# OECD Sustainable Manufacturing Toolkit

## SEVEN STEPS TO ENVIRONMENTAL EXCELLENCE

## START-UP GUIDE

OECD

www.oecd.org/innovation/green/toolkit

# Welcome to the OECD Sustainable Manufacturing Toolkit

Managing operations in an environmentally and socially responsible manner – "sustainable manufacturing" – is no longer just nice-to-have, but a business imperative. Companies across the world face increased costs in materials, energy, and compliance coupled with higher expectations of customers, investors and local communities.

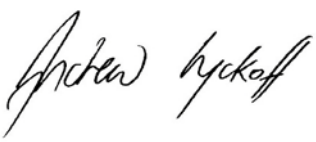
Many businesses have already started to take important steps towards green growth – ensuring their development is economically and environmentally sustainable. Their pioneering experiences largely show that environmental improvements go hand in hand with profit-making and improved competitiveness. However, many small and medium-sized businesses (SMEs), that account for approximately 99% of all enterprises and two thirds of employment across the OECD, have not yet embraced these great opportunities. They may be struggling with their short-term survival, or cost pressure from clients, or lack of knowledge and resources to invest in environmental improvement, or simply not know where to start.

If your business is looking to tackle sustainability – what it means, how it relates to your business, and how you can benefit from greener production – , the ***OECD Sustainable Manufacturing Toolkit*** is a great place to start. Measuring performance is a vital first step to improvement. The ***OECD Sustainable Manufacturing Toolkit*** provides a set of internationally applicable, common and comparable indicators to measure the environmental performance of manufacturing facilities in any business size, sector or country. To make things simpler for those with little experience in this area, the Toolkit offers two components – this step-by-step Start-up Guide and a Web Portal where technical guidance on measurement and relevant links are provided.

We think it is important for you to have the right tools, but also to be informed about what works. That's why we have also included a range of best practice case studies that illustrate the many benefits of sustainable manufacturing. Saving money, improving your products, making your operations more efficient and increasing sales are all possible for those taking up this new challenge.

This Toolkit is the result of a two-year consultation process that involved many practitioners and experts, and the framework it establishes owes much to the existing variety of measurement and reporting initiatives around the world. The OECD gratefully acknowledges support for the development of the Toolkit from the governments of France, Japan, the United Kingdom and the United States, and from the Business and Industry Advisory Committee to the OECD.

We hope that the ***OECD Sustainable Manufacturing Toolkit*** will inspire you to get started on your own journey towards sustainable manufacturing today. Comments and suggestions on how to extend, update and improve this Toolkit will be most welcome.



Andrew Wyckoff
Director, Directorate for Science, Technology and Industry, OECD

# About the OECD Toolkit

***The OECD Sustainable Manufacturing Toolkit*** aims to provide a practical starting point for businesses around the world to improve the efficiency of their production processes and products enabling them to contribute to sustainable development and green growth. The Toolkit includes an internationally applicable common set of indicators helping businesses measure their environmental performance at the level of a plant or facility. This edition focuses on the environmental aspects of sustainable development.

The Toolkit comprises:

**Start-up Guide** (this booklet), which provides easy-to-read guidance to help the reader understand the basic issues and start measurement step by step.


**Web Portal** (www.oecd.org/innovation/green/toolkit) provides detailed explanation on indicators, technical advice on performance management and links to more guidance. The overview is presented on p.49.

Together, the Start-up Guide and Web Portal will help you get the most out of the content, whether you are a beginner, an expert, or somewhere in between.

This Toolkit has been developed with small and medium-sized manufacturing enterprises in mind. However, the indicators and guidance can also be useful for any other size and type of organisation throughout the world.



## About the OECD

The Organisation for Economic Co-operation and Development (OECD) groups 34 member countries committed to democratic government and the market economy. The principle aim of the Organisation is to promote policies for sustainable economic growth and employment, a rising standard of living and trade liberalisation. It provides a forum where governments can compare and exchange policy experiences, identify good practices and promote decisions and recommendations, as well as set international standards. The OECD is also one of the world's largest and most reliable sources of comparable statistical, economic and social data.

The OECD traces its roots back to the Marshall Plan for the reconstruction of Europe after the Second World War. Encouraged by its success and the prospect of carrying the work forward on a global stage, the OECD was established in 1961. In 2011, the OECD is celebrating its 50th anniversary. For more information about the Organisation and the list of member and enhance engagement countries, visit ***www.oecd.org***.

# Table of Contents

## Introduction



## Steps

### *Prepare*



### *Measure*



### *Improve*



## Further actions



### Signposts

Indicates where further guidance can be found in this Start-up Guide.

**Good Practice**

Concrete examples of corporate activities aimed at improving environmental performance in the areas of inputs, operations and products.*

Indicates where further guidance can be found from the homepage of the Web Portal.

**Advanced**

Recommended actions to be taken once the reader has built up experience of measuring basic environmental performance.

* The Good Practice examples are provided solely to help the reader's understanding. They do not mean that the OECD officially endorses the companies and examples presented.

# On your marks

***Sustainable manufacturing creates value for your business***

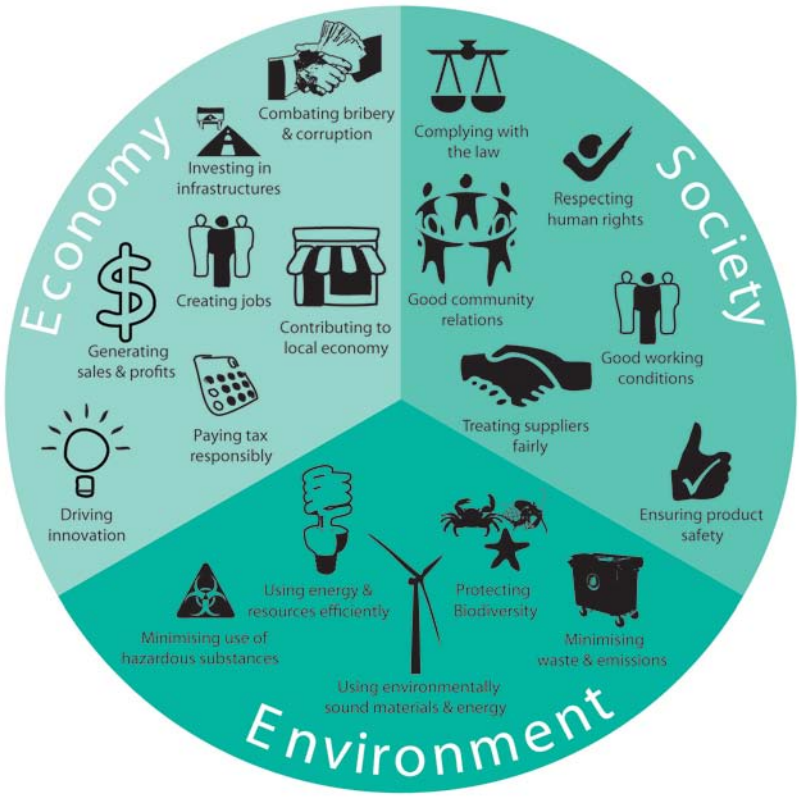
"Sustainable manufacturing" is a formal name for an exciting new way of doing business and creating value. It is behind many of the green products and processes in demand and celebrated around the world today. Businesses of all types are already involved in initiatives and innovations that are helping to foster a healthier environment, enhance their competitive edge, reduce risks, build trust, drive investment, attract customers and generate profit.

Can any business afford to miss out on such opportunities? In this Start-up Guide, we will show you how to get started on a seven-step journey that will maximise sustainable manufacturing opportunities for your business. We will focus on helping you measure the environmental performance of your *facility* so that you can better understand how you currently perform and the improvements you can make (➲**Steps 1-7** **Action Steps**). As you become familiar with various indicators, we will point you in the right direction to learn more (➲**Pass the baton** **Beyond Measurement**). At each measurement step, you can read how other companies are already embracing this challenge and reaping the benefits (➲**Steps 3-5** **Good Practices**).

## *What's the definition of "sustainable manufacturing"?*

There is no single common definition but the US Department of Commerce's Sustainable Manufacturing Initiative sums it up as: "The creation of manufactured products that use processes that minimize negative environmental impacts, conserve energy and natural resources, are safe for employees, communities, and consumers and are economically sound."*

To put simply, sustainable manufacturing is all about minimising the diverse business risks inherent in any manufacturing operation while maximising the new opportunities that arise from improving your processes and products. The economic, environmental and social aspects embraced by this concept are illustrated below. This Guide focuses on helping you to improve the environmental performance of your facility (**About**).




**Three-dimensional aspects of sustainable manufacturing**

* US Department of Commerce (2011), Sustainable Manufacturing Initiative website, *http://trade.gov/competitiveness/sustainablemanufacturing/index.asp*, accessed 27 April 2011.

## *So, sustainable manufacturing creates value? Prove it!*

These days, doing business built on good environmental practice is increasingly becoming essential in the eyes of investors, regulators, customers and the communities where you operate. Failure brings with it high costs – fines, penalties, local unrest and customers choosing to go elsewhere. Success, on the other hand, can save you money, helps build a reputation, attracts investment, spurs innovation, secures loyal customers and brings in repeat business. Benefiting from sustainable manufacturing is not just a game for big business. New firms and small businesses can also play an exciting role. Start-ups and small and medium-sized enterprises (SMEs) with their flexible business models and less reliance on established ways of working, can also benefit, evolving and innovating quickly to gain advantage over on the competition. Need more convincing? Take a look at the facts:

- ***The green marketplace is worth trillions***: A 2010 survey of UK-based manufacturing SMEs shows that **56% are already investing** in low-carbon technologies and strategies. The global market for low-carbon products is already estimated to be worth **over USD 5 trillion**[1] and growing.[2]
- ***Retailers are demanding that suppliers respond to green consumers***: In 2009, Walmart, the largest retailer in the world, introduced a worldwide sustainability index. The index will be applied to **over 100 000 global suppliers** to give consumers a clear environmental and social rating for every product it sells.[3]
- ***A green reputation drives up your financial value***: A study by Harvard and London Business Schools found that financial analysts rate companies with a visible reputation for environmental responsibility higher than others.[4] Conversely, poor performance can be a serious risk. Companies with significant environmental problems, including litigation, have to **pay up to 0.64% more** to service their debts and secure credit.[5]
- ***A little investment in greening may lead to big savings***: The UK's Carbon Trust estimates that most businesses can **cut their energy bills by up to 20%** with only a small investment – a saving that could equate to as much as a **5% increase in your overall profits**.[6]
- ***Young workers value sustainability and demand green workplaces***: A 2010 survey of 5 300 respondents worldwide, carried out by Johnson Controls Global WorkPlace Solutions, shows that over **96% of 18-45 year olds** want their employer and workplace to be environmentally friendly or at least environmentally aware. Over **70%** of all respondents would like to share printers and have recycling bins in the office, while **47%** want to have water saving devices and solar panels installed on site.[7]

1 In this Start-up Guide, the monetary values indicated in local currencies in the original documents are converted into US dollars (USD) for global readers. They are converted by the average exchange rates of the specified year. Where the year is not specified, the average exchange rate of January 2011 is applied.

2 UK Manufacturing Advisory Service (2010), "Green Light for Low Carbon Future", press release, 2 December 2010, *www.mas.bis.gov.uk/news/green-light-for-low-carbon-future-says-manufacturing-advisory-service*, accessed 27 April 2011

3 Walmart (2010), Sustainability Index website, *http://walmartstores.com/sustainability/9292.aspx*, accessed 9 March 2011.

4 Ioannu, I. and G. Serafeim (2010), *The Impact of Corporate Social Responsibility on Investment Recommendations*, Harvard Business School, Cambridge, MA.

5 Bauer, R. and D. Hann (2010), *Corporate Environmental Management and Credit Risk*, European Centre for Corporate Engagement, University of Maastricht, Maastricht.

6 Carbon Trust (2006), *Energy Saving Fact Sheet: Energy Management*, Carbon Trust, London, *www.carbontrust.co.uk/Publications/pages/publicationdetail.aspx?id=GIL136*, accessed 27 April 2011.

7 Johnson Controls Global WorkPlace Innovation (2010), *Generation Y and the Workplace Annual Report 2010*, Johnson Controls, Inc., Milwaukee, WI, *www.globalworkplaceinnovation.com*, accessed 27 April 2011.

## So, how will my business benefit?

Working and manufacturing in a sustainable manner can make a clear and positive contribution to your business and its bottom line. A number of studies have shown a direct correlation between good environmental performance and better returns on assets, equity and investments. Making your business environmentally sound can also improve the stock price, increase sales, income growth and enhanced profit margins (About).

