



Measuring your Company's

Environmental IMPACT

Templates & Tools for a Complete ISO 14001 Initial Review

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initial review**

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1	Contents of Inventory.xls
2	Questionnaire about travel and environmental habits at Company X
3	Calculation examples
4	Contents of Environment FMEA.xls
5	Alternatives

Read this first

What is the purpose?

The purpose of an initial environmental review is to illustrate the company's environmental impact enabling action to be taken where it is most required. It also increases awareness of environmental issues within the company. An environmental review is an excellent way of introducing an environmental management system.

Many companies have discovered that what they thought had the greatest impact on the environment, is of lesser importance. One example of this is that the environmental impact of energy consumption and transports are often much larger than any emissions or discharges regulated in national environmental legislation.

Perspective

The starting point is the total flow of material and energy through the company. This is then amplified by studying the processing levels and identifying risk areas for accidents, emissions and waste by following the resource flows through the company.

Who should carry out the review?

Environmental work should be an integral part of the business and not something just a few people are engaged in. It is therefore important to involve as many people as possible at the environmental review stage. Many facts and figures will be compiled during the course of the review. Examples include the purchasing department compiling data on material purchases, the design department compiling detailed information about used material, and the warehouse staff making an inventory of chemicals.

The review focuses on environmental issues

Do not take too much notice of economic, technical or other limitations to environmental improvements during the review. That can be done at a later stage. The purpose is to find and evaluate as many areas as possible in which the company can improve its environmental performance.

Software requirements

Minimum requirement is Office 97 or later versions. The CD-ROM is write-protected to guarantee intact copies. *Measuring your Company's Environmental Impact* contains quite a few website references so it would be useful to have access to the internet.

CD-ROM

The CD-ROM contains the following files:

Inventory.xls	In this Excel file you write data and carry out calculations. See Supplement 1
Template.doc	In this Word document you enter the results of the investigations. When complete, the document forms the initial environmental review.
Environmental FMEA.xls	Template, description and analysis tool for failure mode and effects analysis of environmental aspects. See Supplement 4.
Questionnaire.doc	Questionnaire to the staff to compile information about travelling habits and points of view. See Supplement 2.

Text and tables

The environmental review is carried out with the help of the Template where data are entered into various tables. More table rows are available under the [Table, Insert Rows] menu.

The Template also includes formulated text that only needs adjusting or complementing. This allows more energy to be directed towards collecting data and doing analysis than on formulating sentence structures. It is useful to note down how figures have been reached. This can be done with the help of footnotes or comments under [Insert, Footnote and Comment]. Detailed descriptions of how the data were compiled and under what conditions, increase possibilities to reuse the data for product life cycle assessments or environmental performance measurements in the future.

The pages on the right side of this manual describe methods for finding data and explains the contents of text and tables. Those on the left side show how the same chapters in the Template look in unprocessed condition. The tables use *italics* for examples and normal text for instructions.

Text written in normal style in the Template is usable in unchanged condition. All *italic* text must be changed before the final version.

In several places there is reference to Supplement ZZZ. The idea here is that you add your own company specific supplements as you go along. For example, it could be different maps of the plant, detailed inventory lists or other background material. The company name is shown as *Company X*, so it is best to start by searching for *Company X* and replacing it with the company name under [Edit, Replace].

Calculations

The CD-ROM contains an Excel file called Inventory.xls. The file contains data and calculation models required to carry out the calculations. Most mapping out is done in Inventory.xls. Summarized data are then copied into the tables in the Template.doc Word file.

To make changes in Inventory.xls you must first remove the write-protection on the sheet you are working on. You do this by selecting [Tools, Protection, Unprotect].

How was *Measuring your Company's Environmental Impact* compiled?

Measuring your Company's Environmental Impact is the result of various projects where IVF Industrial Research and Development Corporation have helped companies to introduce ISO 14001. The first experience dates back to 1996 when the ISO 14001 standard was first introduced.

IVF assists companies with research and development in different ways. The most common project form is joint R&D projects in which companies operating in the same or similar fields join forces to solve a mutual problem. Much of the early experience behind *Measuring your Company's Environmental Impact* was collected in two such joint R&D projects concerned with the implementation of ISO 14001 in the metal plating industry and in companies acting as suppliers to the automotive industry respectively. Another early and important experience funnelled in to the book was IVF's own certification towards ISO 14001 in 1998. Later that year, the first version of *Measuring your Company's Environmental Impact* was published in Swedish.

The first version in 1998 has been followed by the second, third, fourth and in 2002, the fifth version of *Measuring your Company's Environmental Impact*, all in Swedish. The most profound input to the development of the book over the years has been feedback from users and also certification bodies. Interest and financial support from the multinational Atlas Copco Industrial Technique led to the first English version called *Template for Initial Environmental Review*, published by IVF in 2002.

Other important influences on *Measuring your Company's Environmental Impact* over the years have been: IVF activities and projects in the field of life cycle assessment; participation in the revision of ISO 14001 and ISO 14004 which started in 2000; numerous initial reviews conducted with *Measuring your Company's Environmental Impact* by IVF on behalf of companies; and a project aimed at development of environmental management systems which brought together users, institutes and certification bodies in Sweden. The material in Supplement 5 about alternative methods for environmental evaluation, hitherto unpublished in English, shows some of the results from that last project.

Then do this

1. In Excel **Inventory.xls**, you calculate the emissions that are caused by the company's activities and quantify (put figures on) the environmental impact. The idea is to carry out detailed analyses here that are then summarized in the environmental review. **Start by** entering data in the Raw Materials, Products, Chemicals and Waste sheets. You will often find details of amounts and types of raw materials on purchase invoices. Many suppliers can also provide annual summaries. Take mainly the large flows of material and other resources first. Estimate the rest!
2. Then start to fill in the **Template.doc** Word document. Much of the data written in Inventory.xls can be used directly in the environmental review. But there are many facts and figures. This is why the summary is carried out in Inventory.xls to be copied and pasted into Template.doc. Check that the figures are entered in the right places and that the units are correct.
3. **Compare with other companies.** For energy, transportation and water, indicators are specified in each chapter. The indicators, specified both as average value, and as max/min values, are based on the results of the environmental review at nine Swedish manufacturing companies. Comparing your company's figures with these indicators provides a check that your results are reasonable. In some cases you can see if there is potential for improvement. The indicators are also usable for service companies. That was established by comparing them with figures for IVF business, which is mainly service producing.
4. **Compare inflows with outflows.** Check the accuracy of your figures by summarizing and comparing inflows and outflows in Chapter 12. What goes in must come out, somehow and somewhere. However, it is quite common to find that more goes in than what comes out. The reason is that it is easier to measure the outflows, mainly products and waste, than inflows, which are often very many. But it is also very common to make mistakes, so compare the inflows with the outflows and track down and correct any errors. The description of processes in Chapter 2 may provide valuable leads.
5. **EPS calculations.** In order to compare the environmental impact from such activities as goods transportation with actual raw material consumption, the environmental impact must be quantified. This is described in Chapter 12.
6. **Environmental FMEA.** The final evaluation of the environmental impact is carried out in a failure mode and effect analysis (FMEA). This is described more fully in Chapter 13. In Supplement 5, alternative methods for primarily environmental evaluation are described and discussed including some experience from using the environmental FMEA method.

In order to keep track of progress as you go through the Template, Table 0.1 can be used. How steps 1 to 6 above apply to the different chapters, is shown in the column Achieved. Tick off and make notations as you go along. However, always read the instructions under the respective chapter heading first. The chart below provides an overview; it does not explain how the initial environmental review is carried out.

Table 0.1 Chart for tracking progress

Chapter/section name	No.	Plan	Started	Achieved					Comment
Scope and purpose	1				2				
Methods	1				2				
The company	2				2				
Manufacturing processes	2				2	4			
Legal and other requirements	3				2				
Accidents and near accidents	4				2				
Risk of accidents	4				2			6	
Raw materials and components	5			1	2	4	5		
Chemicals and chemical products	6			1	2	4	5		
Energy consumption	7			1	2	3		5	
Waste and recycling	8			1	2		4		
Waste water	9				2	3	4	5	
Land discharges	9				2		4	5	
Air emissions	9				2		4	5	
Noise	9				2				
Goods transportation	10			1	2	3		5	
Trips to and from work	10			1	2	3		5	
Business trips	10			1	2	3		5	
Outflow of products and packaging	11			1	2		4		
The environmental impact of the products during use and end-of-life disposal	11				2			5	
Material and energy flow analysis	12				2		4		
Quantification with environmental load units	12					3		5	
Evaluation of environmental aspects	13							6	

Summary

When designing the environmental management system in accordance with ISO 14001, it is important to find out what within the organization's activities, products and services has a significant environmental impact. In 'standard language' this is known as significant environmental aspects. All the environmental aspects that the organization can control or those that it can merely influence are dealt with.

The significance of the environmental aspects has been determined by a multifunctional group. The group considered not only the size of the environmental impact but also legal requirements and interested party requirements when determining the significance.

The investigations, calculations, assumptions and conclusions presented in this report lead to the following list of significant environmental aspects of *Company X*'s business. The list begins with the environmental aspect regarded as being the most significant and so on in order of size.

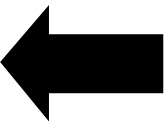
- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.

