



# measuring and valuing environmental impacts

An Introductory Guide



Network for  
Business Sustainability

Business. Thinking. Ahead.

nbs.net

Prepared by NBS



Humans caused  
\$6.6 trillion in  
environmental  
damage in 2008.<sup>1</sup>

<sup>1</sup> Source: Trucost. 2011. Universal Ownership: Why Environmental Externalities Matter to Institutional Investors. Commissioned by UN Principles for Responsible Investment (PRI) and UNEP Finance Initiative.

But it's hard to manage what you can't measure. How can you measure and value your organization's environmental impacts?

# measuring and valuing environmental impacts

## An Introductory Guide

This report is designed to help senior executives and decision-makers new to sustainability navigate the strategic decision-making process for managing their firm's environmental impacts. It presents a high-level guide and suggests tools and additional resources for measuring and valuing environmental impacts.

The report is an extension of the Network for Business Sustainability's systematic review of the body of research on measuring and valuing environmental impacts. Synthesizing data from 180 studies, the review presents the most comprehensive compilation of high-quality knowledge on this topic to date.

Further resources available at [nbs.net](http://nbs.net)

# why should your company consider its environmental impacts?

There are numerous reasons for monitoring how your business affects the natural environment and vice versa. Five key reasons for tracking—and improving—your business' impacts are:

- 1. Reduce costs:** Businesses that have invested in environmental improvements deliver cost savings through efficiency and innovation in products and processes. Further, they may have access to cheaper capital since markets perceive them as less risky: research in the *Strategic Management Journal* shows that firms managing their environmental risks reduce their weighted average cost of capital.
- 2. Respond to investor demands:** Investors are closely monitoring firm environmental performance, aware that the firms that understand and manage their environmental impacts are best positioned to benefit from strategic opportunities. For instance, more than 3,000 organizations in 60 countries voluntarily disclose their carbon emissions and climate strategies by participating in the Carbon Disclosure Project, a consortium of 534 institutional investors holding \$64 trillion in assets. This information helps investors make better decisions and recognize companies with stronger environmental performance.
- 3. Facilitate regulatory approvals and mitigate operational risk:** Negative environmental impacts can lead to delayed project financing and regulatory approvals—at significant cost to the organization. As new environmental issues come to the fore, regulators are exploring options for controlling impacts on air and water. For example, in 2009 the U.S. Environmental Protection Agency listed carbon dioxide as a danger to human health, paving the way for additional regulation. When new regulations are introduced, lagging firms face substantial costs to catch up, and may be handed fines and penalties.

- 4. Hire the best employees:** Research published in the Harvard Business Review in 2009 found that 75 percent of U.S. workforce entrants see social responsibility and environmental commitment as important criteria in selecting employers. To attract employees, words aren't enough. Firms need to provide credible data on their environmental impacts.
- 5. Meet customer demand for “green”:** Environmental marketer Terrachoice found a 79 percent increase in green consumer products from 2009 to 2010. Consumers will pay more for responsibly produced goods in some circumstances. More importantly, research in the MIT Sloan Management Review indicates your firm may be held to task if customers perceive its actions as unsustainable.

## Environmental Impacts

We use the term “environmental impacts” to refer to the ways in which humans or businesses impact living things and the natural environment, as well as the services provided by living things and the natural environment.

# how to measure and value your organization's environmental impacts

## Step 1. Define Success

Measuring your environmental impacts is a means to an end—providing you a tool to help gauge progress towards your goals. So before measuring anything, define success. What **goals** do you want to achieve? How can your long-term goals be broken into interim **targets**? For instance, progress towards a goal of carbon neutrality might involve reducing carbon emissions by 10 percent in the first year.

Every organization faces different pressures. The cases below illustrate some scenarios that could motivate a company to set environmental goals.

	Pressures	Goals
Scenario 1	The government is imposing stringent (and changing) environmental regulations of specific toxins	<ul style="list-style-type: none"><li>• Ensure rapid regulatory approvals and project financing</li><li>• Avoid fines and media scrutiny</li><li>• Position the firm to stay ahead of potential future regulations</li></ul>
Scenario 2	Community groups are increasingly preoccupied by water availability and quality	<ul style="list-style-type: none"><li>• Ensure rapid regulatory approvals (requiring community support)</li><li>• Avoid adverse media coverage and maintain open communication channels with stakeholders</li><li>• Gather "outside-the-box ideas" on how to increase water efficiency</li></ul>
Scenario 3	The Board of Directors expects monitoring of the firm's environmental performance trends and associated risks and opportunities	<ul style="list-style-type: none"><li>• Identify areas of greatest financial, operational and reputation risk</li><li>• Define areas of possible improvement and opportunities for future competitive advantage</li></ul>

