Drivers for life cycle based environmental information – experiences from metal and food sector

Nani Pajunen[1, *] and Juha-Matti Katajajuuri[2]

[1] Aalto University, Espoo, Finland, Department of Materials Science and Engineering, Mechanical Processing and Recycling, PO Box 16200, FI-00076 Aalto, Finland

[2] MTT Agrifood Research Finland, Biotechnology and Food Research, Sustainable Bioeconomy, Latokartanonkaari 9, FI-00790 Helsinki, Finland

*nani.pajunen@aalto.fi

Abstract All products and services have an environmental impact, whether during their production, use or disposal. Many industrial companies use life-cycle approaches (often life cycle assessment) in their sustainability strategy, environmental management, development of production chain and product design. Better product performance and environmental improvements support long-term industrial/company competitiveness, which enables/create conditions win-win situation for all the actors. This work is an overview about the drivers for life cycle based environmental information in companies. Our target is to identify the drivers, benefits and challenges for the different actors to produce and communicate more product level/related environmental information. This paper is based on experiences in metal and food sector.

Keywords: Environmental information, Drivers, Challenges, LCA, Production/supply chain, Life cycle based environmental information, The Criteria of Decision-making, Incentive-based Economic Policy instruments, Benefit, Food, Metal

1 Background

One of the European Union's fundamental objectives is sustainable development [1]. All products and services have an environmental impact, whether during their production, use or disposal. Product-related environmental policies have tended to

focus on large point sources of pollution, such as industrial emissions or waste management issues. Now it is becoming clear that there is need for a policy that looks at the whole life cycle of a product, including the use phase. In order to avoid the shift of these impacts from one part of life cycle to another, an integrated approach is needed. It should also mean that environmental impacts are addressed at the point in the life cycle where they will best and most cost-effectively reduce the overall environmental impacts and resource use [1].

All of these factors underline the need to introduce a product dimension to environmental policy: the overall quantity of the products is increasing, the variety of products and services is increasing, innovation creates new types of products all the time, products are traded in global market, products and supply chains (behind products) are becoming more complex, the product can be designed perfectly, but inappropriate use and disposal will cause significant environmental impacts and products now involve a greater variety of actors throughout their life- cycle [1].

Policy paper should look at products in a holistic way, involve as many actors as possible and leave to them the responsibility for the choices they make. Also notice, that a product's "life cycle" may refer to the entire life cycle of a product, from creation to disposal, or it may refer to only a subset of the product's life cycle (e.g., only from creation to purchase).

Focus of information and communication point of view is to find the most significant environmental impacts of the supply chain and contribute this way to consumer´s choices. Life cycle and environmental impacts of the product are different in different industrial sectors [2]. Products, like papermaking machine, is good example where the manufacturing phase is only 1 % of the environmental impacts and the rest is coming from the use phase, like energy consumption. Opposite to that, the share of the agriculture is around 70 % of the climate impacts of the entire food supply chain [3, 4].

2 Introduction

Industrial companies use more and more environmental information both in business to business and consumer communication. What are the drivers for the widely increased product level environmental impact assessment and communication? Are the drivers for the all actors of production chain same? Is the main driver legislation or the development of the supply chain or is it the customer

who requires LCA, carbon footprint or the environmental declaration of the product? What are the benefits producing life cycle based environmental information? Furthermore, there are also some challenges in calculating and communicating product level environmental information.

There are some differences between European countries to use LCA information. For example in Italy people has thought that LCA results are too complicated to be communicated to the consumers [5]. On the other hand companies do use LCA already as a basis for external information and more and more exploring ways to use LCA also for marketing. This is also one of the reasons, why such issues as carbon footprint and related labels have been increasing: it makes issue much more understandable when presenting only one, globally most comparable impact category.

In this article our target is to introduce few of the drivers for life cycle based environmental information. The chapter 3 *Drivers and barriers* is about the control system behind industrial activities. For example the driver might be legislation, voluntary environmental management or reporting system or pressure from the market. In the chapter 4 *Industrial case study - experiences from metal and food sector* we focus on our case studies from food and metal industry. Our research results from metal industry are based on research project Environmental Footprint co-operation with two global metal industry companies. In the workshop one of the given tasks was: *"LCA and corporate strategy – what are the business opportunities and benefits?"* We asked this from the point of view of selling and management. From the results of the groups we made some conclusions about the drivers behind LCA and LCM. Results and observations from food sector are based on 10-year experience in Foodchain LCA and respective projects.