Before making a final decision about which of the significant environmental aspects *Company X* should be focused on, a more pragmatic prioritization should be carried out. The review contains suggestions on how to do this.

The review also comprises environmentally related legislation, accidents and our current way of working with external environmental issues.

The environmental review starts here

This side of the manual, the right side, contains descriptions, tips and calculations. The left side shows the environmental review in unprocessed form as it would look on the computer screen.



The left side shows how the unprocessed
Template looks on the computer screen.



Summary

The review is summarized here and the company’s greatest environmental impact is listed. Along with legal requirements, a list of the company’s most significant environmental aspects forms the basis upon which to construct your environmental management system. The aspects could lead to environmental targets and improvement projects, be managed by internal procedures and suggest enquiries or demands on suppliers, as well as other measures. It might be difficult to do anything about some of the significant environmental aspects at the present time. This is quite in order, as long as you can explain why.

Maximum utilization of the significant environmental aspects requires organizational, commercial and economic decisions. Technical possibilities must also be observed. Both these factors are reasons why overarching decisions are made outside the environmental review.

1 About this environmental review

Scope and purpose

The purpose of this environmental review is to provide a situation report of our environmental work and our environmental impact for *autumn 20XX* and will thereafter form a basis for our future environmental work within the framework of ISO 14001 and/or EMAS.

The review is not complete with regard to deviations in relation to ISO 14001.

Methods

All consumption of raw materials, components, energy and emissions etc are calculated on year *20XX*. *Figures were compiled through invoices, questionnaires and interviews and similar sources.* These were then added up in Excel and emissions and environmental impacts were calculated. The basis of calculation for emissions and environmental impact are specified under *References*.

In order to compare the various environmental aspects, the environmental impact is determined using environmental load units (ELU). We have, for example, been able to compare the environmental impact of transportation with the environmental impact of material consumption. Read more about this in Chapter 12.

Final identification and evaluation of environmental aspects have been carried out by a multi-functional group with the help of an adapted failure mode and effect analysis, Environment FMEA. This Environment FMEA clearly shows the environmental aspects that are significant.

This environmental review has been compiled by _____, with assistance from _____.

1

About this environmental review

This chapter describes how to carry out the environmental review by adapting the selected text suggestions.

Scope and purpose

If the purpose of the environmental review is other than preparing for ISO 14001 or EMAS, more changes must naturally be made in the text.

Because ISO 14001 is based on analysing how the company influences the environment, its significant environmental aspects, and controlling those aspects, it is pointless for most companies to check for deviations from the standard before they carry out the environmental review.

Actually, the greater part of the initial environmental review focuses on only one paragraph, 4.3.1. of ISO 14001. It reads as follows:

‘The organization shall establish and maintain (a) procedure(s) to identify the environmental aspects of its activities, products or services that it can control and over which it can be expected to have an influence, in order to determine those which have or can have significant impacts on the environment. The organization shall ensure that the aspects related to these significant impacts are considered in setting its environmental objectives.

The organization shall maintain this information up to date.’

In addition, ISO 14001 defines an environmental aspect as: ‘Element of an organization’s activities, products or services that can interact with the environment’. A note to the definition reads: ‘a significant environmental aspect is an environmental aspect that has or can have a significant environmental impact’.

All this is to say that the company should determine how it influences the environment in any significant way. In those cases where the initial environmental review concerns other parts of ISO 14001 than paragraph 4.3.1 about environmental aspects, it is pointed out specifically in this manual.

Methods

You must first decide the time frame. It is often easiest to reckon with a year. It might be a good idea to choose the previous year because there are data available for the whole year.

2 Description of operations

The company

Table 2.1 Description of *Company X*

Products/business	
Number of employees	
Turnover	
Organization	
External environmental managers at the company	
Company location	
Premises	
Management of premises	
Limitations of the review	

A map of the plant is included in Supplement *ZZZ*.

2

Description of operations

Describe the current operations by filling in Tables 2.1 and 2.2. The description of operations explains what the review is based on. It could be useful in the future to be able to compare and see how things have changed.

Think about who the review is aimed at. If the review is to be of any use, the data must be presented openly. It is better to include everything and limit the readership. Include a map of the plant if possible.

The company

Table 2.1 Description of Company X

Products/business	Describe the company's products or services and volumes.
Number of employees	
Turnover	
Organization	Refer to the attached organization diagram.
External environmental managers at the company	Who is responsible for the external environment at the company?
Company location	The company location and proximity to buildings, natural areas of beauty, watercourses etc.
Premises	The size and design of the premises. Are there other companies in the same building? What have the premises previously been used for? Have extensions been made to the buildings?
Management of premises	Does the company manage the premises themselves or is this done by somebody else?
Limitations of the review	If the environmental review does not include the whole company as described above, specify the limitations here.

Manufacturing processes

Manufacturing includes the processes in Table 2.2.

Table 2.2 Manufacturing processes at *Company X*

Process	In Raw materials, input material, chemicals, energy, water	Out Products, waste, air, land and water emissions

Manufacturing processes

Describe how manufacturing is carried out by listing the most important processes in the table. This is to provide an initial view of what is used at the company and the types of waste, emissions and discharges that arise. One way to engage more people at the company is to design a questionnaire where the process operators can fill in information about such items as raw materials, additives, waste involved. The office can also be regarded as a process. It is not so important to specify exact amounts at this stage.

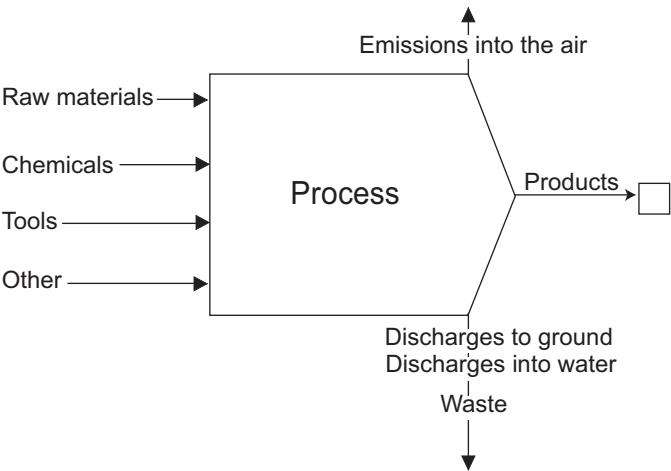


Figure 1.1 Process

Describe a representative process chain in Table 2.2.

Table 2.2 Manufacturing processes at Company X

Process	In Raw materials, input material, chemicals, energy, water	Out Products, waste, air, land and water emissions
Cutting	Steel pipes Sawblades Cutting fluid, lubricating oil Electricity Water to dilute the cutting fluid	Cut pipe length in various dimensions Particles, scrap in the shape of pipe bits and discarded bits and used cutting fluid Water vapour, oil mist
Turning	Steel blanks various dimensions Tools, absorption material Cutting fluid, lubricating oil Electricity Water to dilute the cutting fluid	Turned steel blanks Swarf, scrap Water vapour, oil mist Leakage of cutting fluid onto the floor is absorbed by saw- dust and other absorption material

3 Legal and other requirements

It is not only authorities and customers who make demands on the company. There are many other interested parties, such as neighbours, insurance companies and all who work here. Supplement *ZZZ* contains a complete list of environment-related laws, regulations and provisions concerning the business. The most important are presented below along with demands from customers, suppliers and others. Deviations from the demands are also presented.

3

Legal and other requirements

It is important to know the environmental laws, statutes, regulations, general provisions, customer demands and other demands that concern the business. A fundamental requirement in ISO 14001 is that the company abides by all environmental laws. The company or organization should commit itself to comply with relevant environmental requirements in the environmental policy (paragraph 4.2), it should have procedures to identify and have access to legal and other requirements (paragraph 4.3.2) and it should periodically check and evaluate compliance (paragraph 4.5.1).

Many companies do not actually know the environmental laws and find many deviations when they begin delving into the legislation. There is an abundance of regulations and provisions. If you are unsure which laws concern your business it could take quite a long time to find them all.

Try to find or establish an overview of the environmental legislation relevant to your company. Often such overviews are provided by industry branch organizations. Then base your inventory of laws and other requirements on this overview. To pinpoint the legal and other requirements concerning your business it is recommended you follow the stages below.

1) Process the overview:

- Begin by reading through the descriptions and erasing the statutes that do not concern you.
- Identify who has, or should have, the responsibility and knowledge of each statute and ask these people to describe how observance and monitoring is carried out.
- Remember that suppliers, auditors, authorities and other specialists that carry out services on behalf of the company often help with observance and monitoring of legal requirements.
- Call your municipal health and environmental office and ask which local provisions concern your company. Different municipalities have different regulations for such operations as car engine idling, what you are allowed to discharge into the waste pipe, and what companies can throw on the municipal rubbish tip.
- Get hold of the laws you think should be available at the company and/or contact the supervisory authority for more information.
- Determine, for each statute, how you can ensure that the company operates within compliance, by assigning responsibilities and pointing to relevant procedures.
- The processed overview is a supplement to the environmental review and possibly a complete procedure within the environmental management system depending on how far that work is taken.
- Summarize the most important statutes and **all** deviations in Table 3.1

Table 3.1 Legal and other requirements – the most important

Requirements about/ from	Description	Comments/deviations
Authorization and checking programme in accordance with national environmental legislation		
Legal requirements on the products		
Demands and prefer- ences from customers		
Demands and preferences from suppliers		
Demands and prefer- ences from neighbours		
Demands and prefer- ences from employees		

- 2) Supplement the inventory with laws and standard requirements on the products, demands from customers, suppliers, insurance companies, neighbours, employees, and other applicable facts:
- What demands are made on the products? In addition to laws, there are EU directives, international standards and norms and trading practices. The design department would know about these.
 - Which demands are made by the company's customers? The marketing department would know about these. To compile the customer demands and show that environmental work is underway, it might be a good idea to send a questionnaire to the most important customers. There could also exist demands on products from suppliers, in connection with surface treatment for example.
 - Competitors – how do they manage customer demands?
 - Neighbours, insurance companies and not least those working at the company could also have opinions about environmental work. Find out about their demands and preferences!
 - Summarize the above-mentioned demands and specify **all** deviations in Table 3.1.