Stakeholders are often the source of pressure to measure environmental impacts. Thus, stakeholders should be engaged in the decision of what to measure and why. This stakeholder engagement process should be conducted with buy-in from senior executives and the involvement of the individuals who will ultimately implement the decisions. (Read the NBS framework for stakeholder engagement: [nbs.net/knowledge/stakeholder-engagement/primer](http://nbs.net/knowledge/stakeholder-engagement/primer))



## CASE STUDY 1



# Setting Environmental Goals: Suncor Energy Inc.

Suncor, an integrated energy company, has been tracking and reporting its impacts on water, land, and its emissions and energy use since 1995. As a next step in moving beyond compliance and meeting stakeholders' evolving expectations, Suncor set four environmental performance goals in 2009:

1. Reduce water intake by 12 percent by 2015
2. Increase land area reclaimed by 100 percent by 2015
3. Improve energy efficiency by 10 percent by 2015
4. Reduce current air emissions by 10 percent by 2015

In setting those goals, they needed somewhere to start. The goals were developed by a team from the Suncor's sustainability group and tested with employees and management. "Setting goals isn't a perfect science," says Peter MacConnachie, senior sustainability issues management specialist. "The right goals force the organization to stretch, but aren't so unachievable that people don't buy in."

One of Suncor's goals involves land reclamation. Suncor has been operating the oil sands mine since 1967. As of the end of 2010, its percentage of land

reclaimed was about 6.5 percent. The company developed the goal to increase the land area reclaimed by 100 percent by 2015. Suncor will provide a progress update on the four goals in the 2011 Report on Sustainability, which will be released in July 2011.

Moving from strictly financial goals to environmental ones was a challenge. Says MacConnachie: "We were under pressure to create non-financial goals, which has been a huge step because there are new rules and a new vocabulary. Our team now has to be as comfortable talking about water consumption as earnings per share."

Suncor's merger with Petro-Canada in 2009 posed another challenge—how to apply the environmental goals to the newly acquired operated assets. In the end, the goals were applicable to all operated assets. "It worked because our goals have been formalized and are part of the long-range planning process," MacConnachie states. "Now when we compare capital investments in any area of the organization, considerations such as water and energy use influence the decision."



## Step 2: Decide What to Measure

Once you have identified your goals, decide which impacts need to be measured. Recognize that measuring all impacts is likely unnecessary and inefficient.

Two commonly used guidelines offer laundry lists of issues and measures for consideration:

- the new ISO 26000:2010 Guidance on Social Responsibility provides a comprehensive list of issues and concepts to ensure you are thinking holistically.
- the Global Reporting Initiative's G3 Guidelines provide an extensive list of specific measures, grouped by category. The core environmental indicators from the G3 Guidelines are listed in the table below. If your company has not yet decided what to measure, these metrics are a sound starting point.

Indicator	Example
<b>Materials</b>	Material used by weight or volume, e.g. 1.1 million tons of plastic.
<b>Energy</b>	Direct energy consumption by primary energy sources, e.g. 5,000 GWh of electricity.
<b>Water</b>	Total water withdrawal by source, e.g. 300,000 m <sup>3</sup> of groundwater.
<b>Biodiversity</b>	Habitats protected or restored, e.g. donated 500 hectares of wetlands.
<b>Emissions, effluents and waste</b>	Total direct and indirect GHG emissions by weight, e.g. 350 kt CO <sub>2</sub> .
<b>Products and services</b>	Percentage of products sold and their packaging materials that are reclaimed by category, e.g. 40 percent of packaging for Product X is reclaimed by the company.
<b>Compliance</b>	Monetary value of significant fines and total number of non-monetary sanctions for non-compliance with environmental laws and regulations, e.g. two warning letters, one fine of \$100,000.
<b>Transport</b>	Significant environmental impacts of transporting products and other goods and materials used for the organization's operations, and transporting members of the workforce, e.g. 75 kt CO <sub>2</sub> resulting from fleet vehicle operation.

## Where Should You Start—and Stop—Measuring?

The Global Reporting Initiative suggests organizations report on “all entities that generate significant sustainability impacts (actual and potential) and/or all entities over which the reporting organization exercises control or significant influence with regard to financial and operating policies and practices.”<sup>1</sup>

With that in mind, should you measure the impacts of your employees’ commute to work? Your company’s choice of location influences their impacts; but, so do their decisions regarding where to live and what method of transportation to use. What about the impacts of consumers acquiring, using and disposing of your product? Product design influences impacts; still, consumer behaviour and product use patterns will vary, and measuring consumers’ impacts could lead to double-counting.

