The Environmental Impact of Novartis Along Global Supply Chains

Case Study

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1 INTRODUCTION

Environmental impact, both negative and positive, is a key element of the Financial, Environmental and Social (FES) impact valuation, the Novartis version of the Triple Bottom Line approach. Separate case studies are available on elements of social[1] and economic[2] impact.

Carbon emissions arising from the global supply chains of the European pharmaceutical industry are about ten times as high as its emissions from direct operations.[3] A similar picture is observed for water consumption (about three times as high) and air pollution[4] (twenty times as high). Besides opportunities to effectively reduce total environmental impact, this poses considerable financial risks: carbon prices are expected to rise or to be introduced to provide incentives for significant emissions reductions and suppliers may pass on such costs. As the vast majority of emissions occur along the supply chain, it is thus important to go beyond own operations when assessing the full carbon-pricing risk exposure. The same applies to water risk, as water is increasingly becoming a scarce resource. Overconsumption and pollution put many regions at risk, presumably leading to raw material shortages and higher costs.

ENVIRONMENTAL EFFECTS IN GLOBAL SUPPLY CHAINS ARE MANY TIMES HIGHER THAN DIRECT EFFECTS

This case study describes how Novartis analyzed the total environmental impact of its business activities along the upstream global supply chain with respect to environmental indicators.[5] The objective was to obtain a comprehensive picture of the upstream environmental impacts triggered by Novartis in order to effectively monitor environmental risks and opportunities in different geographical and operational areas by comparing impacts and dependencies.

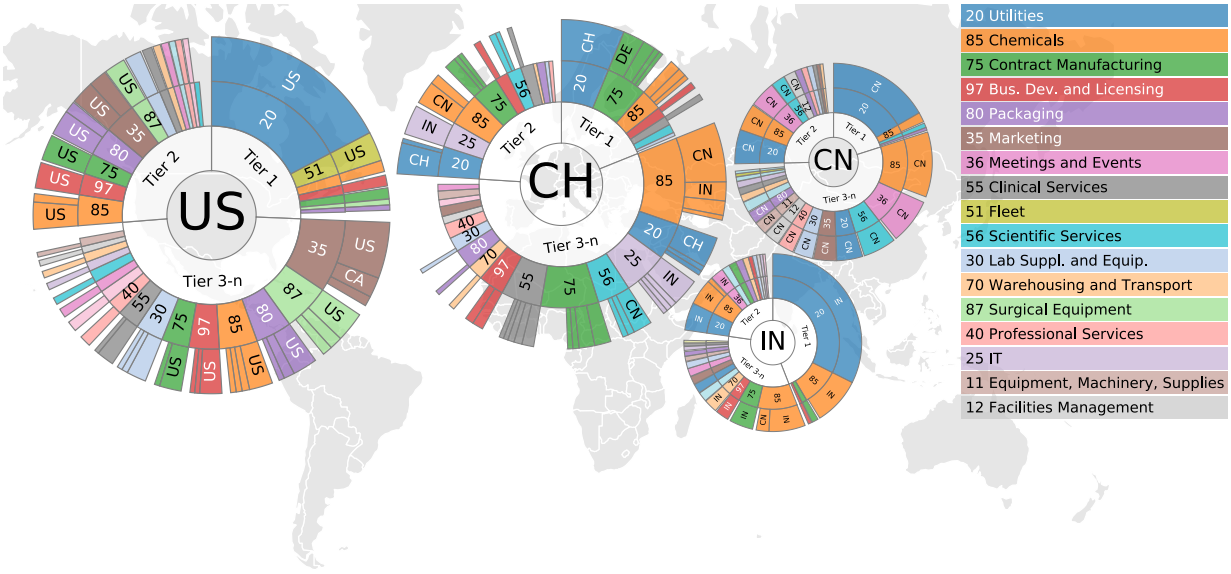


***Figure 1. Water consumption along global supply chains**. Indirect water consumption by tier, procurement commodity class, and country of impact for Novartis US, Switzerland, China, and India.*

[1] A.H. Seddik, J. Branner, R. Helmy, D.A. Ostwald, S. Haut, *The Social Impact of Novartis Products: Two Case Studies from South Africa and Kenya.* Basel/Berlin/Darmstadt, August 2018.
[2] R. Scholz, N. Albu, N. Benke, M. Cramer, D.A. Ostwald, and S. Haut, *The Global Economic Impact of Novartis*, Basel/Berlin/Darmstadt, July 2018.
[3] WifOR calculation.
[4] Here: NO_x.
[5] Emissions and air pollutants considered: CO_2, CH_4, N_2O, CO, NMVOC, NO_x, SO_x and NH_3. Water impact: Blue, green, and grey water footprint.