This Guide can help your business improve its bottom line and operational performance, as well as establish better relationships with your key stakeholders, as highlighted below:

### Key business benefits from sustainable manufacturing

**Financial performance**

- ***Increase sales*** – by anticipating and meeting environmental and social expectations better than your competitors.
- ***Improve efficiency and productivity*** – by reducing resource use and waste, and by cutting regulatory burdens.
- ***Reduce dependence on expensive or hazardous materials*** – by exploring, innovating and introducing greener alternatives.

**Business excellence**

- ***Stay ahead of regulations*** – by being proactive and shaping best practice, rather than reacting after changes are implemented.
- ***Win access to capital*** – by reducing risks in operations, strategy and the supply chain and by developing innovative solutions and new products for market.
- ***Gain strategic foresight*** – by anticipating how your business can innovate solutions or adaptations to new added value.

**Relationships with stakeholders**

- ***Enhance reputation*** – by demonstrating green know-how and setting a positive example.
- ***Improve employees' morale and retention*** – by empowering them to contribute to a better environment and more productive business.
- ***Build better community relations*** – by demonstrating a responsible and proactive approach to the local environment and people.

***What's next?***

*We will show how manufacturing activities interact with the environment and introduce the overall structure of the OECD Sustainable Manufacturing Indicators.*

Indicators are a well established means of defining, tracking and improving performance. Most businesses use familiar indicators nearly every day to track sales, costs, employee performance and customer satisfaction, to name but a few. This Start-up Guide introduces and provides advice on **18 key environmental indicators** that will help evaluate and drive performance at your facilities.

## *What does my business have to do with the environment?*

Your business may manufacture complete products that are destined for consumers, or components or intermediate products that are transported to other businesses and that may become part of the final products for sale or products used to provide services. Whatever you make, your business uses resources and services provided by the natural environment (*e.g.* metals, materials, fossil fuels, soil, water, biodiversity) and discharges "by-products" (*e.g.* wastes, emissions) into the environment. As a consequence, your actions have an impact on the environment. This Guide provides a simple step-by-step process using indicators to help you map your impact, find the most effective way to reduce it and maximise the benefits from your improvements.

The figure below indicates the basic interaction between your facility and the environment and the impact it may have on the environment throughout the 'lifecycle' of the products that it produces. Even though the actual production processes are far more sophisticated, your environmental impacts are principally formed in the following three stages:

### Basic relationships between manufacturing and the environment

| Inputs | Operations | Products |
|---|---|---|
| Materials or intermediate products used to manufacture your products | Processes to turn inputs into products and activities necessary to operate the production processes (*e.g.* facility operation, transport of inputs and products, business travel, staff commuting and other overheads) | Products manufactured and their use and treatment at the end of their lifetime. |

**Note:** This Toolkit focuses on the environmental impact directly linked to production activities in a facility. In principle, the corresponding indicators do not include the impact from commuting staff and logistics to transport inputs or products shown in the figure, but include the impact from business travel. It is possible to extend the coverage of indicators to include these indirect impacts in order to have a fuller picture of your impact (➲**Step 4 Advanced**).

## How can indicators help my business?

Indicators are used by businesses to measure and monitor performance. They usually comprise a combination of quantitative and qualitative measures. Quantitative indicators are expressed in numbers and help measure quantities: How many? How often? How much? Qualitative indicators provide contextual insight including location, responsibility and rationale.*

Indicators enable you to:

- Track progress over time
- Identify and take action to address problems and improve performance
- Identify considerations that may be missing from your analysis and where further measurements could help provide a fuller picture

Indicators will ideally be used to provide straightforward insights, whose implications are clearly understandable and actionable by your business.

## Which indicators do you recommend?

The *Sustainable Manufacturing Toolkit* includes **18 of the most important and commonly applicable quantitative indicators** for environmental performance. These indicators will mainly assist internal management and decision-making and can be used for all types of manufacturing.

### Overview of the OECD Sustainable Manufacturing Indicators

| Inputs | Operations | Products |
|---|---|---|
| | **O1** Water intensity | **P1** Recycled/reused content |
| | **O2** Energy intensity | **P2** Recyclability |
| | **O3** Renewable proportion of energy | **P3** Renewable materials content |
| | **O4** Greenhouse gas intensity | **P4** Non-renewable materials intensity |
| **I1** Non-renewable materials intensity | **O5** Residuals intensity | **P5** Restricted substances content |
| **I2** Restricted substances intensity | **O6** Air releases intensity | **P6** Energy consumption intensity |
| **I3** Recycled/reused content | **O7** Water releases intensity | **P7** Greenhouse gas emissions intensity |
| | **O8** Proportion of natural land | |

**Note:** Indicators **O1**, **O2** and **O4** can be extended to measure the impact associated with your supply chain as well as your facility: namely, water and energy consumed and greenhouse gas emissions caused during the production of inputs (➲Step 4 Advanced**).**

## *Which part of my business can I measure?*

These indicators have been developed to help measure the environmental impact relating to the production activities of **a single facility** in your business (*e.g.* site, factory, office) as a starting point for sustainable manufacturing. The Guide provides advice for collecting local data and calculating indicators to help improve immediate performance. You can appraise and communicate the environmental qualities of a particular facility and its products to communities, customers, employees and other stakeholders. You can also compare the activities and performance among different facilities in your business, enabling you to improve your overall corporate performance (➲**Steps 6-7**).†

You can also monitor and evaluate the performance at the overall organisational level by aggregating the data obtained to calculate the indicators. Towards the end of this Guide, we provide guidance on other information sources, should you want to think more broadly about approaches to sustainable manufacturing and overarching corporate sustainability strategies (➲**Pass the baton**).

***What's next?***

*We will outline the seven steps that we recommend you to follow so as to understand, measure and improve your environmental performance.*

* New Economics Foundation (2009), Proving and Improving website, *www.proveandimprove.org*, accessed 9 March 2011.

† It may also be possible to compare your performance with the facilities of other companies that have similar operational functions and products if the indicators can be obtained (➲**Step 6**).

# Go!

## *Learning the indicators step by step*

Are you ready to get started? You will follow a simple **seven-step process** in the next pages to understand the OECD Sustainable Manufacturing Indicators. You will learn how to prepare and conduct the measurements, and how to use the indicators to improve your environmental performance.

### Seven steps to utilise the OECD Sustainable Manufacturing Indicators

**Improve**

5 ***Evaluate your products***: Identify factors such as energy consumption in use, recyclability and use of hazardous substances that help determine how sustainable your end product is.

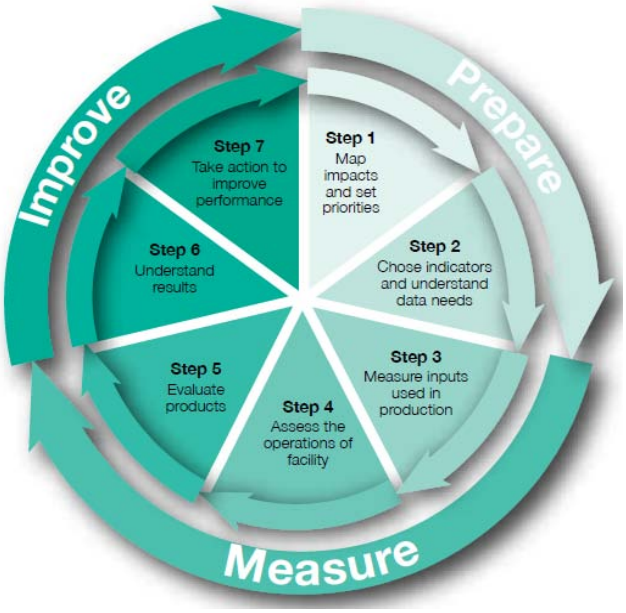
6 ***Understand measured results***: Learn to read and interpret your indicators and understand trends in your performance.

7 ***Take action to improve performance***: Choose opportunities to improve your performance and create action plans to implement them.

**Prepare**

1 ***Map your impact and set priorities***: Learn how to bring together an internal "sustainability team" to set objectives, review your environmental impact and decide on priorities.

2 ***Select useful performance indicators***: Identify indicators that are important for your business and learn about what data should be collected to help drive continuous improvement.




**Measure**

3 ***Measure the inputs used in production***: Identify how materials and components used into your production processes influence environmental performance.

4 ***Assess operations of your facility***: Consider the impact and efficiency of the operations in your facility (*e.g.* energy intensity, greenhouse gas generation, emissions to air and water).

## How does this process work?

The seven steps are not necessarily a one-way journey. We recommend that you apply them for a cyclical management process. Doing so will help you measure and understand your environmental impact, as well as improve your performance on an on-going basis. It is important to appreciate that sustainable manufacturing is not about a final destination or result, but about continuous learning, innovation and improvement. Therefore, after completing all seven steps, you may want to revisit the process regularly (*e.g.* yearly or every few years) to continually improve your activities.

## How long will it take to go through the seven steps?

It is difficult to say exactly how long any step – or the whole process – will take in any given situation, as this will vary widely from one facility to the next. You may already be taking steps in some areas, or you may be totally new to the terrain. Your operations may be straightforward or more complex. Step 1 of the process explains about how to set your own reasonable goals.

However, you should expect to see progress in a matter of months. It should be possible, in most cases, for a facility to go from having no information at all to being able to measure at least some indicators within a year. Your timeline may also change as you progress, so be sure to communicate regularly with your colleagues along the way. This will ensure consistent expectations (**About**).

Remember, the most important thing is engaging in this process and the rest is what you make of it. No matter how much or how long you engage, the same basic seven steps will apply throughout.

***What's next?***

*Now, you should be ready to get going.*
*Let's start with mapping the environmental impacts of your facility.*

# Step 1

## *Map your impact and set priorities*

For any journey you need a good map to help you get to your destination. In Step 1, we focus on where you are starting and where you want to end up, which is essential to ensure that you have all you need to get there. The aim of this first step is to establish a general understanding of your positive and negative environmental impact by mapping your activities and determining which ones affect your performance the most. There will be many ways to reduce the environmental impact of your facility and improve its performance, and no single person will have all the answers.

## *Who is taking the journey with me?*

### Convene a "sustainability team"

Enlist the help of knowledgeable colleagues. Convening a "sustainability team" with colleagues – who are familiar with the whole facility and local community and who can help get agreement on objectives as well as who can organise practicalities – is an essential first step of this journey.

As you select your team, be sure to include people from different business units, operational experts and individuals who understand the expectations of key groups such as regulators, local communities, purchasers and customers. There is no limit to the number of people in a team. However, team members should have sufficient overall knowledge of your operations and their surroundings and enough time to devote to the task.

## *Where should the team begin?*

### Agree on ambitions

Your team should first ensure that it has shared ambitions that are supported by the management team at your facility. You might be starting out as a complete beginner, an experienced sustainability team, or something in between. How you view your current level of experience and ambition will have an impact on what indicators you select and how you view the task of improving your performance. Consider the table below as your team determines the ambitions in light of your own level of experience.

**An illustrative list of shared ambitions**

| Beginner | Intermediate | Advanced |
|---|---|---|
| Understand your business better<br><br>Improve efficiency to reduce environmental impact and save money | Identify business risks and opportunities related to the environment<br><br>Set and achieve environmental performance targets that clearly differentiate us from our competitors | Anticipate the needs and concerns of customers and stakeholders<br><br>Deliver environmental performance and innovative products that attract external investment and make us the preferred supplier and brand |

## *How do I begin to grasp environmental issues at my facility?*

### Map the facility and its impact

Once you have agreed on the broad ambitions to improve the facility, the team should start mapping both its positive and negative environmental impact, while capturing initial thoughts on how to improve performance. You can do this by considering each step of your manufacturing process – inputs, operations (including logistics) and products – and by identifying the key environmental concerns and opportunities that spring to mind. You may also use the table of 18 key indicators (➲Get set) as a prompt to consider different types of environmental concern and how they might apply to your business. It may be useful to record the results on a simple spreadsheet capturing the impact according to different parts of your facility, as follows:

**An illustrative example of mapping environmental impact**

| Impact area | Nature of impact & any stakeholder concerns (positive / negative) | Insights to potential improvements & cost and benefit | Further information available or needed |
|---|---|---|---|
| | Inputs | | |
| **Use of harmful materials** | Some materials might be restricted by law or toxic to health and the environment. Civic campaigns are increas-ingly focusing on this issue. | ***Replace with less damaging alternatives.*** | Need to explore potential providers and confirm with cost-benefit analysis. |
| | Operations | | |
| **No monitoring of energy efficiency or heat loss** | Poor efficiency and heat loss is a waste of energy and money. Employees and purchasers are interested in our performance. | ***Basic monitoring will help to track performance and identify opportunities for improvement.*** | Find out options to monitor energy efficiency and explore how to inform and involve staff. |
| | Products | | |
| **End product has a lot of plastic packaging** | Current packaging is non-renewable and isn't easily recycled. There are a growing number of customer complaints. | ***Need to look at potential for using recycled cardboard for packaging.*** | Explore cardboard packaging options and any implications for branding and product quality. |

## *What if I have a very long list of impacts?*

### Identify priority areas

As you map the environmental impact of your facility, some areas may quickly emerge as clear priorities. For instance, you may identify:

- ***Quick wins***: Areas where you know you can have a rapid, positive impact, such as improving energy efficiency.
- ***Hot issues***: Areas where there is already debate or concern, for instance, among local communities to do with emissions from the facility.
- ***Strategic imperatives***: Initiatives that are essential for your core business, for instance, to meet regulatory demands or to provide certain customers with assurance that the products are manufactured to certain environmental standards.