Table 3.1 Legal and other requirements – the most important

Requirements about/ from	Description	Comments/deviations
Authorization and checking programme in accordance with national environmental legislation	<i>The company is classed as a C business and is not subject to authorization in accordance with national environmental legislation. (Example from Sweden)</i>	<i>The company has sent in an application</i>
Legal requirements on the products	Product designers are often aware of legal requirements applicable for the company's products.	
Demands and preferences from customers	Explore customer demands by surveying customers and/or studying how competitors deal with environmental preferences of the customers.	
Demands and preferences from suppliers	Find out how your suppliers could help reduce the environmental impact along the supply chain.	
Demands and preferences from neighbours	You could for example invite your neighbours to visit your company and then take the opportunity to ask them about possible disturbance.	
Demands and preferences from employees	Possible sources of information on employee demands and preferences include the health and safety work carried out at the company and the questionnaire in Supplement 2.	

4 Accidents

Accidents and near accidents

Accidents and near accidents that have taken place during the past five years that have had a negative influence on the external environment are described in Table 4.1.

Table 4.1 Accidents at *Company X*

When?	Where?	The reason?	Damage to the environment?

4 Accidents

Emissions can be most catastrophic during accidents. Smoke is often very toxic and watercourses can be polluted if chemicals leak into the waste water system.

Accidents and near accidents

According to paragraph 4.4.7 in ISO 14001, an organization shall have procedures to identify potential for accidents and emergency situations. Begin identifying accident risks by describing accidents and near accidents, in Table 4.1. Include all accidents that have taken place during, for example, the past five years, which have had a negative effect on the external environment.

Table 4.1 Accidents at Company X

When?	Where?	The reasons?	Damage to the environment?
			Was the environment damaged by chemicals or did toxic smoke develop?

Risk of accidents

The risks of accidents that could have a negative influence on the external environment are summarized below. Existing procedures for the prevention of accidents and remedies are also described.

Table 4.2 Risk of accidents at *Company X*

Process, premises, other activity	Accident risk	Preventive measure	Measures for accidents that have occurred

Risk of accidents

Describe accident risks in Table 4.2. According to paragraph 4.4.7 in ISO 14001, an organization shall have procedures to respond to accidents and emergency situations and for preventing and mitigating associated environmental impacts. Such existing procedures should also be described in Table 4.2.

In Chapter 13 a failure mode and effect analysis is carried out with regard to the environment. You could wait with finalizing Table 4.2 until the failure mode and effect analysis has been carried out because it constitutes a form of risk analysis. It is also important to consider whether there are risks of accidents happening again.

Table 4.2 Risk of accidents at Company X

Process, premises, other activity	Accident risk	Preventive measure	Measures for accidents that have occurred
Specify processes, work tasks or premises where there is a great risk of accidents that could lead to a negative impact on the external environment.	Common events include fire, explosion, flooding and unintentional releases of chemicals, oils or gases in connection with handling or storage.	Provide brief descriptions of inspection procedures, co-operation with fire and environmental authorities and inspection rounds. Refer to any written instructions. Report on how to avoid releasing oil, chemicals and hazardous waste into the waste water system: oil separators (with sensors), dykings, sealed drains or no drains.	Provide short descriptions of procedures for fire, explosion or other accident risk. Alarm system and extinguishing procedures. Are there fire alarms and other sensors? Are there an evacuation plan, emergency exits and fire extinguishers? Is there protective equipment such as eye washers, infirmary and personal protective clothing? Is there cleaning equipment, material to seal drains etc in case of chemical spills?

5 Raw materials and components

The table below shows the annual consumption of raw materials and components.

Table 5.1 Annual consumption of raw materials and components

Type	Amount	Where does it go?	Comments regarding environmental impact

5 Raw materials and components

It is best to begin this inventory in the Inventory.xls Excel file, *Raw Material* sheet. Then copy the first two columns from the Excel sheet to the first two columns in Table 5.1. Include as much as possible of all physical flows within the company except water, chemicals, heating, fuel and electricity. Try to group the material and components in some sort of logical way. It is not necessary to go down to a detailed level. In the environmental review it is the order of size of the environmental impact that is determined. If the environmental aspect is seen to be extensive, a more detailed review can be carried out at a later date.

Table 5.1 Annual consumption of raw materials and components

Type	Amount	Where does it go?	Comments regarding environmental impact
Try to list as specifically as possible. For example, for alloy steel, use % for the various alloy ingredients.	Annual quantity bought, preferably in tons.	For example 75% to the product, 25% to waste (sent to material recycling).	Comment on special problems with the raw material, for example hazardous additives. Note environmentally harmful processes performed by suppliers on the raw materials/ components, eg surface treatment. Related emissions can be further described in Chapter 12.
<i>Alloyed steel (0.6% Mn)</i>	<i>100 tons</i>	<i>60% to different products, 40% recycled as scrap</i>	<i>ELU resource index for Fe and Mn gives an approximate size of the associated environmental impact: $100,000 \cdot 0.994 \cdot 0.96 + 100,000 \cdot 0.006 \cdot 5.6 = 98,784$ ELU. It is a rough estimate as it only expresses the environmental impact of the use of virgin raw material. Refinement or recycling is not taken into account</i>

Raw materials and components can be described under separate headings if required.

6 Chemicals and chemical products

Use of chemicals

Our annual consumption of chemicals is as presented below. Supplement *ZZZ* contains a complete list of chemicals.

Table 6.1 Consumption of various types of chemicals

Type of chemical	Amount	Use	Where does it go?

6 Chemicals and chemical products

Most engineering industries use many more chemicals than they are aware of. There are many laws and directives concerning the handling of chemicals. In most countries, legislation states that the least environmentally harmful product must be used and that sufficient knowledge of the product must exist in order to avoid detrimental effects to people and the environment.

The more general requirements on chemicals in laws are often further elaborated in statutes ensuring that those using chemicals:

1. Use the best possible chemicals, which not only fulfil quality requirements, but also cause as little damage to the environment as possible.
2. Maintain a list of chemicals used at the company that can also function as a list of chemicals approved for purchase.
3. Keep health and safety product information sheets of all chemicals used in the business and make them available to the workforce.

It is sometimes difficult to define what a chemical or a chemical product is. A practical method is to include everything that must be marked in accordance with national classification and labelling regulations.

Use of chemicals

Inventory.xls contains a chemical inventory list. Begin by filling in this list. Try to group the chemicals into different types, such as lubricants, degreasing agents, rust protection agents etc. Then copy the data totals in the *Type*, *Annual Consumption* and *Use* columns to the first three columns of Table 6. Tip: While you are doing this inventory, get rid of old, unused chemicals. Compare the *Annual Consumption* column with *Storage* in Inventory.xls to see which they are.

Table 6.1 Consumption of various types of chemicals

Type	Amount	Use	Where does it go?
Based on the classification used in the company, for example oils, cleaning chemicals, degreasing agents.	Annual quantity bought, preferably in kg.	What is this type of chemical used for?	What happens to the chemical when being used? Where does it go afterwards? Chemicals often evaporate, are mixed with other waste or follow the product. Try to supply per cent amounts.

Handling

The list of chemicals in Supplement *ZZZ* provides a good picture of how to handle the chemicals. Below follows supplementary information.

Table 6.2 Chemicals handling

Purchase	
Goods inspection	
Storage	
Procedures for use	

Handling

A chemical inventory provides a relatively good picture of how chemicals are used at the company. For a complete check you should fill in the following list.

Table 6.2 Chemicals handling

Purchase	Specify how the purchase is managed (and the application of the substitution principle to choose the least hazardous alternative).
Goods inspection	How the control of labelling and product information sheets and registering on the chemical list etc are managed.
Storage	Manager, restrictions for those with access etc.
Procedures for use	The procedures for using different types of chemicals.

Environmentally hazardous chemicals

Product information is often divided into 16 items. Item 2, *Composition and Classification*, specifies the contents of the chemicals and the danger symbols the product should be labelled with. Figure 6.1 below shows the current danger symbols and descriptions.

Government bodies have often compiled lists of substances that require special attention from a risk point of view (Observation lists) and substances that are banned or restricted (Restrictions lists). Several large companies have compiled lists of substances that must not be used in connection with their products. Find out about the relevant legislation and listed chemicals in your country and by your clients.

Environmentally hazardous chemicals

Chemicals that should be replaced or handled extra carefully are listed in Table 6.3.