Achieving this goal required both an in-depth analysis and a broad scope. With the customized approach Novartis chose, critical hotspots could be identified and analyzed by region of operation, business activity, commodity class, and country of impact.

Novartis strives to achieve major progress in alignment with the UN Sustainable Development Goal 12 (Sustainable consumption and production), SDG 7 (Clean energy) and SDG 6 (Clean water and sanitation) by quantifying its environmental footprint. SDG 12 emphasizes the need for a systematic approach among actors in the supply chain, from producer to final consumer. Novartis followed a more holistic approach compared to the scope of current sustainability standards and considered one additional layer of information in the model: The consumption of households supported through wages and salaries paid by Novartis or through wages and salaries paid by vendors for the production of goods and the provision of services for Novartis. The resulting so-called *induced effects* arise through the increase in production caused by the spending of personal income of Novartis staff and increased personal income along supply chains.

NOVARTIS FOLLOWED A MORE HOLISTIC APPROACH AS COMPARED TO CURRENT SUSTAINABILITY STANDARDS

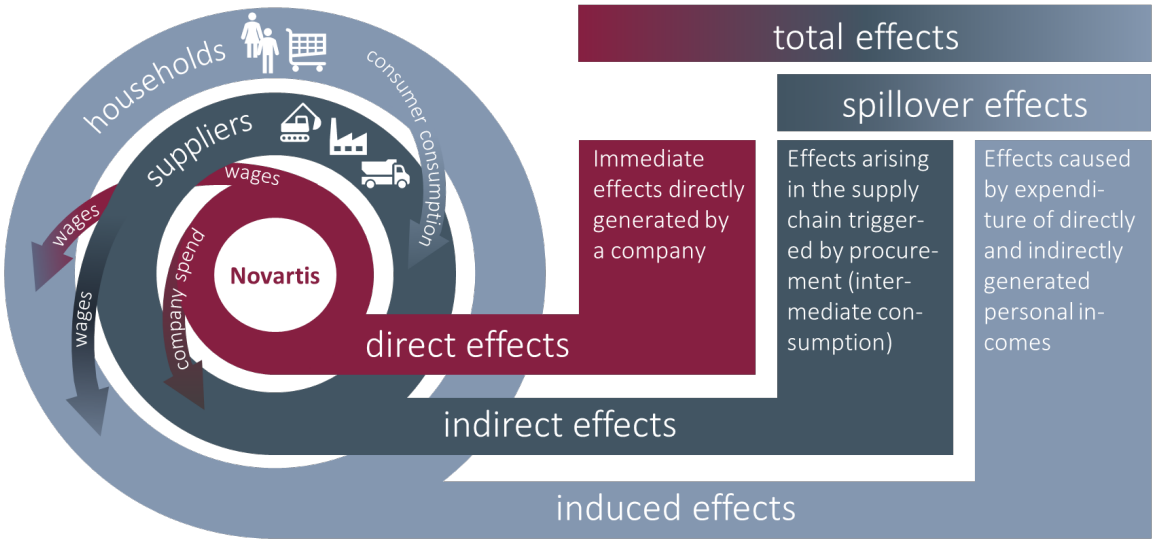


Figure 2. Model scope. *Direct, indirect, and induced effects.*

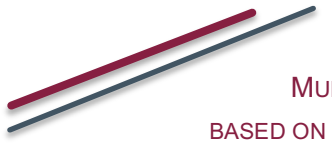
Therefore, the assessment also went further than what is required by the WBCSD/WRI GHG Protocol. The following effects were measured and analyzed.

- Direct GHG emissions (Scope 1)
- Effects resulting from the generation of purchased energy (Scope 2)
- The *total impact* of all upstream intermediates used by Novartis (tier 1 to n, including the GHG emissions Scope 3 categories 1-4 and 6)
- Consumption-enabled induced environmental impacts (“Scope 4”).

Here, *tier 1* refers to all direct vendors, *tier 2* to all supplying sectors of tier 1 direct vendors, *tier 3* to supplying sectors of tier 2 and so forth. *Tier 1-n* is a short way to express that the entire upstream supply chain is taken into account.

