – 15 minutes total

- Name
- Company
- Energy Management Experience
- What do you expect to learn over these two days?

Purpose of the course

- Access to energy is becoming more costly and environmentally damaging
- The era of cheap energy is over (in many countries!)
- Reduce energy consumption
  - Reduce cost
  - Reduce GHG emissions
- Role of energy efficiency
- Benefits of a systematic approach to energy management

Central Message: It is not difficult to reduce energy consumption in most organisations


SOLPAK

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Industrial Energy Use

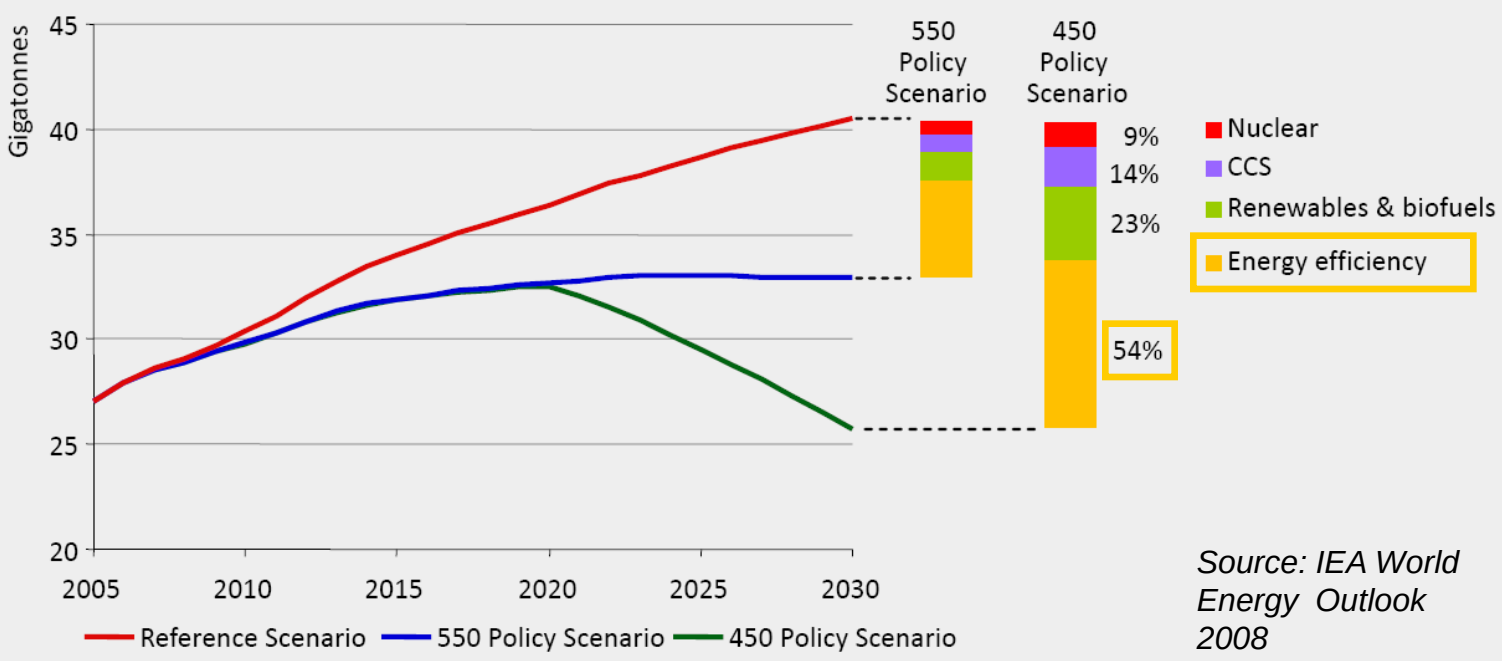
- Industrial energy use globally accounts for
  40% of electricity use
  77% of coal and derivatives use
  37% of natural gas use
  and 1/3 of global CO_2 emissions[1]

- Industry has the potential to reduce its energy intensity and emissions by up to 26–32%, providing a 8-12% reduction in total energy use and CO_2 emissions[2]

[1,2] **Source: IEA, 2006 and 2007**

Climate Change - What needs to be done

- Reduction in energy-related CO_2 emissions in the climate-policy scenarios



Source: IEA World Energy Outlook 2008

While technological progress is needed to achieve some emissions reductions, efficiency gains and deployment of existing low-carbon energy account for most of the savings

Placeholder for specific local issues

- Short discussion

Industrial Energy Efficiency Benefits

- Energy efficiency has demonstrated, time and again, that
  - ✓ It saves industrial firms money
  - ✓ It increase reliability of operations
  - ✓ It has a positive effect on productivity and competitiveness
  - ✓ It can offer attractive financial and economic returns
  - ✓ Reduces exposure to rising energy prices
  - ✓ Increases security of supply
  - ✓ ….

then

Why it is not happening?

Barriers to Industrial Energy Efficiency

- Management focus is on production and not on energy efficiency
- Lack of information and understanding of financial and qualitative benefits
- Lack of adequate technical skills for developing and implementing EE measures and projects
- Poor monitoring systems and data
- First costs more important than recurring costs → disconnection between capital and operating budgets
- When EE knowledge exists it very often resides with individuals rather than with the company/ organization → sustainability risk
- ……

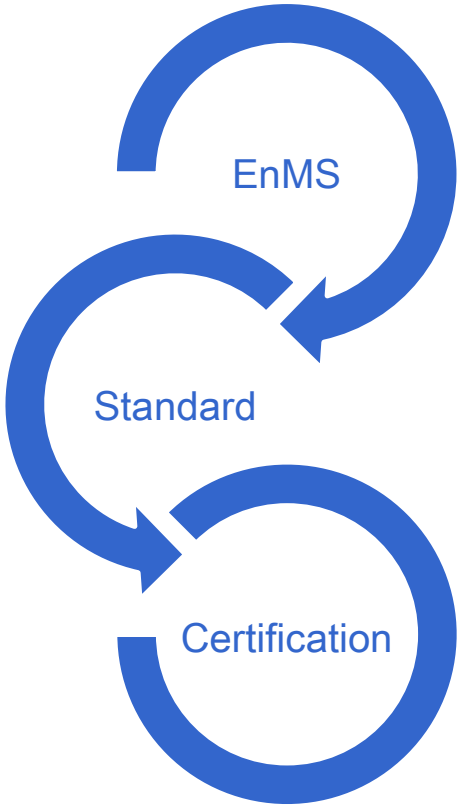
Industry and Energy Efficiency

Problem: *Energy efficiency is not integrated into daily management and operational practices*

Solution: *Top management needs to be engaged in the management of energy on an ongoing basis.*

Some terms to understand

- Energy Management System (EnMS)
  - Systematic approach to the management of energy use
- Energy Management System Standard
  - Standardised approach to implementing an EnMS
  - You may decide to base your EnMS on a standard e.g. ISO 50001:2011
- Certification of EnMS
  - You may decide to have your EnMS certified to a standard
- Self-evaluation and self declaration of conformance



ISO 50001 Energy Management Standard

- **Purpose of ISO 50001**

" ..to enable organizations to establish the systems and processes necessary **to improve energy performance** ..

- **Scope of ISO 50001**

".. specifies requirements applicable to energy use and consumption, including measurement, documentation and reporting, design and procurement practices for equipment, systems, processes, and personnel that contribute to energy performance"

- ".. is applicable to all organizations."

ISO 50001 does NOT prescribe specific performance criteria with respect to energy.

- ISO 50001 was published on 15 June 2011

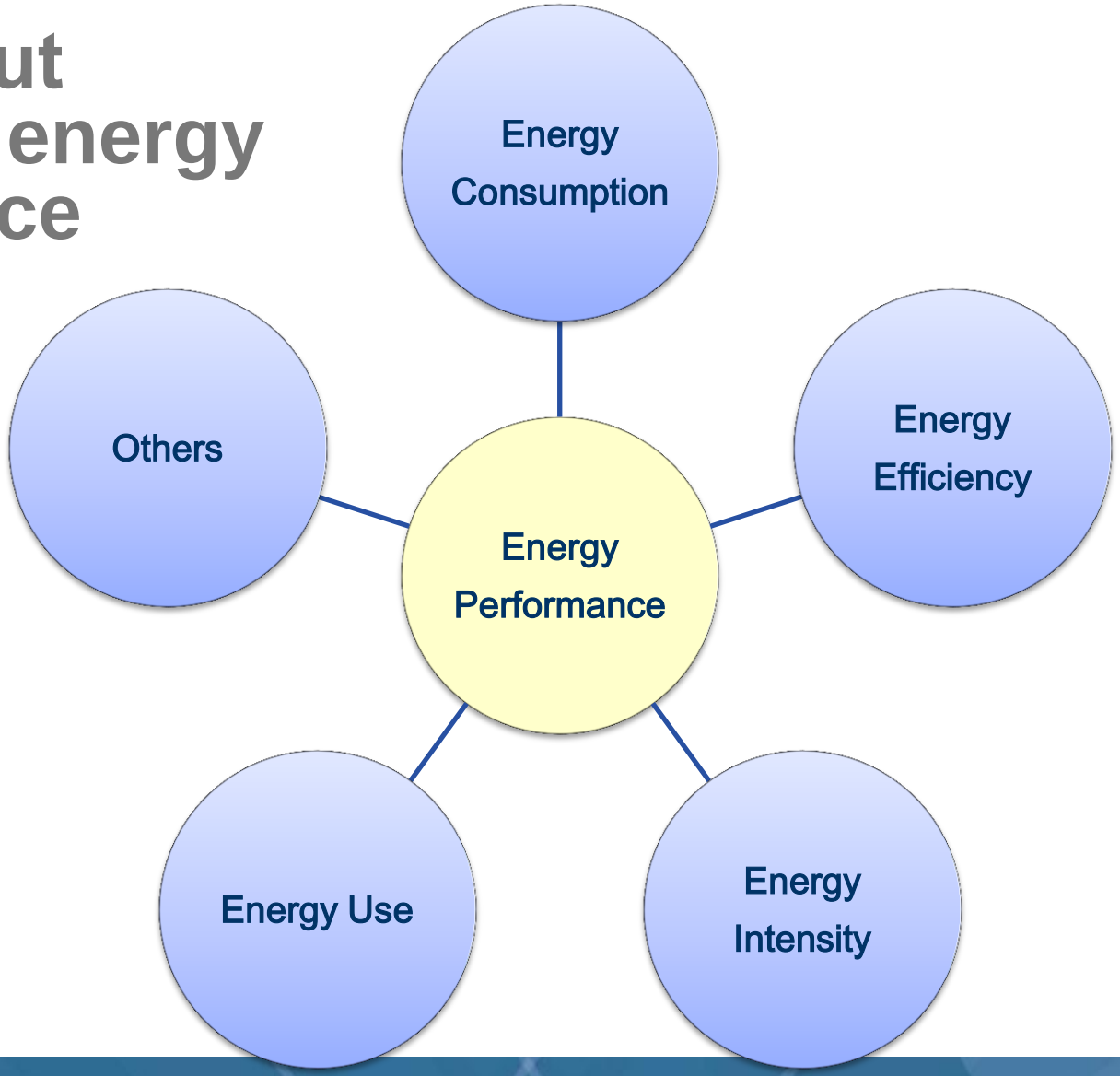
Purpose of this training

- Help you to implement an EnMS in your organisation
- Give you a full overview of an EnMS
- Understand cost and resource requirements for EnMS implementation
- Show you some practical tools that you can use or adapt
- Show you some of the pitfalls
  - Avoid bureaucracy when possible
  - While the implementation of an EnMS is a project, its use is a continual improvement process

Role of tomorrow's workshop

KISS – Keep it Simple and Sustainable

It's all about improving energy performance



Discussion:

Does anyone here think it is difficult to achieve savings of over 10% in energy consumption without financial investment?

Improve energy performance

A logical approach to energy management

Energy Management System

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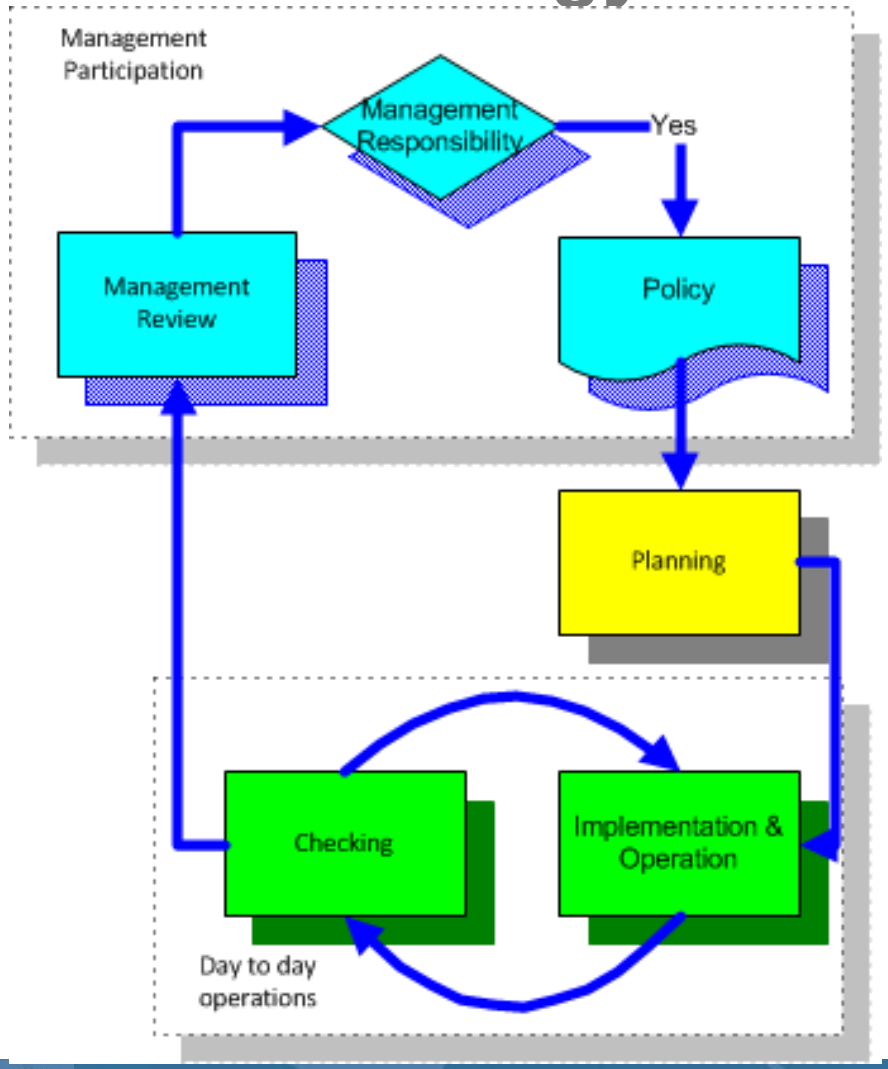
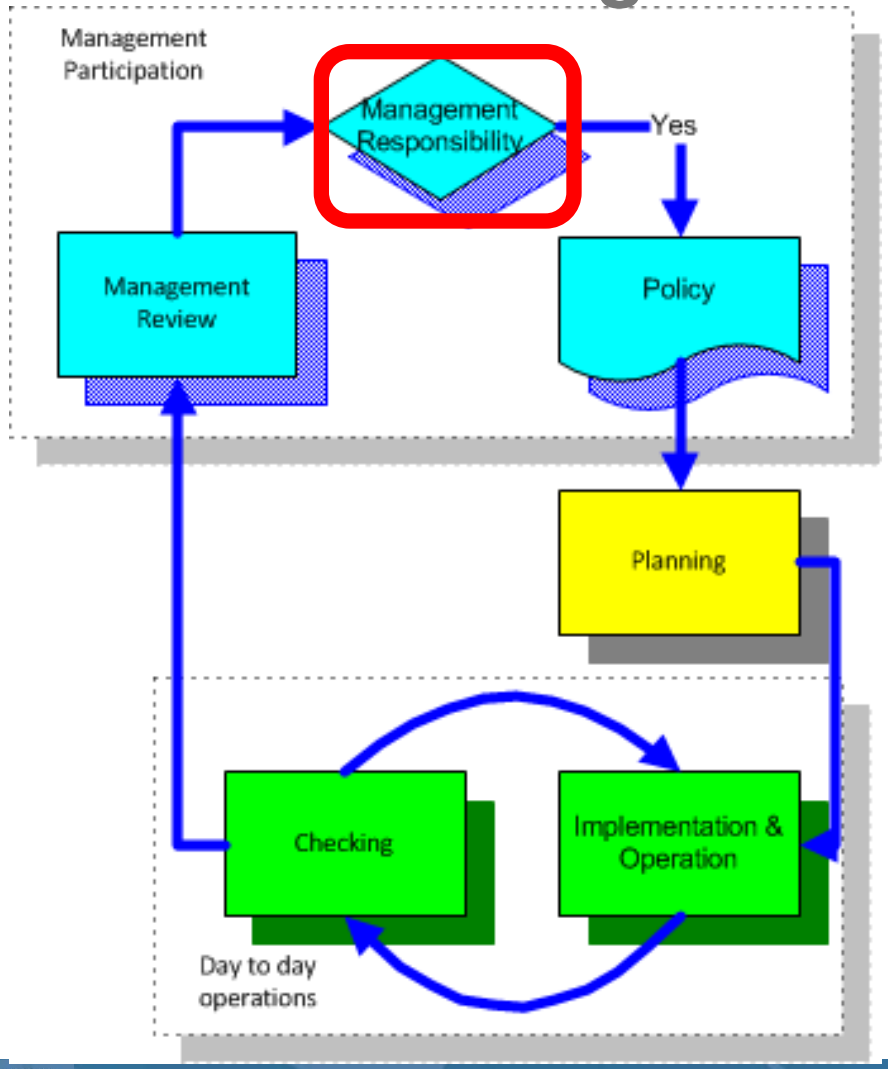
Energy Management System