You can highlight these priorities as they emerge. If you are a beginner, you may want to focus on a few areas where you can demonstrate immediate results. As you gain experience, you may have a larger number of priorities in hand at one time.

A more sophisticated way to prioritise a range of issues involves ranking them according to their relative environmental and business impact. The team can work to specify or quantify the exact nature of high, medium or low impact for your particular facility and the results may then be mapped on a simple matrix as illustrated in the table and figure below.

For instance, an issue such as improving air quality may score high on environmental concerns as well as on business concerns. This would immediately place the issue in the high-priority zone of the matrix.

**Assessing degree of impact for prioritising issues**

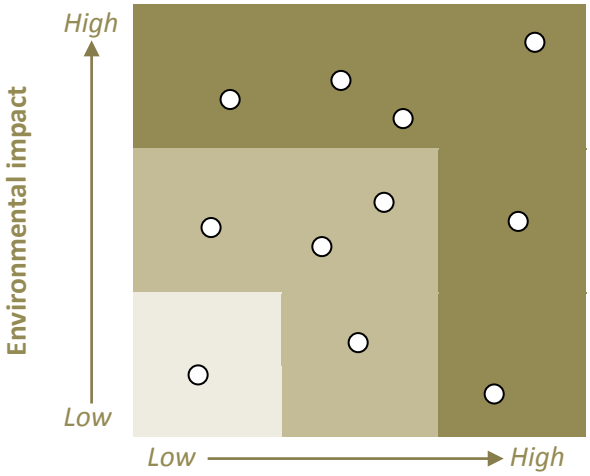
| *Impact level* | *Environmental impact* | *Business impact* |
|---|---|---|
| **High** | Results in significant damage or enhancement to the general environment and is of great concern to stakeholders. | Significant ramifications for business and reputation with potential for substantial losses or gains. |
| **Medium** | Causes some damage or enhancement to some parts of the environment and attracts some stakeholder concern. | Moderate ramifications for business and reputation. |
| **Low** | Results in minimal environmental damage or enhancement, with limited stakeholder interest. | Minimal ramifications for business and reputation. |

See figure on next page

## An issue priority matrix

Positive or negative impact on *e.g.*:

- Energy efficiency
- Air quality
- Water quality
- Use of toxic materials
- Use of renewable materials
- Greenhouse gas emissions
- Product impact




**Dark** – high priority issues

**Medium** – medium priority

**Light** – low priority

Positive or negative impact on *e.g.*:

- Sales
- Cost
- Licence to operate
- Operations (*e.g.* shutdown)
- Health & Safety
- Reputation / Brand value

## *Do I need to take into account the views of other people?*

### Consider stakeholders

As you map your impact, it can be really helpful to reflect on key internal and external audiences and their concerns about your environmental performance. Their views may help you to identify any impact or opportunities that you may not have considered, or highlight when something is more important than you might have thought.

Stakeholders might include employees, investors, local communities, regulators, competitors, supply-chain partners and customers. Some colleagues on your team may have regular contact with certain groups and be able to share their concerns. For other groups, you may need to do some research or contact them directly to find out their views. It may be helpful to list your stakeholders on a spreadsheet and capture their key interests or concerns as they emerge.

### An illustrative example of listing stakeholder interest and concerns

| Stakeholder group | Interest and concerns |
|---|---|
| **Business customers** | Desire to demonstrate that all sourced components have been manufactured to certain environmental standards. Some have asked us to undertake a self-audit against key areas. |
| **Employees** | Concerned about air quality in the workplace and exposure levels. Want to understand best practices and steps to mitigate the impact on health and safety. |
| **Local community** | Anxious about emissions from the facility into the atmosphere. Would like more information on performance, trends, standards and significance. |
| **Regulator** | Concerned about improving water efficiency at the facility over the next year and has requested quarterly meetings on performance. |
| **Consumer action group** | Concerned about the greenhouse gas emissions from our end products. They plan to list us on their "name and shame" website. |

## *What should I do with all this information?*

### Organise information and actions for follow-up

As the team goes through these exercises, it will collect a variety of information about your facility's activities and impact. It will also identify areas where more information or research is needed, or where further discussion needs to take place with other parts of the business or external stakeholders. It will be helpful to capture these follow-up actions and ensure individuals or parts of the business are accountable for implementing them, with a clear timeline for feedback.

As the follow-up actions are completed, the team will begin to have a much clearer idea of the priorities in their facility and be better placed to identify the most useful indicators, discussed in the following steps. Using centrally stored information collection and knowledge management tools – such as spreadsheets and databases – will make a big difference in your team's ability to share information and keep an eye on the bigger picture.

## *How can we maintain momentum?*

### Implement a regular process to check-in and report on progress

Perhaps via a team meeting every two to four weeks. You can use your knowledge management tools as a basis for discussions in meetings. It will then be clear to everyone where you are making the most progress, where you are experiencing challenges and where you need more help to get started or to stay on track.

***What's next?***

*You will need to confirm the indicators that you are using.*
*Let's take a look at how to select indicators for your facility.*

You have already been introduced to the 18 key environmental indicators of this Toolkit (➲**Get set**), and you will learn about them in detail shortly. While these indicators are a great starting point, they are by no means exhaustive. Some companies will benefit from adding more indicators over time, while other companies may only want to use a handful of the indicators provided.

## *How do I select the right indicators?*

You need to take a few things into account when selecting your indicators:

**Identify what is relevant**

- The indicators that you select should reflect the priorities identified in Step 1. For instance, if you identified energy use as a priority, you should consider the indicators related to this issue such as: your use of renewable energy (indicator **O3**); greenhouse gas intensity (**O4**); and energy intensity (**O2**). If you are concerned about waste and emissions, you should consider: the intensity of your residuals (**O6**); releases into the air (**O5**); and water (**O7**).

**Establish data needs**

- Each indicator will require you to track and manage different data. For instance, to establish the proportion of your energy that comes from renewable sources, you will need to know your overall energy consumption as well as the mix of sources that provide your energy. If you decide to track performance against the 18 key environmental indicators, you will need to collect information relating to **54 different data points**. Detailed information on the required data can be found on the Web Portal (**Essential Data**), and is summarised at the end of this Guide (➲**List of data**).

**Set a data collection process**

- Set up clear processes and practices to ensure data can be collected and managed in a robust and meaningful way. For instance, you may want to establish a policy that ensures certain data is always measured in a certain way, at a specific interval and that the results are consistently recorded in a particular document. You should also assign responsibility for undertaking this task to ensure that the results are regularly shared and reviewed by relevant parts of the business. Any anomalies or problems that arise can then be understood and addressed. You will also need to document your data sources, calculations and assumptions where relevant.

## *How many indicators should I use?*

### Start with what you have

If you don't have the complete data set required for the indicators from outset, this should not stop you from getting started and making progress. You will probably already have some data that you routinely collect as part of business operations. If this is the case, then you should go ahead and use this existing data to better understand your performance as far as possible. It is not necessary to have all data items covered to start managing and improving environmental performance. Feel confident to begin managing and improving results on the basis of a few indicators. Then build on it over time as your experience grows and the value of using the indicators becomes clear, as illustrated below:

**An illustrative example of indicator selection**

| Experience level | Number of indicators to select | Basis of indicator selection |
|---|---|---|
| **Beginner** | **1-5** | Data already available and collected. |
| **Intermediate** | **6-12** | **Priorities highlighted through your issue identification.** |
| **Advanced** | **13-18+** | All indicators relevant to the facility. Additional indicators may be developed to facilitate further improvement. |

## *What specifics do I need to know before starting to measure?*

### Decide on the "normalisation factors" that you will use

A majority of the 18 indicators are "normalised". Instead of using the total amount, the indicators are presented in relative terms as a ratio of performance per specific unit of output ("intensity"). The indicators to which this applies are **I1**, **I2**, **O1**, **O2**, **O4**, **O5**, **O6**, **O7**, **P4**, **P6** and **P7**. What this means is that, instead of simply reporting a total amount, the indicator for water intensity (**O1**), for example, is defined as water consumption per unit of output from your facility. Normalisation helps users understand performance in a particular context. If, on the other hand, water were only measured as a total consumption figure, it would change according to levels of production and would not provide any real insight to water efficiency or allow a comparison with other facilities.

A variety of factors may be used to normalise performance, including:

- ***Number, weight or units of products produced in the facility.***
- ***Sales or value added in the facility.***
- ***Person-hours worked in the facility.***
- ***Units of function or level of services to be provided by the products produced in the facility.***
- ***Lifetime of the products produced in the facility.***

While Indicator **P4** specifies the use of product lifetime as a normalisation factor, you may choose the factors that are most relevant to your businesses for other intensity indicators.

In order to get the best use out of the indicators and improve your performance, it is important to use the defined normalisation factor consistently over time. You should also use the normalisation factor used by any peers against which you would like to benchmark your own performance, *e.g.* other facilities in your business or competitors (➲**Steps 6-7**). Your industry or trade associations may provide standard factors to be applied in your sector (➲**Pass the baton** **Beyond Measurement**). Further guidance on normalisation is available in our Web Portal (**Technical Advice**).

***What's next?***

*Now, let's start measuring.*
*First, we need to review the inputs into your facility.*

# Step 3

## *Measure inputs used in production*

The first set of indicators relates to the raw materials and intermediate products used in your production processes to make your products. Let's take a closer look at the impact that material inputs can have on your environmental performance.

### *Why is it important to measure inputs in sustainable manufacturing?*

Your inputs will have a substantial impact on your overall environmental performance. So opting for more environmentally friendly inputs can reduce any negative impact and eliminate risks right at the start of your manufacturing activities.

In general, you can improve the environmental performance of your inputs in a number of ways that produce win-win benefits and often save costs.

For instance, in 2009, companies in Massachusetts, United States participating in a programme to reduce the use of toxic substances reported a range of benefits, including:

- **55%** reported management's increased attention to environmental practices.
- **51%** reported improvements in workers' health and safety.
- **41%** reported financial savings from reducing the use of toxic substances.*

### Key benefits from greening inputs

| | |
|---|---|
| **Reduce the use of materials** | Reduces expenditure on materials |
| **Minimise harmful substances** | Reduces costs related to handling, storage and treating |
| **Substitute harmful materials with less damaging alternatives** | Carries a lower regulatory compliance burden |
| **Increase use of renewable and recyclable materials** | Reduces waste disposal requirements |

These actions will also play a part in helping to ensure that your end product meets the environmental expectations of a growing number of retail and business customers (➲**Step 5**).

* Toxics Use Reduction Institute (2009), *Toxics Use Reduction Act Program Assessment: Executive Summary*, TURI Methods and Policy Report 26, University of Massachusetts Lowell, Lowell, MA, *www.turi.org/library/turi_publications/tura_program_assessment/toxics_use_reduction_act_program_assessment_executive_summary_2009*, accessed 27 April 2011.

## *Which key environmental performance issues relate to inputs?*

Any materials and substances that go into making your products will all have an environmental impact. For instance, your inputs may be:

### Key environmental issues related to inputs

| Finite | Resource-intensive | Harmful | Renewable, recycled or reused |
|---|---|---|---|
| Non-renewable substances deplete supplies of natural resources and may cause serious environmental damagen during extraction. | Large amounts of energy and other resources may be required to produce the inputs. | Some inputs may comprise substances that are restricted by law or that are toxic to health and the environment. | In contrast, such inputs tend to have a lower environmental impact. |



## *How can I measure my performance?*

We introduce you to **three key performance indicators** relevant to inputs in your facility. Each indicator measures the intensity with which you use:

| *Non-renewable materials* | *Restricted substances* | *Recycled or reused materials* |
|---|---|---|

In order to calculate each indicator, you will need to know the proportions of non-renewable materials and restricted substances and the volumes of recycled or reused materials used in your processes and for making products. Your suppliers should be able to provide you with most of this information. You will need to record the weight of each material input, both raw materials and intermediate products, as well as the total weight of all material inputs.