2 METHODS

The environmental footprint provides a consistent multi-criteria analysis of the complete upstream supply chain, i.e., all stages from the extraction of raw materials to the own business operations of Novartis. The analysis required the collection of third-party procurement data of all legal entities across the world for the time periods under consideration. A detailed breakdown of intermediary inputs by country and according to the International Standard Industrial Classification (ISIC Rev.4) was performed. This was the basis for quantifying the indirect and induced environmental effects, which occur throughout the globalized economy and may be resolved on country or even supplier level. WifOR applied an economic input-output life-cycle-assessment model and extended it threefold.



MULTI-CRITERIA ANALYSIS BASED ON SOCIO-ECONOMICALLY AND ENVIRONMENTALLY EXTENDED GLOBAL MULTI-REGIONAL INPUT-OUTPUT LIFE-CYCLE ASSESSMENT

- While in the traditional model households belong to the final-demand sector (are *exogenous*), their activities were included in the model and thus treated as endogenous. As a result, not only the indirect effects – occurring through purchases in supplier industries and the resulting ripple effect on the supply chain – but also the induced effects – arising due to the spending of wages and their indirect effects – are accounted for.
- The traditional model assesses the economic interaction between industries. WifOR's model can be described as an environmentally-extended model since it includes a variety of environmental indicators such as greenhouse gas and other emissions to air, water consumption, energy use, as well as land use, material use and waste generation.[6]
- Rather than including only domestic transactions, the model is based on a global multi-regional input-output table and thus includes global trade linkages required to fully assess today´s global value chains. The underlying database[7] traces supply chains across 56 sectors and 43 countries (All EU28 countries as well as Australia, Brazil, Canada, China, India, Indonesia, Japan, Mexico, Norway, Russia, South Korea, Switzerland, Taiwan, Turkey, USA, and a model for the rest of the World).

3 RESULTS

Novartis quantified its overall environmental impact by decomposing its supply chain by operational areas, procurement commodity classes, suppliers, and by countries of operation. WifOR was able to identify the environmental impact both *of* the countries of Novartis business activities and *on* the countries (indirectly) affected by the activities of the company. The impact was analyzed in terms of the emissions and air pollutants CO_2, CH_4, N_2O, CO, NMVOC, NO_x, SO_x, NH_3, as well as the blue, green, and grey water footprint. The high level of detail of the analysis allowed for a broad range of evaluations: From a general overview of the biggest impacts (see e.g., Figure 3) to a closer view, e.g., on commodity-class-level (Table 1), and up to precise observations of specific parameters (see Figure 1 and Table 2).

[6] The environmental accounts are based on the WIOD 2013 release (Aurélien Genty (ed) (2012), *Final Database of Environmental Satellite Accounts: Technical Report on their compilation*) but updated with the latest EUROSTAT and OECD environmental account data.
[7] Timmer, M. P., Dietzenbacher, E., Los, B., Stehrer, R. and de Vries, G. J. (2015), *An Illustrated User Guide to the World Input–Output Database: The Case of Global Automotive Production*, Rev. Int. Econ., 23: 575–605. Analysis is based on the WIOD 2016 release.

Figure 3. Environmental impact along global supply chains. *Indirect CO_2 emissions (left) and indirect water consumption[8] (right) triggered by Novartis global, by country of impact and tier (yellow: tier 1, red: tier 2, blue: tier 3-n).*

In the following, selected results are presented using the example of CO_2 emissions.

An analysis by commodity class revealed the strategic relevance of six commodity classes (see Table 1). The procurement of those is responsible for more than 60% of the total indirect CO_2 emissions in the supply chain. Having identified the procurement commodities causing the largest carbon footprint, Novartis then took a more detailed look by breaking down emissions by Novartis countries of operation. This breakdown revealed how the indirect emissions triggered by the procurement of a commodity are distributed among Novartis countries. In this way Novartis gained information about its strategic position in the dialogue with its suppliers. For example, if a product with poor environmental performance is consistently demanded by all Novartis sites, it makes little sense for each of the Novartis sites to focus on reducing those emissions on their own. Instead, efforts are needed on a global scale and the Novartis headquarter may be in a better position to encourage and support its suppliers' environmental performance improvement. If, on the other hand, individual sites are responsible for disproportionately large parts of the commodity-specific emissions, actions should be undertaken locally.