Based on the concept of:

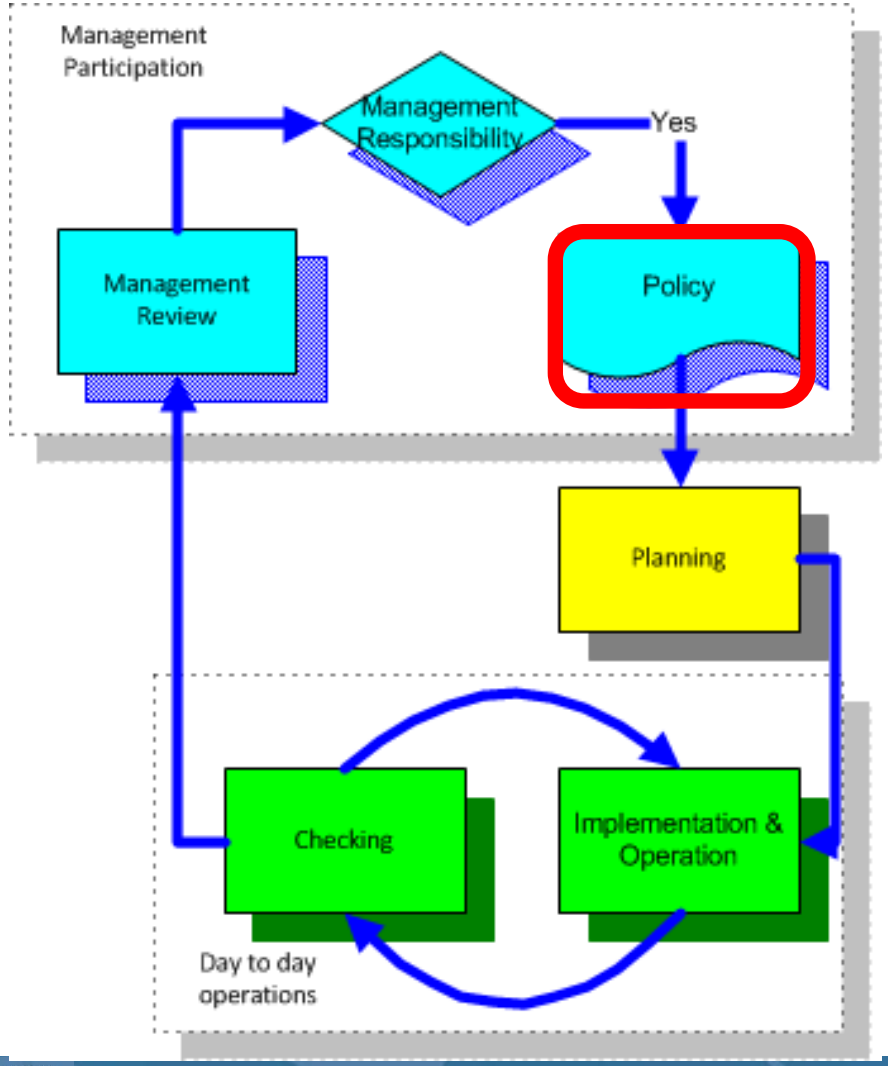
- **Plan**
- **Do**
- **Check**
- **Act**

Management Responsibility



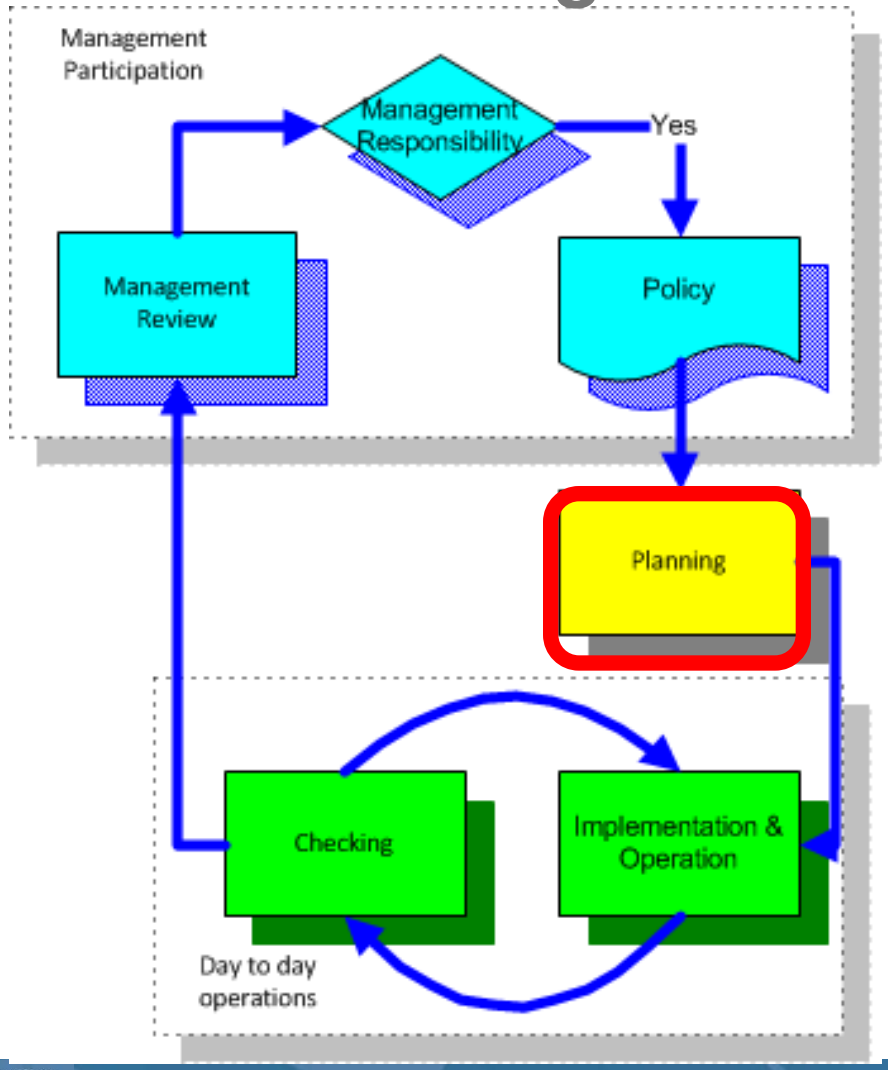
- Is the top management really comitted?
- Will they support the system?
- This is a decision point!
- If not, we can all go for coffee now!
- Will they make the necessary resources available (technical, financial and human)

Policy



- **Management commitment**
- Not just a signature!
- Define scope of EnMS
- Appropriate to scale
- **Commitment to continual improvement**
- Make resources available
- Framework for target setting and management review

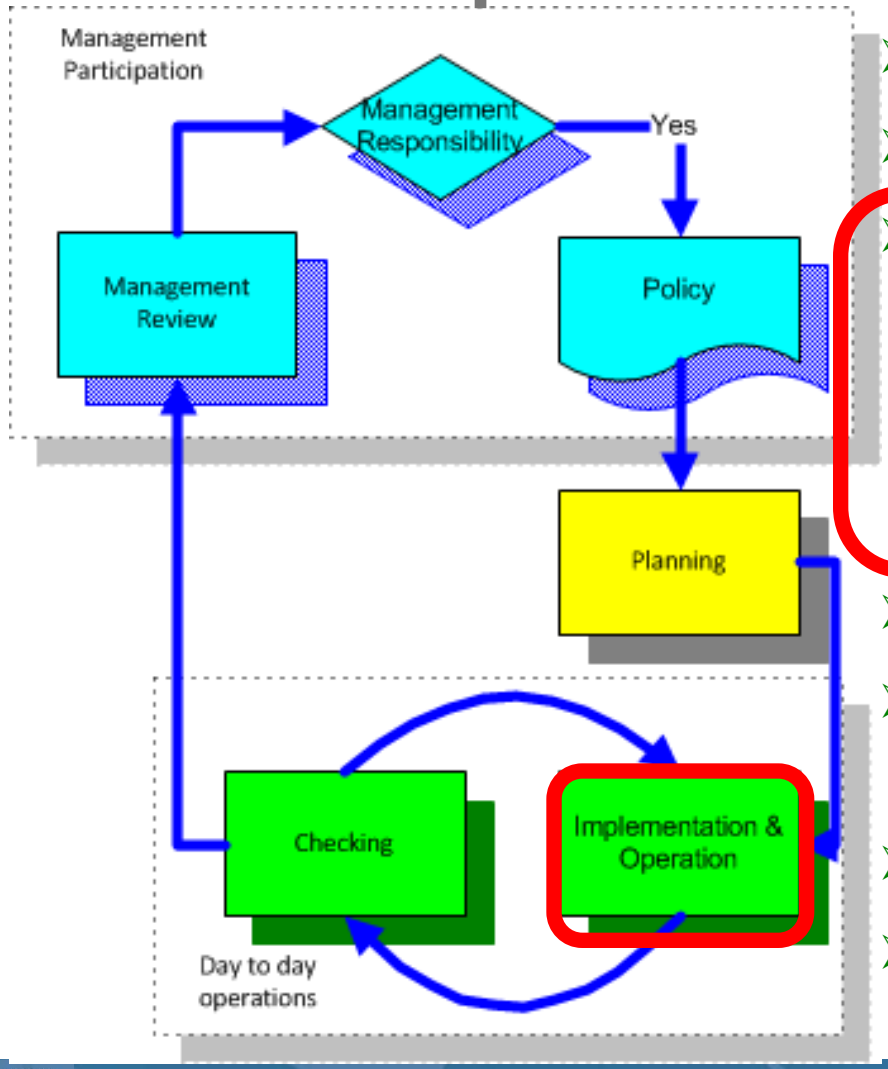
Planning



- 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 assessment (=audit)?

  If yes, focus it
- **System Optimization**
- Renewable energy options
- Are there legal or other requirements?
- Develop baselines & EnPIs
- Set objectives and targets
- **Action Plan**

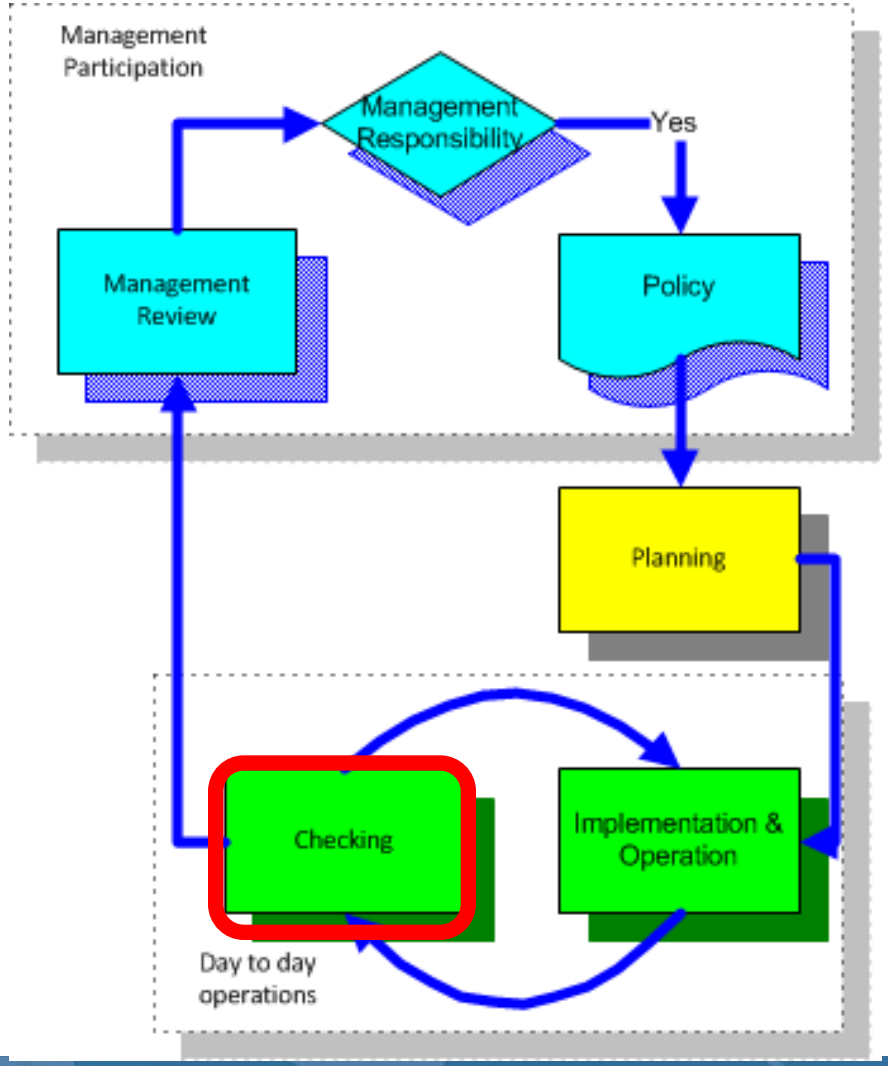
Implementation & Operation



- Competence, training and awareness
- Documentation
- Operational control
  - Key Area
  - Operation and Maintenance
  - Service Contractors
  - Training
- Communication
- Design

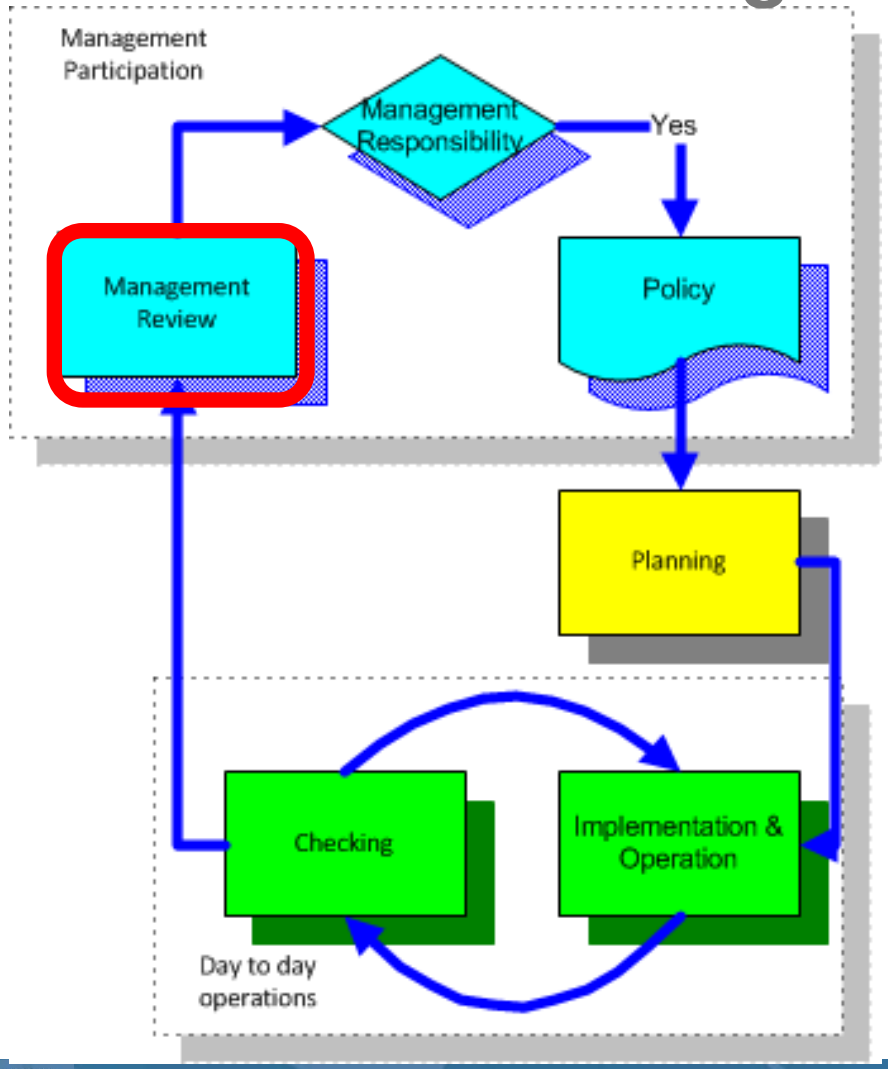
  Energy Efficient Design (EED)
- Purchasing energy, services, goods
- Action Plan