The basic formula for calculating each indicator is shown below. The Web Portal also provides more technical advice and worksheets to help you record and calculate your figures (**Indicators, Data Tools, Technical Advice**).

# List of indicators on inputs

## I1: Non-renewable materials intensity

Your use of materials in finite supply as a proportion of your production

$$\frac{\textit{Weight of non-renewable resources consumed}}{\textit{Normalisation factor}}$$

## I2: Restricted substances intensity

Your use of substances restricted by law as a proportion of your production

$$\frac{\textit{Weight of restricted substances consumed}}{\textit{Normalisation factor}}$$

## I3: Recycled/reused materials

Your use of recycled and reused materials as a proportion of overall materials used

$$\frac{\textit{Weight of recycled and reused materials consumed}}{\textit{Total weight of all material inputs}}$$

**Note:**

As performance improves, the indicator score will rise.

As performance improves, the indicator score will fall.

Some formulae in this table may be presented in a simplified way to ease your understanding – visit the Web Portal for the full details (**Indicators**).

Good Practice

## *Solvent use reduced by finding alternatives*

**Isothane (Accrington, United Kingdom)**

**Sector: Construction materials**
**Employees: 32**
**Annual turnover: USD 14 million (2009)**

Isothane is a manufacturer of products used for insulating buildings, providing buoyancy for boats, protecting bridges and reinforcing roads. It decided to eliminate flammable materials from its product lines in order to reduce substantially the solvent emissions and help ensure compliance with legislation. Most of this was accomplished through material substitution, but a few product lines were discontinued. The company's research and development (R&D) team spent two months researching less hazardous alternatives to find substitutes.

Isothane was able to reduce its solvent use from 150 tonnes (165 US tons) of three types of flammable solvent to just 22 tonnes (24 US tons) a year of only one type of non-flammable solvent. The only cost was for internal R&D team. But it saved the company USD 400 000, which would have been the cost of upgrading all electrical equipment in the factory and warehouses to comply with the required flameproof standards, as well as for several other modifications. As a further benefit, employees' exposure to hazardous materials has been reduced and the company generates less hazardous waste.*

* Business Link (n.d.), Reduce and Manage Your Solvent Use website, *www.businesslink.gov.uk/bdotg/action/detail?itemId=1086172746&type=CASE%20STUDIES*, accessed 9 March 2011, and personal communication with Isothane Limited.

Photos: Isothane Limited

Good Practice

## *Used materials improve aesthetics while reducing impact*

**Wausau Tile (Wausau, Wisconsin, United States)**

**Sector: Construction materials**
**Employees: 300**
**Annual turnover: Undisclosed**

Wausau Tile manufactures architectural products for the global market, such as: plastic site furnishings; precast concrete and metal site furnishings; concrete pavers; terrazzo tile; and precast terrazzo. The company wanted to reduce the use of natural raw materials and save costs at the same time as part of its "green initiative". It investigated the possibility to find alternative aggregates to mix with concrete, where gravels are normally used and found a process to treat glass for that purpose.

Wausau Tile considered trying used glass as a new concrete aggregate. Of all the collected post-consumer materials, glass has been one of the most difficult to recycle and much of the used glass ends up in landfills. Even though using broken glass can lead to additional costs, the company believed that any extra cost could be offset by the decorative value of the material, by developing new products, attracting new customers and reducing the environmental impact. With this in mind, the company managed to include large glass chips in their products that were large enough to be architecturally and aesthetically valuable.


The company has redesigned a number of their products incorporating used glass as an aggregate such as: benches, tables, planters, concrete pavers and terrazzo tiles. The glass aggregate accounts for up to 56% of the total product weight or volume in some products. In 2009, the company used about 450 tonnes (500 US tons) of post-consumer/post-industrial glass, creating a market for used glass and attracting customers. Following this success, it has recently introduced a new line of products that use post-industrial porcelain like sinks, bathtubs and toilet bowls as an aggregate.*

* National Concrete Precast Association, United States (2009), Precast Solutions website, *www.solutions.precast.org/precast-concrete-recycled-glass-tiles-case-study*, accessed 9 March 2011.

Wausau Tile, Inc. (2009), Company website, *www.wausautile.com*, accessed 9 March 2011 and personal communication with the company.

Photos: Wausau Tile, Inc.

***What's next?***
*Time to take a look at your internal operations and their environmental impact.*

Let's take a look now at what happens within your facility and the activities you undertake to transform a variety of inputs (➲**Step 3**) into end products for delivery and sale (➲**Step 5**). Here, we focus on the key processing and manufacturing functions and design of your facility and the related back-office functions as well as the emissions that arise from these operations.

## *Why is it important to assess operations in sustainable manufacturing?*

Designing and managing your facility and its surroundings, including operations and production processes have a significant influence on your overall environmental performance. It may also be a source of interest for local communities. As your facilities and internal processes are directly under your control, these areas top the list when it comes to thinking about how to reduce the environmental impact and improve performance.

A survey of over 300 North American businesses highlighted that the majority of respondents expected sustainable manufacturing trends to increase in the future. Some **84%** believed environmental measures played a vital role in their overall strategies to optimise their businesses. Respondents pinpointed the following key actions: implementing recycling and reuse programmes; water reduction; energy management; and a commitment to continuous improvement.*

Some specific benefits for your business from environmentally sustainable operations include:

### Key benefits from greening operations

| | |
|---|---|
| **Reduce energy consumption** | Reduces energy costs |
| **Reduce waste generation and emissions** | Reduces cost of monitoring, treatment and disposal<br>Reduces loss of economic value of materials |
| **Reprocess/ remanufacture end-of-life materials** | Increases value of your material inputs |
| **Replace or upgrade equipment and/or production line** | Improves efficiency of operations |
| **Improve on-site biodiversity and native habitat** | Reduces the need for watering, air conditioning and other maintenance |

* Eye for Transport (2008), Green Manufacturing: Adoption & Implementation 2008 Report, London, *http://events.eyefortransport.com/manufacturing/free_report.shtml*, accessed 27 April 2011.

## *Which key environmental performance issues relate to operations?*

All buildings and production processes in your facility have an impact on the environment and their surroundings by virtue of their:

### Key environmental issues related to operations

**Energy and water use**

as essential to operating most of production processes. Use of energy from fossil fuels result in carbon dioxide ($CO_2$) emissions.

**Waste generation**

as residuals from production processes. It may cost businesses more for proper treatment and disposal.

**Emissions into air and water**

often have a detrimental impact on human health and other species both locally and beyond national boundaries. Human health could also be affected indirectly if excessive amounts enter the food chain.

**Production of noise and odour**

may have a direct impact on local residents, causing annoyance as well as a significant impact on health. However, this Toolkit does not provide an indicator on this aspect.

**Logistics**

used to deliver inputs for production and ship finished products, which entail fuel consumption, emissions, noise, and impact on infrastructure.

**Staff travel and overheads**

Although not directly used for production, items used in operating a facility such as office furniture, lighting and air-conditioning can also have an impact on the environment. Staff travel (commuting and business travel) has a similar impact to those of logistics.

**Land use and impact on the natural habitat**

often have the most visible impact on local communities. The impact depends on how ecologically sensitive the facility area is; how close your facility is to residential areas; and how you manage buildings and the immediate surroundings.

## *How can I measure my performance?*

For measuring operations, we introduce you to **eight key performance indicators**, covering:

| | | | |
|---|---|---|---|
| ***Water consumption*** at your facility | ***Energy consumption*** at your facility | Your use of ***renewable energy*** | ***Greenhouse gases*** from operations |
| ***Wastes*** generated by your operations | ***Emissions into air*** generated by your operations | ***Emissions into water*** generated by your operations | Your facility's ***natural cover*** |

To measure these, you will need data on your water and energy consumption and the sources used to generate that energy. Your energy and water providers should be able to provide these figures. You will also need to know the amounts of generated emissions and wastes, including greenhouse gases.

Some of these such as wastes can be directly measured, while others will need to be estimated based on your use of materials. Greenhouse gases can be estimated based on your energy sources and consumption, using a conversion table. Lastly, you will also need to collect information about the total surface of land included as part of your facility and how much of this is in a natural condition. You can find this out using surveyors' maps or satellite imagery. More information on how to do all of this is included in the Web Portal (**Indicators, Data Tools, Technical Advice**). The basic indicator formulae are shown below.

## List of indicators on operations

### O1: Water intensity

Your consumption of water per unit of output

$$\frac{\textit{Total water intake}}{\textit{Normalisation factor}}$$

### O2: Energy intensity

Energy consumed per unit of output

$$\frac{\textit{Total energy consumed}}{\textit{Normalisation factor}}$$

### O3: Renewable proportion of energy consumed

The percentage of energy you use from sustainable sources (*e.g.* biomass, biogas, solar, wind, hydropower)

$$\frac{\textit{Renewable energy consumed}}{\textit{Total energy consumed}}$$

### O4: Greenhouse gas (GHG) intensity

GHGs produced during production per unit of output

$$\frac{\textit{GHGs released in production and overhead}}{\textit{Total energy consumed}}$$

### O5: Residuals intensity

Generation of wastes per unit of output

*2 approaches to calculate:*

$$\frac{\textit{(Weights of all inputs + Weight of fuel consumed – Weight of all products)}}{\textit{Normalisation factor}}$$

$$\frac{\textit{Aggregation of weights of releases to different destinations}}{\textit{Normalisation factor}}$$

### O6: Intensity of residual releases to air

Release of air emissions per unit of output

$$\frac{\textit{Weight of releases to air}}{\textit{Normalisation factor}}$$

### O7: Intensity of residual releases to surface water

Release of effluents per unit of output

$$\frac{\textit{Weight of releases to surface water}}{\textit{Normalisation factor}}$$

### O8: Natural cover

The proportion of land occupied that is natural cover

$$\frac{\textit{Natural cover area}}{\textit{Total land area}}$$

**Note:**

As performance improves, the indicator score will rise.

As performance improves, the indicator score will fall.

Some formulae in this table may be presented in a simplified way to ease your understanding – visit the Web Portal for the full details (**Indicators**).

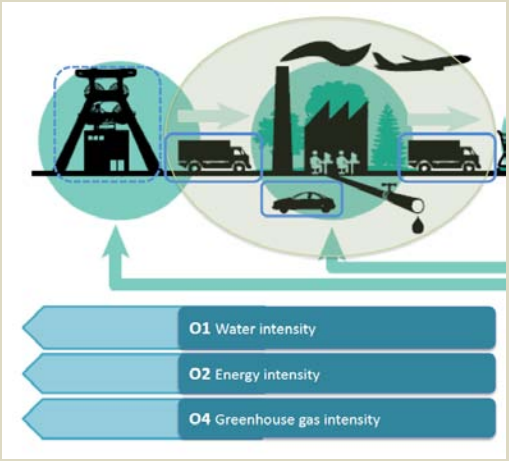
Advanced

## Extend your boundary

This Guide primarily focuses on measuring the direct environmental impacts from the facility, the materials it consumes and the products it manufactures. However, there are also other indirect impacts related to your production – for example, energy may also be consumed during the refining processes of the materials you use, resulting in greenhouse gas emissions.

As your experience deepens, we encourage you to consider the impacts beyond your natural organisational boundary and expand your indicator coverage to include impacts associated with your supply chain, such as:

- **Water consumed during the production of inputs** (particularly where this is relevant in water-stressed regions) – as an extension of Indicator **O1**
- **Energy consumed during the production of inputs** (materials and intermediate products) – as an extension of Indicator **O2**
- **Greenhouse gas emissions caused during the production of inputs** – as an extension of Indicator **O4**




You might also consider greenhouse gas emissions associated with logistics – as an extension of Indicator **O4**, particularly:

- **Shipping of materials** from suppliers to your facility
- **Staff commuting**
- **Shipping of finished products** to their final destinations

Data for those items can be obtained or estimated from different sources:

- **Directly survey suppliers and logistics companies** (and employees in the case of staff commuting)
- **Use 'water footprint' and 'carbon footprint' tools**
- **Use conversion tables or lifecycle inventory data** for calculating carbon emissions and energy and water consumption 'embedded' in inputs.

When extending your indicator coverage, be sure to record clearly what your boundary is and any related assumptions. Our Web Portal provides more guidance on boundary setting and links to existing tools and conversion tables (**Technical Advice, Indicators**).

Good Practice

## *Modifications in plant reduce resource use significantly*

**Calstone (Scarborough, Ontario, Canada)**

**Sector: Furniture**
**Employees: 28**
**Annual turnover: USD 7 million (2010)**

Calstone is a family-owned business that designs and manufactures metal furniture products. The company discovered that selling more environmentally sustainable furniture products could provide a valuable competitive advantage and could expand its market for conscious consumers. In 2007, it started implementing several measures to reduce the environmental impact of its manufacturing plant.