Commodity	% of total indirect CO_2 emissions	thereof		
		Tier 1	Tier 2	Tier 3-n
Chemicals	21 %	24 %	28 %	49 %
Utilities	14 %	74 %	13 %	13 %
Packaging	8 %	30 %	28 %	42 %
Marketing	7 %	18 %	25 %	57 %
Contract Manufacturing	6 %	29 %	25 %	45 %
Warehousing & Transport	5 %	50 %	21 %	30 %

Table 1. Carbon emissions along the supply chain. *Indirect CO_2 emissions by procurement commodity type and tier.*

In the process of investigating the hotspots along the supply chain, Novartis also focused on the question which commodity purchased by which Novartis country has the highest indirect CO_2 impact. In order to establish a priority list for improvement measures, Novartis identified the most promising areas of improvement for individual coun-

Novartis country	Commodity	Indirect CO_2 emissions [kt]	thereof		
			Tier 1	Tier 2	Tier 3-n
US	Utilities	305	96 %	2 %	2 %
US	Marketing	260	23 %	31 %	46 %
IE	Chemicals	244	22 %	28 %	50 %
CH	Chemicals	214	22 %	27 %	52 %
SI	Chemicals	188	22 %	28 %	50 %

Table 2. Carbon emissions along the supply chain. *Indirect CO_2 emissions by triggering Novartis country, procurement commodity type, and tier.*

[8] Blue water footprint: "Consumption of surface and ground water" (Aurélien Genty (ed) (2012), *Final Database of Environmental Satellite Accounts: Technical Report on their Compilation*, WIOD Deliv erable 4.6). The green and grey water footprint were also included in the analysis.

tries by sorting the pairs *commodity type and Novartis country* by the size of their indirect impact. For instance, it was found that the largest product-specific impact triggered by a single Novartis country is the demand for utilities, triggered by the US sites. The emissions which arise through the purchase of utilities constitute 16% of Novartis US' total indirect emissions. Consequently, a great potential to reduce its CO_2 footprint lies in switching those to renewable energy sources. Through this measure, Novartis' overall CO_2 emissions could be noticeably decreased, as utilities purchased by Novartis US accounts for 4.3% of the company's global indirect CO_2 emissions.

3.1 Intensities as share of GVA

Quantifying carbon emissions in absolute figures provides an important and useful overview of the environmental impact that is being caused by a company. Nevertheless, absolute numbers alone can be misleading as they do not reflect any economic specifics, e.g., the size of the company, the amount of produced goods or the number of workers. Furthermore, Novartis activities not only have an environmental impact on different countries in the world but also an economic one: Value is created directly and along its supply chain. This economic value contribution is best quantified in terms of gross value added (GVA) – the contribution to a country's gross domestic product (GDP).

ECO-MANAGEMENT AND AUDIT SCHEME (EMAS) RECOMMENDS INTENSITIES AS SHARE OF GROSS VALUE ADDED AS KEY INDICATORS

GVA is a macroeconomic key figure and the CO_2 intensity (the CO_2 emissions to GVA ratio) shows to which degree economic growth is decoupled from environmental degradation. Furthermore, such intensities provide a high level of significance for and comparability to national and international policy targets. Key business figures like revenue, sales, or the number of employees (alone) are not satisfactory for this purpose. The Eco-Management and Audit Scheme (EMAS), which is considered to be the most ambitious environmental management scheme, recommends intensities as share of GVA as key indicators.

To identify the regions with the highest potential of decreasing environmental impact while at the same time increasing economic value contribution, Novartis has analyzed indirect CO_2 intensity along its global supply chain. The company was able to determine the hot spots of emissions in its supply chain, i.e. countries with the highest CO_2 output per dollar of GVA. Likewise, countries with the least CO_2 emitted per dollar of GVA were identified (see Table 3). The results were then decomposed by supplier, allowing Novartis to highlight areas with the greatest potential of CO_2 reduction in order to focus the company's efforts on these opportunities. Similarly, the most environmentally friendly suppliers could be identified, which provided strategic insight on sustainable business partnerships.

Country of impact	Indirect CO_2 intensity [kg/USD]
China	1.89
India	1.68
Russian Federation	1.55
Taiwan	1.42
Indonesia	1.31
⋮	⋮
Finland	0.15
Sweden	0.12
United Kingdom	0.11
Ireland	0.08
Switzerland	0.04

Table 3. CO_2 intensity along global supply chains. *Top and bottom 5 CO_2 intensity hotspot countries, based on indirect effects.*

3.2 Induced effects

As described above, one strength of the analysis lies in the broad scope of WifOR's model. In addition to the indirect effects, the company quantified the so-called induced effects which are the environmental effects caused by the increased production due to the private consumption of Novartis staff and of the workforce along the supply chain. This additional perspective provides a greater understanding of the far-reaching implications of a company's activities, as it takes into account the consumption patterns of employees. The underlying assumption is that a company can be seen as more environmentally friendly than another company if, all other items being equal, the people who work for it spend their wages in a more environmentally friendly way. Thus, considering the spillover effects (the sum of all indirect and induced effects) rather than solely indirect effects can make the difference between the impact of two companies or two company locations, which otherwise cause the same amount of direct and indirect effects.