Checking



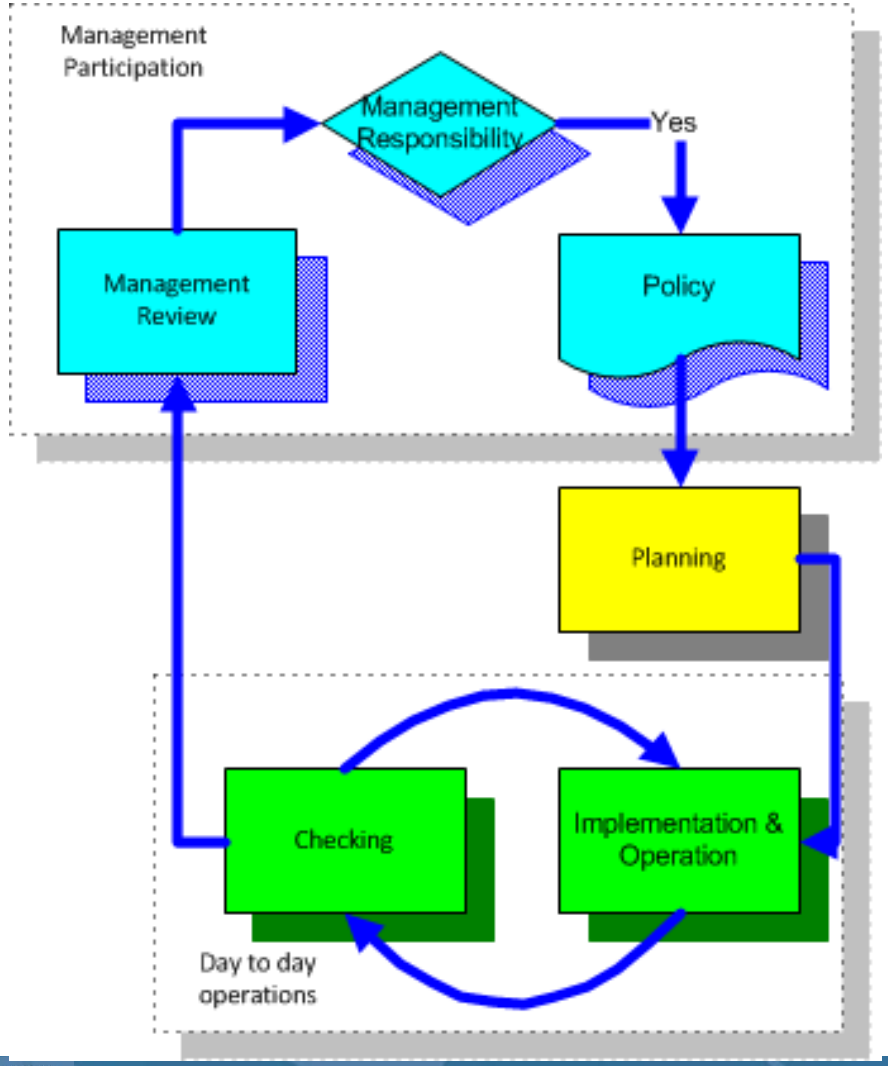
- Check Operations
  - Check operator records
  - Check maintenance records
  - Equipment checking
- Check the system
  - Is everyone doing what is required?
- Check Performance
  - Check EnPIs
  - Check trends and costs
- Check progress
  - Against plans

Management Review



- Regular presentation
- How are we getting on?
  - Is performance improving as targeted?
  - Problems and barriers to overcome?
  - Achievements
- What is the plan for next year?
  - What do we need to achieve this plan?

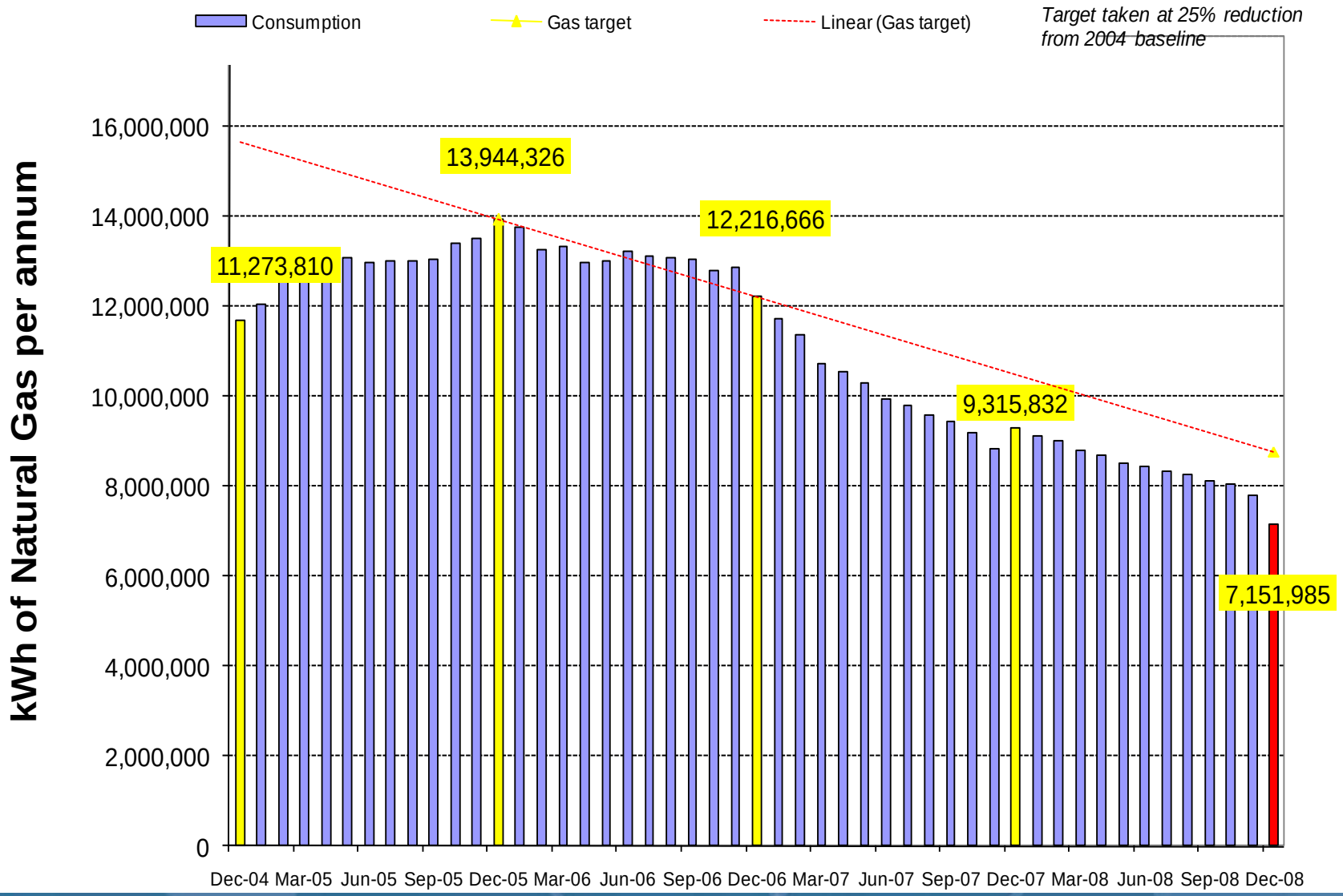
You're not finished – this is not a project!



Then you start all over again!!

What does an EnMS achieve?

- Management focus
- Systematic activity
- Identify and focus on significant users
- Identify and focus on significant people → **Training**
- Focus on data and numerical methods
- Integrated approach
  - ✓ People
  - ✓ Departments
  - ✓ Budgets
- Continuity through changes of personnel
- Continual improvement → **It is all about improving energy performance!**

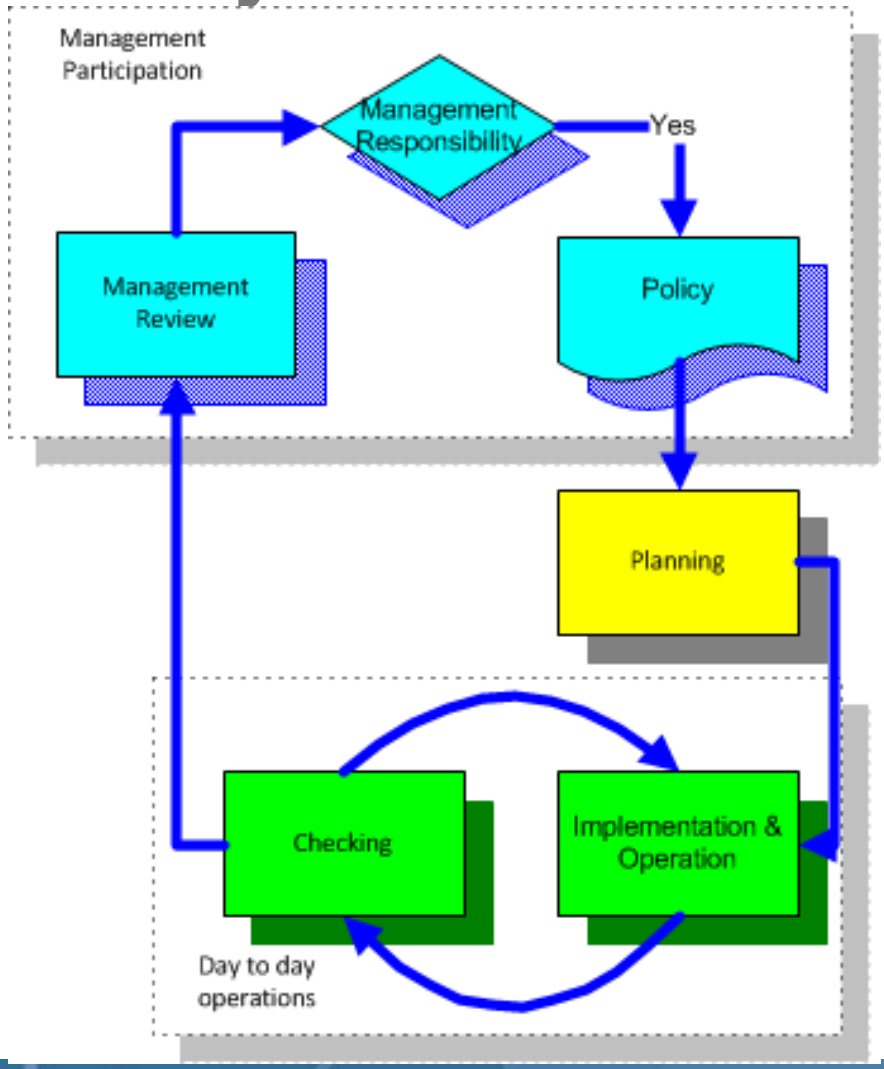

Consumption
Gas target
Linear (Gas target)
Target taken at 25% reduction from 2004 baseline
kWh of Natural Gas per annum
16,000,000
14,000,000
12,000,000
10,000,000
8,000,000
6,000,000
4,000,000
2,000,000
0
13,944,326
12,216,666
11,273,810
9,315,832
7,151,985
Dec-04 Mar-05 Jun-05 Sep-05 Dec-05 Mar-06 Jun-06 Sep-06 Dec-06 Mar-07 Jun-07 Sep-07 Dec-07 Mar-08 Jun-08 Sep-08 Dec-08

Tools to help

- 3 spreadsheets
  - Planning
  - Operating
  - Checking
- Each has multiple tabs
- This is what they look like
- These files will be made available to all participants

Energy Management Systems

- Most energy efficiency in industry is achieved through changes in **how energy is managed**, rather than new technologies
- **Results:** Industrial enterprises implemented EnMS achieved average annual energy intensity reductions of 2.0-3.0% against the 1.0% reduction of business as usual (Ireland, Netherlands, Denmark, USA data)



Beware of these pitfalls

- *Making your system too complex*
- *Not recording changes (exclusive focus on doing)*
- *Focusing on the technical aspects but ignoring the system (EnMS)*
- *Maintaining two systems*
- *Not seeing the value in internal audits*
- *Restricting communication*
- *Not giving enough resources to the system*

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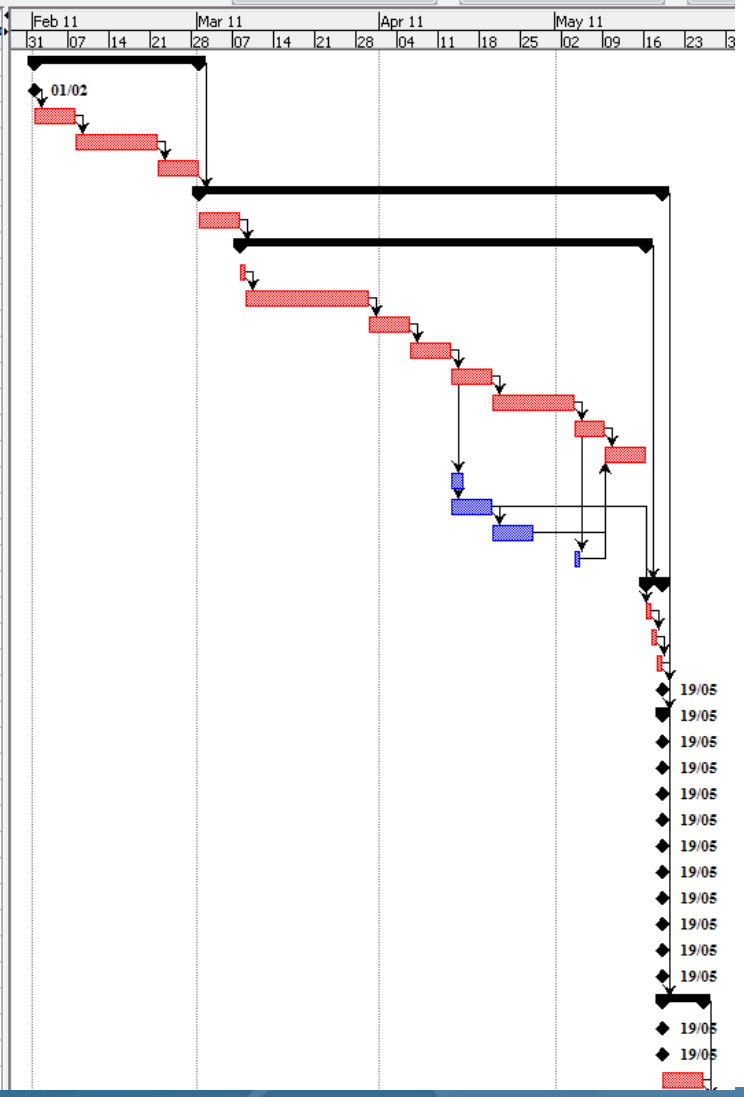
Project Plan

- We will look at a sample of how you might plan your project
  - Note: The implementation of an EnMS is a project
  - The use or operation of the EnMS is **NOT** a project
- Every organisation will be different
  - Different complexity and scale
  - Different approach to change management
  - Different cultures
  - Different speeds of action

OPENPROJ File Edit View Insert Tools Project Help

No Filter | No Sorting | No Gro

		Name	Duration	Start	Finish	Pr...	Resc
1		**Preparation**	20 days	**01/02/11 09:00**	**01/03/11 09:00**		
2		Ensure management committment	0 days	01/02/11 09:00	01/02/11 09:00		
3		Clarify roles, responsibilities and authority	5 days	01/02/11 09:00	08/02/11 09:00	2	
4		Draft energy policy including approval	10 days	08/02/11 09:00	22/02/11 09:00	3	
5		Estimate resources required	5 days	22/02/11 09:00	01/03/11 09:00	4	
6		**Planning**	57 days	**01/03/11 09:00**	**19/05/11 09:00**	**1**	
7		Review legal and other requirements	5 days	01/03/11 09:00	08/03/11 09:00		
8		**Energy Review**	49 days	**08/03/11 09:00**	**16/05/11 09:00**	**7**	
9		Acquire and analyse energy data	1 day	08/03/11 09:00	09/03/11 09:00		
10		Identify SEUs	15 days	09/03/11 09:00	30/03/11 09:00	9	
11		Identify significant people and develop training plans	5 days	30/03/11 09:00	06/04/11 09:00	10	
12		Analyse energy drivers	5 days	06/04/11 09:00	13/04/11 09:00	11	
13		Develop critical operating parameters for SEUs	5 days	13/04/11 09:00	20/04/11 09:00	12	
14		Do you need to conduct a focussed energy audit?	10 days	20/04/11 09:00	04/05/11 09:00	13	
15		Review operational control	3 days	04/05/11 09:00	09/05/11 09:00	14	
16		Develop EPO Database	5 days	09/05/11 09:00	16/05/11 09:00	15...	
17		Develop baseline	2 days	13/04/11 09:00	15/04/11 09:00	12	
18		Develop EnPIs	5 days	13/04/11 09:00	20/04/11 09:00	12	
19		Develop Metering plan	5 days	20/04/11 09:00	27/04/11 09:00	18	
20		Review potential for renewables and alternatives	1 day	04/05/11 09:00	05/05/11 09:00	14	
21		**Objectives, targets and action plan**	3 days	**16/05/11 09:00**	**19/05/11 09:00**	**8**	
22		Develop Objectives	1 day	16/05/11 09:00	17/05/11 09:00	18	
23		Develop Targets	1 day	17/05/11 09:00	18/05/11 09:00	22	
24		Develop Action Plan	1 day	18/05/11 09:00	19/05/11 09:00	23	
25		Get approval for action plan	0 days	19/05/11 09:00	19/05/11 09:00	24	
26		**Implementation and Operation**	0 days	**19/05/11 09:00**	**19/05/11 09:00**	**6**	
27		Carry out training	0 days	19/05/11 09:00	19/05/11 09:00		
28		Increase energy awareness	0 days	19/05/11 09:00	19/05/11 09:00		
29		Manage documentation	0 days	19/05/11 09:00	19/05/11 09:00		
30		Operate equipment	0 days	19/05/11 09:00	19/05/11 09:00		
31		Maintain equipment	0 days	19/05/11 09:00	19/05/11 09:00		
32		Manage action plan	0 days	19/05/11 09:00	19/05/11 09:00		
33		Develop and use EED methodology	0 days	19/05/11 09:00	19/05/11 09:00		
34		Develop and use procurement specifications	0 days	19/05/11 09:00	19/05/11 09:00		
35		Run awareness campaigns	0 days	19/05/11 09:00	19/05/11 09:00		
36		Communicate	0 days	19/05/11 09:00	19/05/11 09:00		
37		**Checking**	5 days	**19/05/11 09:00**	**26/05/11 09:00**	**6**	
38		Technical Checking	0 days	19/05/11 09:00	19/05/11 09:00		
39		Performance Checking	0 days	19/05/11 09:00	19/05/11 09:00		
40		Plan internal audits	5 days	19/05/11 09:00	26/05/11 09:00		