To reduce harmful emissions, the company introduced a vapour spray system to decrease the chemicals applied to degrease metal components. Chemical use has since been reduced by 60% compared to 2005 levels. A stainless steel water tank of 7 600 litres (2 000 gallons) was installed to reuse water for cooling the equipment and rainwater is collected for flushing all toilets. Water use for cooling has been reduced by 65% and that for toilets has also been cut by 15% compared to 2004 levels. Skylights have been installed in the plant to bring in natural light, which reduces energy requirements and encourages the growth of nearly 100 foliage plants that purify the indoor air.

The company also installed a heat exchanger made from an old car radiator and automatic heat control units, and hung large pieces of polystyrene foam from the plant's ceiling to minimise the amount of air space to be heated and cooled. The company buys 10 megawatt hours (MWh) of electricity per month from a hydro and wind power provider and has installed solar panels on the roof. With all the above resource efficiency measures combined, the company is estimated to have reduced operating costs by USD 20 000 annually.

Furthermore, Calstone launched a remanufacturing programme in 2007 that enables it to take back any of their existing furniture and recycle or remanufacture every component. Their furniture is certified by a third-party body for its low volatile organic compound (VOC) emission, helping improve indoor air quality and employees' health.*

* Environment Canada (2009), Agents of Change website, *www.ec.gc.ca/p2/default.asp?lang=En&n=36EB925F-1*, accessed 17 February 2011 and personal communication with Calstone Inc.

Photos: Calstone Inc.

Good Practice

## *Manufacturing in harmony with nature*

### Sanden Corporation, Akagi Plant (Maebashi, Japan)

**Sector: Electronics**
**Employees: 1 000**
**Annual production output: USD 380 million (FY2009)**

In 2002 Sanden Corporation, an electronics manufacturer, established a complex of manufacturing and forest areas located on a 64 ha tract of land on the southern slopes of Mount Akagi in Gunma prefecture, north of Tokyo. This site was established with the concept to realise "the factory of the 21st century in harmony with nature". Only half of the site has been allocated for the factory area, while the other half comprises a forest (33 ha). The complex currently has facilities for manufacturing vending machines, refrigerated display cases and car air-conditioning compressor components as well as logistics processing centres.

In constructing this complex, Sanden employed large-scale, close-to-nature construction methods to improve the natural environment and ecosystems. For example: biotope ponds were created as reservoirs in the complex; the stones and timbers found in the site were used for its own construction; and the discovered rare species of plants were replanted in ideal locations within the site with appropriate maintenance and care.

These efforts also provided economic benefits of more than USD 6.5 million owing to a reduction in the use of concrete and reduced cost of waste management. The company set a goal to increase the number of species in the local ecosystem to be higher than the level when the construction of the site was started in 1998. In its fourth natural environment survey conducted in 2008, the site's biodiversity had generally recovered and surpassed the levels of 1998. The complex is also used for nature experience educational programmes and more than 5 000 students visit every year. A $CO_2$ absorption of 530 tonnes in the forest area was certified by the prefectural government in 2010.*

* Urban Green Space Development Foundation (2011), Social and Environmental Green Evaluation System (SEGES) website, *http://seges.jp* (Japanese only), accessed 9 March 2011, and personal communication with Sanden Corporation.

Photos: Sanden Corporation

**Good Practice**

### *Plant improvements cope with rising energy price*

**Rapid-Line (Grand Rapids, Michigan, United States)**

**Sector: Metal fabrication**
**Employees: 120**
**Annual turnover: USD 15 million (2010)**

Rapid-Line, a metal fabrication and tooling company, wanted to reduce its energy use. The company had experienced significant increases in its natural gas costs, which more than tripled between 2002 and 2005. At the same time, one of the company's customers encouraged them to get involved in greening their operations.

The company used natural gas throughout their operations for processes such as heating and parts washing, and to fuel its powder coat-curing oven. Following an investigation, it made several improvements:

- Capturing and redirecting excess heat from paint-line ovens back into the plant eliminated the need for furnace heating of the plant in cold weather and increased oven efficiency.
- Installing a system of ceiling fans and baffles increased the heating and cooling efficiency of the building.
- Extra insulation and automated controls boosted the operating efficiency of systems.
- Monitoring the external temperature of curing ovens helped locate and repair heat leaks.

These combined efforts across several areas lowered the company's annual natural gas consumption by 125 000$m^3$ (4 400 mil cubic feet) and allowed cost savings of USD 46 000 a year.*

* Green Suppliers Network, United States (n.d.), Success Stories website, *www.greensuppliers.gov/results/rapid-line.html*, accessed 9 March 2011, and personal communication with Rapid-Line, Inc.

***What's next?***
*We will now examine the environmental impact of the products your facility produces and how you can measure them.*

# Step 5

## *Evaluate your products*

We will turn our attention to the environmental impact of the products produced by your facility. These are the items or goods that you deliver to market and that – in their own right – will have a range of environmental qualities and impact arising from their composition and use.

### *Why is product assessment important to sustainable manufacturing?*

The characteristics of your products are critical to the environmental performance of your business as well as your customers' ability to manage their own environmental impact. A European Union (EU) study shows that private individuals' environmental impact is largely the result of the products they choose to buy. Products from only three areas of consumption – food and drink, private transportation, and housing – are collectively responsible for 70-80% of all individuals' consumption-related impacts.* For many products, their most significant environmental impact relates to how they are used by customers or consumers – for example, their energy and greenhouse gas performance during use, and whether they are reused or recycled.

The quality of your products – often more than anything else – helps to: define the reputation of your business; inspire your employees in their daily activities and decisions; and build and maintain loyal relationships throughout your supply chain and with customers.

While many factors affect the environmental performance of a product, it is the original product design that largely determines performance even before the product leaves the drawing board. Paying attention to environmental issues and opportunities – throughout the design and improvement cycles – brings many benefits, which include:

### Key benefits from greening products

| | |
|---|---|
| **Substitute recycled/renewable materials for non-renewables** | Saves material cost<br>Creates a more attractive product for some buyers |
| **Reduce hazardous substances in products** | Lowers cost of monitoring, treatment and disposal<br>Products seen as safer and more desirable |
| **Improve recyclability or biodegradability of products** | Enhances value of material inputs<br>Reduces cost associated with disposal |
| **Lower product energy requirements** | Reduces cost of use<br>Can improve product desirability<br>Anticipates regulatory requirements and future standards |
| **Improve product durability** | Lessens the need for non-renewable materials<br>Increases product value |

* European Commission, Directorate-General for Environment and Joint Research Centre (2006), *Environmental Impact of Products (EIPRO): Analysis of the life-cycle environmental impacts related to the final consumption of the EU-25*, Summary of the final report, European Commission, Brussels, *http://ec.europa.eu/environment/ipp/pdf/eipro_summary.pdf*, accessed 27 April 2011.

## What are the key environmental performance issues related to products?

Manufacturers may make a single product or hundreds and each one will have its own environmental profile and impact, which can occur long after the product has left the facility where it was made. In some cases, how a customer uses a product – throughout its life – causes the greatest environmental impact and is also the manufacturer's greatest opportunity for green innovation and improvement. The types of environmental issues and opportunities presented by products include their:

### Key environmental issues related to products

| Material composition | Need to be disposed of or recycled | Energy consumption | Ability to help customers |
|---|---|---|---|
| and whether they comprise recycled, renewable or reused materials, or are non-renewable or hazardous | at the end of their useful life | and release of greenhouse gases during use | and consumers to reduce their own environmental impact |

## How can I measure my performance?

We introduce you to seven key indicators that relate to the environmental performance of your products:

- ***Recycled/reused content*** of your products
- ***Recyclability*** of your products
- ***Renewable materials*** used in your products
- ***Non-renewable materials*** used in your products
- ***Restricted substances*** contained in your products
- ***Energy consumption*** in using your products
- ***Greenhouse gas emissions*** from the use of your products

To measure these, you will need to know the proportions of recycled or reused materials, renewable materials and restricted substances used in your products. These might be estimated from the data you gathered in Step 3 (inputs). You should also record the weight of each product and the volume of products you produce. You will also need to estimate how much energy your product requires in a typical year of use. You can then estimate the generation of greenhouse gases from the type of energy typically required in using your products through a conversion table. You may also need to estimate how long your product is expected to remain in use by testing the product or through other means. Visit the Web Portal for more information on how to calculate these indicators (**Indicators**, **Data Tools**, **Technical Advice**). Each basic formula is provided below:

## List of indicators on products

### P1: Recycled/reused content of products

Proportion of products that is recycled or reused

$$\frac{\textit{Weight of recycled and reused content in products}}{\textit{Total weight of products}}$$

### P2: Recyclability of products

Proportion of products that is made up of renewable materials

$$\frac{\textit{Weight of recyclable content in products}}{\textit{Total weight of products}}$$

### P3: Renewable materials content of products

Proportion of products that is made up of renewable materials

$$\frac{\textit{Weight of renewable materials in products}}{\textit{Total weight of products}}$$

### P4: Non-renewable materials intensity over product lifetime

Annual use of non-renewable materials in products

$$\frac{\textit{Weight of non-renewable content in products}}{\textit{Expected lifetime of products}}$$

### P5: Restricted substances content of products

Proportion of products made up of restricted substances

$$\frac{\textit{Weight of restricted substances in products}}{\textit{Total weight of products}}$$

### P6: Intensity of energy consumption of products

Amount of energy the product requires during a typical year's use per unit of output

$$\frac{\textit{(Average annual energy consumption per product x Number produced)}}{\textit{Normalisation factor}}$$

### P7: Intensity of greenhouse gas (GHG) emissions from products

Amount of GHGs generated by a product during a typical year's use per unit of output

$$\frac{\textit{(Average annual GHG emissions per product x Number produced)}}{\textit{Normalisation factor}}$$

**Note:**

As performance improves, the indicator score will rise.

As performance improves, the indicator score will fall.

Some formulae in this table may be presented in a simplified way to ease your understanding – visit the Web Portal for the full details (**Indicators**).

Good Practice

## *Greener products enhance competitiveness*

### PortionPac Chemical Corporation (Chicago, United States)

**Sector: Cleaning chemicals**
**Employees: 84**
**Annual turnover: USD 20 million (2009)**

PortionPac Chemical Corporation is a producer of high-concentrate, pre-measured cleaning and floor finish products for commercial, institutional and public sector use. The company considered the environment and health and safety of sanitary workers to be important when creating the concept of a pre-measured product in 1964. The formulations were made with consideration for the safest components available, but at that time, the company did not talk about the "greenness" of a product but focused on the cost savings of shipping concentrates. In 2005, looking to become more sustainable, the company began work to assess the lifecycle impact of its products and obtained a third-party green certification for all of its floor cleaners, all purpose cleaners, glass cleaners and bowl cleaners. It also updated packaging components to further reduce waste, saving disposal, freight and other costs.



These innovations enabled PortionPac to market the sustainability credentials of its products along with their potential for saving costs. Improvements to the packaging has saved the company USD 40 000 each year through reducing the use of materials. It also found a commercial user for one of the by-products, enabling them to divert waste materials from entering landfills and save the cost of hauling it away. This strategy, in return, has led to expanded sales and helped the company grow during the recession. The increased profitability and reduced costs led to the creation of 15 new jobs. The company received awards for its efforts from the City of Chicago and the State of Illinois.*

* National Institute of Standards and Technology (NIST), United States (n.d.), Hollings Manufacturing Extension Partnership website, *http://blue.nist.gov/ss/7155624E343C8A7E85257244006E9DCF*, accessed 9 March 2011 and personal communication with PortionPac Chemical Corporation.

Photos: PortionPac Chemical Corporation

Good Practice

## *Products that help consumers reduce ecological footprint*

**Henkel (Dusseldorf, Germany)**

**Sector: Household products**
**Employees: 48 000**
**Annual sales: USD 20 billion (2010)**


Henkel, the consumer products manufacturer with global brands including Somat, Right Guard and Pritt, has taken a number of steps to reduce the impact that their products have during use. For example, studies have found that a significant proportion of the lifecycle impact of their products comes from the use of energy required to heat water and run a laundry or dishwasher and the use of water. The company set out to identify opportunities to reduce this impact, which resulted in:

- Products that work at lower temperatures: A new dishwasher detergent effectively cleans and removes stains at temperatures as low as 40 °C (104 °F). Relative to comparable programmes at 50-55°C (122-131°F), consumers can achieve energy savings of 20% on average.
- Overall reduction of the ecological footprint: Some products have an increased consumer benefit due to new formulations and at the same time a reduced ecological footprint. An improved spray valve reduces common spray losses of a deodorant spray by 20%. Optimised production processes and logistics further reduce the footprint.
- High renewable and biodegradable materials: The housing of a correction roller consists almost 90% of plastic made from plants.