INDUCED EFFECTS TAKE CONSUMPTION PATTERNS OF EMPLOYEES INTO ACCOUNT

This can be demonstrated by comparing the indirect, induced and spillover effects triggered by Novartis Germany and Austria, see Table 4. While both locations cause nearly the same amount of indirect emissions, the German sites cause significantly more induced emissions, resulting in higher spillover emissions.

Novartis country	Indirect CO_2 emissions [kt]	Induced CO_2 emissions [kt]	Spillover CO_2 emissions [kt]
DE	399	361	760
AT	409	182	591

Table 4. Carbon emissions along the supply chain. *Indirect, induced and spillover CO_2 emissions for Novartis Germany and Austria.*

Considering the spillover effects can likewise make the difference between two commodities. In our example, considering the spillover effects changes the order of the products within Table 1. While *Marketing* is fourth in the indirect effects ranking, it takes the second position in the ranking on spillover effects, see Tables 5 and 6. These findings illustrate how considering the induced effects can change the picture significantly. In this case, the difference may be explained by the fact that many of the marketing services (such as market research for instance) are provided in the US, which is by far the country with the highest induced CO_2 effects.

Commodity	Indirect CO_2 emissions [kt]	% of total indirect emissions
Chemicals	1,523	21 %
Utilities	969	14 %
Packaging	578	8 %
Marketing	484	7 %

Table 5. Carbon emissions along the supply chain. *Indirect CO_2 emissions by procurement commodity type.*

Commodity	Indirect CO_2 emissions [kt]	% of total spillover emissions
Chemicals	1,810	12%
Marketing	1,288	9%
Utilities	1,021	7%
Packaging	779	5%

Table 6. Carbon emissions along the supply chain. *Spillover CO_2 emissions by procurement commodity type.*

When considering the spillover CO_2 effects for the Novartis country/commodity type pairs, the results differ based on the scope as well (see Tables 7 and 8).

Novartis country	Commodity type	Indirect CO_2 emissions [kt]
US	Utilities	305
US	Marketing	260
IE	Chemicals	244
CH	Chemicals	214
SI	Chemicals	188

Table 7. Carbon emissions along the supply chain. *Indirect CO_2 emissions by triggering Novartis country and procurement commodity type.*

Novartis country	Commodity type	Spillover CO_2 emissions [kt]
US	Marketing	776
US	Utilities	316
CH	IT	295
IE	Chemicals	286
CH	Clinical Serv.	262

Table 8. Carbon emissions along the supply chain. *Spillover CO_2 emissions by triggering Novartis country and procurement commodity type.*

The same applies for the CO_2 intensity ranking (see Tables 9 and 10).

Country of impact	Indirect CO_2 intensity [kg/USD]
China	1.89
India	1.68
Russian Federation	1.55
Taiwan	1.42
Indonesia	1.31
⋮	⋮
Finland	0.15
Sweden	0.12
United Kingdom	0.11
Ireland	0.08
Switzerland	0.04

Table 9. CO_2 intensity along global supply chains. *Top and bottom 5 CO_2 intensity hotspot countries, based on indirect effects.*

Country of impact	Spillover CO_2 intensity [kg/USD]
Russian Federation	1.69
China	1.58
India	1.52
Estonia	0.98
Bulgaria	0.95
⋮	⋮
Norway	0.17
Luxembourg	0.17
United Kingdom	0.16
Sweden	0.13
Switzerland	0.07

Table 10. CO_2 intensity along global supply chains. *Top and bottom 5 CO_2 intensity hotspot countries, based on spillover effects.*

3.3 Impact valuation

In order to compare environmental impacts with financial and social impacts, environmental impacts are valued using damage-cost-based shadow prices as published by CE Delft in March 2010.[9] The 2008 study results in Euro in the Netherlands were converted into USD and adjusted with a GDP ratio to other countries. Annually, the shadow prices are determined by an inflation adjustment of the previous year´s values. Some shadow prices are uniform across geographies and locations, like the cost per ton of CO_2 which Novartis fixed internally at 100 USD.[10] The 2017 shadow prices for selected environmental impacts and countries are, in USD, per ton (air emissions and waste) and in cubic meters (water) given in Table 11.

