Sustainable Lifecycle Engineering at Siemens AG

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Abstract As Siemens history shows, our understanding of sustainability is closely linked to our company values – responsible, excellent and innovative. From the very first, Werner von Siemens insisted that his company fulfill its responsibilities to its employees, to society and to nature. To achieve excellence, to capture leading positions in the markets of tomorrow, to develop innovative technologies that help ensure the future viability of modern civilization – this has always been our vision and our challenge. Siemens Sustainability Program has three strategically relevant core components: expanding our Environmental Portfolio, implementing Key Performance Indicators and expanding collaboration and alliances with external stakeholders and business partners. [1] The Global Technology Field "Sustainable Lifecycle Engineering" of Corporate Research and Technology at Siemens supports this commitment by monitoring environmental impacts, evaluating the eco-efficiency of processes, technologies and solutions, environmental consulting and implementation of green innovations.

1 Introduction

Companies are increasingly taking action to reduce their environmental impact. Prominent examples include emission reporting and reduction programs, product stewardship activities, and sustainable supply chain initiatives. Siemens sustainability goals reflect the company's major challenges and topics. The goals are developed and defined in a joint analysis with the relevant specialist departments and stakeholders. The following selection represents four key goals [1]:

Help customers reduce their CO2 emissions by 300 million tons: in fiscal 2010, products and systems from Siemens Environmental Portfolio reduced CO2 emissions at our customers by some 270 tons. By 2011, we intend to increase these reductions to 300 million tons annually.

Grow Environmental Portfolio revenue to €40 billion: goal is to generate revenue of at least €40 billion from Siemens Environmental Portfolio in fiscal 2014. With revenue of some €28 billion in fiscal 2010, we are on the way to achieving it.
Improve CO2 efficiency by 20 percent: Improving our CO2 efficiency by 20 percent in fiscal 2011 in relation to emissions from energy use is one of our key targets. In fiscal 2009, we increased our environmental performance to 17 percent from nine percent.
Increase water efficiency by 20 percent: We have made progress toward achieving our goal of increasing the efficiency of water consumption by 20 percent by fiscal 2011 compared to 2006 on a revenue-adjusted basis.
A core environmental management task is to monitor key factors and record the data necessary for tracking environmental performance such as regarding energy and resource efficiency. These management tasks have to consider products, solutions and organizations.

2 Eco-efficiency of products and solutions

The product portfolio of Siemens contains a high number of energy efficient and environmental sound solutions. With well in excess of 100,000 different products and solutions, it is essential that we work to unified design and development standards continuing to improve energy and resource efficiency. The in-house design standard, SN 36 350, aims at ensuring environmental compatibility across product’s and systems’ entire lifecycles and provides the basis on which we develop environmental sound technologies. [1]
The Siemens portfolio is primarily focused on capital goods with long lifecycles and used by our customers for long periods of time. Product responsibility at Siemens goes beyond “cradle-to-gate” to encompass the entire product lifecycle. Full-scale lifecycle assessments (LCA) based on the international ISO 14040 ff suite of standards or, alternatively, screening lifecycle assessments are conducted to thoroughly understand the entire lifecycle of products and solutions, to compare alternative solutions as an essential step to increase the amount of environmental sound products / solutions, i.e. green products / solutions significantly in the product portfolio. However the to be developed green solutions should be better in both eco-dimensions, i.e. eco-nomic and eco-logical. For that purpose the “eco care matrix” (ECM) has been developed which defines environmental sound industrial products / solutions with advantages in both “eco” dimensions (eco-nomic + eco-logical). This method has been fully introduced into the Product Lifecycle Management (PLM) process at Industry Solutions. (Fig. 1)