Table 6.3 Hazardous chemicals

Product name	Type and use	Amount	Labelling	Components hazardous to health or environment

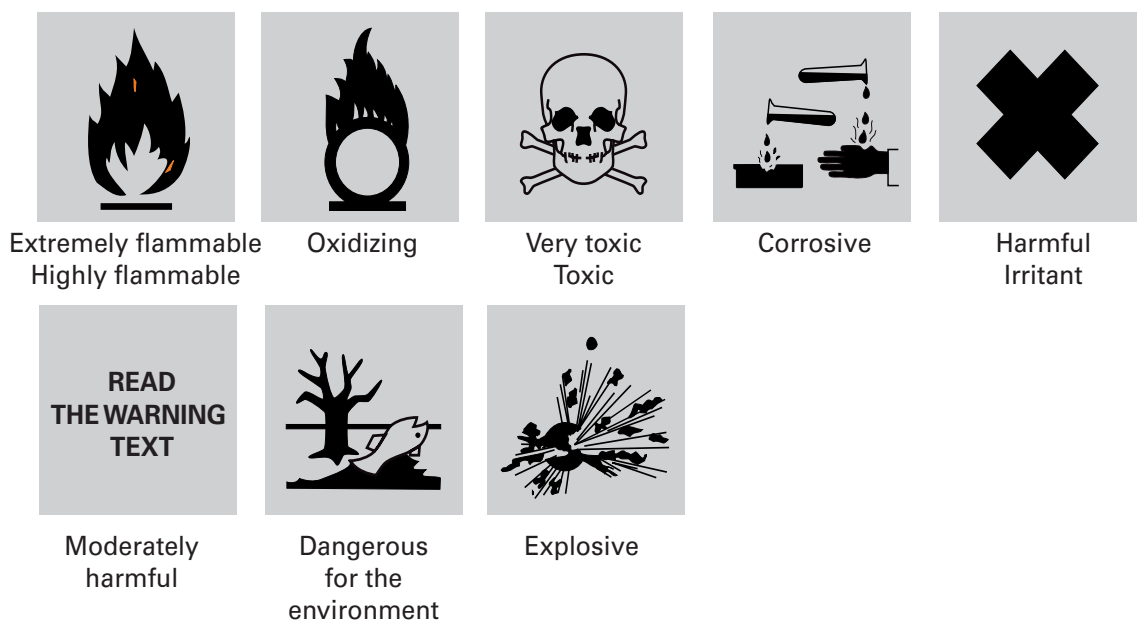


Figure 6.1 **Danger symbols**

Were any particularly hazardous chemicals found during the chemical inventory?
Fill in Table 6.3.

Tip! Make a list of chemicals that should not be used at the company.

Table 6.3 **Hazardous chemicals**

Product name	Type and use	Amount	Labelling	Components hazardous to health or environment
	For example: <i>degreasing agent for component Y</i>	Amount purchased annually.	Danger symbols, eg harmful, inflammable.	Specify the substance. Is the substance on any 'prohibition list' of chemicals that should not be used?

7 Energy consumption

The annual energy consumption is presented in the following table.

Table 7.1 Annual energy consumption

Type of energy	Consumption (MWh)	Cost	Use	Way of determining use

Energy utilization gives rise to the following emissions and resource consumptions. The calculations are based on emissions and resource consumption for the production of electricity and district heating in Europe as specified. The calculations are included in Supplement *ZZZ*.

Table 7.2 Emissions and resource consumption for the production of the company’s energy

Type of energy	Con- sumption (MWh)	HC (kg)	CO (kg)	NO _x (kg)	SO _x (kg)	CO ₂ (tons)	PM (kg)	ELU

7 Energy consumption

Energy bills are the best sources of data on energy consumption. Try to divide the energy consumption up as much as possible.

Table 7.1 Annual energy consumption

Type of energy	Consumption (MWh)	Cost	Use	Way of determining use
For example, oil-fired boiler, district heating, electricity, etc.	Annual consumption.		For heating facilities, electricity for motors and processes, etc.	For heating buildings, an average consumption should be worked out for use over several years to level the differences between cold and warm winters. Electricity use should probably be related to production volume in some way.
<i>Electricity, European average</i>	<i>2000</i>	<i>200,000 Euro</i>	<i>Various machinery, lighting, ventilation including AC</i>	<i>Electricity bill</i>

Use the Energy EPS sheet in the Excel file Inventory.xls to calculate resource consumption, emissions and ELU-values from the energy consumption. Copy the results to Table 7.2, see example below. You may also print the calculations and put them as a supplement to the environmental review.

For electricity, data for European average electricity data and 'green' electricity are given in Inventory.xls. Use what is appropriate.

For district heating local variations are large. Use site specific data for district heating if available or try to compose your district heating mix in Inventory.xls.

Table 7.2 Emissions and resource consumption for the production of the company's energy

Type of energy	Consumption (MWh)	HC (kg)	CO (kg)	NO _x (kg)	SO _x (kg)	CO ₂ (tons)	PM (kg)	ELU
<i>Electricity, European average</i>	<i>2000</i>	<i>533</i>	<i>158</i>	<i>1843</i>	<i>4514</i>	<i>857</i>	<i>1022</i>	<i>266,821</i>
Total								

In Table 7.3 our company’s energy consumption is compared to the energy consumption of nine Swedish manufacturing companies. The main purpose of the comparison is to make sure the collected data is reasonable.

Table 7.3 Comparisons of energy indicators

Type of energy	Unit	Our Company	Average	Maximum value	Minimum value
Heating	MWh/m²		0.16	0.28	0.09
Electricity	MWh/m²		0.19	0.36	0.07
Heating & electricity	MWh/m²		0.33	0.50	0.19
Heating	MWh/employee		11.2	20.2	5.1
Electricity	MWh/employee		13.3	26.1	3.6
Heating & electricity	MWh/employee		22.8	35.2	10.6

The following processes within the plant consume a lot of energy.

Table 7.4 Energy consuming processes

Process	Power (kW)	Annual consumption from process (kWh)

In Table 7.3 energy consumption indicators for nine Swedish manufacturing companies are given. Compare your figures with these indicators. Are they reasonable? Is there potential for improvement?

Table 7.3 Comparisons of energy indicators

Type of energy	Unit	Our Company	Average	Maximum value	Minimum value
Heating	MWh/m ²		0.16	0.28	0.09
Electricity	MWh/m ²		0.19	0.36	0.07
Heating & electricity	MWh/m ²		0.33	0.50	0.19
Heating	MWh/employee		11.2	20.2	5.1
Electricity	MWh/employee		13.3	26.1	3.6
Heating & electricity	MWh/employee		22.8	35.2	10.6

Are there processes within the company that are particularly energy consuming? List them in Table 7.4.

Table 7.4 Energy consuming processes

Process	Power (kW)	Annual consumption from process (kWh)
<i>Degreasing</i>	<i>50 kW* 17.5 h/day = 875 kWh/day</i>	<i>875 kWh/day * 220 operating days per year = 192.5 MWh/year</i>

8 Waste and recycling

Waste is generated annually as presented below. Supplement *ZZZ* contains a more detailed list.

Hazardous waste

Hazardous waste is waste that has to be managed in accordance with special restrictions. It can be divided into the following waste fractions.

Table 8.1 Hazardous waste

Type of waste	Amount	Internal handling	External handling	Cost

Sorted waste

Table 8.2 Sorted waste

Type of waste	Amount	Internal handling	External handling	Cost

8

Waste and recycling

Here you present the types of waste at your company and how they are handled. Demands on companies to provide good waste management are steadily increasing. Current developments are leading to waste being divided up into more and more fractions. Begin the waste inventory in the Inventory.xls Excel file.

Hazardous waste

Hazardous waste is waste that has to be managed in accordance with special restrictions. Normally it concerns, for instance, all waste polluted by used oil. List hazardous waste in Table 8.1.

Normally those who transport and handle hazardous waste must have authorization to do so. As producer of hazardous waste you should find out if this authorization exists. Normally you must also keep a journal of hazardous waste.

Table 8.1 Hazardous waste

Type of waste	Amount	Internal handling	External handling	Cost
What each fraction is called and what is included in it.	Annual quantity, preferably in tons.	Creation, collection and storage of the hazardous waste. Safety procedures such as dykings, locks, monitoring, alarms. Who is responsible?	Transports, receiver, treatment (such as energy recycling) if this is known. Do the various instances have authorization?	For the external handling.

Sorted waste

In many countries you are compelled by law also to sort waste not classified as hazardous. Other common sorting fractions are different quality metals, combustable and compostable waste and the like.

Table 8.2 Sorted waste

Type of waste	Amount	Internal handling	External handling	Cost
What each fraction is called and what is included in it.	Annual quantity, preferably in tons.	Creation, collection and storage of the waste. Who is responsible?	Transports, receiver, treatment (such as energy recycling) if this is known.	For the external handling.

Other waste

Table 8.3 Other waste

Type of waste	Amount	What does the waste consist of?	Handling	Cost

Other waste

A fraction that contains unmixed material, for example metal scrap or plastic, has a higher value than mixed material sent for landfilling. Some fractions can be recycled and become new products.

Even when sorting, there are often fractions left that have to be sent for landfilling or burning. What does the mixed waste actually contain? Make an estimate by looking into the container. Check that this waste does not contain any hazardous waste.