There is no universal right answer on where to define boundaries. *Your decision should depend on your goal—be it meeting regulations, keeping communities happy or making better managerial decisions.* It will also necessarily depend on any regulations in your sector or geographic region. For instance, the European Union requires companies to take back and recycle electronic waste from customers.

<sup>1</sup> Source: [http://www.globalreporting.org/NR/rdonlyres/DDB9A2EA-7715-4E1A-9047-FD2FA8032762/0/G3\\_QuickReferenceSheet.pdf](http://www.globalreporting.org/NR/rdonlyres/DDB9A2EA-7715-4E1A-9047-FD2FA8032762/0/G3_QuickReferenceSheet.pdf)

# Step 3: Determine How to Measure and Value Impacts



## 3a: Measuring

Tracking individual metrics, such as tonnes emitted of CO<sub>2</sub> equivalent, is not hard to do (though it may be costly or time-consuming). These one-off measurements may satisfy regulators, accountants, reporters and the general public, but managers risk missing the big picture. To make better decisions, executives and investors should consider a broader range of impacts within the context of the company's activities. New standards such as the forthcoming Product Accounting and Reporting Standard developed by the World Resources Institute and the World Business Council for Sustainable Development are indicative of this shift to a more comprehensive approach.

Various measurement tools and methodologies have been developed to help managers measure more holistically. The two most common tools for measuring environmental impacts are life cycle analysis and environmental footprint. See *page 14* for the pros and cons of each tool.

### LIFE CYCLE ANALYSIS

In 1969, The Coca-Cola Company studied the full range of environmental impacts of its packaging, laying the foundation for what has today become life-cycle analysis<sup>2</sup> (or LCA, life cycle assessment, cradle-to-grave analysis, ecobalance). LCA quantifies the impacts of a product or process over its life, design and manufacturing to transport and disposal. The four basic steps in conducting an LCA are: scope and goal definition, inventory analysis, impact assessment and interpretation of the results.

The use of LCA in business is widespread and increasing. The United Nations Environment Programme promotes its use, an International Organization for Standardization standard exists, and many consultants and software packages have been developed to serve executives.

<sup>2</sup> Source: [http://www.thecoca-colacompany.com/citizenship/package\\_design.html](http://www.thecoca-colacompany.com/citizenship/package_design.html)

## **ENVIRONMENTAL FOOTPRINT**

The environmental (or ecological) footprint was developed in the early 1990s by Professor William Rees and PhD student Mathis Wackernagel at the University of British Columbia. It has since undergone numerous iterations, and similar tools have been developed for measuring water usage and carbon emissions.

The environmental (or ecological) footprint measures demand on ecosystems relative to their ability to regenerate. It is typically expressed very compellingly through a simple number representing an area of biologically productive land or water.

Environmental footprints are traditionally known to be calculated for countries (or even the entire globe)—for instance, it takes roughly eight hectares of land to sustain the average American; in Canada, the average footprint is roughly six hectares, and the global average is roughly 1.5 hectares per capita<sup>3</sup>. But they can also be calculated for smaller units, such as individuals, products, facilities or organizations. The Global Footprint Network has developed standards for using the tool.

<sup>3</sup> Source: <http://www.footprintnetwork.org>

### **3b: Valuing**

Financials are the common language of business. Translating environmental measures into financial values helps managers better understand the implications of environmental impacts and make informed decisions.

Monetizing environmental impacts can be relatively simple or staggeringly complex. For example, translating a weight of toxic effluent into a financial value is easy if the market or regulators have put a price on it. However, the financial implications of compromising wildlife habitat may be more difficult to grasp.

A few public tools exist to help managers value environmental impacts. The most commonly used in the literature include ecosystem service valuation and environmental input-output modelling, described below. We speculate that many proprietary tools exist but are carefully guarded by consultants.

#### **ECOSYSTEM SERVICE VALUATION**

Ecosystem services are the functions that support life, such as clean drinking water or nutrient cycling. Ecosystem service valuation (ESV) places financial values on those functions.

Measuring the value of ecosystem services is challenging as economic markets do not typically reflect the entire cost or benefit of a function and most of the services are public goods. Various methods can be used to generate inputs to an ESV when there is not a market for a particular service. For instance, a house adjacent to a lake will likely command a higher price than one farther away. The difference in real estate prices is one method of estimating the market value of services the lake provides. This method, called hedonic pricing, and others are described at <http://www.ecosystemvaluation.org>. Various assessment tools built on ESV are available to managers, some of which are listed in a 2008 Business for Social Responsibility report.