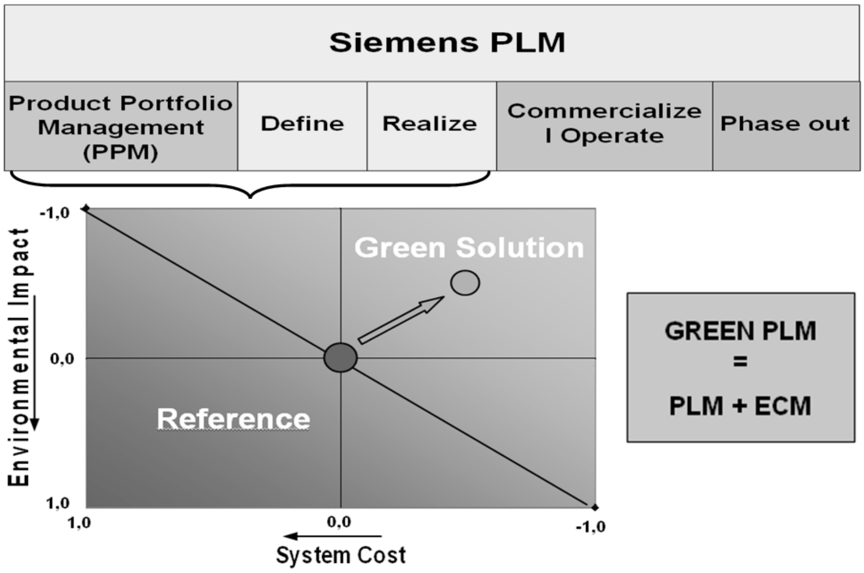

Fig.1: Green PLM [3]

The ECM describes both dimensions of economical performance (horizontal) and environmental impact (vertical). The ecological dimension is described by the LCA methodology. To describe the economical dimension it is favorable to use system costs e.g. CAPEX and OPEX, customer benefit or system productivity. An existing technology / solution is set as a reference in the center of the ECM.
A typical example for industrial processes is the production of steel. Siemens provides a number of eco-efficient solutions. The sinter plant typically produces the largest proportion of the total emissions of an integrated iron and steel works. In a sinter plant, thermal sintering - combustion of carbon carriers - causes fine ore to adhere to each other form agglomerates. Sinter is the iron carrier for the production of pig iron n a blast furnace.
SIMETAL MEROS is a sinter off-gas cleaning process which, in several stages, removers dust, acidic gases, toxic metals and organic compounds from the stream of off-gas from the sinter plant to a previously unachieved extent. Both calcium hydroxide ($CaOH_2$) and sodium hydrogencarbonate ($NaHCO_3$) are possible desulfurization additives. A screening LCA has drawn up focusing on the operation of the solution and evaluating the environmental aspects according to CML2001 Dec.07. Following results have been also published in an environmental product declaration [4].
Five environmental impact categories were calculated: acidification potential (Fig.2), global warming potential, photochemical ozone creation potential,

eutrophication potential, and abiotic depletion potential comparing the following processes:

- Off-gas cleaning with calcium hydroxide with 55% SO_2 removal
- Off-gas cleaning with sodium hydrogencarbonate with 55% SO_2 removal
- Off-gas cleaning with sodium hydrogencarbonate with 90% SO_2 removal
- Gas cleaning with the Airfine process was used as a reference

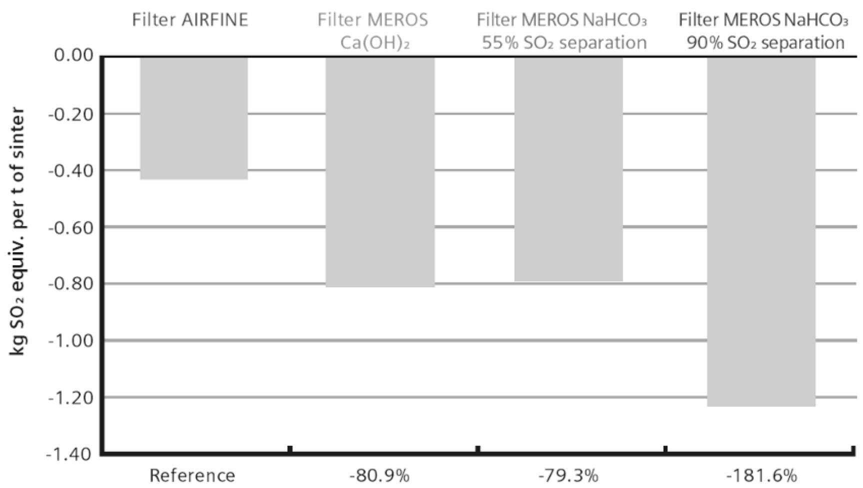

Fig.2: Example of environmental impact category: Acidification potential (AP) [4]

Taking investment and operation cost of a 10 year operation period into account, the results showed that all three of the MEROS solutions examined performed better than the reference, with cost benefits of more than 50% [4].

Applying Siemens technologies and solutions reduce emissions at customer site, too. At the same time Siemens is also depending on the performance of material and product suppliers. Therefore sustainability is a major topic of our supplier management.