These innovations save customers money and reduce the environmental impact of mainstream brands and products, thus attracting a large number of consumers.*


* Henkel AG & Co. KGaA (2011), Sustainability at Henkel website, *www.henkel.com/sustainability,* accessed 9 March 2011 and personal communication with the company.

Photos: Henkel AG & Co. KGaA

***What's next?***

*You have completed the measurement by now. The next step is to show you how you can use the collected information to evaluate your performance.*

You are now well on your way to understanding and realising the benefits of a better environmental performance. The work involved in identifying and tracking indicators will yield significant information that can help to improve your knowledge, strategy and results. The next step is to understand the different ways to review and analyse the information generated by the indicators to identify options for improving the performance of your facility.

## *What are the different ways of using the information that the indicators provide?*

When you have collected data for a period of time – weeks, months or years – you will be able to see where your performance has been consistent over time and also where there may be positive or negative occurrences or trends. You can use this information to improve performance by going through the following five stages:

### Five stages to use indicators for improving performance

1. Evaluate current indicator data to assess opportunities
2. Establish a benchmark
3. Identify and evaluate improvement options
4. Develop scenarios and compare options
5. Determine the best option while taking into account trade-offs

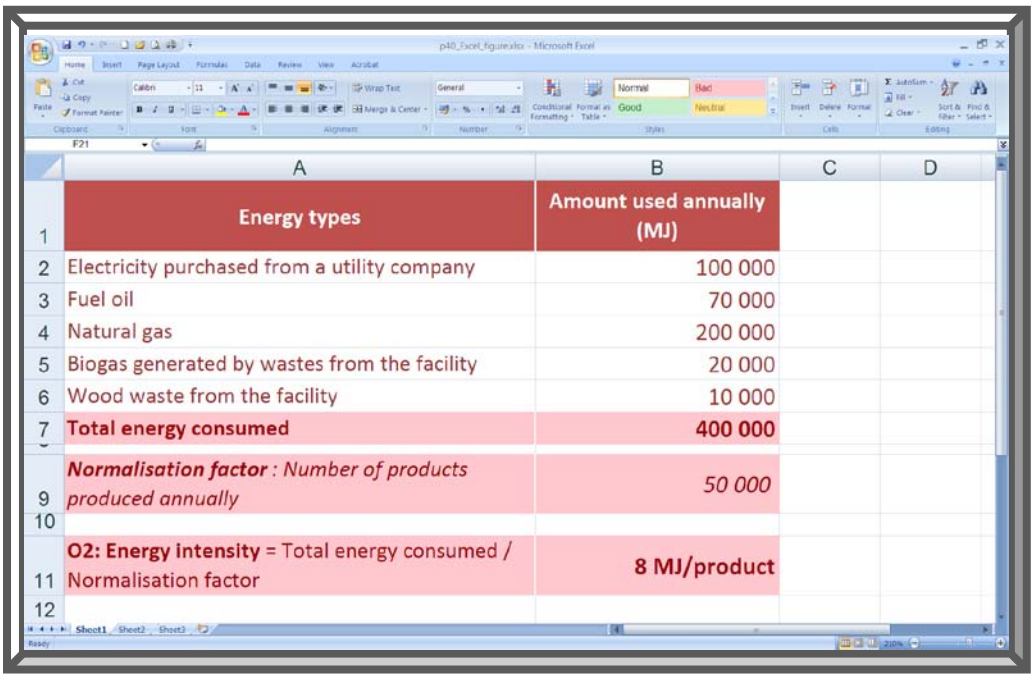
We will now guide you through some simple hypothetical examples of how to do this in practice, using worksheets and tools that are also provided in the Web Portal (**Data Tools, Technical Advice**). Of course, your own data is likely to be quite different from these examples.

## *How can I read my data to identify opportunities?*

### Evaluate indicator data to assess opportunities for improvement

The following worksheet can be used to capture key baseline performance data. In this instance, we are using it to examine hypothetical data on indicator **O2 – Energy intensity** (➲**Step 4**). The worksheet shows that a hypothetical company has a current energy intensity of 8 megajoules (MJ) per product (in this case, the company chose the number of products produced in the facility as the normalisation factor). It also captures important information that will help to identify the biggest opportunities for improvement.

**Example worksheet of a hypothetical company – baseline data for Indicator O2**



| | A | B | C | D |
|---|---|---|---|---|
| 1 | **Energy types** | **Amount used annually (MJ)** | | |
| 2 | Electricity purchased from a utility company | 100 000 | | |
| 3 | Fuel oil | 70 000 | | |
| 4 | Natural gas | 200 000 | | |
| 5 | Biogas generated by wastes from the facility | 20 000 | | |
| 6 | Wood waste from the facility | 10 000 | | |
| 7 | **Total energy consumed** | **400 000** | | |
| 9 | ***Normalisation factor*** *: Number of products produced annually* | *50 000* | | |
| 10 | | | | |
| 11 | **O2: Energy intensity** = Total energy consumed / Normalisation factor | **8 MJ/product** | | |
| 12 | | | | |

In this instance, if you look at the column that displays the amount of energy used, you will see that natural gas, at 200 000 MJ, represents the largest proportion of energy use. This is followed by purchased electricity at 100 000 MJ and fuel oil at 70 000 MJ.

This hypothetical company could consider a number of options for reducing its overall energy intensity, by, for example, improving energy efficiency across the board, or by targeting reductions to one or more particular energy sources, depending on how those energies are used. We'll look at those options in a moment.

## *How do I know if this performance is good or bad?*

### Establish a benchmark to enable comparison over time and against peers

You need to collect data over a period of time to benchmark performance. If our hypothetical company measured its performance against the same baseline data every year, it would eventually be able to assess whether it is getting better or worse over time.

Beyond a single facility, it would also be possible to benchmark and compare performance against other facilities within your business to collectively improve your overall organisational performance. Care needs to be taken to ensure that measurements are conducted in the same way, using the same normalisation factors, in each facility (➲Step 2). You can also monitor and evaluate the performance at the organisational level by aggregating the data from all facilities in your business.

In addition to your own company data, industry peers can also provide valuable insight into good performance and practice. Performance data and statistics can often be sourced from industry or trade associations and some individual competitors may also publicly report their performance on various indicators. Take care, however, to compare like with like – data from external sources may not be exactly the same as your own indicators and in that instance would not provide an appropriate basis for comparison.

In this instance, our hypothetical company might research its industry association and peers, to discover that the sector average per-product energy intensity is about 20% less than its own current usage. This information will help the company appreciate that it is both possible and necessary to improve performance and that it may be able to learn how to do this from more experienced peers.

Once you have gathered baseline performance data, the same basic evaluation and benchmarking can be done for all calculated indicators.

## *What happens after I've looked at all my calculated indicators?*

### Identify options for improvement and assess feasibility

Once you have a sense of how to improve your operations, you can start to investigate the various options and their feasibility. Returning to our hypothetical company and the opportunity for decreasing energy intensity, the following table provides a checklist of considerations that could help in decision-making. The checklist highlights the various risks and benefits of instigating a change. You can undertake this exercise formally or on a simple flipchart.

**Model checklist for identifying improvement options**

| Consideration for options | Feasibility |
|---|---|
| **What do we use the different energy sources for? Could we significantly reduce or eliminate any one of them?** | ✓ ***Yes*** *– Fuel oil is used exclusively for backup generators. If our aging refrigeration equipment were replaced, we wouldn't need to use backup generators as frequently. This would enable us to achieve a radical reduction in the use of fuel oil.* |
| **Are there options for us to reduce our energy requirements across the board?** | ✓ ***Yes*** *– We could increase our building insulation, improve ventilation and install more skylights to save the energy needed for heating, cooling and lighting.* |

*How would the proposed changes affect our business success drivers?*

*You can look at factors such as:*

- ✓ Price
- ✓ Quality
- ✓ Reliability of supply
- ✓ Performance
- ✓ Production equipment
- ✓ Production processes
- ✓ Employee skills
- ✓ Time to market
- ✓ Customer expectations
- ✓ Reputation
- ✓ Sales
- ✓ Profits

*We would require capital expenditure to reduce our reliance on backup generators.*

*We would also require capital expenditure to improve insulation, ventilation and skylights.*

*Our operating costs would become significantly lower.*

*Our operations would be more reliable if we did not need to generate backup power periodically.*

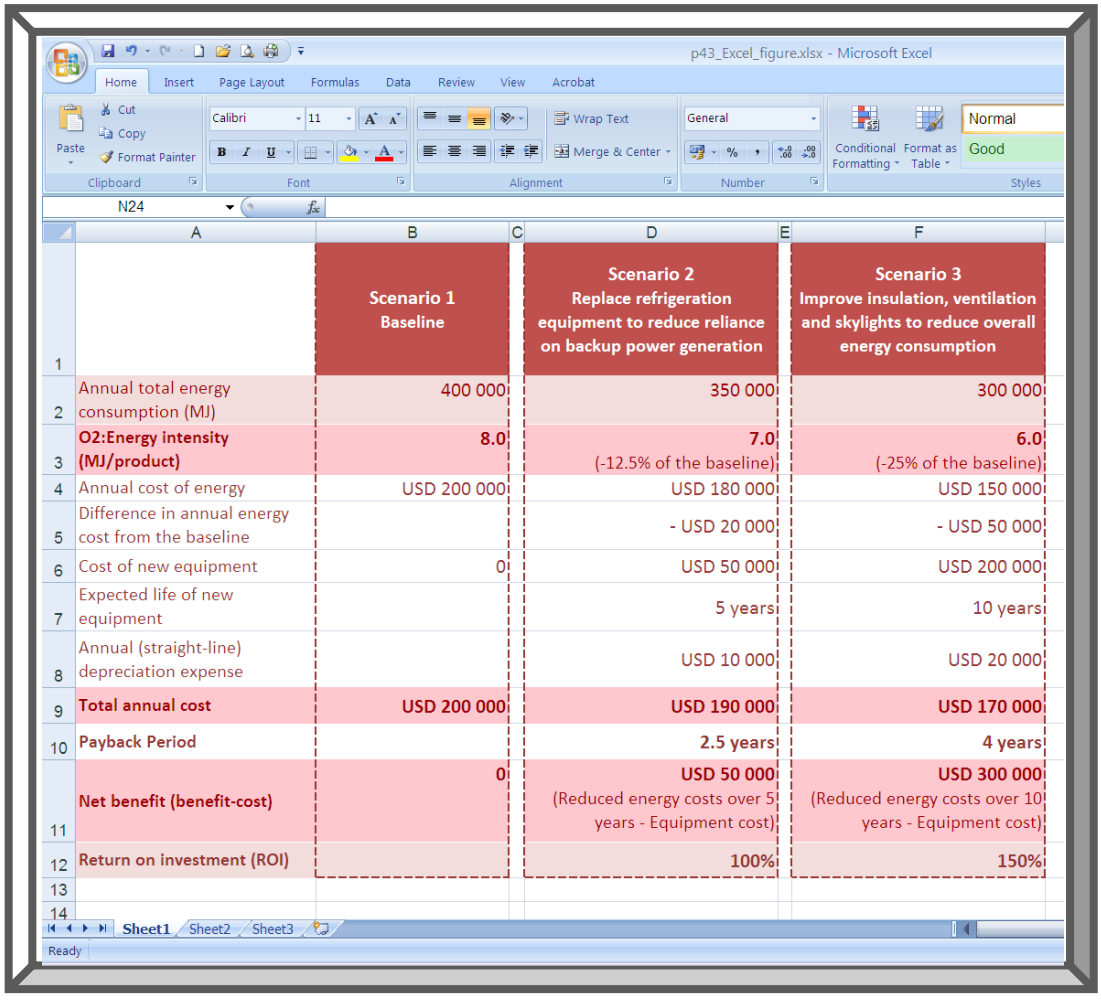
*We would contribute to our customers' environmental improvements, for example one major retailer's strategic plan to reduce environmental impact from supply chain. This would help secure long-term contracts with them.*

## *What if there are several options for improving performance?*

### Compare the options by developing scenarios

Based on the options examined by the exercise above, you can draw several scenarios for environmental improvement in order to compare how the changes would affect your business (**Technical Advice**). A simple worksheet helps to capture the various cost and benefits of pursuing one approach over another. In the following example, our hypothetical company is using the worksheet to weigh up the financial considerations that will influence its decision on whether or not to change its current baseline. The worksheet is not limited to financial data but can also be used to compare environmental and reputation cost and benefits, as well as related intangibles such as brand and employee morale.