#### **ENVIRONMENTAL INPUT-OUTPUT MODELING**

Input-output models are traditional economic tools originally introduced by Wassily Leontief in 1951 to study changes in demand within an economy by measuring the economic flows between industry sectors. Since one sector's outputs are another's inputs, an I-O model can help decision-makers analyze relationships, in terms of dollars, between different departments, companies or even sectors of the economy. Environmental impacts, measured in dollars, can be added into the analysis alongside other revenue and cost streams, allowing managers to see the implications of different products or processes on environmental costs.

## DECIDE WHICH TOOLS TO USE

This table can help you decide which of the four most common tools for measuring and valuing environmental impacts is most appropriate for your needs. See our full [report on this topic](#) for other emerging, industry-specific and less common tools you may want to explore.

Tool	Best for...	Pros	Cons	How to do it
<b>Measuring (#)</b>	<b>Life Cycle Analysis</b> 	Measuring any and all impacts stemming from production, use and disposal of a particular product.	<ul style="list-style-type: none"> <li>Can be used to directly compare alternatives (e.g. Input A vs Input B) and identify opportunities or risks in product categories.</li> <li>Incorporates external factors (e.g. social, political, technological).</li> <li>Many cheap/free software packages are available.</li> <li>EIO-LCA (Environmental Input-output Life Cycle Analysis) can add a valuation layer to your LCA, turning numbers into dollars.</li> </ul>	<ul style="list-style-type: none"> <li>Only as good as its data, and getting reliable data can be challenging and costly.</li> <li>LCAs may be difficult to compare due to differences in calculation methods.</li> <li>May be difficult to choose the right level of detail for analysis.</li> </ul>
	<b>Environmental Footprint</b>   	Measuring the overall impact of your organization's activities on the natural environment in a single number.	<ul style="list-style-type: none"> <li>Yields one number (hectares or acres) which can be compared easily to other footprints, facilitating benchmarking.</li> <li>Good educational tool to illustrate aggregated impacts.</li> </ul>	<ul style="list-style-type: none"> <li>Aggregating impacts into one number can be an oversimplification.</li> <li>Less relevant to certain industries (e.g. services).</li> <li>Doesn't help identify "hot spots" within product categories</li> </ul>
<b>Valuing (\$)</b>	<b>Ecosystem Services Valuation</b>  	Valuing "services" provided by the natural environment, and/or determining how their values will change.	<ul style="list-style-type: none"> <li>Provides a thorough valuation that considers many/all facets.</li> <li>Can be used to value a service (e.g. biodiversity, protection from UV rays) or how that value will change given a decision (e.g. to construct a new building, or clear a plot of land).</li> <li>Includes both market (i.e. out-of-pocket) and non-market values.</li> </ul>	<ul style="list-style-type: none"> <li>Complete valuations are extensive—and can be expensive.</li> <li>Studies are difficult to compare due to differences in calculation methods. e.g. non-market values can be estimated using travel cost, hedonic pricing, contingent valuation, etc.</li> </ul>
	<b>Environmental Input-Output Modeling</b> 	Measuring (in dollars) flows of a business' goods and services. Based on the formula: "Production – Consumption = Demand."	<ul style="list-style-type: none"> <li>Attempts to incorporate all business activities and effects on outputs, profits and pollution.</li> <li>Highlights the relationships across units in a company and between companies.</li> <li>Calculations are easily computed, understood and presented.</li> <li>High comparability across countries using the UN's System of National Accounts.</li> <li>Helps quantify externalities.</li> </ul>	<ul style="list-style-type: none"> <li>Requires many assumptions that may be difficult to validate.</li> <li>Requires extensive data.</li> <li>Input-Output tables must be constantly updated to reflect the latest information.</li> </ul>

Note: symbols denote product level (), organizational level () , and national or global level ().



## CASE STUDY 2

# Using Environmental Metrics to Inform Corporate Strategy: Canadian Tire Corporation, Limited

Canadian Tire, one of Canada's largest retailers, has realized that measuring environmental impacts can help deliver short-term operational improvements while highlighting long-term strategic risks and opportunities.

One key initiative, the Corporate and Supply Chain Environmental Footprint, calculates the energy use and greenhouse gas (GHG) emissions for products, transport and operations.

The “product” component is based on Canadian Tire’s economic Input-Output Life Cycle Analysis model (EIO-LCA), which estimates the energy and GHG emissions embedded in the product the company sells—quantifying the values associated with manufacturing and material composition of products. “We have more than 100,000 retail products,” says Tyler Elm, vice president of business sustainability. “It’s impractical to conduct an LCA on every product. This model lets us estimate the carbon footprint for each product category, providing the insight we require for strategic decision-making.”