[9] Sander de Bruyn, Marisa Korteland, Agnieszka Markowska, Marc Davidson, Femke de Jong, Mart Bles, Maartje Sevenster, *Shadow Prices Handbook - Valuation and weighting of emissions and environmental impacts*, CE Delft, March 2010.
[10] Novartis Annual Report 2016, pg. 30

The impacts of N_2O and CH_4 were valued with the CO_2 equivalent volumes and the CO_2 shadow price. The conversion factors were 298 and 25 respectively.

In order to determine the impact value of the water footprint, the water scarcity factor of each Novartis location was used. Supply chain impacts in countries with a Novartis legal entity were valued at the same shadow price as own operations.

		Australia	China	Ecuador	Egypt	Slovenia	Spain
CO_2 equivalent		100	100	100	100	100	100
CFC-11 (R11r)		182,850	182,850	182,850	182,850	182,850	182,850
NO_x		23,143	3,321	2,624	1,815	8,238	10,254
SO_2		15,930	2,286	1,806	1,249	5,671	7,058
PM		61,615	8,841	6,985	4,832	21,933	27,300
VOC		4,358	625	494	342	1,551	1,931
N		19,536	2,803	2,215	1,532	6,954	8,656
PO_4		2,705	388	307	212	963	1,199
NH_3		41,177	5,908	4,668	3,229	14,658	18,245
Water	Severe stress area	13.07	1.88	1.48	1.02	4.65	5.79
	High/medium stress area	4.57	0.66	0.52	0.36	1.63	2.03
	Low stress area	0.65	0.09	0.07	0.05	0.23	0.29
Hazardous waste	Incineration with energy recovery	10	10	10	10	10	10
	Incineration w/o energy recovery	25	25	25	25	25	25
	Landfill	1,000	1,000	1,000	1,000	1,000	1,000
Non-hazardous waste	Incineration with energy recovery	10	10	10	10	10	10
	Incineration w/o energy recovery	25	25	25	25	25	25
	Landfill	200	200	200	200	200	200

***Table 11. Shadow prices**. For air emissions and waste in USD per ton, for water in USD per m^3. Available for 170 countries.*

These valuation approaches were applied consistently to both the countries with a Novartis presence as well as to the countries touched by the full supply chain (tier 1-n). In comparison to the scope of the 2016 results published, this new approach is more complete and more precise as the previously used

method. With this is mind, it is not surprising that the overall results for 2017 went up to negative USD 2.2 billion. Restating the 2016 results with the same methodology yields almost the same result with an insignificant 0.6% increase in 2017. In these global results, 81% of the negative impact occur within the supply chain, of which 32% stem from CO_2 emissions. These make up about 48% of the entire supply chain impact value. When including the negative USD 2.5 billion impact value from induced effects, the global result is 91% driven by the supply chain.

4 DISCUSSION AND OUTLOOK

Quantifying its environmental footprint provided Novartis with actionable insights. The company obtained a complete picture of its environmental impact along its global supply chains and greatly enhanced its transparency by eliminating environmental blind spots and exposing potentially undetected risks. The level of detail provided by the analysis allowed Novartis to gather precise information and to use it in the dialogue with specific stakeholders, e.g., when communicating and collaborating with suppliers on environmental issues.

The analysis gave valuable answers to questions such as:

- Which Novartis countries cause the highest CO_2 emissions, air emissions and water consumption in their upstream supply chain?
- How is this impact distributed among the different commodities purchased by the respective sites?
- Which (operational) areas have the biggest potentials?
- Which impacts occur along the supply chain, and at which stages?
- Which impacts occur in which countries?

By providing answers to these questions, the analysis:

- Allowed Novartis to consider the potential cost of carbon and of water, as well as their corresponding financial risks,
- Improved internal management practices,
- Created incentives for management to refocus its objectives and strategic decisions,
- Enabled Novartis to report its environmental impact according to the GHG Protocol and the Global Reporting Initiative (GRI),
- Complemented Novartis environmental management systems according to ISO 14001 and EMAS by providing relevant insights on the areas where environmental management efforts can have the greatest impact, and
- Complemented Novartis responsible supply chain management by revealing hot spots within the supply chain as well as the potentially eco-friendliest suppliers.

Novartis is implementing these learnings throughout its organization and intends to follow up with key suppliers to realize performance improvements in specific areas.