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6		**Planning**	54 days	**01/03/11 09:00**	**16/05/11 09:00**	**1**
23		**Implementation and Operation**	0 days	**16/05/11 09:00**	**16/05/11 09:00**	**6**
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7		Review legal and other requirements	5 days	01/03/11 09:00	08/03/11 09:00	
8		**Energy Review**	46 days	**08/03/11 09:00**	**11/05/11 09:00**	**7**
9		Energy Consumption trends	1 day	08/03/11 09:00	09/03/11 09:00	
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1		**Preparation**	20 days	**01/02/11 09:00**	**01/03/11 09:00**	
6		**Planning**	54 days	**01/03/11 09:00**	**16/05/11 09:00**	**1**
23		**Implementation and Operation**	0 days	**16/05/11 09:00**	**16/05/11 09:00**	**6**
24		Carry out training	0 days	16/05/11 09:00	16/05/11 09:00	
25		Manage documentation	0 days	16/05/11 09:00	16/05/11 09:00	
26		Manage action plan	0 days	16/05/11 09:00	16/05/11 09:00	
27		Develop EED methodology	0 days	16/05/11 09:00	16/05/11 09:00	
28		Develop procurements specifications	0 days	16/05/11 09:00	16/05/11 09:00	
29		Communicate	0 days	16/05/11 09:00	16/05/11 09:00	
30		**Checking**	5 days	**16/05/11 09:00**	**23/05/11 09:00**	**6**
35		**Management review**	5.5 days	**23/05/11 09:00**	**30/05/11 14:00**	**30**

		Name	Duration	Start	Finish	Prede...
1		**Preparation**	20 days	**01/02/11 09:00**	**01/03/11 09:00**	
6		**Planning**	54 days	**01/03/11 09:00**	**16/05/11 09:00**	**1**
23		**Implementation and Operation**	0 days	**16/05/11 09:00**	**16/05/11 09:00**	**6**
30		**Checking**	5 days	**16/05/11 09:00**	**23/05/11 09:00**	**6**
31		Technical Checking	0 days	16/05/11 09:00	16/05/11 09:00	
32		Performance Checking	0 days	16/05/11 09:00	16/05/11 09:00	
33		Plan internal audits	5 days	16/05/11 09:00	23/05/11 09:00	
34		Carry out internal audits	0 days	23/05/11 09:00	23/05/11 09:00	33
35		**Management review**	5.5 days	**23/05/11 09:00**	**30/05/11 14:00**	**30**
36		Plan management review	5 days	23/05/11 09:00	30/05/11 09:00	
37		Deliver reivew	0.5 days	30/05/11 09:00	30/05/11 14:00	36

What resources are required?

- Management Resources required
  - Consider the opportunity
  - Make the decision to go ahead
  - Review and approve the policy
  - Participate in the regular review meeting
  - Make on-going decisions as required
  - Offer encouragement and support
- Operational resources
- Implementation cost (for EnMS itself)
- Capital Investment

What resources are required?

- Management Resources required
- Operational resources
  - Completion of planning steps
  - Training is probably the largest
  - Support from other departments
  - Some time for energy manager to focus on EE
- Implementation cost (for EnMS itself)
- Capital investment

What resources are required?

- Management Resources required
- Operational resources
- Implementation cost (for EnMS itself)
  - Consultancy support (if required)
  - Certification cost (if required)
- Capital investment

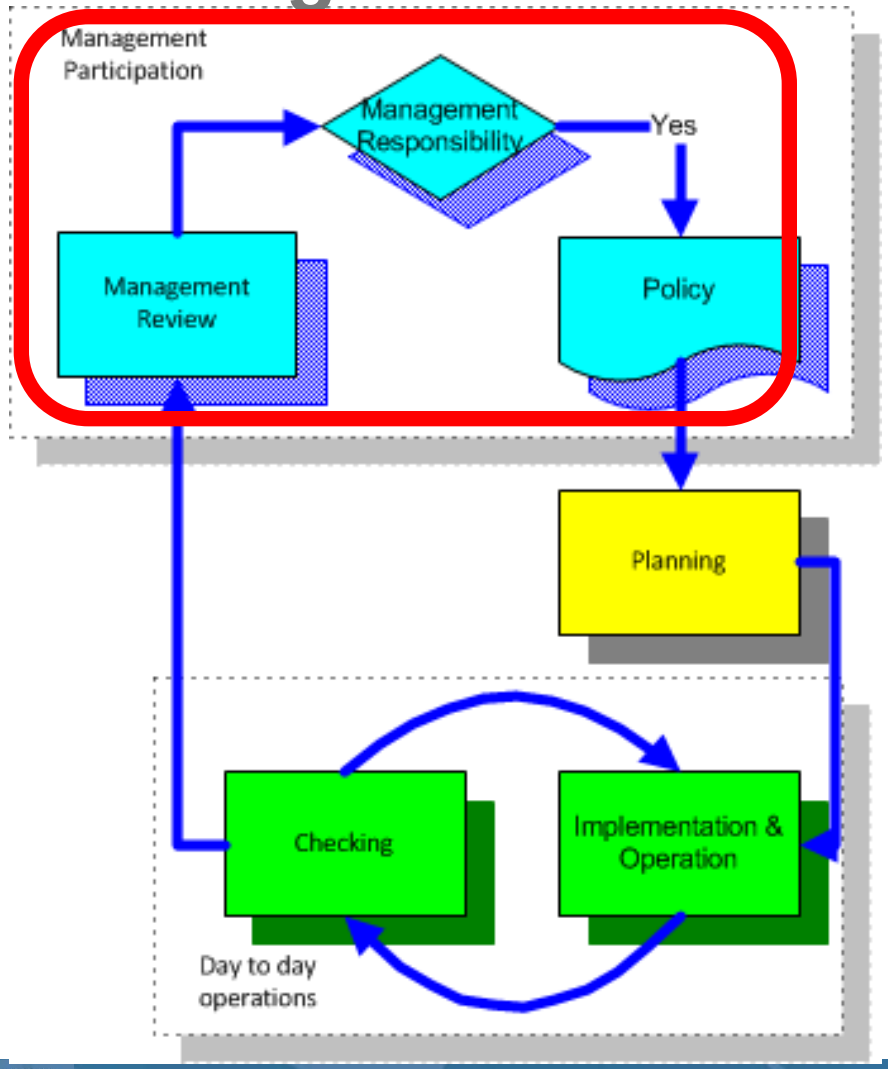
What resources are required?

- Management Resources required
- Operational resources
- Implementation cost (for EnMS itself)
- Capital investment is straightforward!
  - Either finance is justifiable and available or it isn't!
  - The focus of the EnMS is on low cost opportunities
  - Capital projects are also identified and justified

Day 1

Topic	Duration (hours)	Break duration	Start Time	End Time
Registration		0.25	08:00	08:15
Introductions	0.25		08:15	08:30
Why are we here?	0.5		08:30	09:00
Overview of whole system	0.5		09:00	09:30
Project management - EnMS implementation	0.5		09:30	10:00
Break		0.25	10:00	10:15
Management commitment	0.25		10:15	10:30
Policy	0.25		10:30	10:45
Develop energy information and plans inc tools	1.75		10:45	12:30
Lunch		0.75	12:30	13:15
Q&A - planning	0.25		13:15	13:30
Interactive session - energy information and plans	1		13:30	14:30
Energy Metrics	0.75		14:30	15:15
Break		0.25	15:15	15:30
Financial appraisal of opportunities inc tool	0.5		15:30	16:00
Day to day operations - part 1	0.75		16:00	16:45

Management Role



- Give commitment
- Sign policy
- Allocate resources
- Assign responsibility
- Top management representative
- Give support
- Participate in annual review
- Make decisions

This is the foundation of the system

- Most managements have limited resources
  - They can't give all of us everything we want
- They need to be persuaded that this is a good idea
  - Maybe they have if you are here!
- You need to show quick results to sustain their interest
- Your efforts will reduce costs
  - This feeds directly into increasing profits
- You will improve the organisations environmental performance
  - This is very good public relations
  - Make the boss feel good
- You need to keep them convinced

Overview

- We want someone at the top level of the organisation to lead the energy management activities
  - Direct the activities
  - Represent energy management at senior level
  - Gain support for energy management
- We want someone to run the EnMS on a daily basis
  - Know it in detail
  - Coordinate its development
  - Represent it at external audits
- In some cases both of these roles will be the same person, in others the duties may be split

Terminology

- The senior member of the management team is the **management representative** and in smaller organisations they will also be the energy manager
- The day to day coordinator of energy management is the **energy manager**. In most organisations this role is not fulltime. It may be undertaken by a plant engineer, maintenance engineer, utilities manager, environmental officer, etc. etc.
- Neither of these removes the critical role of an **energy team** in most organisations.
- The energy team will include cross functional representation to help ensure that energy management becomes part of the culture of all departments with a significant impact on the organisation's energy consumption.

Management representative responsibilities

- Implementing of the energy management system;
- Reporting to top management on the performance of the energy management system;
- Reporting to top management on the energy performance of the organisation;
- Formation of an energy management team;
- Plan and direct energy management activities;
- In a larger organisation, most of the day to day energy work may be completed by others, e.g. energy manager.

Management representative desirable skills

- High-level communication skills, including liaison, negotiation and consultation skills;
- Proven experience in project management;
- An understanding of energy costs and the structure of the energy industry;
- Familiarity with engineering systems and energy efficiency technologies;
- Knowledge and experience of change management;
- Other relevant skills, knowledge and experience may include:
  - Experience with implementing energy management systems;
  - Motivation and willingness to undertake further training and skill acquisition;
  - Ability to use word processing, spreadsheet and database packages;
  - An understanding of operations and other areas such as safety, quality, finance and environmental issues.

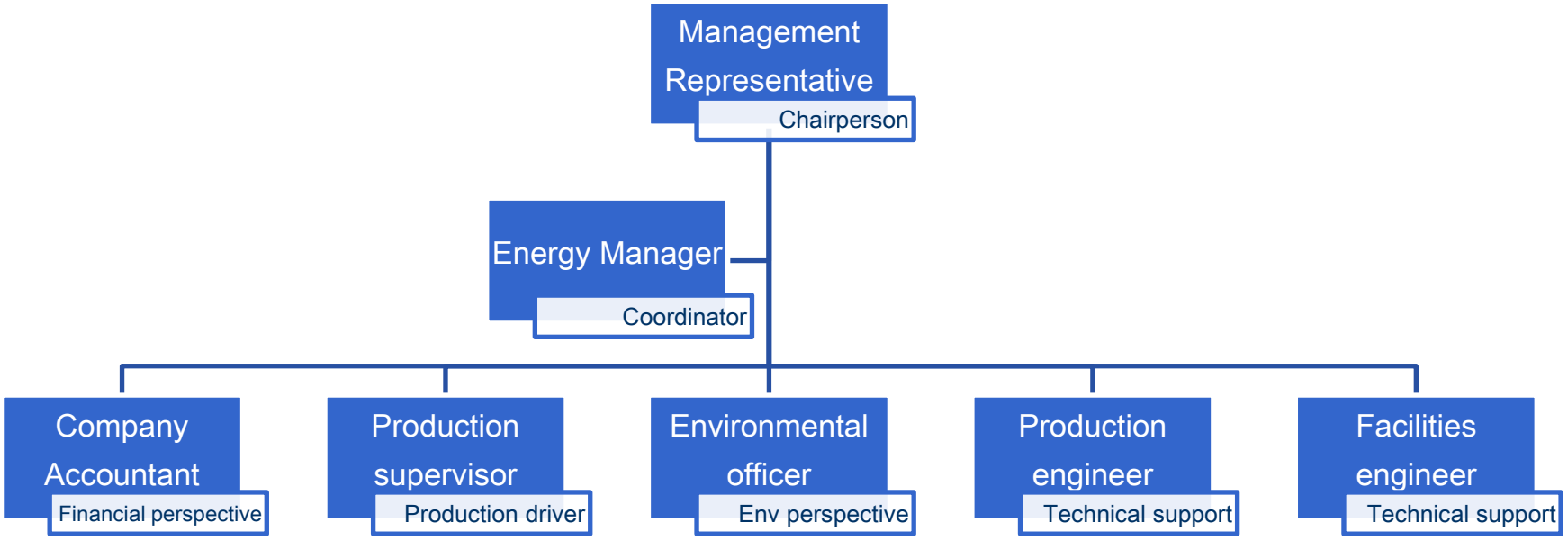
Energy Manager

- In some organisations, this may be the same person as the mgmt rep
- Often not a full time job;
  - For example, maintenance or engineering manager or engineer
  - Probably a technical person with energy engineering knowledge
- Role
  - Implement the EnMS
  - Owns the EnMS
  - Manages energy use
  - Acts as auditee for the EnMS
- Responsibility
  - Varies with organisation
  - Implementation
  - Energy budget
  - Reporting
- Comparison with management representative

Energy management team

- Decide structure and membership based on size and complexity of your organisation
- Representatives from relevant departments
  - Production, finance, engineering, operations, senior management representative, energy manager or engineer, etc.
- Cross functional cooperation
- Common and shared goal

Sample energy management team



- Composition will vary with organisation and culture
- Size will vary
- The energy manager may deputise for the mgmt rep
- Teamwork

Roles, responsibility & authority

- The above are required for each individual involved in the EnMS.
- Each person needs to understand their own role and responsibilities
- Every needs to know each others authority levels
- This may seem like common sense but is often a source of ineffectiveness

Roles and Responsibility

	A	B	C	D	E	F	G	H	I
1	**Task**	**Top Manager**	**Management Representative**	**Energy Manager**	**Finance Manager**	**Production Manager**	**Maintenance Engineer**	**Utilities Engineer**	**Utilities Operators**
2	Develop Policy		Lead	Participate					
3	Approve Policy	Lead	Participate		Participate	Participate			
4	Member of energy team		Lead	Participate	Participate	Participate	Participate	Participate	
5	Analyse energy consumption		Inform	Lead					
6	Develop energy metrics		Inform	Lead					
7	Use energy metrics			Lead					
8	Operational Control					Lead		Lead	
9	Financial Appraisal		Participate	Participate	Lead				
10	Monitor bills		Inform	Lead	Participate				
11	Maintain EPO database		Inform	Lead					
12	Implement training			Participate		Lead		Lead	
13	Implement EED			Lead		Participate		Participate	
14	etc								