Table 8.3 Other waste

Type of waste	Amount	What does the waste consist of?	Handling	Cost
Landfilling	56 tons a year	20% food leftovers and disposable items, 40% packaging material (plastic, corrugated cardboard), 10% drying paper and various plastic banding, paper, tape, filter paper etc	Fetches by Waste Disposal Ltd, deposited on the municipal rubbish tip	1500 Euro

9 Impact on the surrounding area

Waste water

Company X consumes water as specified in Table 9.1.

Table 9.1 Water consumption

Source	Use	Volumes	Drainage	Current monitoring procedures	Pollutants

Supplement *ZZZ* contains a sketch of our drainage network and the location of the underground tanks.

In Table 9.2 our company’s water consumption is compared to the water consumption of five Swedish manufacturing companies. The main purpose of the comparison is to make sure the collected data is reasonable.

Table 9.2 Comparisons of water indicators

Consumption	Unit	Our Company	Average	Maximum value	Minimum value
Water	m ³ /employee		26.5	56.9	4.2

9 Impact on the surrounding area

Impact on the surrounding area has already been documented to some extent in the chapters on accidents, manufacturing processes, raw materials and chemicals. Use that material and expand it with estimates of emissions amounts.

Waste water

Water is often polluted as it is used in manufacturing processes. A great deal of energy and a large amount of resources are put into building drainage networks and cleaning the water that is used. But the water is never really cleaned completely and the pollutants contribute to excessive fertilization of lakes and watercourses. A lot of water is often not cleaned at all, for example water in the street drainage networks or surface water pipes. Try to map out the company's drainage network so you can see where the various types of flows and spills go. Attach a sketch to the environmental review. The sketch could also include important environmental information regarding the location of oil traps, underground storage tanks and similar facilities.

Table 9.1 Water consumption

Source	Use	Volumes	Drainage	Current monitoring procedures	Pollutants
Eg municipal water, own well.	Eg sanitation water	Annual volume bought	Eg municipal drain (to municipal treatment plant), surface water pipe (often without cleaning), via own treatment plant to waterworks, collected and treated as hazardous waste, evaporation.	Eg taking of samples.	Annual quantities in kilos if known. Own treatment plant can be described in Chapter 2 under Manufacturing Processes.

In Table 9.2 water consumption indicators for five Swedish manufacturing companies are given. Compare your figures with these indicators. Are they reasonable? Is there potential for improvement?

Table 9.2 Comparisons of water indicators

Consumption	Unit	Our Company	Average	Maximum value	Minimum value
Water	m ³ /employee		26.5	56.9	4.2

Land discharges

Table 9.3 Land discharges

Location	Reason	Pollutant	Amount	Cleaning

Land discharges

The normal cause of land pollution in the engineering industry is from metal scrap containers standing on bare ground instead of a hard base. The scrap often has a thin layer of oily cutting fluid that drips off or is rinsed off in the rain. Containers are often not watertight so the oil runs into the ground. It is only small amounts, but after a few years of leakage the amount is considerable. Companies must clean up polluted land.

Other causes of land discharges are accidents, leaking tanks and waste buried in the ground. It is a good idea to go back in time and check to see if there is any waste buried on the company property. Interview those who know the history of the company and site. If buried waste is discovered it will result in a large investigation to determine who is responsible for cleaning, among other things.

Table 9.3 Land discharges

Location	Reason	Pollutant	Amount	Cleaning
Yard	<i>Swarf container</i>	<i>Cutting fluid containing mineral oil</i>	<i>1 litre of 3% oil solution a day gives 10 litres of oil in the yard a year. Approx. 10% of the purchased cutting fluid.</i>	<i>Not planned</i>
Yard	<i>Truck drove over chemical container in 1999</i>	<i>Cutting fluid concentrate 20% mineral oil</i>	<i>Approx. 800 litres of cutting fluid gives approx. 160 litres of mineral oil</i>	<i>With absol and sawdust</i>

Air emissions

Table 9.4 Air emissions from the plant

Process/activity	Pollutant	Amount	Current monitoring procedures

Noise

The greatest noise sources in and outside the plant are summarized below.

Table 9.5 The largest noise sources

Source	Noise level and/or disturbance in working environment	Noise level and/or disturbance in surrounding environment

moderate disturbance: you can talk without hindrance; **considerable:** complaints are made; **very loud:** levels exceed the guidelines.

Air emissions

Air emissions from engineering companies are relatively small, but there are processes that cause considerable emissions, eg painting with solvent-based paint. Other examples, but with smaller emissions, are welding (smoke gases), cooling in hardening oil (organic pollutants and particles), mechanical processing with cutting fluid (oil mist) and all handling of chemicals containing solvents.

Table 9.4 Air emissions from the plant

Process/activity:	Pollutant	Amount	Current monitoring procedures
<i>Hardening</i>	<i>Heavy hydrocarbons, particles</i>	<i>0.025 g/h</i>	<i>Filter installed. Fulfils municipal requirements</i>
<i>Oil mist from mechanical processing</i>	<i>Oil</i>	<i>< 1 mg/m³</i>	<i>Measured and is below hygienic limit values. More and more machines are encased</i>
<i>Improvement painting</i>	<i>Organic solvent in the paint give emissions of hydrocarbons</i>	<i>2 tons of paint with 50% solvent content give rise to 1 ton of volatile organic compounds (VOC) emissions. ELU-index for hydrocarbons is 2.14 ELU/kg, ie size of corresponding environmental impact is 2140 ELU</i>	<i>No current procedures. Good ventilation is required</i>

Noise

A company had a problem becoming certified because most of their loading and unloading was carried out at night. Noise levels outside the plant were too high and disturbed the neighbours. The problem was solved by building a new road to the plant.

Noise is regarded as environmental pollution. There are normally restrictions for how much noise you are allowed to make outside the plant. Has the company carried out noise measurements inside and outside the plant? Has the company received complaints from neighbours or local authorities?

Table 9.5 The largest noise sources

Source	Noise level and/or disturbance in working environment	Noise level and/or disturbance in surrounding environment
	Indicate if possible the measured value and classify the level as moderate, considerable or very loud.	Indicate if possible the measured value and classify the level as moderate, considerable or very loud.
moderate disturbance: you can talk without hindrance; considerable: complaints are made; very loud: levels exceed the guidelines.		

10 Transportation

Goods transportation

Goods transportation is presented in four parts: transportation of raw materials and components to the company, transportation of products to the customer, waste transportation and other transportation.

Other transportation includes transportation of chemicals, fuel and work in progress, ie products that are transported for reasons such as surface treatment and then back to the company again.

When calculating the emissions from goods transportation, consideration is taken to how many tons are to be transported, the transport stretch and the means of transport. The emissions and resource consumption that transportation gives rise to have been calculated with the help of data from *The Swedish Network for Transportation and Environment* and are presented below. Supplements ZZZ present the inventory and calculations in more detail.

Table 10.1 Annual resource consumption for goods transportation

Transportation of	Weight (tons)	Ton kilometre	Resource consumption (MWh)	ELU	Division, means of transport (% tonkm)
Raw materials in					
Products out					
Waste out					
Other flows					
Own lorry					
Total					

10 Transportation

Goods transportation

Transportation causes exhaust emissions that contribute to the greenhouse effect, excessive fertilization and acidification of lakes and watercourses and the like. Transportation also consumes oil, which is a finite resource.

The *Raw Materials*, *Products*, *Waste* and *Other flows* sheets in *Inventory.xls* are used for this inventory. They include a calculation tool for calculating resource consumption and goods transportation emissions. The calculation tool provides average European values for emissions and resource consumption for various means of transport with the fill ratios that are normal for each group. Note that the calculations at this stage are to be considered as estimates. If goods transportation gives significant environmental impact, detailed calculations of transport chains could be useful later on. Then turn to for example the website www.ntm.a.se.

If the company owns a lorry where it is difficult to calculate the load weight, there is a calculation model included in the *Transports* sheet in the same file. The only thing you need to know is the fuel consumption and the type of engine, Euro 0, 1, 2 or 3. The *Transports* sheet also contains links to websites with free software to calculate distances between two places.

There are no rules for how far back you should follow the raw material in the supply chain or how far forward you should follow the product. Let data access determine, but specify how far the calculations have been made along the transportation chain.

Add up the result on each Excel sheet and then enter them into the Table in the *Transports* sheet in *Inventory.xls*. Check that the inflow is the same size as the outflow. If it is not, an explanation is required.

Table 10.1 Annual resource consumption for goods transportation

Transportation of	Weight (tons)	Ton kilometre	Resource consumption (MWh)	ELU	Division, means of transport (% tonkm)
Raw materials in	1000	1,000,000	268.7	22,856	90% heavy lorry 10% train electric
Products out	1000	1,000,000	293.8	24,755	100% heavy lorry
Waste out	100	1000	0.5	46	100% medium-weight lorry
Other flows	100	20,000	10.9	919	100% medium-weight lorry
Own lorry		15,000 litre diesel	163.7	13,792	Euro 1 engine
Total			738	62,368	

Table 10.2 Annual emissions for goods transportation

Transportation of	HC (kg)	CO (kg)	NO _x (kg)	PM (kg)	SO _x (kg)	CO ₂ (tons)
Raw materials in						
Products out						
Waste out						
Other flows						
Own lorry						
Total						

In Table 10.3 our company’s goods transportation is compared to the goods transports of five Swedish manufacturing companies. The main purpose of the comparison is to make sure the collected data is reasonable.