3 Supplier management: sharing expertise

Environmental topics and questions represent an important aspect of supplier assessments in many companies [5]. They are mostly on a management level or of a qualitative nature to enable general supplier evaluation on the organizational level.
In 2009, Siemens purchased products and services in 177 countries. These were worth around 37 billion Euros, making it one of the world's largest purchasers. Implementation of sustainability in purchasing can therefore only be ensured in collaboration with excellent and innovative suppliers/service providers. The contractual obligation of our suppliers/service providers to adhere to the principles of the Code of Conduct for suppliers, and to promote their implementation also in their own supply chains, forms the basis for integration of the sustainability principles, namely acting in a cost-effective, ecological and socially responsible manner. [1-2] These topics are integrated in the supplier management system (Fig.3).

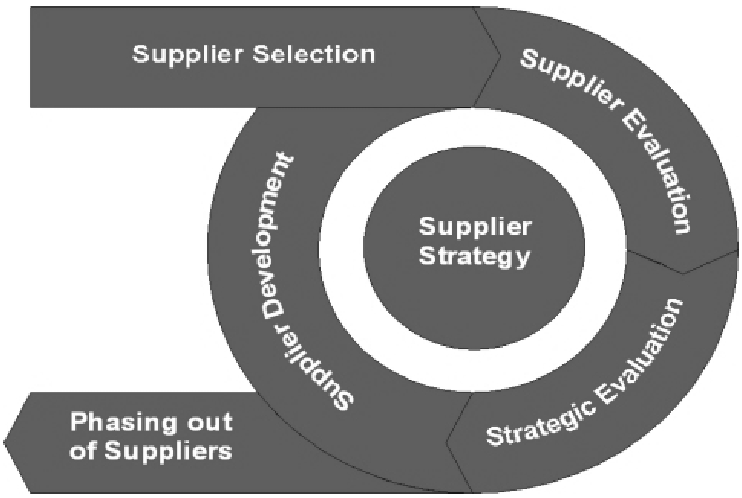

Fig.3: Siemens supplier management system [6]

Knowing that a major environmental impact of our production results from our material and semi-finished goods purchased we are intensifying our collaboration and sharing our knowhow with suppliers to implement sustainable business practices in our supply chain and qualitative assessment is enhanced with quantitative environmental performance indicators.

A special program has been developed combining the expertise of improving energy efficiency in production processes and the environmental impact analysis.
Goal of the Energy Efficiency Program for suppliers, a program which we had developed originally for our own production processes, is to assess and improve supplier sites regarding energy and resources efficiency. The program has been adopted from our methods we had developed originally for our own production processes and discussed in our supplier forum.
A set of questionnaires regarding the three topics: environment, energy management and technology have been designed considering the requirements of energy management systems (DIN ISO 50001, DIN 16000ff) and green house gas protocol (GHG emissions Scope 1 and 2). The qualitative and quantitative questions contain sites input and output data concerning data like material, energy and waste. This data are also the basic for GHG-emission calculation. Different level of details might be applied depending on energy intensity of the industry sector and strategic relevance of supplier.
A single evaluation of each of the three topics and the complete sites evaluation will be conducted based on the returned questionnaires, potential improvement and recommendations are identified in each of the areas. With the help of our experts, a number of suppliers have already taken part in the Energy Efficiency Program for suppliers. Particularly in energy-intensive production processes such as steel processing, but also in logistics, there are usually always possibilities to be found for reducing energy consumption and therefore costs [1, 2, 8].
In the next step, we want to include all the A-suppliers, i.e. the suppliers with a high energy cost component, in the program. In subsequent steps, the entire relevant supplier base will then be progressively included. The appropriate procedure is being developed in dialog with representative suppliers and ranges from the implementation of their own energy efficiency programs, to the use of Siemens advisers, through to supplier self-assessment. An Internet-based self-assessment tool is already being developed and is to be tested and deployed before the end of 2011. [8]
Our experiences show addressing environmental issues in a proactive manner goes beyond corporate boundaries and quantitative data is essential across organizations to identify any potential for reducing the consumption of energy and resources.