#### Sample worksheet for comparing scenarios




| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | | **Scenario 1 Baseline** | | **Scenario 2 Replace refrigeration equipment to reduce reliance on backup power generation** | | **Scenario 3 Improve insulation, ventilation and skylights to reduce overall energy consumption** |
| 2 | Annual total energy consumption (MJ) | 400 000 | | 350 000 | | 300 000 |
| 3 | **O2:Energy intensity (MJ/product)** | **8.0** | | **7.0** (-12.5% of the baseline) | | **6.0** (-25% of the baseline) |
| 4 | Annual cost of energy | USD 200 000 | | USD 180 000 | | USD 150 000 |
| 5 | Difference in annual energy cost from the baseline | | | - USD 20 000 | | - USD 50 000 |
| 6 | Cost of new equipment | 0 | | USD 50 000 | | USD 200 000 |
| 7 | Expected life of new equipment | | | 5 years | | 10 years |
| 8 | Annual (straight-line) depreciation expense | | | USD 10 000 | | USD 20 000 |
| 9 | **Total annual cost** | **USD 200 000** | | **USD 190 000** | | **USD 170 000** |
| 10 | **Payback Period** | | | **2.5 years** | | **4 years** |
| 11 | **Net benefit (benefit-cost)** | **0** | | **USD 50 000** (Reduced energy costs over 5 years - Equipment cost) | | **USD 300 000** (Reduced energy costs over 10 years - Equipment cost) |
| 12 | **Return on investment (ROI)** | | | **100%** | | **150%** |
| 13 | | | | | | |
| 14 | | | | | | |

The scenarios above show that there are different opportunities to reduce energy intensity, each with different benefits. In Scenarios 2 and 3, it is possible to save both energy and money although there are up-front costs.

## *Could some options for improvement be detrimental to performance in certain areas?*

### Determine the best option while taking trade-offs into account

Some improvements may have a negative impact elsewhere and it is important to be aware of "trade-offs". For instance, our hypothetical company has discovered that it is possible to save money and energy in Scenario 2; the saving is relatively modest, but the investment pays for itself in a few years. In Scenario 3, on the other hand, the up-front costs are larger, require longer to be paid off through savings but the potential savings and financial benefits are much greater. The company may also find that, for example, in Scenario 2, the reduced reliance on backup power generators makes the company more dependent on purchased electricity and this may have implications for running costs as well as reliability of supply. As such trade-offs are identified, it is important to include these in your scenario comparison so as to balance your decision-making. Ultimately, the best choice will be determined by the factors that are most important to your business.

If it is difficult to make a decision about the various options and their consequences, it is often helpful to consult stakeholders who might be affected – suppliers, employees, local communities, regulators, customers, investors and others – to share thinking and understand the outcomes that would be most acceptable. For example, the hypothetical company could consider: enlisting the help of a specialised energy saving company or of manufacturers of refrigeration equipment to find the best solution; consulting employees before introducing skylights and reducing the use of air-conditioning and lighting; or talking with lenders about the terms for financing new equipment. Involving stakeholders can even help you identify options that you may not have considered and provide you with information on how goals and timelines are established (**Technical Advice**).



***What's next?***

*The final step will look at how you can set your improvement goals and put them into action.*

Your efforts should be starting to pay off now. In the previous step, you have established your baseline performance on selected indicators. You have reviewed the data and taken decisions on options for improving performance. Now, you need to make your decisions happen – by setting clear targets and creating a tangible action plan.

## *How do I specify what we are aiming for?*

### Define your performance improvement targets

Setting a target is essential to drive progress and demonstrate a credible commitment to others, both your colleagues and external audiences. It can also be very motivating to achieve agreed targets and desired results. Having conducted the exercises in Step 6 for each of your selected indicators, you can now set a range of targets to improve your particular performance year on year or to accelerate your efforts and set a new best practice benchmark.

You can set targets in a way that enables you to achieve the best improvement identified for each indicator that you have selected and measured for your facility. You can record your targets in a simple format, such as the table below, which uses the hypothetical example from the previous step:

**Example of target setting for improving performance**

| Indicator | Insights | Targets |
|---|---|---|
| **I3. Recycled/reused content of material inputs** | *Our use of recycled materials lags behind the industry average by a large distance. Retailers and consumers are increasingly demanding information on the source and environmental quality of materials.* | Increase use of recycled materials over three years by changing suppliers:<br>• Year 1: To 20%.<br>• Year 2: To 30% (industry average).<br>• Year 3: To 40% (the best possible option considering the current recycling rate). |
| **O2. Energy intensity** | *Our energy use in factories is quite significant and can be radically reduced across the board by retrofitting the buildings.* | Reduce energy intensity by 25% in three years (based on Scenario 3 in Step 6) by following measures:<br>• Year 1: Install a new ventilation system to reduce energy use for air-conditioning.<br>• Year 2: Install skylights to reduce the need for lighting.<br>• Year 3: Work on improving insulation of all buildings to reduce the need for air-conditioning. |
| **P5. Restricted substances content of products** | *About 20% of the total weight of our products is made up of restricted substances. New legislation to ban the use of those substances is likely to be introduced in the near future.* | Achieve the complete removal of restricted substances from our products within five years by the following measures:<br>• Increase use of alternative non-toxic materials in production processes by 20% annually.<br>• Develop a new range of non-toxic products by the end of Year 2.<br>• Gradually reduce production of the current product range from Year 3. |

It is not unusual for targets to involve product design changes or adjustments to existing processes to reduce impact. Targets should also ideally include a timeline for their achievement.

## What if my targets turn out to be unrealistic or something changes along the way?

The improvement options you judged to be the best and the targets you subsequently set sometimes prove problematic to achieve in practice. If this happens for any reason, then it can also be regarded as a unique learning opportunity to refine your options and reappraise the best way forward.

## What does a "way forward" look like?

### Create your action plans

An action plan is a simple and invaluable tool for delivering on the set targets by carefully identifying the work activities, rationale, responsibilities and timelines for moving along a vital path towards improvement. A spreadsheet can be a useful way to manage and share an action plan with colleagues. The following is an example of the plan for the hypothetical company for improving energy intensity by retrofitting buildings.

**Sample action plan for improving performance**

| Action and purpose | Responsibility | Deadline |
|---|---|---|
| Complete cost analysis and ensure financing for retrofitting projects. | Finance Department | 2 weeks |
| Deliver internal assessment and recommendations on how the introduction of the new ventilation system and skylights may affect the manufacturing process and employees and related solutions. | Facility officers | 1 month |
| Brief management team on options and next steps. | Head of Facility | End of month |
| Draw up contracts with the supplier of the new ventilation system and the installers and develop working plan for transition. | Facility officers | 1st quarter |
| Install the ventilation system. | Facility officers | 2nd quarter |
| Review and evaluate successes and challenges in consultation with factory workers. | Facility officers, Sustainability Team | 3rd quarter |
| Adjust schedules and next steps in accordance with initial experience. | Sustainability Team | 4th quarter |

You will probably need an action plan for each of your key indicators to help your team appraise the many opportunities that arise across your various goals as you progress in your journey of continuous environmental improvement.

## *If I do all of this, will my performance improve?*

Your targets and action plan are invaluable tools to identify what you need to do, how and when. But it's up to you to take action and to make the most of the opportunities!

***Congratulations** on taking the initial steps*
*on your journey towards*
*a more sustainable – and better performing – business!*

***What's next?***

*As you improve your performance, you might want to consider going beyond the indicators in this Toolkit. We will introduce other opportunities for action in the next section.*

# Pass the baton

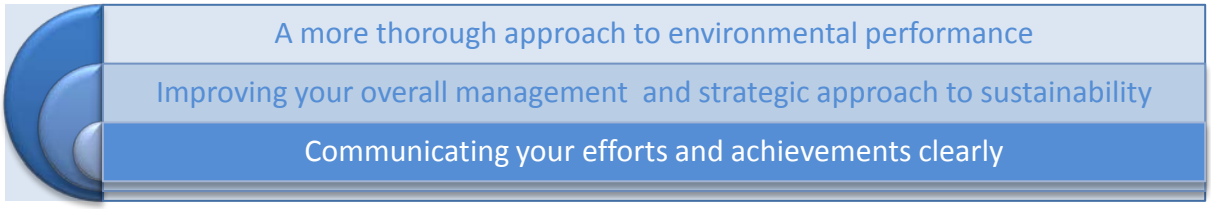
## *Go beyond measurement*

Your journey towards sustainable manufacturing may only just be starting and your first set of indicators may prove a real challenge to assemble and learn from but you can benefit a lot as you progress. The rewards will certainly be worth the effort. We hope you find much to challenge and reward you in this Start-up Guide and the Web Portal. Once you are more familiar with sustainable manufacturing and tracking your performance indicators, you might want to expand your knowledge and benefit even further from improved sustainability performance.

***Is there more to go?***

There are several significant areas not covered in this Guide that you might find of value to explore further when you are ready.

You could consider:




## Go further to improve environmental performance

While the 18 indicators in this Toolkit are a great place to start, they are not exhaustive. To address your environmental impact more thoroughly, you could:

***Expand your performance indicators*:** As you develop, you might find that your impact and business value drivers relate to areas not addressed in this Toolkit. Keep making the most of your regular reviews of priority issues (➲**Step 1**) to identify these new areas and seek out other tools and expertise where you need them. The **International Organization for Standardization (ISO) 14031** standard gives general guidance on the design and use of environmental performance evaluation and on identification and selection of environmental performance indicators.

***Consider the whole lifecycle of your products*:** There are many methodologies available that take into account the total lifecycle impact of products from "cradle to grave", including raw materials sourcing, refining, manufacturing, distribution, use and reuse/recycling/disposal. Although highly technical in data analysis and calculation, they enable you to compare similar products on the basis of their full impact and can help you design products with consideration for environment, cost and value from a very early stage of development. The most widely recognised is **lifecycle assessment (LCA),** which is standardised internationally as the **ISO 14040 series**, but other related concepts and methods are also increasingly being adopted by many companies.

***Use external standards for environmental performance*:** A wide range of **product eco-labels and certification schemes** exist and can provide good motivation to comprehensively improve your environmental performance. These labels set clear standards for performance in different environmental aspects and they may be developed by governments, industry groups or non-governmental organisations (NGOs). Attaining the standards set by such labels can give customers particular confidence in the environmental credentials of your products. The **ISO 14020 series** gives specific guidance on how environmental claims should be made and communicated.

## Improve the way your management and strategy deal with sustainability issues

Environmental and social issues relate to many different internal management functions and if you are prepared to address them you can decrease risks as well as improve performance. You might do this through efforts to:

***Manage and improve performance systematically*:** An **environmental management system (EMS)** can help you manage and improve environmental performance systematically and can demonstrate commitment and professionalism with respect to sustainable manufacturing. It is a comprehensive approach to organisational structure, planning and resources aimed at developing, implementing and maintaining policies for achieving your environmental goals. Using an EMS can ensure continuous improvement using the "Plan, Do, Check, Act" cycle. The most commonly used frameworks are the **ISO 14001** standard and the European Union's **Eco-Management and Audit Scheme (EMAS)**.

***Address the social and economic impact*:** Sustainable manufacturing is about more than improving environmental performance and while many companies begin with environmental aspects the social and economic dimensions are just as important. These might include: workplace quality issues; human rights; ethics; anti-corruption; and customer satisfaction. The economic aspect may go beyond the familiar financial issues to encompass your wider effects on the economy, such as job creation, tax payment and local development (➲**On your marks**). In many respects, common standards are still emerging, though major strides have been made through the efforts of a variety of organisations, including the **ISO 26000** social responsibility standard, the **OECD Guidelines for Multinational Enterprises** and the **United Nations Environment Programme (UNEP) Guidelines for Social Life Cycle Assessment of Products**.