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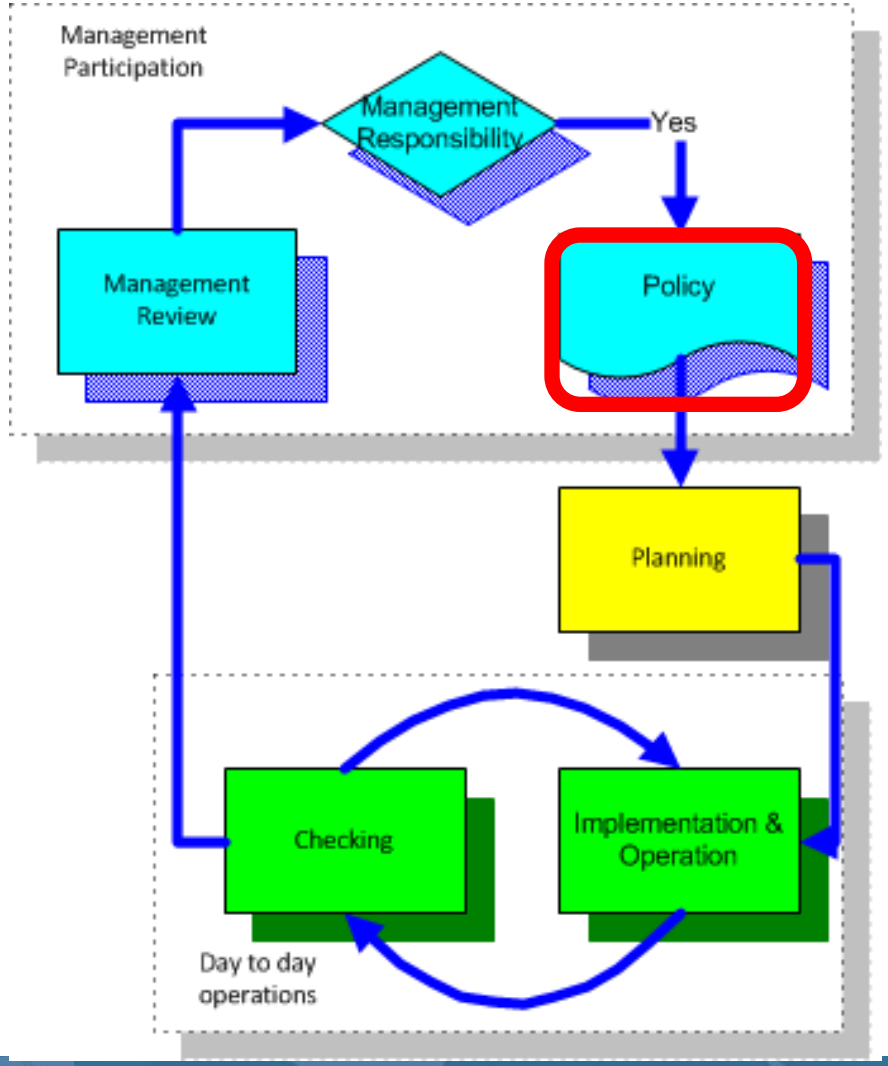
Policy



- **Management commitment**
- Not just a signature!
- Define scope of EnMS
- Appropriate to scale
- **Commitment to continual improvement**
- Make resources available
- Framework for target setting and review organizations

Energy Policy document

- It is an official document that demonstrates support and commitment to improving energy performance
- Doesn't need to go into detail
- Scope and boundaries of the system
  - Which plant, buildings, energy sources (water?) are included
- The policy (and EnMS) should be appropriate to the nature and scale of the operations
  - Small organisation -> simple EnMS
  - Large organisation -> simple EnMS!
- Review and update regularly
  - Changes are usually minimal
- Prepare at an early stage
  - Possibly update after planning if required

Policy should include

- Commitment to continual improvement of energy performance through the development and achievement of relevant objectives and targets.
- Commitment to provide the necessary information and resources to achieve its energy objectives and targets
- Commitment to comply with all legal and other requirements that apply to its energy using activities
- Support for the purchase of energy efficient products and services where economically feasible.
- Support the use of energy efficient design practices in new projects
- The policy should be communicated to all levels of the organisation.

Example

XYZ Company Energy Policy

As an energy intense manufacturer of specialty glass, 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:

Reduce energy intensity by 25% in 10 years in our manufacturing and distribution operations

Ensure continual improvement in our energy performance

Deploy information and resources to achieve our objectives and targets

Uphold legal and other requirements regarding energy

Consider energy performance improvements in design and modification of our facilities, equipment, systems and processes

Effectively procure and utilize energy-efficient products and services

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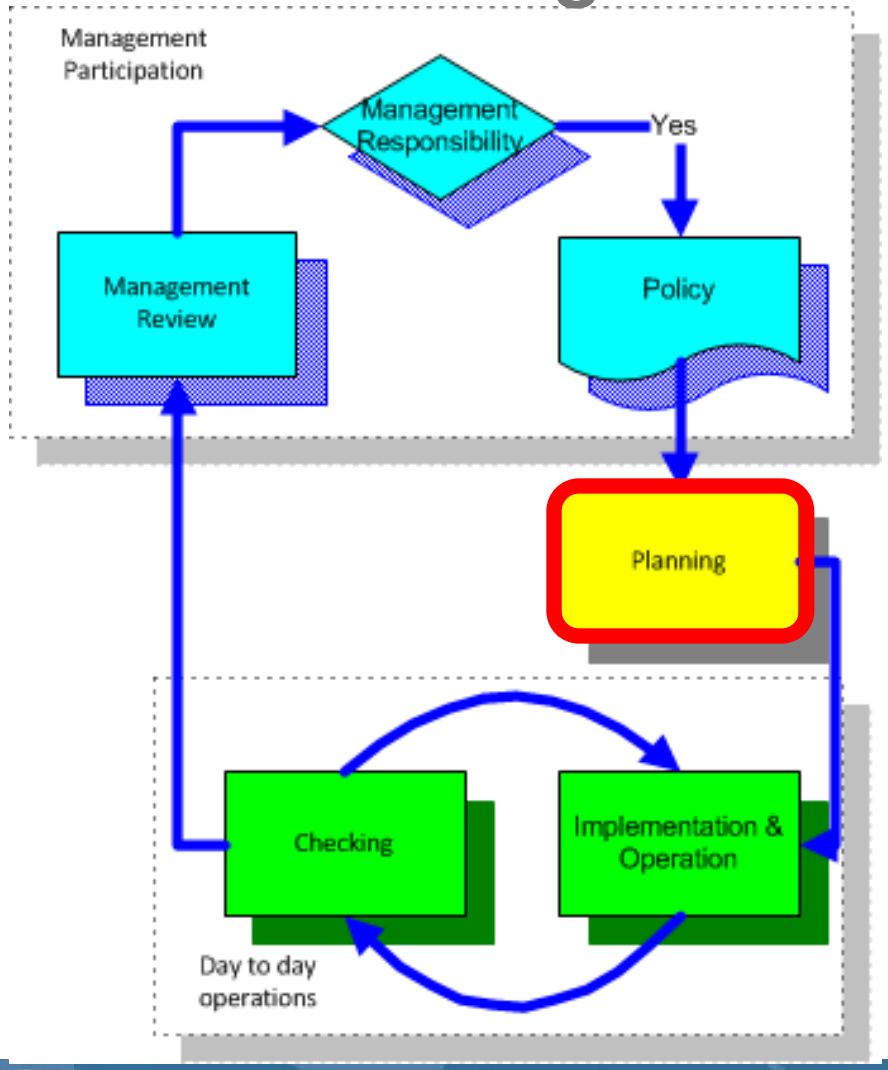
Planning

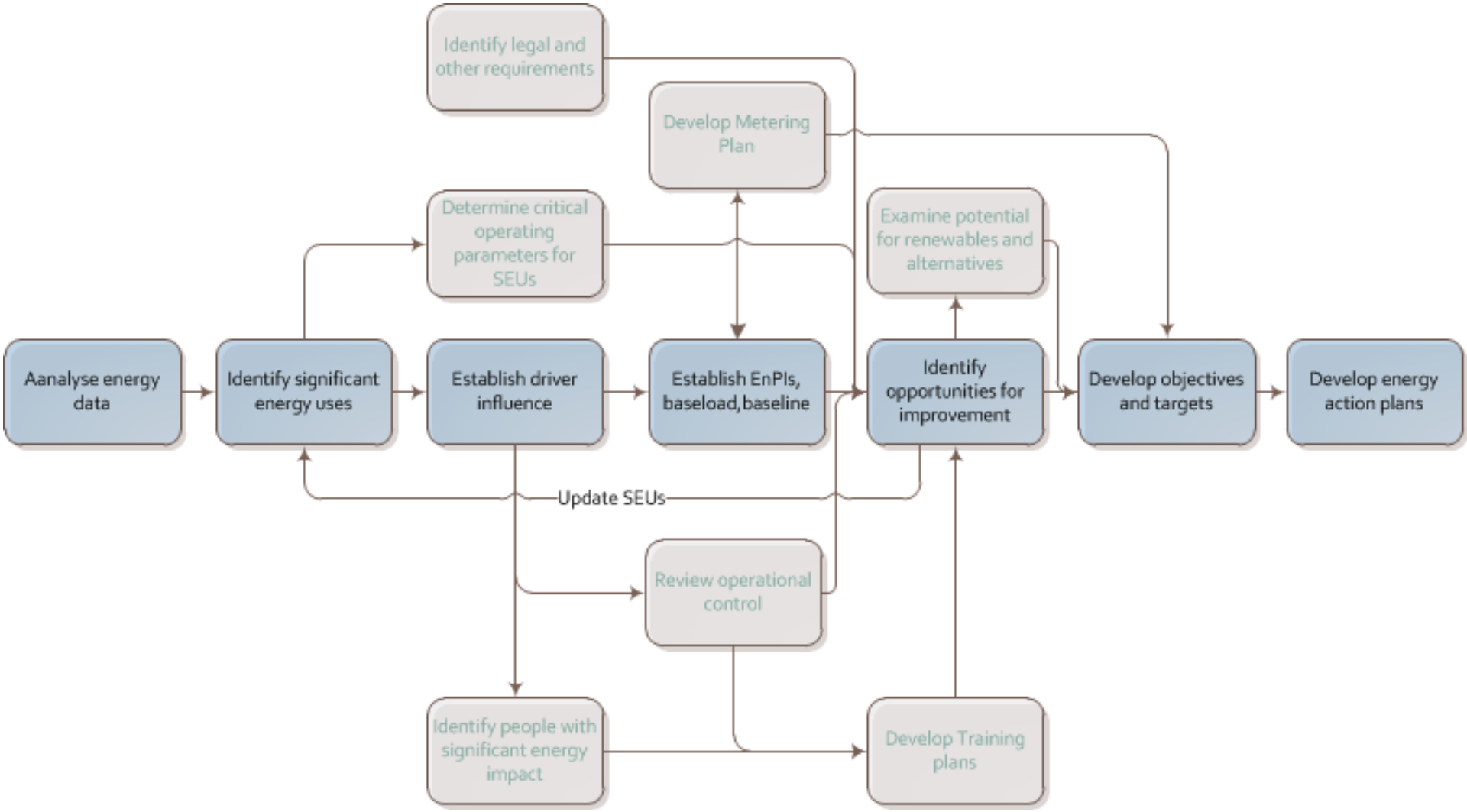
Translating the commitment and energy policy into objectives, targets and action plans

Planning

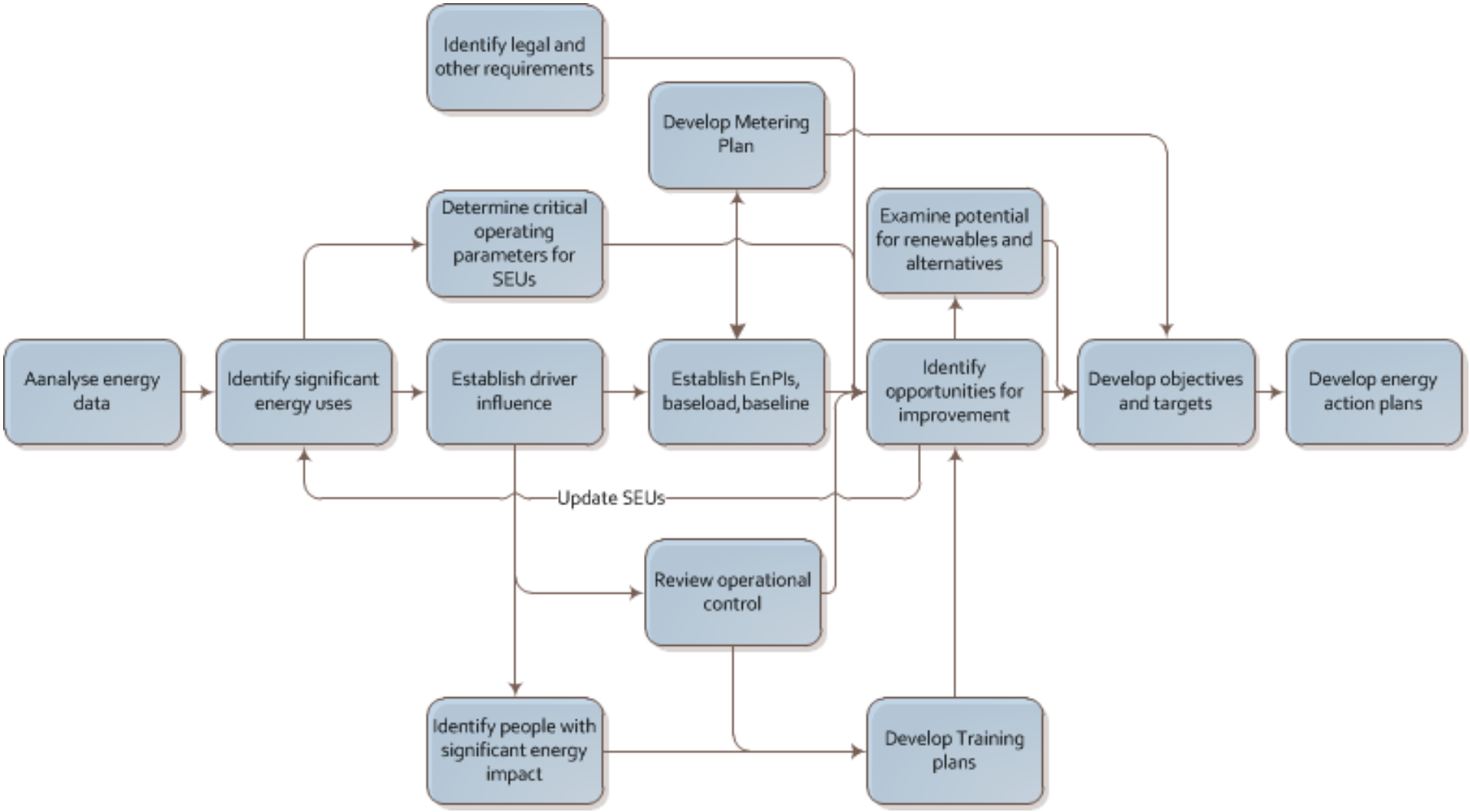


- How much energy am I using?
- Where am I using it?
- **Which are significant users?**
- What is driving it?
- Who is influencing its use?
- Do I need to have an energy audit?
  - If yes, focus it
- **System Optimization**
- Renewable energy options
- Are there legal or other requirements?
- Develop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

Develop plans – core workflow



Full Workflow



How much energy am I using?

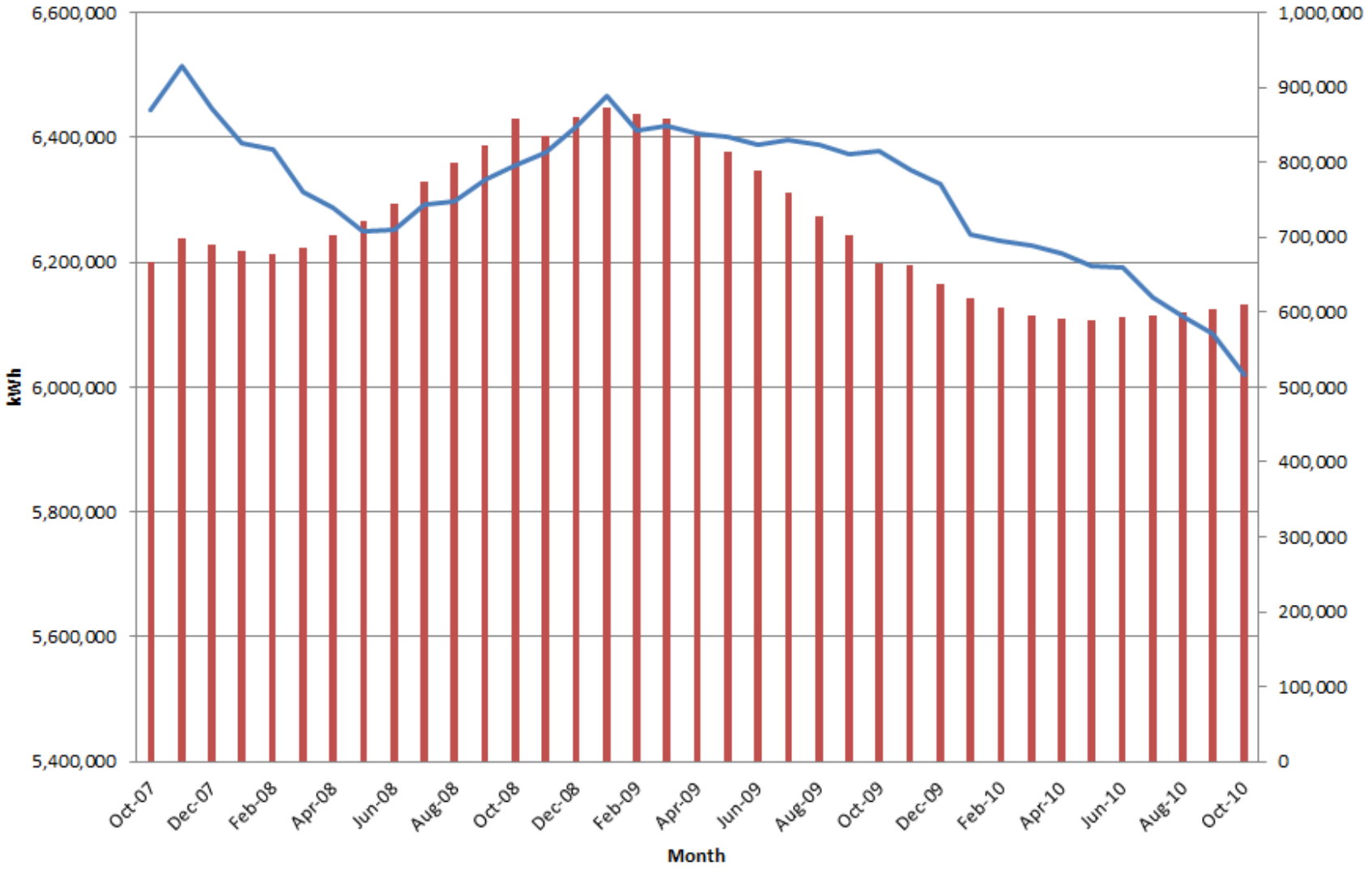
- How many people here know how much energy their organisation used in the 12 months ending last month?
- How much did it cost?
- How much did you use last year?
- How much are you going to use next year?
- How are you performing against your budget?
  - Why are there deviations?
- Are you using too much energy?
  - If so, how much should you be using?