4 Managing environmental performance indicators across organizations

Companies use a wide variety of IT solutions to help them in assessing, optimizing, and reporting the environmental impacts of their operations and products. Existing solutions include tools to build inventories of the environmental impacts of organizations, set reduction targets, and report to various bodies. Other systems are specialized in environment-related process and product modeling and optimization. Although environment and sustainability as topics within the enterprise are gaining importance, business practice still shows up with isolated applications instead of integrated solutions. The integration is often constrained by a lack of standardized interfaces and appropriate data interchange formats. [9]

However to allow businesses to compare the environmental impacts of alternatives e.g. in material and energy procurement, product design, service outsourcing in a meaningful way, they should be presented with quantitative Environmental Performance Indicators (EPI) that describe environmental impacts at an organizational, product, and process level in a comprehensive and concise manner [10]. This is currently difficult because of the lack of a common business platform that collects EPIs from various companies, harmonizes them, and provides them upon request in different business scenarios.

The European project OEPI will work towards this goal by providing a platform that hosts intra- and inter-organizational EPIs and services to monitor and integrate them in their daily decision-support systems. To build such an EPI management platform requires drafting a common EPI syntax and semantics that meets the requirements of the underlying business scenarios.

Work has been driven by enabling high EPI availability, determination of transparency, flexibility of EPI calculation and reducing EPI collection costs considering requirements from different applications (see Fig.1)

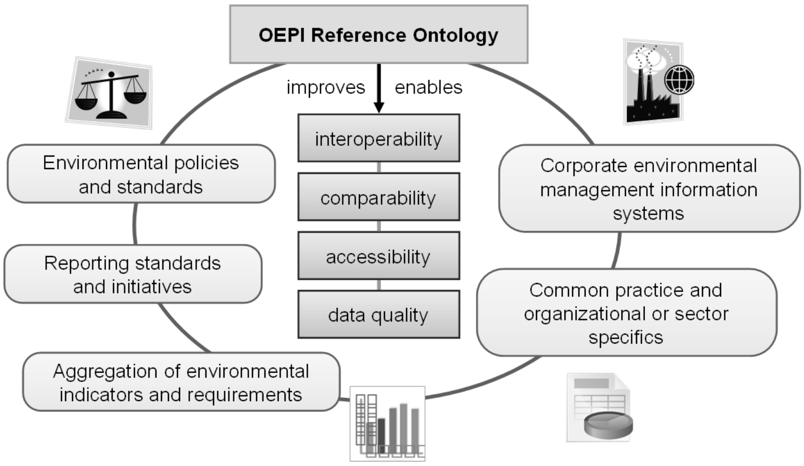

Fig.1: Defining the requirements of the OEPI reference ontology.

Additionally four use cases have been studied:

- Sustainable procurement
- Design for environment
- Network deployment & circuit provisioning
- Corporate communications.

Based on the overall requirements capture process, 49 requirements have been extracted relevant for knowledge representation and information exchange. Examples are represented in Tab.1.

Tab.1: Examples of OEPI ontology requirements (ID / Summary) [11]

ID	Summary
1	Provide concept for definition of Environmental Performance Indicators
6	Support specification of data collection method of EPI values
7	Support quality rating of EPI values by quality aspects and rating values
11	Support classification of required / optional EPI for industrial sectors or products
12	Ensure usability for intended ontology users
21	Support selection of measurements
22	Support specification of calculation rules for EPI values
89	Support different GHG scopes of organizational EPI values
95	Provide concept to describe to which object an EPI value is related

The vision of OEPI is to enable the creation of services that ensure the proper interpretation and use of performance data from different models or sources automatically. A necessary precondition for this evolutionary process is the formalized description language for EPIs which is represented by the OEPI Ontology and its description language OWL 2. The OEPI Ontology is supposed to provide sufficient concepts to describe the elements that are necessary to infer or to induce compatibility of environmental performance data. These concepts can be used to annotate existing data in a common, formalized way and thus leverage their utilization in automated services and applications. Moreover, they can be used for tagging new environmental performance data properly and uniformly from the beginning. [11]

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5 Conclusion

A large number of methods and tools are available at company level and continuous improvement processes are targeting availability, quality and consistency as well as improving the efficiency of reporting processes. The company's holistic understanding of sustainability is the key to improve products and production at all levels. Among new solutions for energy supply and optimized products, integrated considerations of their interactions play an increasing role to achieve next level solutions. In a global network strong relationships between the partners and common understanding of environmental impacts and improvement potential are essential for future business success. A common description language helps to improve collaboration across organizations and enables a flexible, efficient and comparable exchange of environmental information.

6 References

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