***Consider a comprehensive sustainability strategy*:** As you start to understand your environmental performance, you will begin to see how sustainability issues can affect: the markets in which you operate; your competitive environment; the ever-changing regulatory framework; and the expectations of your customers. You can use these perspectives to set goals and plans for the future of your business and your sustainability impact. Numerous tools and initiatives exist to help you in this respect. You could consult the **UN Global Compact** and the ISO 26000 standard as well as your local responsible business organisations or initiatives

## Communicate your performance to stakeholders

Different types of stakeholders have an interest in better understanding your environmental or sustainability performance. To meet these needs and to benefit from an increased understanding from your stakeholders, you could:

***Report emissions according to national registries*:** All OECD countries and several non-OECD countries introduced or have been introducing a **Pollutant Release and Transfer Register (PRTR)** scheme to quantify emissions of hazardous chemical substances and pollutants to the environment. A PRTR is a national or regional database of emissions based on reports provided by each facility to authorities. PRTR data collected by the authorities are made available to the public to support risk management of relevant stakeholders. As PRTR schemes vary in terms of the types of businesses that have to report and substances to be reported, it is important to check whether you should report under the PRTR scheme in your country or region. If you do have to report you must comply with the relevant scheme. Even if you do not have to report, you should follow the requirements and technical guidance to better understand the pollutants that you discharge into the environment. Some data items to be collected for calculating this Toolkit's indicators are compatible with PRTR schemes and can be used for this purpose

***Publish a sustainability report***: There is a well-established trend towards external environmental or sustainability reporting in many countries and sectors, involving companies of all sizes. Whether on paper or on the Internet, reporting on your strategy, risks, opportunities and performance arising from environmental, social and economic issues can help: improve your strategic approach; provide management benefits; involve your employees; and provide valuable insight for investors, customers and other key stakeholders. You can also use reports prepared by your suppliers and customers to understand their approach and expectations and to obtain data for the calculation of your own indicators. Leading accountancy bodies, governments and institutional investors are calling for sustainability reporting to be integrated within financial annual reporting so as to provide more comprehensive and useful information for markets. The **Global Reporting Initiative (GRI) Sustainability Reporting Guidelines**, which provide tools to prepare sustainability reports, are emerging as an international standard.

### *Are there any tools in my country or sector that I could benefit from?*

Sustainable manufacturing is of great interest to many sectors in many regions and there are a wealth of tools and initiatives to help you get started and continue your journey. There are tools, websites, helplines and networks to support sustainability efforts in many local languages. There are also sector-specific guidelines, standards, performance benchmarks, case studies and awards programmes. Our Web Portal provides a full list of tools and detailed information to help you as outlined on the next page (**Beyond Measurement**).*

* Please note that the links to the other tools listed in this Guide and the Web Portal are meant to encourage further learning and action and do not indicate an official approval of the listed initiatives by the OECD in any way.

**Visit** → ***www.oecd.org/innovation/green/toolkit***

This Start-up Guide is accompanied by a more detailed and searchable **Web Portal**, designed to enhance your learning and practical implementation of sustainable manufacturing.

Here is an overview of what you can find there.

### About

presents the definition of sustainable manufacturing and lists existing evidence of business benefits, as well as explains the objectives and outline of this Toolkit.

### Technical Advice

offers other relevant guidance to use indicators effectively, including facility mapping, boundaries, normalisation, data interpretation and scenario comparison.

### Essential Data

provides the definitions and guidance on 54 data items needed to calculate indicators.

### Glossary

explains the keywords used in the Toolkit.

### Action Steps

explains seven steps to enable you to measure your environmental performance with links to detailed guidance not covered in this Guide.

### Good Practices

showcases sustainable manufacturing practices from different countries to provide concrete ideas for improving and encouraging actions.

### Beyond Measurement

provides useful links to other sustainable manufacturing related tools and initiatives that may help you go beyond measuring OECD indicators and obtain guidance and advice that is more specific and relevant to your business.

### Indicators

provides detailed explanations and notes, calculation methods and advice on interpretation of 18 OECD Sustainable Manufacturing Indicators.

### Data Tools

provides model worksheets for data collection and links to existing data conversion tables that help calculate some indicators.

## We'd love to hear from you!

The OECD welcomes your feedback on this Toolkit's content and usability as well as any additional tools, issues and links that you would like to see addressed in the future. Share your comments and thoughts with us through the Web Portal (**Contact Us & Feedback**).

# List of data to calculate the OECD Sustainable Manufacturing Indicators

● … indicates data items that are essential to calculate indicators.
○ … indicates data items that are optional to include in the calculation of indicators.
In addition to those data items, you need normalisation factor(s) of your choice to calculate intensity indicators (➲Step 2 ☜Technical Advice).
For details on data items and calculation of indicators, visit the Web Portal (☜Essential Data, Indicators)

| Data items | OECD Sustainable Manufacturing Indicators | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Non-renewable materials intensity | Restricted substances intensity | Recycled/reused content of input materials | Water intensity | Energy intensity | Renewable proportion of energy | GHG intensity | Residuals intensity (mass balance approach) | Residuals intensity (waste output approach) | Intensity of residual releases into air | Intensity of residual releases into water | Proportion of natural land | Recycled/reused content of products | Recyclability of products | Renewable materials content of products | Non-renewable materials intensity of products | Restricted substances content of products | Product energy consumption intensity | Product GHG emissions intensity |
| | I1 | I2 | I3 | O1 | O2 | O3 | O4 | O5a | O5b | O6 | O7 | O8 | P1 | P2 | P3 | P4 | P5 | P6 | P7 |
| **Materials (to be collected for each input material)** | | | | | | | | | | | | | | | | | | | |
| Units of materials consumed | ● | ● | ● | ○ | ○ | | ○ | ● | | | | | | | | | | | |
| Weight per unit | ● | ● | ● | ○ | ○ | | | ● | | | | | | | | | | | |
| Proportion of non-renewable content (%) | ● | | | | | | | | | | | | | | | | | | |
| Proportion of restricted substances contained (%) | | ● | | | | | | | | | | | | | | | | | |
| Proportion of recycled content (%) | | | ● | | | | | | | | | | | | | | | | |
| Proportion of reused content (%) | | | ● | | | | | | | | | | | | | | | | |
| GHGs ($CO_2$ equivalent) released per unit of material during its production | | | | | | | ○ | | | | | | | | | | | | |
| **Water** | | | | | | | | | | | | | | | | | | | |
| Units of water consumed in production process | | | | ● | | | | | | | | | | | | | | | |
| Units of water consumed in overhead | | | | ● | | | | | | | | | | | | | | | |
| Factor to calculate water consumed during the production of materials | | | | ○ | | | | | | | | | | | | | | | |
| **Energy (to be collected for each type of energy source)** | | | | | | | | | | | | | | | | | | | |
| Units of energy consumed in production process | | | | | ● | ● | ● | ● | ● | | | | | | | | | | |
| Units of energy consumed in overhead | | | | | ● | ● | ● | ● | ○ | | | | | | | | | | |
| Proportion of renewable content | | | | | | ● | | | | | | | | | | | | | |
| Energy content (MJ) per unit [look-up value] | | | | | ● | ● | | | | | | | | | | | | | |
| GHG emissions ($CO_2e$) per unit [look-up value] | | | | | | | ● | | ● | | | | | | | | | | |
| Weight per unit [look-up value] | | | | | | | | ● | | | | | | | | | | | |
| Factor to calculate energy consumed during the production of materials [look-up value] | | | | | ○ | | | | | | | | | | | | | | |
| **Infrastructure** | | | | | | | | | | | | | | | | | | | |
| Facility land area | | | | | | | | | | | | ● | | | | | | | |
| Natural land cover area | | | | | | | | | | | | ● | | | | | | | |
| **Travel and logistics (to be collected for each mode)** | | | | | | | | | | | | | | | | | | | |
| Distance travelled by all employees for business purposes | | | | | | | ● | | | | | | | | | | | | |
| Distance of transporting input materials from suppliers to the facility | | | | | | | ○ | | | | | | | | | | | | |
| Distance of transporting products from the facility to the purchasers | | | | | | | ○ | | | | | | | | | | | | |
| Distance travelled by all employees for commuting | | | | | | | ○ | | | | | | | | | | | | |
| GHG emissions ($CO_2e$) per distance [look-up value] | | | | | | | ● | | | | | | | | | | | | |

| Data items | OECD Sustainable Manufacturing Indicators | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Non-renewable materials intensity | Restricted substances intensity | Recycled/reused content of input materials | Water intensity | Energy intensity | Renewable proportion of energy | GHG intensity | Residuals intensity (mass balance approach) | Residuals intensity (waste output approach) | Intensity of residual releases into air | Intensity of residual releases into water | Proportion of natural land | Recycled/reused content of products | Recyclability of products | Renewable materials content of products | Non-renewable materials intensity of products | Restricted substances content of products | Product energy consumption intensity | Product GHG emissions intensity |
| | I1 | I2 | I3 | O1 | O2 | O3 | O4 | O5a | O5b | O6 | O7 | O8 | P1 | P2 | P3 | P4 | P5 | P6 | P7 |
| **Releases** | | | | | | | | | | | | | | | | | | | |
| Weight of releases into air from production process | | | | | | | | | ● | ● | | | | | | | | | |
| Weights of releases into air from overhead | | | | | | | | | ○ | ○ | | | | | | | | | |
| Weight of releases into surface water from production process | | | | | | | | | ● | | ● | | | | | | | | |
| Weight of releases into surface water from overhead | | | | | | | | | ○ | | ○ | | | | | | | | |
| Weight of releases into land from production process | | | | | | | | | ● | | | | | | | | | | |
| Weight of releases into land from overhead | | | | | | | | | ○ | | | | | | | | | | |
| Weight of releases into landfills from production process | | | | | | | | | ● | | | | | | | | | | |
| Weight of releases into landfills from overhead | | | | | | | | | ○ | | | | | | | | | | |
| Weight of transfers into disposal from production process | | | | | | | | | ● | | | | | | | | | | |
| Weight of transfers to disposal from overhead | | | | | | | | | ○ | | | | | | | | | | |
| Weight of transfers for treatment from production process | | | | | | | | | ● | | | | | | | | | | |
| Weight of transfers for treatment from overhead | | | | | | | | | ○ | | | | | | | | | | |
| Weight of transfers to recycling from production process | | | | | | | | | ● | | | | | | | | | | |
| Weight of transfers to recycling from overhead | | | | | | | | | ○ | | | | | | | | | | |
| Weight of transfers for energy recovery from production process | | | | | | | | | ● | | | | | | | | | | |
| Weight of transfers for energy recovery from overhead | | | | | | | | | ○ | | | | | | | | | | |
| Weight of transfers to sewage from production process | | | | | | | | | ● | | | | | | | | | | |
| Weight of transfers to sewage from overhead | | | | | | | | | ○ | | | | | | | | | | |
| Weight of additional GHG emissions released from production process | | | | | | | ● | | ● | | | | | | | | | | |
| Weight of additional GHG emissions released from overhead | | | | | | | ○ | | ○ | | | | | | | | | | |
| **Products (to be collected for each product)** | | | | | | | | | | | | | | | | | | | |
| Average product weight | | | | | | | | ● | | | | | ● | ● | ● | ● | ● | | |
| Number of products produced | | | | | | | | ● | | | | | ● | ● | ● | ● | ● | ● | ● |
| Proportion of recycled materials in product (%) | | | | | | | | | | | | | ● | | | | | | |
| Proportion of reused materials in product (%) | | | | | | | | | | | | | ● | | | | | | |
| Proportion of recyclable content in product (%) | | | | | | | | | | | | | | ● | | | | | |
| Proportion of renewable materials of product (%) | | | | | | | | | | | | | | | ● | ● | | | |
| Proportion of restricted substances in product (%) | | | | | | | | | | | | | | | | | ● | | |
| Average annual energy consumption (MJ) per product | | | | | | | | | | | | | | | | | | ● | |
| Average annual GHG production ($CO_2e$) per product | | | | | | | | | | | | | | | | | | | ● |
| Expected lifetime of product | | | | | | | | | | | | | | | | ● | | | |

# *OECD Sustainable Manufacturing Toolkit*

## Start-up Guide: Seven steps to environmental excellence

Environmentally sound and socially responsible business practices can no longer be limited to pioneering companies if we want to push our current resource-intensive economy along a path towards green growth. Despite the need for more environmentally sustainable businesses in the ever globalising market, many supply chain firms and small and medium-sized enterprises (SMEs) still lag behind and are missing out on win-win opportunities that will make them more sustainable, profitable and competitive at the same time.

The ***OECD Sustainable Manufacturing Toolkit*** provides a unique, practical starting point for businesses around the world to improve the environmental efficiency of their production processes and products. It provides a set of internationally applicable, common and comparable indicators to measure the environmental performance of any manufacturing facility. The ***Toolkit*** consists of two parts – the ***Start-up Guide,*** which provides a step-by-step approach to measuring and benchmarking environmental performance, and the ***Web Portal,*** which supplements the former with more technical guidance, data tools and useful links: ***www.oecd.org/innovation/green/toolkit***.



This project was developed by the OECD Directorate for Science, Technology and Industry (DSTI) under the auspices of the Committee on Industry, Innovation and Entrepreneurship (CIIE).

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**This Toolkit is a contribution to the OECD Green Growth Strategy**

The ***OECD Sustainable Manufacturing Toolkit*** aims to contribute to the implementation of the **OECD Green Growth Strategy**, which was launched in May 2011 to provide a practical policy package for governments to stimulate economic growth while preventing environmental degradation, biodiversity loss and unsustainable natural resource use. For more about the Strategy, visit ***www.oecd.org/greengrowth***.