Table 10.3 Comparisons of indicators for goods transports

Consumption	Unit	Our Company	Average	Maximum value	Minimum value
Goods transports	MWh/MEuro turnover		1.4	2.0	0.8
Goods transports	MWh/ton delivered product		0.49	1.76	0.07

Other flows include transportation of chemicals, fuel and work in progress. Work in progress consists of products that are transported for surface treatment, for example, and then back to the company.

Copy and paste the corresponding emission figures into Table 10.2.

Table 10.2 Annual emissions for goods transportation

Transportation of	HC (kg)	CO (kg)	NO _x (kg)	PM (kg)	SO _x (kg)	CO ₂ (tons)
Raw materials in	63	117	755	24.0	57.0	75.4
Products out	69	129	834	24.1	52.3	81.7
Waste out	0	0	2	0.0	0.1	0.2
Other flows	3	5	31	0.9	1.9	3.0
Own lorry	38	72	465	13.4	29.2	45.5
Total	173	323	2087	62.4	140.5	205.8

In Table 10.3 indicators for goods transports for five Swedish manufacturing companies are given. Compare your figures with these indicators. Are they reasonable? Is there potential for improvement?

Table 10.3 Comparisons of indicators for goods transports

Consumption	Unit	Our Company	Average	Maximum value	Minimum value
Goods transports	MWh/MEuro turnover		1.4	2.0	0.8
Goods transports	MWh/ton delivered product		0.49	1.76	0.07

Trips to and from work

Employee trips to and from work have been determined with the help of *questionnaires and estimates* and are presented below.

Table 10.4 Annual trips to and from work

Means of travel	Number of return trips	Annual distance (km)	Number of trips with each means of transport (%)	Comments
Total				

The above-mentioned trips to and from work give rise to emissions and resource consumption as shown below.

Trips to and from work

Employee trips to and from work could constitute a considerable part of a company’s total environmental load. In order to determine how many trips take place to and from the workplace, a rough estimate would suffice as a first step. You could for instance count the number of cars in the car park for a few days and estimate the average distance to work. Together with the number of working days, this provides a reasonable measure of how many travel kilometres are needed to get the staff to work each year.

If it turns out that the trips to and from work contribute significantly to the total environmental impact, a questionnaire can be sent out to determine the exact driving stretch and ascertain possibilities for improvement. Supplement 2 contains a sample of a questionnaire. Help to process the results is found under the *Survey staff trips* sheet in Inventory.xls.

For many companies it is equally, or even more relevant to consider also customers’ journeys to and from the company. Do a quick estimate of customers’ trips to and from the company as outlined above for employee trips. As car parks are normally divided into separate areas for customers and for employees, this should not take much extra effort. Investigate customers’ trips to and from the company further if found significant, for example, by means of a survey. Such a survey could be combined with finding out about customers’ environmental preferences and demands on the company’s products or services, see Chapter 3.

Table 10.4 Annual trips to and from work

Means of travel	Number of return trips	Annual distance (km)	Number of trips with each means of transport (%)	Comments
If you estimate as shown above, the means of transport are Car and Other. If you follow the questionnaire, means of transport are Alone in a car, Car-pooling, Public transport, Cycle, Walk, Other.				
Total				

Calculate emissions and energy or resource consumption with the help of the *Transports* sheet in Inventory.xls. Make sure you carry out calculations under the *Trips to and from Work* heading.

Table 10.5 Annual emissions and resource consumption for trips to and from work

Means of travel	Annual distance (km)	HC (kg)	CO (kg)	NO _x (kg)	CO ₂ (tons)	Resource consumption (MWh)	ELU
Total							

In Table 10.6 our company’s travels to and from work are compared to the travels to and from work of eight Swedish manufacturing companies. The main purpose of the comparison is to make sure the collected data is reasonable.

Table 10.6 Comparisons of indicators for travel to and from work

Consumption	Unit	Our Company	Average	Maximum value	Minimum value
Travel to and from work	MWh/employee		2.6	6.4	1.0

Table 10.5 Annual emissions and resource consumption for trips to and from work

Means of travel	Annual distance (km)	HC (kg)	CO (kg)	NO _x (kg)	CO ₂ (ton)	Resource consumption (MWh)	ELU
<i>Alone in a car</i>							
<i>Car-pooling</i>							
<i>Public transport</i>							
<i>Cycle or walk</i>							
<i>Other</i>							
Total							

In Table 10.6 indicators for travel to and from work for eight Swedish manufacturing companies are given. Compare your figures with these indicators. Are they reasonable? Is there potential for improvement?

Table 10.6 Comparisons of indicators for travel to and from work

Consumption	Unit	Our Company	Average	Maximum value	Minimum value
Travel to and from work	MWh/employee		2.6	6.4	1.0

Business trips

Business trips give rise to emissions and resource consumption as shown in the following table.

Table 10.7 Annual emissions and resource consumption from business trips

Means of travel	Distance (km)	HC (kg)	CO (kg)	NO _x (kg)	CO ₂ (tons)	Resource consumption (MWh)	ELU
Total							

The amount of business travel and means of transport have been calculated with the help of travelling expenses/statistics from travel agents etc.

In Table 10.8 our company's business trips are compared to the business trips of five Swedish manufacturing companies. The main purpose of the comparison is to make sure the collected data is reasonable.

Table 10.8 Comparisons of indicators for business trips

Consumption	Unit	Our Company	Average	Maximum value	Minimum value
Business trips	MWh/employee		1.3	3.5	0.2

Business trips

Business trips can be divided into trips by car, train and aeroplane. Travelling expense forms are a good information source, though flying distances are not normally specified there. The *Transports* sheet in *Inventory.xls* contains links to websites with free software to calculate distances between two places. Further down in the same sheet you calculate the emissions and resource consumption for business trips. Ensure you carry out the calculation under the heading *Business Trips*.

Table 10.7 Annual emissions and resource consumption from business trips

Means of travel	Distance (km)	HC (kg)	CO (kg)	NO _x (kg)	CO ₂ (ton)	Resource consumption (MWh)	ELU
<i>Car</i>							
<i>Train</i>							
<i>Air flights</i>							
Total							

In Table 10.8 indicators for goods transports for five Swedish manufacturing companies are given. Compare your figures with these indicators. Are they reasonable? Is there potential for improvement?

Table 10.8 Comparisons of indicators for business trips

Consumption	Unit	Our Company	Average	Maximum value	Minimum value
Business trips	MWh/employee		1.3	3.5	0.2

11 The products

Outflow of products and packaging

The company manufactures and supplies products annually as in the following table.

Table 11.1 Products and packaging

Product	Annual quantity (units)	Weight per unit (kg)	Total annual weight (tons)	Packaging (type, weight/unit, total weight)

11 The products

In many cases it is not the manufacturing process that affects the environment the most during the life span of a product. During recent years it has become more common to evaluate the environmental impact of products during their entire life cycle in what is known as life cycle assessments. It is often found that the greatest environmental impact is during use of products.

Outflow of products and packaging

The inventory of product flows can partly be done in the following table and partly in the *Products* sheet in *Inventory.xls*.

Table 11.1 Products and packaging

Product	Annual quantity (units)	Weight per unit (kg)	Total annual weight (tons)	Packaging (type, weight/unit, total weight)
<i>Printer</i>	<i>2000</i>	<i>5 kg</i>	<i>10</i>	<i>Corrugated board, 0.5 kg/unit, 1 ton total. Plastic bag, 0.1 kg/unit, 0.2 tons total. Shrinkwrap, 0.07 kg/unit, 0.13 tons total</i>

The environmental impact of the products during use and end-of-life disposal

The environmental impact of the products during use and end-of-life processing is described in the following table.

Table 11.2 The environmental impact of the products

Product	Environmental impact during use	Environmental impact during disposal

The environmental impact of the products during use and end-of-life disposal

Describe the environmental impact of the products during use and end-of-life disposal in Table 11.2. Supplement 3 contains two examples on how the size of the environmental impact during use can be estimated, in addition to the example given below.

It is recommended to try hard to find environmental aspects during use and disposal because such aspects are often linked to potential for increasing product value and customer satisfaction. Any energy efficiency improvements of a product would, for example, mean that the customer and user of that product would pay less for energy.

Table 11.2 The environmental impact of the products

Product	Environmental impact during use	Environmental impact during disposal
	If possible, describe the environmental impact of the products in use, such as ties between product weight or shape and energy use. What happens to any packaging material? Calculation examples are in Supplement 3.	Describe how the products are or ought to be taken care of once they no longer are functional. Can the material used be reused? Are there possibilities for recycling?
<i>Printer</i>	<i>Uses 1.2 MWh during service life. Each year 2000 printers are made. On an annual basis, the environmental impact is 2000*1.2=2400 MWh</i>	<i>Today there is no organized system. Dealers do as they think best</i>

12 Summary of emissions and consumption of resources

Chapter 13 presents how to determine the company’s significant environmental aspects and place them in order of magnitude using a failure mode and effect analysis or environmental FMEA. The basis for this analysis is data that show material and energy flows within the company and the estimated size of the environmental aspects through the EPS index. These data and the estimates are presented below.

Material and energy flow analysis

Below follows a summary of the material and energy flow through the plant. Indirect emissions are also listed.