Is the amount of money you spend on energy of any significance?

Acquire and analyse energy data

- Review the data you already have:
  - Bills include both energy consumption, cost and other parameters
- You may have sub-meters
  - Manually or automatically read
- See tool Billing

Annualised electricity usage and cost



Significant energy users (largest or presenting most significant opportunities)

Which systems?

- Sub meters
- Motor list
- Estimation
- Calculation
- Pie Charts
- Sankey Diagrams

Which people?

- Who influences SEUs?
- Training needs
- Organisation charts

Drivers?

- What is driving use?
- Variables
- Activity
- Weather
- Regression analysis

Which systems?

- What is the single largest energy user in your organisation?
- How much energy does it use?
- What drives that use?
  - What causes it to increase or decrease?
- Which people affect the energy use of that item/system?

How to quantify each energy user

- Do you have sub-metering?
  - This is the best situation
  - Ideally automatically logged to a database
  - Manually read also gives good information
  - Are meters accurate and working
  - Is data collection working and accurate
- Do you have local meters?
  - kW, A, flowrate, etc.
  - These can be read manually and calculated/estimated
  - Care with time of readings
- Quantification or estimation of use
  - Motor List
  - Heat Balance

Motor list

	A	B	C	D	E	F	G	H	I	J	K
1	ID	Purpose	Nameplate (kW)	Hours per year	Ave VSD speed (100% if fixed)	% nameplate load	Actual Power (kW)	Annual Power (kWh)	Note	When can this be switched off?	% of total
2	1	Cooling Water Pump #1	20	4200	50%	0.90	18.00	16,453	shares load with #2		2%
3	2	Cooling Water Pump #2	20	4200	100%	0.90	18.00	75,600			8%
4	3	Hydraulic pack drive	100	250	100%	0.90	90.00	22,500	used intermittently		2%
5	4	Seal cooler pump	1	8400	100%	0.90	0.90	7,560		almost always	1%
6	5	AHU 1 Fan	10	8400	80%	0.90	9.00	46,272		night and weekend	5%
7	6				100%	0.90	-	-			0%
19	18				100%	0.90	-	-			0%
20	19				100%	0.90	-	-			0%
21					100%	0.90	-	-			
22											
23		**Total**						168,386			17%
24											
25		Total electricity consumption						1,000,000	kWh per year		

What is the second largest user?

- We need to know the answers to the previous questions for all significant users (SEUs)
- Ideally we keep working on the list until we know where at least 80% of our energy is going
- This list of SEUs will be the basis of most of the rest of our system
- Remember that a SEU can be wither a large user or one with good performance improvement potential.

Heat balance

- Use what you know:
  - Steam flow
  - Feedwater flow (= steam flow approximately)
  - Fuel flow (heat flow = fuel flow * efficiency)
  - Gas bills
  - Hot water flow and temperature difference (dT) (Q=m*Cp*dT)
- Build up a balance
  - Heat in = heat out
  - If you have a significant gap, you may need to measure it
  - Ultrasonic flowmeters, portable heat meters
- More challenging than electrical power

  Typically fewer measuring points

Heat Users

	A	B	C	D	E	F	G	H	I	J	K
1	ID	Purpose	Design (kw)	Hours per year	Load factor	Actual Power (kW)	Annual Power (kWh)	% of total	Notes	When can this be switched off?	How was this estimated?
2	1	Process 1	100	4000	0.50	50.00	200,000	25%			
3	2	Process 2	80	2000	0.70	56.00	112,000	14%			
4	3	Building 1 heating	120	2080	0.6	72.00	149,760	19%			
5	4	Building 2 heating	50	2080	0.6	30.00	62,400	8%			
6	5					-	-	0%			
21											
22		Total of users					524,160	66%			
23		Total fuel used		kWh per year (from bills)			1,000,000				
24		Generation efficiency					80%				
25		Total heat used		kWh per year			800,000				

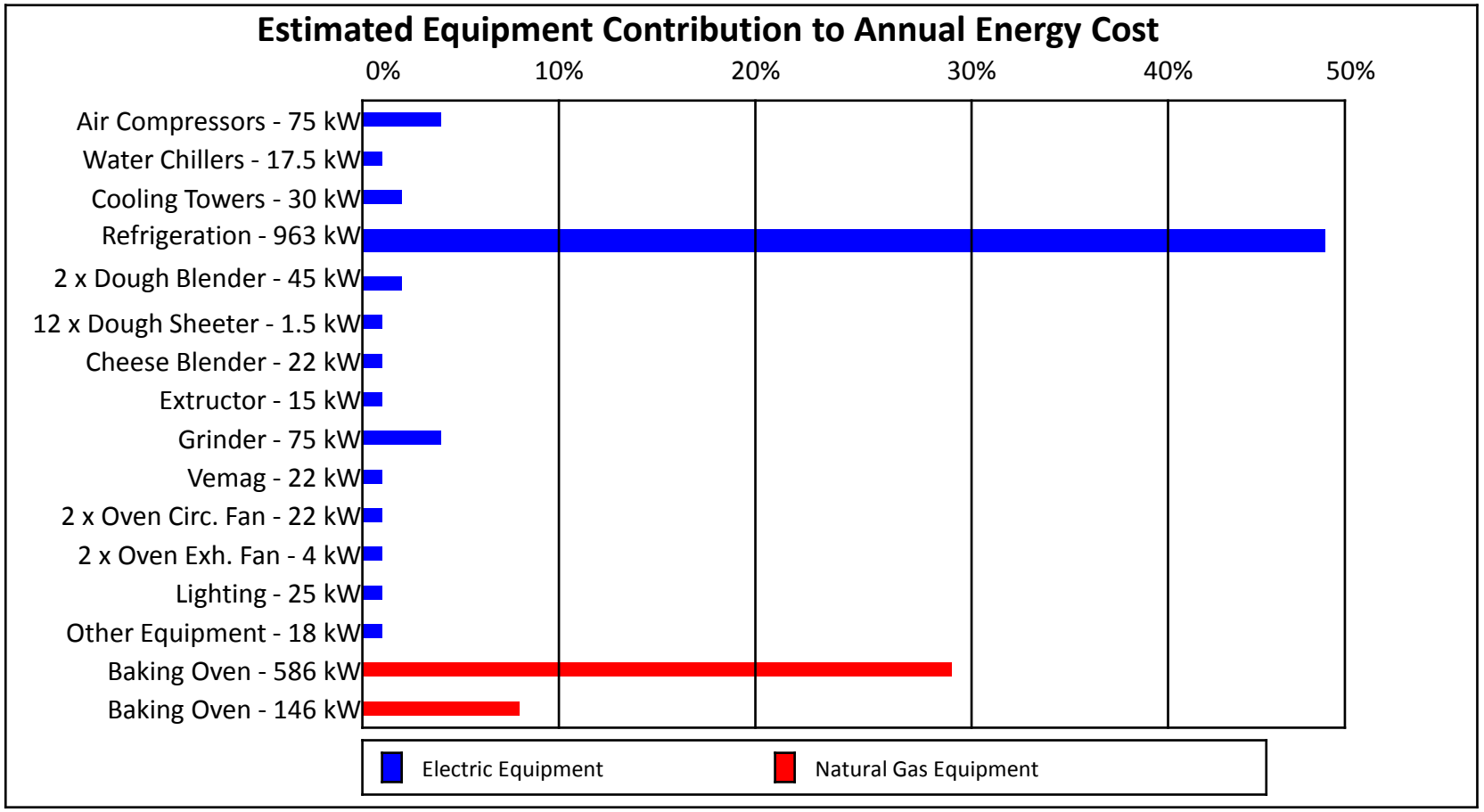
SEU List

- Include table with list in order of magnitude of energy consumption (SEUs)
- Group motors into systems:
  - All air compressors
  - Pumps and fans for cooling water
  - Pumps, fans, compressors for refrigeration

SEUs

	A	B	C	D	E	F	G
1	Electricity						
2	ID	Name of SEU	What are the main drivers?	Is the SEU metered (automatically or mannually)?	kWh/annum	% of Overall Usage	Who influences the energy use?
3	1	Building Cooling	Weather	No	4000	20%	Facility operator
4	2	Process Cooling	Production	Auto	6000	30%	Production supervisor
5	3	Compressed air	Leaks and waste	Man	5000	25%	Facility operator
6	4	Lighting	Daylight	No	3000	15%	Everyone
7	5						
8	6						
9							
10							

SEUs


Estimated Equipment Contribution to Annual Energy Cost
0%
10%
20%
30%
40%
50%
Air Compressors - 75 kW
Water Chillers - 17.5 kW
Cooling Towers - 30 kW
Refrigeration - 963 kW
2 x Dough Blender - 45 kW
12 x Dough Sheeter - 1.5 kW
Cheese Blender - 22 kW
Extructor - 15 kW
Grinder - 75 kW
Vemag - 22 kW
2 x Oven Circ. Fan - 22 kW
2 x Oven Exh. Fan - 4 kW
Lighting - 25 kW
Other Equipment - 18 kW
Baking Oven - 586 kW
Baking Oven - 146 kW
Electric Equipment
Natural Gas Equipment

Establish drivers

- Terminology: drivers, driving factors, variables, energy factors, etc.

- Each energy use is driven by some activity
  - What is it?
  - How do they interact

What is driving this use?

- Top level electricity and fuel
- Each SEU driver
- If you can't quantify a driver is there a **real** reason
  - There rarely is a legitimate reason
  - Maybe you are simply out of control
- There are often indicators of significant savings from this step
  - Anomalies
  - Demonstrate with examples
- See tool Drivers

Energy Metrics

- Details this afternoon.
- Consider the drivers for each SEU
- This relationship may be your baseline
- Energy Performance Indicators (EnPI)
- Baseline
- Baseload
- Regression Analysis
- CUSUM
- Link to checking

Establish energy performance indicators (EnPIs)

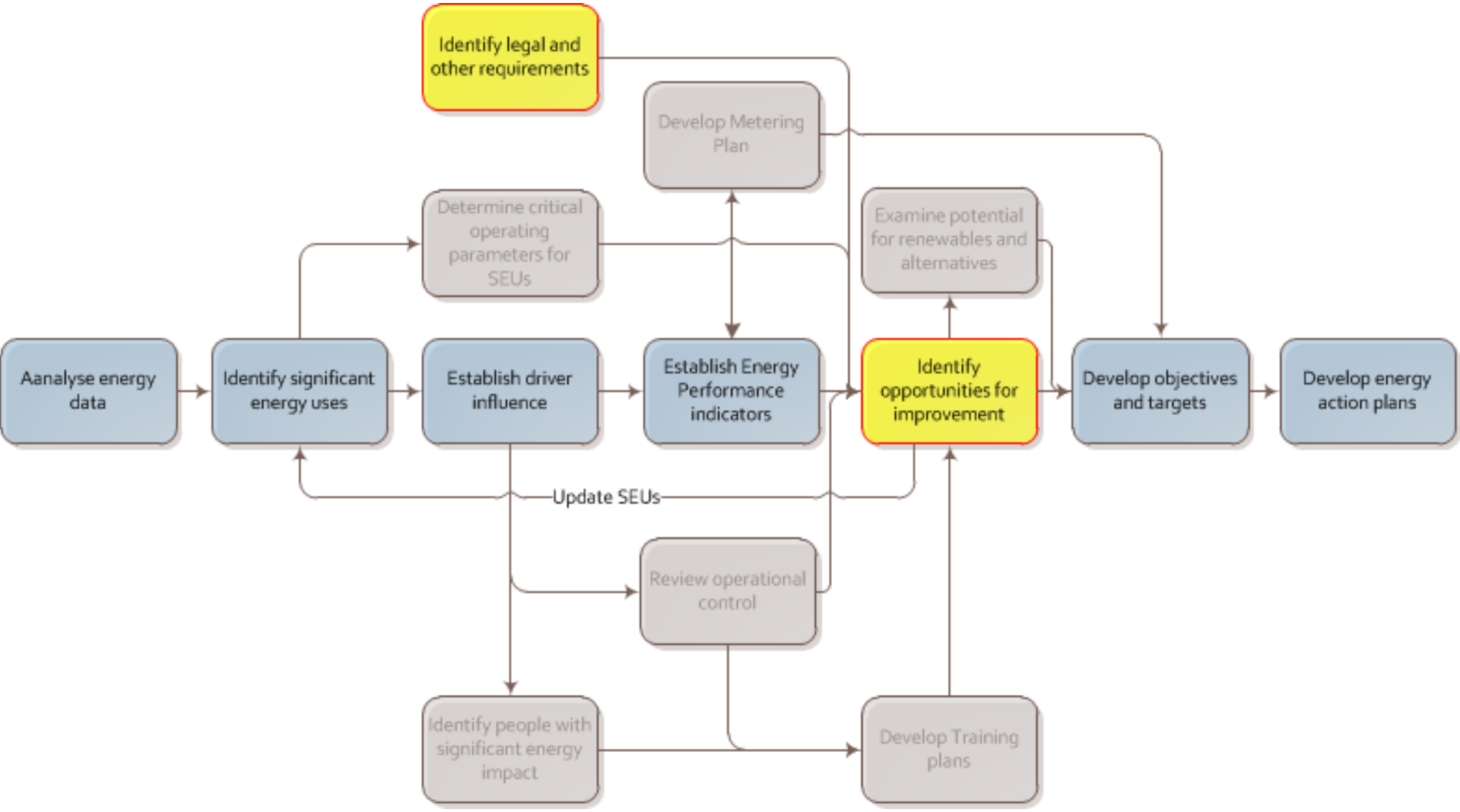
- Varying levels of complexity
- Absolute energy consumption
  - Simple but ignores activity levels
- Simple Ratios
  - Easy to use but can be misleading
  - Take account of activity levels
- Regression analysis
  - More complex
  - Quantifies driver effects
  - CUSUM for monitoring
- Try to have an EnPI for each SEU
- Tool EnPIs

It should now be 1130hrs

We will take a 5 minute break

You probably need it!