The model uses easily accessible internal product data (cost of goods sold, product units received and place of manufacturing) along with existing macro data on energy use and emissions from sources such as Carnegie Mellon University’s EIO-LCA model, the Intergovernmental Panel

on Climate Change and Environment Canada. An external consultant helps Canadian Tire combine the datasets to track overall impacts.

The Input-Output Life Cycle Analysis tool enables Canadian Tire to identify products with the highest energy and carbon price risk as a percent of cost of goods sold. It also identifies products that may benefit from reengineering. This ultimately saves money and helps identify risks and opportunities.

“When our board asks: ‘How would a price on carbon of \$30 per tonne affect us?’ we can answer,” says Elm. “They don’t need to know the impact to the penny, but they need to know whether the impact will be three percent or 30 percent of cost of goods sold. When we see a product category with a 30 percent carbon price risk, we can work with the manufacturers to improve product design or packaging.”

This tool has already helped Canadian Tire drive significant amounts of carbon out of their supply chain. In 2010, re-designs of 161 products and packaging were forecasted to annually avoid more than \$3.6 million in costs and eliminate 1,700 tonnes of greenhouse gases, equivalent to the energy use and emissions from powering over 200 Canadian homes each year.

## Step 4: Incorporate Environmental Measures into Decision-Making

Unless your primary goal is to improve your firm's environmental performance on select criteria, measuring and valuing is not the end point in the process.

Armed with environmental measures and values, you can evaluate your progress or assess your present position, communicate with or report to key stakeholders and revise your strategy or tactics to better reach your goals.

This figure identifies questions to guide your thinking as you evaluate your actions, communicate progress and improve impacts.

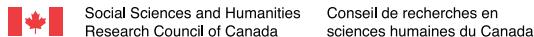


# about the research

This research was inspired by the NBS Leadership Council, which gathers annually to identify the Priorities for Business Sustainability.

The report is an extension of the systematic review of the same name. To conduct the systematic review, the research team, led by Dr. Pamela Kaval, reviewed 180 relevant sources. Read the [systematic review](#) for a detailed discussion of practices, case studies and implications for research and practice.

This research was funded in part by the Social Sciences and Humanities Research Council of Canada.



NBS gratefully acknowledges the input of the following individuals for their helpful comments on this research and/or the executive report: Karen Clarke-Whistler (TD Bank Group), Andrew Wilczynski (TELUS), Blair Feltmate (University of Waterloo), Luc Robitaille (Holcim), Dror Etzion (McGill University), Agnieszka Rum (CBSR) and Andrea Baldwin (CBSR). Note: This report is authored exclusively by the Network for Business Sustainability and does not necessarily reflect the views of the aforementioned individuals or their organizations.

## Feedback

Please let us know what you thought of this report.  
Contact NBS at [info@nbs.net](mailto:info@nbs.net).

# about NBS

A Canadian non-profit, the Network for Business Sustainability produces authoritative resources on important sustainability issues – with the goal of changing management practice. We unite thousands of researchers and professionals worldwide who believe passionately in research-based practice and practice-based research.

NBS is funded by the Social Sciences and Humanities Research Council of Canada, the Richard Ivey School of Business (at The University of Western Ontario), the Université du Québec à Montréal and our Leadership Council.

## NBS Knowledge Centre

For additional resources visit the NBS' Knowledge Centre at [nbs.net/knowledge](http://nbs.net/knowledge).

## NBS Leadership Council

NBS' Leadership Council is a group of Canadian sustainability leaders from diverse sectors. At an annual meeting, these leaders identify their top priorities in business sustainability – the issues on which their organizations need authoritative answers and reliable insights. Our 2009 Leadership Council inspired and funded this research project.



This report is authored solely by NBS and does not necessarily reflect the views of the Leadership Council.





Network for  
Business Sustainability  
*Business. Thinking. Ahead.*

Network for Business Sustainability  
c/o Richard Ivey School of Business  
University of Western Ontario  
1151 Richmond Street  
London, Ontario, Canada N6A 3K7  
519-661-2111, x80094



Réseau entreprise et  
développement durable  
*Penser l'entreprise en visionnaire*

Réseau entreprise et développement durable  
École des Sciences de la gestion,  
Université du Québec à Montréal  
1290, rue Saint-Denis,  
Montréal, Québec, Canada H2X 3J7  
514-987-3000 x7898

nbs.net