Table 12.1 Inflows

Inflows	Type and amount
Raw materials and components	
Packaging	
Energy	
Chemicals	
Water	
Transportation	

12 Summary of emissions and consumption of resources

It is now time to summarize and compare the data produced during the review so as to arrange them in order of environmental impact. This chapter includes preparations for establishing the order of precedence in Chapter 13 and for determining what actually has the greatest influence on the environment. In Supplement 5 alternative methods for environmental evaluation are described and discussed.

Material and energy flow analysis

The first thing to do is to summarize all the data that show material and energy flows through the company.

Fill in the data from the previous chapters in Tables 12.1 and 12.2. The tables can also be used when presenting the review to management and other staff.

Table 12.1 Inflows

Inflows	Type and amount	
Raw materials and components	<i>Paper</i>	<i>3 tons</i>
	<i>Wood</i>	<i>28 tons</i>
	<i>Plastic Primo</i>	<i>2 tons</i>
	<i>PVC</i>	<i>6.7 tons</i>
	<i>Epoxy powder</i>	<i>3.5 tons</i>
	<i>Plastic Orion</i>	<i>5.9 tons</i>
	<i>Plastic Era</i>	<i>6.2 tons</i>
	<i>Polyurethane Cirrus</i>	<i>73 tons</i>
	<i>Textiles</i>	<i>36.9 tons</i>
	<i>Leather</i>	<i>50 tons</i>
	<i>Metal screws</i>	<i>8 tons</i>
	<i>Steel</i>	<i>275.4 tons</i>
Packaging	<i>Included under raw materials</i>	
Energy	<i>Electricity consumption</i>	<i>625 MWh electricity</i>
	<i>District heating</i>	<i>645 MWh district heating</i>
Chemicals	<i>Included under raw materials</i>	
Water	<i>Water</i>	<i>3200 tons</i>
Transportation	<i>Duty travel</i>	<i>151,000 person kilometres</i>
	<i>Goods transports</i>	<i>536,400 ton kilometres</i>
	<i>Staff travel to and from work</i>	<i>259,800 person kilometres</i>

Table 12.2 Outflows

Outflows	Type and amount
Products, packaging	
Waste, (landfilling, hazardous, recycling)	
Noise	
Drainage	
Land discharges	
Air emissions from the plant	

External transportation, and in many cases production of electricity and heating, give rise to indirect emissions, ie emissions that do not occur at the plant but can be counted as part of the company’s environmental load. Such indirect emissions are listed in Table 12.3.

Table 12.3 Indirect air emissions

Activity	HC (kg)	CO (kg)	NO _x (kg)	PM (kg)	SO _x (kg)	CO ₂ (tons)

Table 12.2 Outflows

Outflows	Type and amount
Products, packaging	<i>The products consume annually 1,730,000 litres of diesel in the use phase</i>
Waste, (landfilling, hazardous, recycling)	<i>Missing from inventory</i>
Noise	<i>Missing from inventory</i>
Drainage	<i>Sanitary water, 3200 tons</i>
Land discharges	<i>Negligible</i>
Air emissions from the plant	<i>Xylene emission, 70 kg</i>

Indirect emission concerns emissions that take place in other activities, but which the company has a certain amount of control over. External transportation and production of heating and electricity are examples of activities that cause air emissions. Other examples may include surface treatment performed by suppliers. Decide where the border goes between direct and indirect emissions, but do not make a double report.

Table 12.3 Indirect air emissions

Activity	HC (kg)	CO (kg)	NO_x (kg)	PM (kg)	SO_x (kg)	CO₂ (tons)
<i>Duty travel</i>	11	78	62	-	-	28
<i>Staff travel to and from work</i>	84	683	92	-	-	58
<i>Etc</i>						

Quantification with environmental load units

The following bar chart shows the company’s various emissions and resource consumption converted into ELU units. The calculations are included in Supplement *ZZZ*.

Paste in the figure you have drawn!

In the EPS system (environmental priority strategies in product design) you can calculate the environmental impact for various emissions and energy and resource consumption and compare them with each other. You calculate using the environmental load unit (ELU). The calculations consider five safeguard areas of protection: health, biological diversity, biological production, resources and aesthetic values.

One should be aware that ELU calculations are very rough and have many limitations. The most serious limitations are:

- The resource index only comprises withdrawals, not emissions during processing of resources. This means that energy consumption and emissions during the processing of, for example, metals (which could be large) are not included.
- Waste is not dealt with. There is no EPS index for waste. Depending on what happens with the waste, you can imagine it giving rise to emissions, energy or replacement of virgin materials, ie increased as well as reduced (or absence of) environmental impact.
- Many substances do not have a resource and emissions index.

Because of this, the above results should only be seen as an indication of the size of the environmental impact.

Quantification with environmental load units

In order to compare the environmental impact from such sources as goods transportation with raw material consumption, the environmental impact must be quantified. The unit used to compare the environmental impact of the various environmental aspects is ELU (environmental load unit).

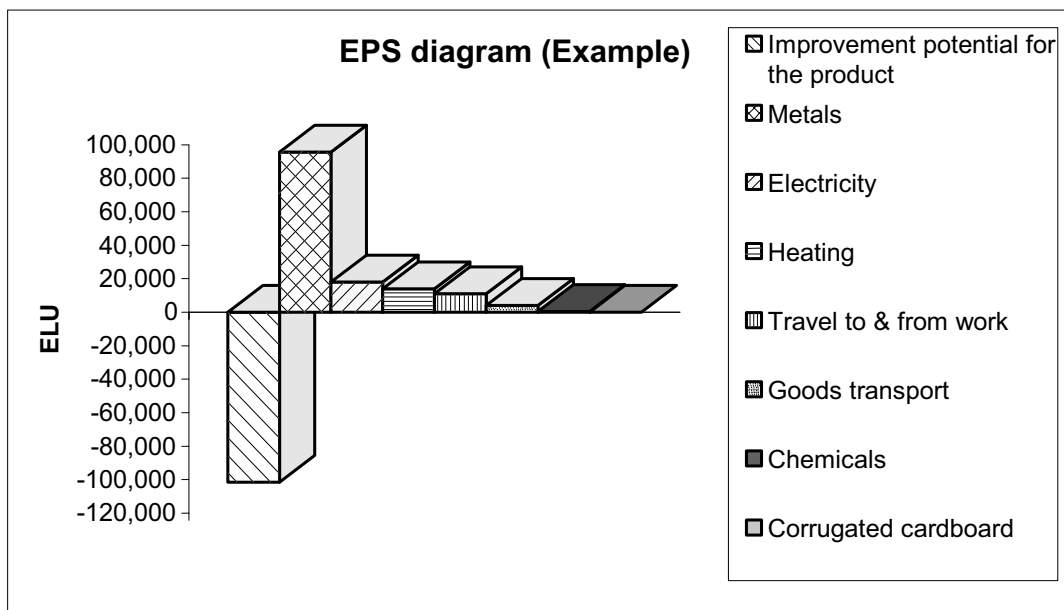
There are ELU figures for various types of materials and emissions. For example, a kilo of copper has an environmental impact of 208 ELU, while the emission of one kilo of carbon dioxide gives an environmental impact of 0.108 ELU. The ELU figure reflects the influence on five safeguard areas: health, biological diversity, biological production, resources and aesthetic values. The system of using ELU figures is called EPS (Environmental Priority Strategies in product design) and has been developed by IVL Swedish Environmental Research Institute Ltd, The Federation of Swedish Industries and Volvo, among others.

There are other methods of evaluating environmental impact quantitatively. Common to all of these, including the EPS method, is that they must be used with great care because they cover the environmental impact of substances inadequately. *You should therefore only use ELU figures as a tool to separate large from small.* Re-evaluate emissions and resource consumption by using the *Resource EPS*, *Energy EPS*, *Transports* and *Emissions EPS* sheets in Inventory.xls.

Supplement 3 provides a few examples of how to calculate ELU for products' environmental impact during use. Additional examples of EPS calculations are given at the end of Supplement 4.

Draw a diagram in the *EPS diagram* sheet in Inventory.xls, copy and paste it into the environmental review. Look at the example of an EPS analysis of environmental impact in Figure 12.1 and at EPS examples in Inventory.xls.

Figure 12.1 Example of an EPS analysis of the environmental impact



To ensure that no calculation errors have been made, our company’s ELU figures are compared to those of other companies in Table 12.4.

Table 12.4 Comparisons of ELU indicators

Consumption	Unit	Our Company	Average	Maximum value	Minimum value
Heating	ELU/m²		5.9	10.7	2.8
Electricity	ELU/m²		4.2	7.1	2.1
Heating	ELU/employee		354	675	166
Electricity	ELU/employee		269	500	106
Trips to/from work	ELU/employee		184	221	74

How one can reason and calculate the ‘Improvement potential for the product’ in Figure 12.1, is described in Supplement 3. That the improvement potential has a negative ELU-value, should be interpreted as the corresponding environmental impact being avoided.

In Table 12.4 indicators converted to ELU values for nine Swedish manufacturing companies are given. Compare your figures with these indicators. Are they reasonable? It is easy to make mistakes when calculating.