Identify legal and other requirements



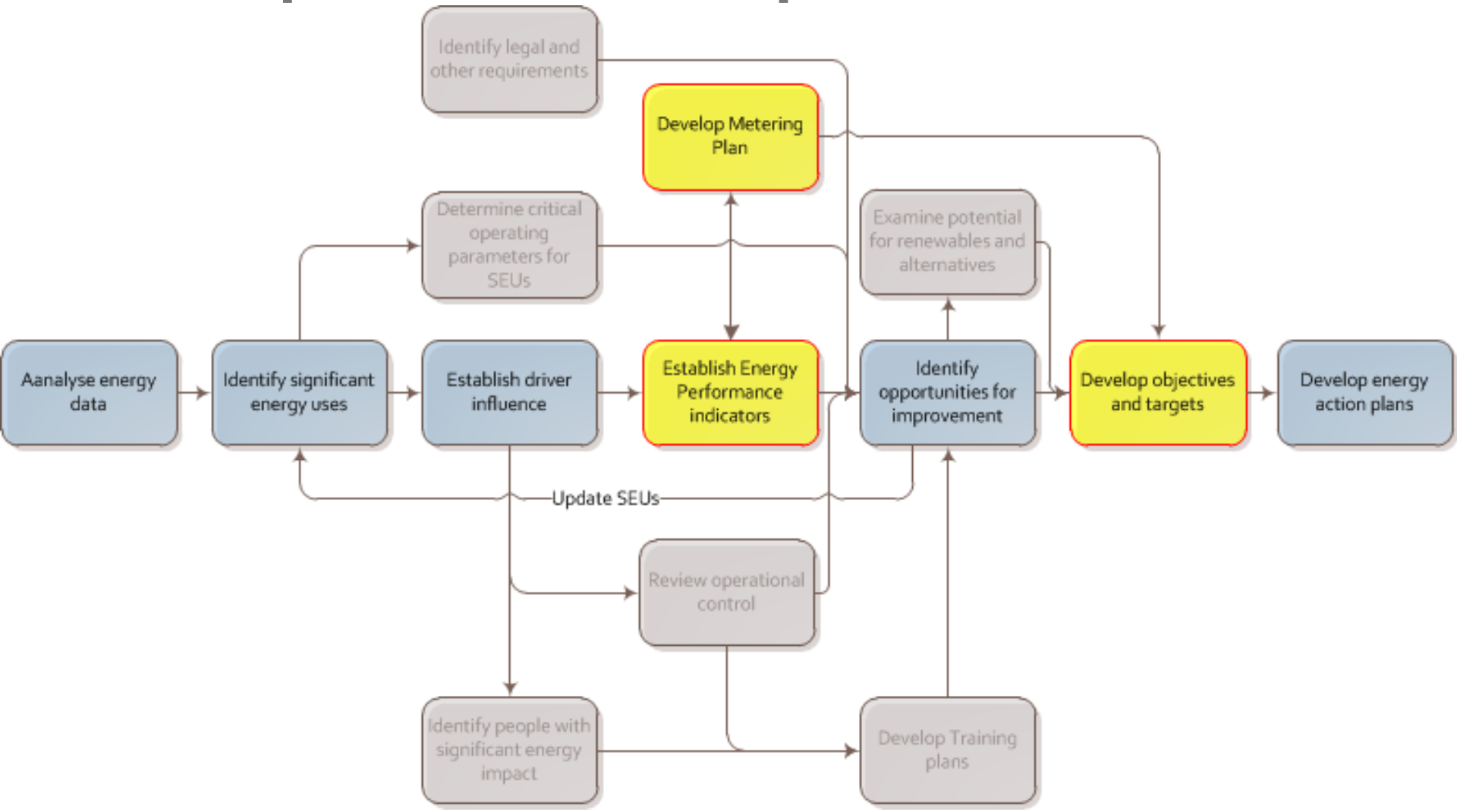
Legal and other requirements

- Probably good to review this first as it may impact later decisions
- It is part of the context
- Develop a list of all requirements
  - Local, national and regional laws, e.g. EU Emission trading scheme
  - Corporate requirements, e.g. reports, plans, data, etc.
  - Management requirements, e.g. monthly performance, annual budget, etc.
  - Voluntary agreements, e.g. with energy agency or customers
- Review the list at regular intervals (checking)
- Look at Legal and other requirements

Legal Tool

ID	Title of requirement	Category	Date identified	Relevant (y/n)	What is affected by this requirement?	What action is required	Responsible	Reqd date	Compliance date	Does it require further action?
1	Quarterly corporate energy report	Corporate	01/01/2011	y	All energy data	Generate and deliver	JB	Quarterly	Quarterly	N
2	Annual energy agency carbon accounts	Legal	01/01/2011	y	All specified carbon emissions		JB			N
3	Boiler emission licence limits	Legal	01/01/2011	y	Steam boilers	Monitor and report	AN	continuous	Continuous	N
4	Annual enegy budget	Corporate	01/01/2011	y	all purchased energies	Estimate usage and cost	JB	01/11/2011		N

Develop measurement plan



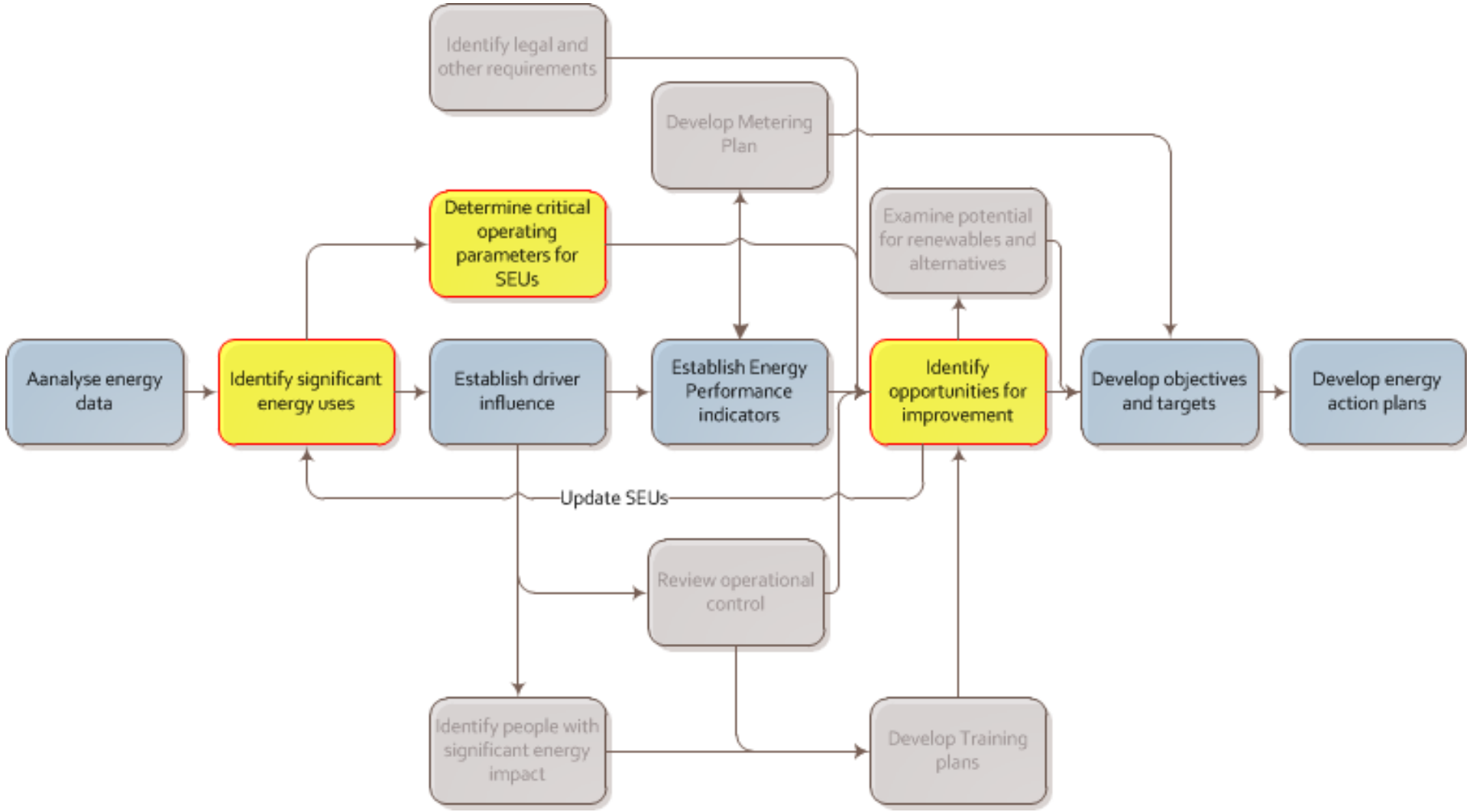
Measurement Plan

- Once SEUs are known
  - Including drivers
- Reporting requirements can be specified
- What meters and measurements are required to deliver these reports?
- How much can be achieved with existing instruments?
- 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)

Sample measurement plan

ID	Tag Number	SEU	User Area	Description (if required)	Purpose	Status	Type	Range	Units	Connection
1	nnnn	Electricity	Total Site		EnPI	Existing	Pulse	0-1000	kW	DCS
2	nnnn	Electricity	Production 1		EnPI	Existing	Pulse	0-500	kW	DCS
3	nnnn	Electricity	Offices			New	Pulse	0-250	kW	BMS
4	nnnn	Compressed Air	Production 1		EnPI	Existing	4-20mA	0-500	NM3/h	DCS
5	nnnn	Compressed Air	Water Treatment Plant		EnPI	New	4-20mA	0-500	NM3/h	PLC
6	nnnn	Electricity	Water Treatment Plant		EnPI	New	Pulse	0-500	kW	PLC
7	nnnn	Cooling Water	Distillation plant	Flowrate	EnPI	New	4-20mA	0-500	kW	DCS
8	nnnn	Cooling Water	Production 1	Flowrate	EnPI	Existing	4-20mA	0-500	kW	DCS
9	nnnn	Compressed Air	Utilities	Flowrate	EnPI	New	4-20mA	0-500	NM3/h	BMS
10	nnnn	Compressed Air	Utilities	Pressure	COP	Existing	4-20mA	0-3000	kg/h	DCS
11	nnnn	Steam	Utilities	Pressure	COP	Existing	Local	0-15	barg	N.A.

Determine critical operating parameters



Critical operating parameters

- Each SEU has operating parameters which affect its energy use
- These need to be identified, quantified, recorded and communicated, monitored and controlled
- Boiler examples:
  - Pressure, Total dissolved solids (TDS), stack temperature (variable), stack O2, condensate return rate, feedwater tank temperature
- Refrigeration examples:
  - Delivery temperature, condensing temperature (temperature lift), evaporator and condenser approach temperatures,
- Compressed air
  - Pressure, dryness, pressure drops

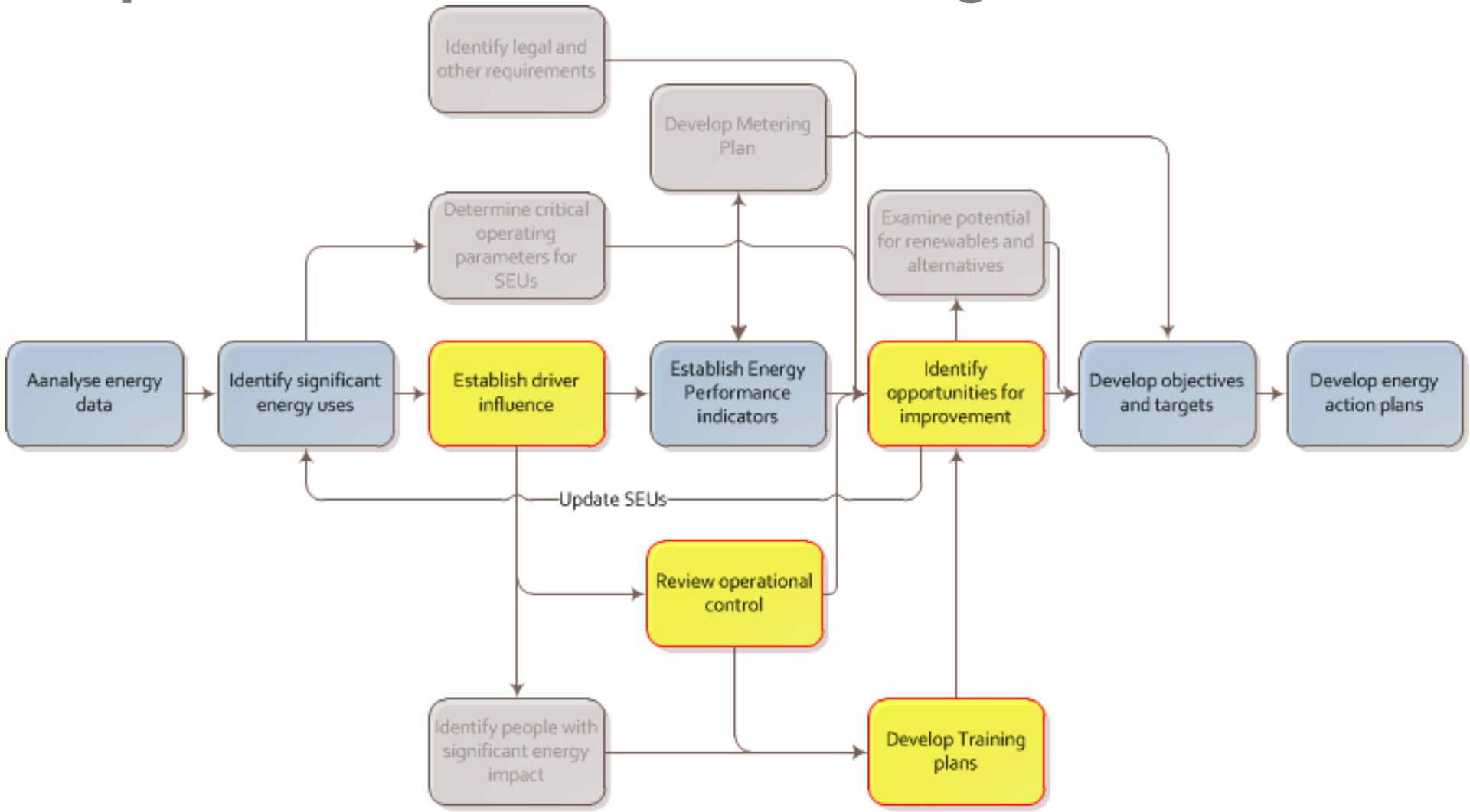
Critical operating parameters

SEU (inc use)	Parameter	Eng Units	Normal set point	Upper Limit	Lower Limit	Measuring Instrument	Calibration Frequency	Who needs to be informed?	Note
Steam system	Total Dissolved Solids	ppm	3500	3800	3400	TDS001	3m		
Steam system	Boiler Pressure	bar	9.5	10	9	PT123	12m		
Steam system	Exhaust Oxygen	% O2	3	3.5	2	Portable 2123	12m		
Steam system	Stack Temperature	DegC	N.A.	300	N.A.	TT124	12m		Varies with firing rate

Maintenance criteria

SEU (inc use)	Task	Frequency	Who needs to be informed ?	Note
Steam system	Statutory inspection	12 monthly		
Steam system	Combustion testing	3 monthly		
Steam system	Chemical treatment testing	weekly		

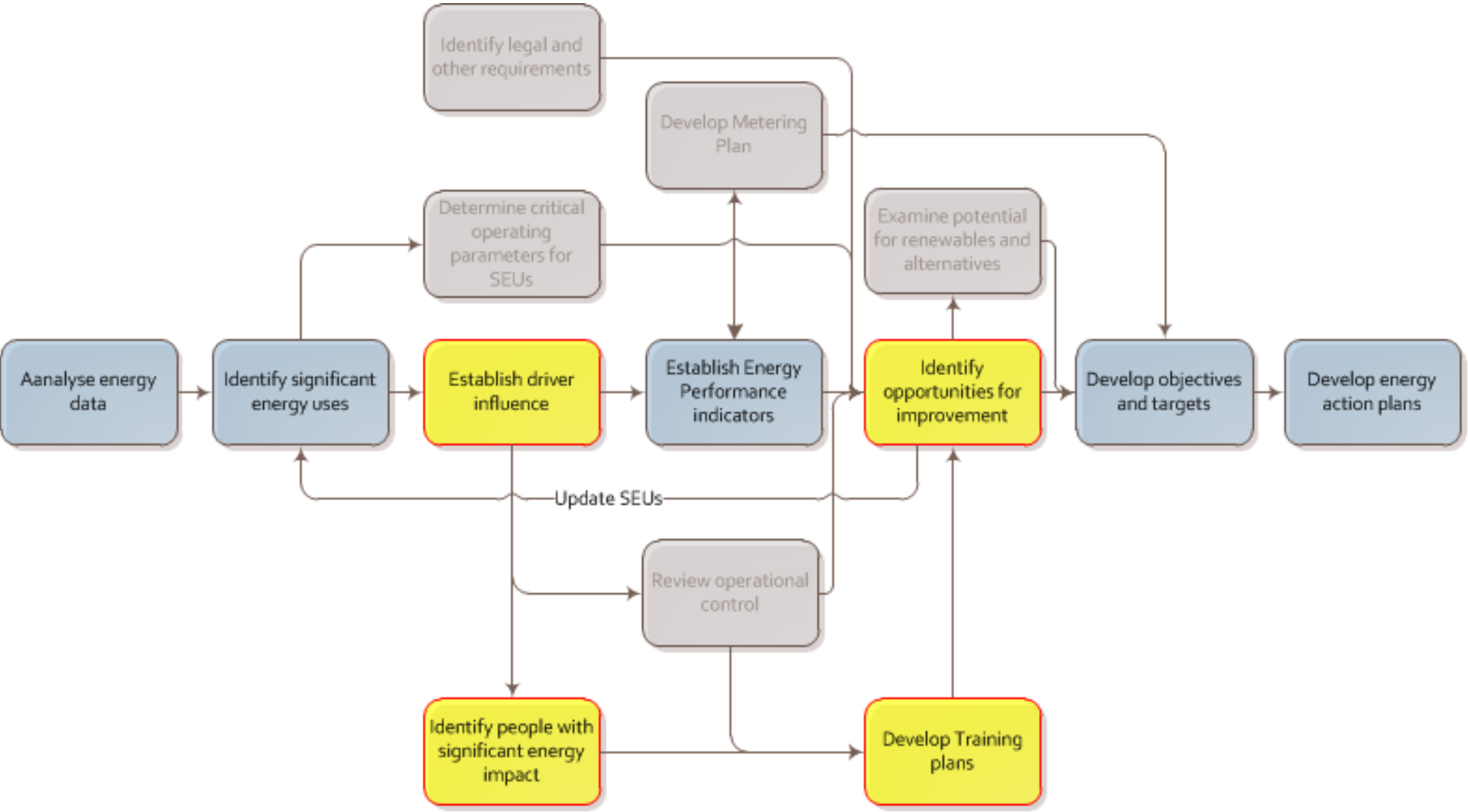
Operational control & training



Review Operation control

- This is aligned with the review of training needs
  - It additionally checks operating and maintenance procedures
- Check operating procedures
- Are operators familiar with the energy impact of operations?
- Check maintenance procedures
- Check maintenance frequencies
- Are maintenance staff familiar with the energy impact of their work?
- This review will help to assess training needs

People and training



Types of people who impact energy cons

- Immediate and direct impact
  - SEU Operators
  - Maintenance and external service personnel
- Influencers
  - Managers, supervisors, leaders
- Production people
- People who see things differently
  - Cleaners
  - Security
  - Safety Officers

Significant people

- Who operates the SEUs?
- Who maintains the SEUs?
- Who engineers the SEUs?
- Who manages the SEUs?

Training Matrix

- Make a list of all people who need to be trained
- Make a list of potential training materials/courses
- Develop a training matrix
  - Who does what and when
  - Use it also to record completion of each course
  - If your organisation already has a training tracking system, use it.
- Develop training materials
- If external help is required identify potential training service providers

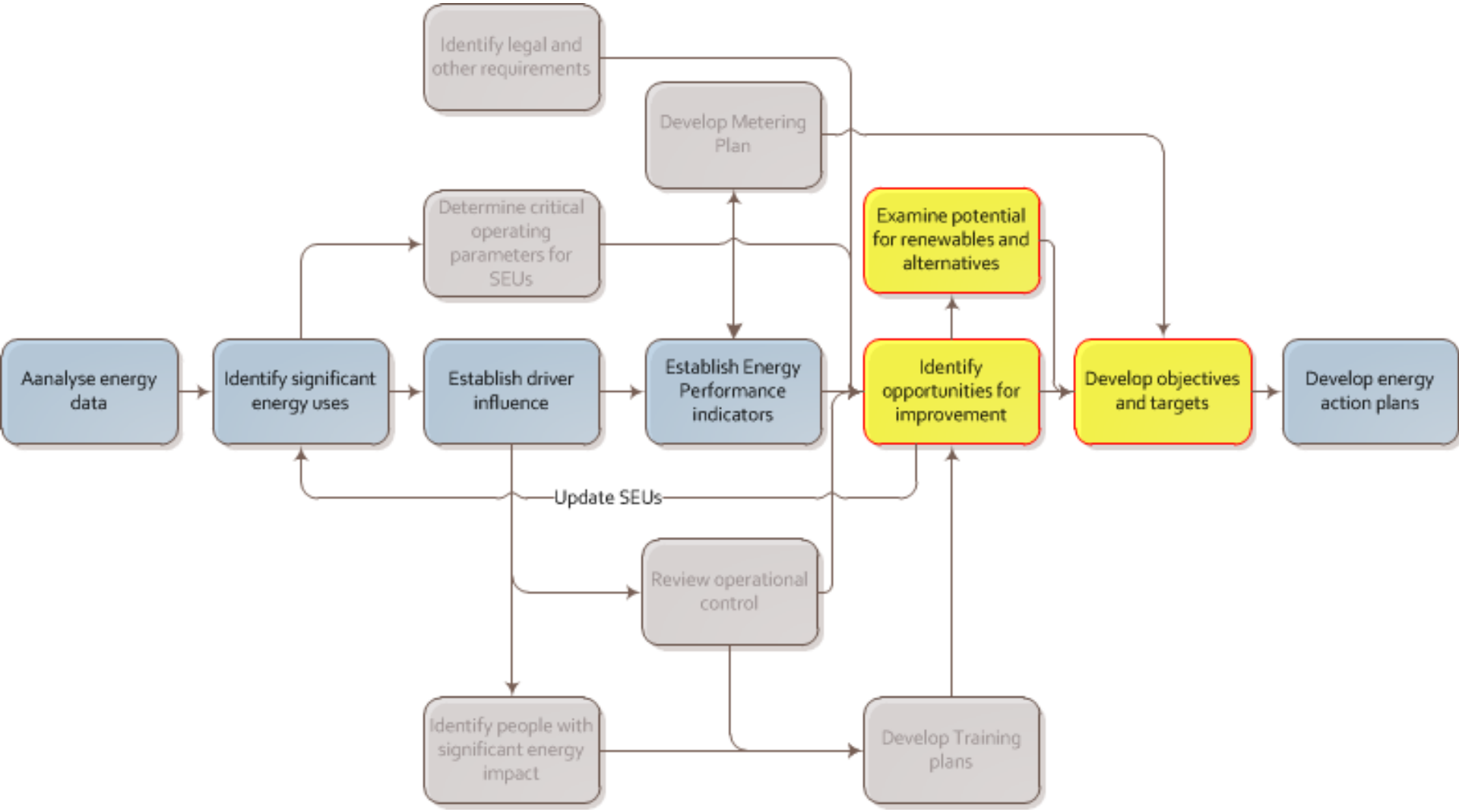
Types of training

- UNIDO Program for system optimisation
  - Steam systems
  - Compressed air
  - Pumps
  - Fans
  - Motors
  - Process Heating
  - Refrigeration
- Waste water treatment operation and maintenance
- Introduction to the EnMS
- Energy Vigilance (cleaners, security, safety)
- EnPIs

Training matrix

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Employee ID	Name	Job Title	Department	Category	Introduction to EnMS	EnPIs	SEU 1	SEU 2	SEU 3	Energy for Influencers	Energy for Maint	Energy Vigilance
2			Production Supervisor		Influencer	Y					Y		
3			Utilities Operator		Direct			Y	Y				
4			WWT Operator		Direct					Y			
5				Maintenance	Direct							Y	
6			Cleaner										Y
7			Security										Y
8			Safety Officer										Y
9			Manager		Influencer	Y					Y		
10			Energy Engineer		Direct	Y	Y	Y	Y	Y	Y	Y	Y

Potential for renewables and alternatives



Examine potential for renewables and alternative energy sources

- Which renewable sources are available?
  - Solar (thermal or photovoltaic)
  - Wind power
  - Biomass
- Which renewable technologies are economical with these resources?
- Which alternative energy sources are available?
  - Waste heat recovery
  - Fuel switching
- Which might be economical?
  - Cogeneration (Combined Heat and Power (CHP)

System Optimisation

- Examine the whole system and not individual components

- Establish user requirements and specification
- Examine opportunities with use
- Examine opportunities with distribution
- Examine opportunities with generation last.

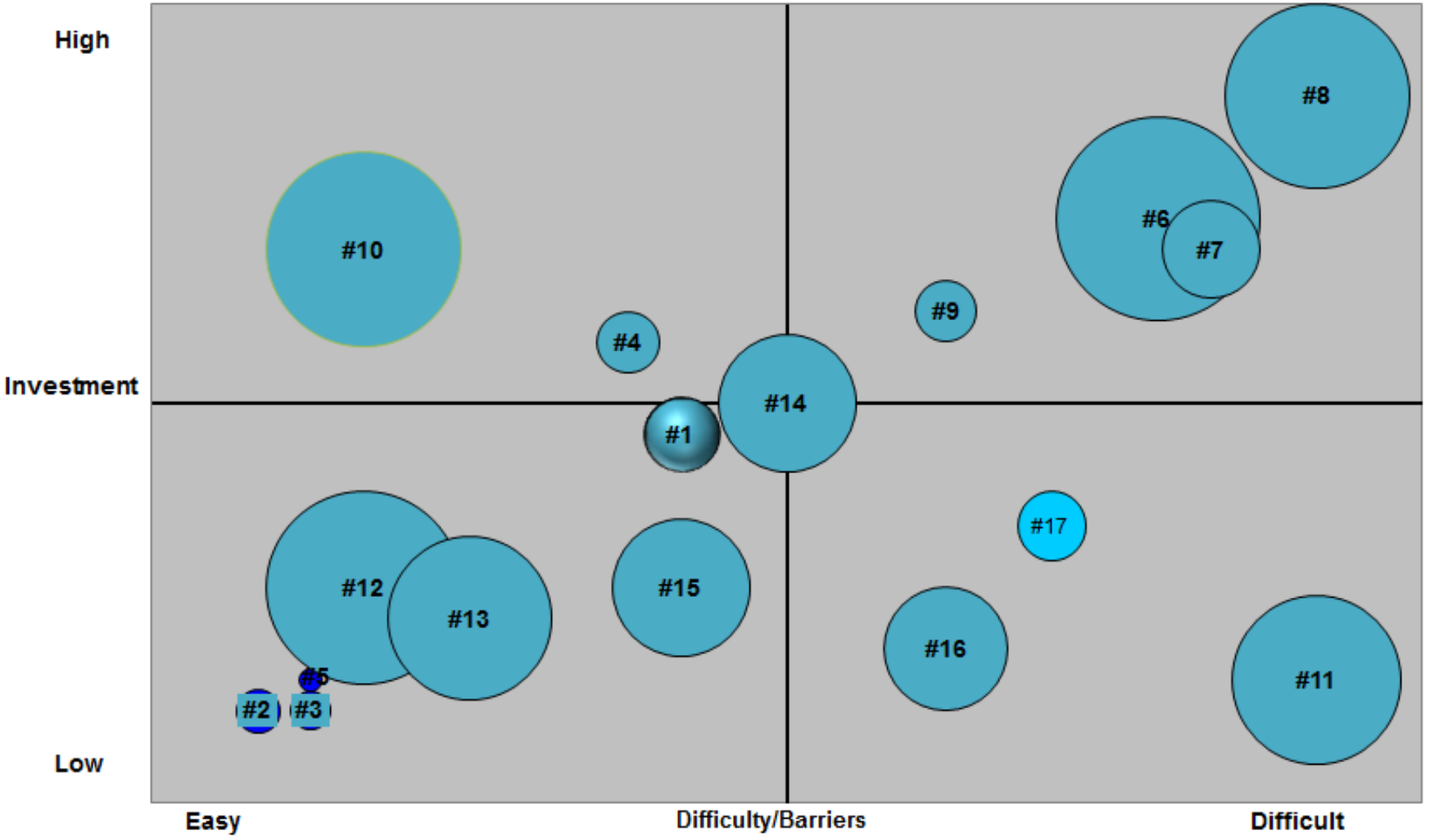
ECO List

- Develop a list of all potential ideas
- Select items for implementation
- Plan and manage their implementation

ECO List

ID	Description of Opportunity	Service	Investment Class	Capital Cost	Potential payback (years)	Savings (est or actual)			Person Responsible	Completion Date	Status	Notes
						€/£/$	C02	kWh				
1	Fit VSD to boiler fan	Steam	Low	5000	1.43	3500			JB	01/04/2011	Approved	need service company to commission
2	Replace lights in warehouse	Lighting	Med	3000	2.00	1500			KL	01/05/2011	Idea	waiting approval
3	Train operators in refrigeration efficiency	Mgmt	Low	1000	0.10	10000			JB	01/12/2011	in progress	
4	Reduce chiller condensing pressure	Refrig	No	0	-	4500			JB	01/02/2011	idea	are there any risks
5	Train cleaners in energy vigilance	Mgmt	Low	300	0.30	1000			JB	01/03/2011	idea	prepare material

Which opportunities to implement?



Planning Outputs

- Energy Baseline(s)
- EnPIs
- Objectives
- Targets
- Action Plan

Energy Baseline(s)

- Where are we starting from?
- Permits quantification of success (or failure!)
- Different types:
  - Absolute consumption
  - Specific energy consumption, e.g. kWh/unit output
  - Regression formula

- See Baseline

Objectives, Targets and action plan

Relationship

Objectives

- Longer term (maybe three years)
- Specific
- Consistent with the policy

Targets

- Specific
- Measureable
- Achievable
- Relevant
- Timed
- Support the objectives

Action plans

- What?
- Who?
- When?
- Is it complete?
- Was it successful?

Sample objectives

ID	Description	Resp	Target Date	Status
1	Reduce electricity consumption by 15%	JB	31 Dec2014	
2	Increase awareness of energy matters to 90% of employees	MM	31 Dec 2013	
3				
4				
5				

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

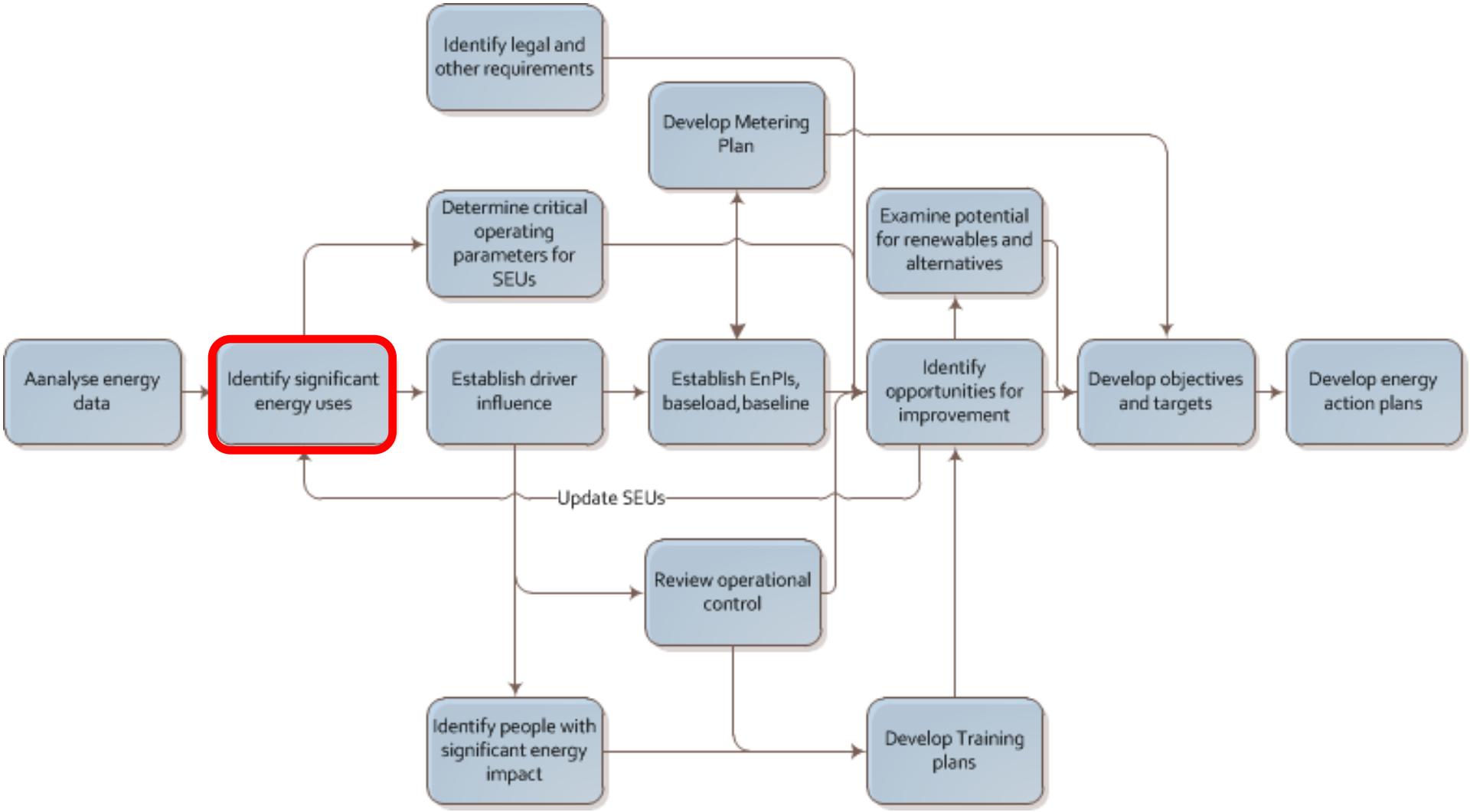
Sample targets

ID	Description	Resp	Target Date	Status
1	Train all boilers operators on energy efficient operations	JB	31 Dec2011	
2	Carry out 4 energy awareness training sessions	MM	31 Dec 2011	1 comp
3	Increase condensate recovery rate to 90%	JB	31 Dec 2011	83%
4				
5				

Measurement and Verification (M&V)

- How will you demonstrate that you actually made the savings?
- Need to take account of driving factors
- Different levels of M&V for different EPO depending on scale and complexity.

Remember: focus on SEUs



Day 1

Topic	Duration (hours)	Break duration	Start Time	End Time
Registration		0.25	08:00	08:15
Introductions	0.25		08:15	08:30
Why are we here?	0.5		08:30	09:00
Overview of whole system	0.5		09:00	09:30
Project management - EnMS implementation	0.5		09:30	10:00
Break		0.25	10:00	10:15
Management committment	0.25		10:15	10:30
Policy	0.25		10:30	10:45
Develop energy information and plans inc tools	1.75		10:45	12:30
Lunch		0.75	12:30	13:15
Q&A - planning	0.25		13:15	13:30
Interactive session - energy information and plans	1		13:30	14:30
Energy Metrics	0.75		14:30	15:15
Break		0.25	15:15	15:30
Financial appraisal of opportunities inc tool	0.5		15:30	16:00
Day to day operations - part 1	0.75		16:00	16:45