Table 12.4 Comparisons of ELU indicators

Consumption	Unit	Our Company	Average	Maximum value	Minimum value
Heating	ELU/m ²		5.9	10.7	2.8
Electricity	ELU/m ²		4.2	7.1	2.1
Heating	ELU/employee		354	675	166
Electricity	ELU/employee		269	500	106
Trips to/from work	ELU/employee		184	221	74

13 Evaluation of environmental aspects

The main aim of this review is to establish the significant environmental aspects of *Company X*'s business activities and products. ISO 14001 states that a significant environmental aspect 'is an environmental aspect that has or can have a significant environmental impact'. We interpret this as meaning that the size of the environmental impact is decisive. In order to carry out this size evaluation, resources consumption and emissions have, as far as possible, been converted into the same measurement of environmental impact called environmental load units (ELU). This was followed by a failure mode and effect analysis based on resource consumption, emissions, waste, risks for accidents, and such. The environmental FMEA, which also considers the environment-related laws and customer requirements, results in the following order of precedence of significant environmental aspects in *Company X*'s business activities and products.

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.

A more pragmatic prioritizing must be done before a final decision is taken of which of the significant environmental aspects *Company X*'s environmental work should be directed at. Important issues or criteria when prioritizing are:

- What are our improvement options?
- Is it easy or difficult to achieve an improvement?
- How much can the environmental impact be reduced?
- Investment costs?
- Can we reduce the costs?
- Can the improvement be measured?
- How much can we influence and control?
- Can we improve our image?
- Is the consumption of finite raw materials reduced?

13 Evaluation of environmental aspects

This is where you summarize the results of the most significant environmental aspects in a list. An environmental FMEA, as described below, is carried out to determine which these are. An environmental FMEA mainly evaluates the size of the environmental impact, because the ISO 14001 standard, in paragraph 4.3.1, specifies that it is this criterion that determines whether an aspect should be deemed significant or not. However, before an environmental aspect can be dismissed, also legal requirements and interested party requirements must be considered. Therefore, the environmental FMEA also contains such considerations.

It is important to remember that this first listing must be further processed before finally deciding which environmental aspects to work with. Among other, you have to consider the technical and economic possibilities of achieving improvements before you set environmental objectives and targets according to paragraph 4.3.3 in ISO 14001. Such considerations are best done outside the FMEA and the initial environmental review.

In Supplement 5, alternative methods to evaluate environmental aspects are described and discussed. Some of the discussion concerns what to do after the initial environmental review is finalized. It also includes some experience from using the environmental FMEA method. So even if you do not want to hear about any alternatives, it could be worthwhile to take a look at Supplement 5 at this point.

Environmental FMEA

The environmental FMEA is a method for evaluating if the environmental impact of a certain activity, product or service should be deemed significant. The environmental FMEA also helps to a certain extent in identifying environmental aspects.

The FMEA should be carried out by a multi-functional group within the company. Examples of functions to include are production, design, marketing, purchasing, safety representatives, quality and environment. It is the multi-functional aspect that makes the FMEA into a powerful tool for identifying previously unknown environmental aspects and accident risks.

You prepare for the FMEA by working through the environmental review to this chapter. The picture of material and energy flows through the company and the ELU estimates should be copied to all FMEA participants. The Environmental FMEA form, instructions and examples are found in Supplement 4 and in the Environmental FMEA.xls Excel file. A good tip is to print the FMEA forms and enlarge them to A3 to make enough room for notes. The Instructions & Criteria should also be sent to all participants. Below is a step-by-step description of how to carry out the FMEA.

Environmental FMEA

To evaluate the company’s environmental aspects and assess which of them are significant, a failure mode and effect analysis has been carried out. The environmental FMEA was carried out on *XX-XX-20XX* by the following persons:

The main procedure during the environmental FMEA was to follow each raw material through the company and identify and evaluate the environmental impact of resource consumption, risk of accidents, emissions and waste. The environmental FMEA is included as Supplement ZZZ in this report.

A) Begin by following the raw materials, one at a time, from when they arrive at the company until they leave.

- 1 Determine the environmental aspect, for example:
 - Resource consumption
 - Risk of accidents
 - Emissions
 - Waste
 - But not consumption of energy, transportation, chemicals or packaging material, if these are treated as separate inflows.
- 2 Determine the associated environmental impact and try to estimate the environmental impact in ELU.
- 3 Determine if the environmental aspect is contrary to law or customer requirements. Get help from the list of laws in Chapter 3.
- 4 Determine the Probability and Consequence. See Instructions & Criteria in Supplement 4 (also in Environmental FMEA.xls).
- 5 Note obvious measures, barriers and the like. Give suggestions in the comments column, but do not spend too much time doing this. Experience shows that it is easy to get stuck on discussing measures, ie what could be done about the aspects. Quickly note suggestions down and get on with evaluating the aspects.

B) Transportation and energy consumption. Go through steps 1 to 5 above in applicable parts.

C) Did you capture all the aspects? Double check by looking through the outflows in the material and energy flow analysis:

- Are all the waste fractions included? Do any specific problems arise when different wastes are mixed?
- Are all the air and water emissions included?
- Product-specific aspects. What aspects do the product give rise to during its life span and when it becomes waste?

Go through steps 1 to 5 above in applicable parts.

D) Has the same aspect appeared in several items? Collect them as a separate item at the end. Typical examples are fire risk and waste fractions.

E) Check the Probability * Consequence (P*C) product. Does it give a good picture of the significance of each environmental aspect? Adjust any ELU scales to suit your company better.

F) The significant environmental aspects are listed in order of precedence (with regard to the P*C product) in Chapter 13 and in the summary.

Improvement proposals

Improvement proposals have been noted under *Comments* in the Environmental FMEA. *They are commented on below:*

-

Improvement proposals

Experience shows that there is a tendency to talk about measures and responses before the environmental issues have been correctly defined. For example, environmental FMEA users often want to discuss what can be done about the environmental aspects before even having decided whether they are significant or not. If the action proposals are noted down immediately, attention can be brought back to the task at hand.

It is not that generating improvement measures is not essential. In fact, it is such an important (and often neglected) part of environmental management that it warrants special attention. But it is outside the scope of the initial environmental review as defined in *Measuring your Company's Environmental Impact*. Supplement 5 contains some advice and experience on generating and evaluating improvement measures. The improvement measures that emerged during the FMEA or else during the review can be further described under the sub-heading Improvement proposals.

14 References

Basis for calculations

Mats Zackrisson, Gunnar Bengtsson, Camilla Norberg. Measuring your Company's Environmental Impact: templates & tools for a complete ISO 14001 initial review. Earthscan 2004.

References related to transportation:

- Road Traffic Institute's report No. 718, 1993.
- Working material of NTM, the Transportation & Environmental Network, www.ntm.a.se.

References related to EPS calculations:

- Bengt Steen. A Systematic Approach to Environmental Priority Strategies in Product Development, (EPS) Version 2000. Models and data of the default method. CPM Report 1999:5, www.cpm.chalmers.se.

References related to Energy:

- Miljöfaktabok för bränslen (Environmental facts about fuels). Part 1. Huvudrapport (Main report). B 1334A-2. IVL. Stockholm. Maj 2001.
- Miljöfaktabok för bränslen (Environmental facts about fuels). Part 2. Bakgrunds-information och Teknisk Bilaga (Background information and technical appendix). B 1334B-2. IVL. Stockholm. Maj 2001.)

Related documents

The following documents contain data that supplements this environmental review or have some other connection.

- ISO 14001:1996. Environmental management – Specifications with guidance for use. CEN European Committee for Standardization. Brussels.
- *Application for Authorization in accordance with Environmental Protection Act XX-XX-20XX.*
- *Supplementary information to application XX-XX-20XX.*
- *Periodical inspection 20XX with regard to water emissions.*
- *Environmental report for 20XX.*
- *Monitoring programme for activities at Company X in 20XX.*

14 References

Basis for calculations

If you follow this manual and the accompanying Inventory.xls Excel file, the specified references suffice.

Related documents

List the documents that are connected with the environmental review. Complement the list in the Template.doc and delete the documents that were not used. One alternative is to give running references in the text with the help of final comments. They will be printed last in the document.

List of acronyms and abbreviations

BOD	biological oxygen demand
COD	chemical oxygen demand
CO	carbon monoxide
CO ₂	carbon dioxide
CPM	Centre for Environmental Assessment of Product and Material Systems
ELU	environmental load unit(s)
EMAS	Eco-Management and Audit Scheme(s)
EPS	environmental priority strategies in product design
ESU-ETHZ	Eidgenössische Technische Hochschule, Zürich, Switzerland
EU	European Union
FMEA	failure mode and effects analysis
g	gram
h	hour
HC	hydrocarbon(s)
IMT	Institute for Media Technology
ISO	International Organization for Standardization
IVF	IVF Industrial Research and Development Corporation
IVL	IVL Swedish Environmental Research Institute
kg	kilogram
kW	kilowatt
kWh	kilowatt-hour
m	metre
mg	milligram
MEuro	million Euro
MJ	megajoule
MWh	megawatt-hour
NO _x	nitrogen oxides
NTM	The Network for Transport and Environment
P*C	Probability * Consequence
PM	particulate matter
SEK	Swedish kronor
SO _x	sulphur dioxides
TFK	Transport Research Institute
TNS	The Natural Step
VOC	volatile organic compound(s)
VTI	Road Traffic Institute

List of acronyms and abbreviations

If you do not add any new acronyms or abbreviations to the report, the specified list would suffice.