3 About drivers and barriers

The traditional way to control industrial activity has been command and control by legislation. The aim of environmental law is to foresee and control harmful environmental impacts. There are number of regulations that prohibit the use of certain substances or set emission limits, for example environmental permits, requirement of the certain technical standards as BAT (Best Available Techniques) or producer´s responsibility for waste. Also, restrictions on land use, like nature reserves, i.e. planning and providing guidance for land use are environmental protection [5].

Behind LCA is no actual legislation. The traditional environmental law has been focused on pollution, emission and prevention of harmful events. It has been more local and conserned the activities of the single plant. There is no legislation for the products and the life cycle of the products. But, producers´ responsibility is one step to that direction. In the next figure 1 (Fig. 1) we demonstrate the situation of traditional legislation and the life cycle of the product and relationships between them.

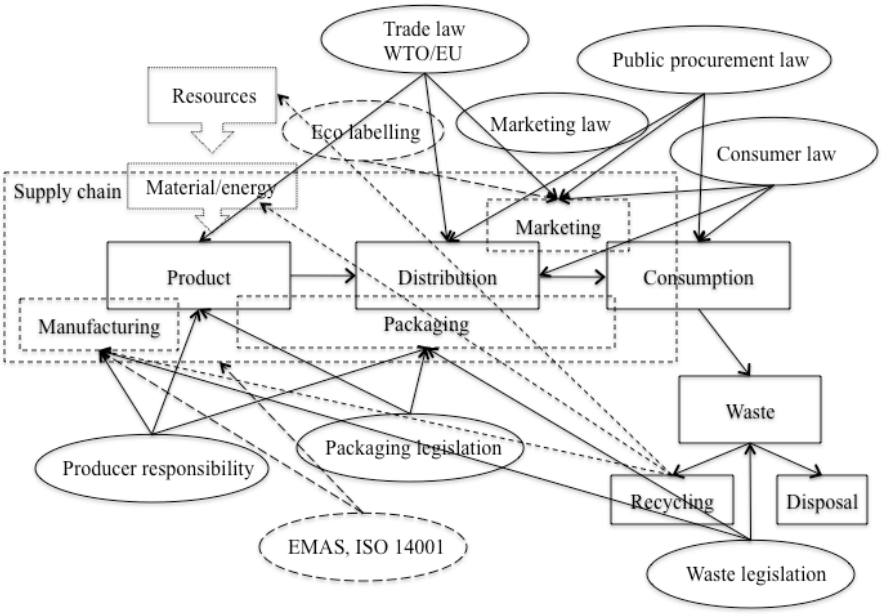

Fig.1: Traditional legislation did not use to influence to product´s life cycle. [6]

However, now there is a law initiative in France to improve the consumer communications, which obligates the producers to give information about their products' environmental impacts (including climate impacts). The first trials are ongoing 2011 and they will cover main consumer products in France.

The authorities also use softer policy instruments than legislation to improve people´s understanding and awareness of environmental issues. The public awareness of environmental issues should be increased through education and special training. Other informative measures such as environmental labelling

attempt to control consumer habits by encouraging consumers to use goods and services that are less harmful to the environment.

Economic and voluntary so called marked-based instruments, like taxes, environmental management systems and reporting, competition for market shares, price of the raw material might be very effective drivers to improve responsibility of the industrial actor to act and make decisions in more environmental friendly ways. Informative instruments, like education, communication, ecolabels, environmental footprints and information material, are aimed at increasing knowledge of environmental issues and understanding the consequences of industrial activities. The categories of these instruments are not so clear. For example reporting might be both voluntary and informative instrument [7].

The term barriers refers to factors which slow down the advancement and act more as obstacle than incentives. The competition law, locality, differences in business culture, or even the best available techniques (BAT) might be a barrier if the consequence of these actions is that development work at a company slows down and they find reasons to delay seeking innovation. The most important barriers for environmental friendly innovations seem to be the investment costs, i.e. the high risk involved in committing capital to unproven technology [7].

Within the supply chain there are many stakeholders, such as auditors, authorities, banks, competitors, insurance companies, the media, politicians and shareholders, that may have an important role and might influence the motives and opportunities to reach environmental improvements. The power structures and incentives involved certainly affect the individual firm. For a company to act, sufficient incentives are needed, often in the form of economic benefits. Also large corporations might have a major impact on their smaller suppliers. It is also important to note that different supply chain actors like raw materials manufacturer, producer of the product, transport company, shipowner and stock entrepreneur, may have different drivers, although the goal and result might be the same. Is legislation the main driver or the development of the supply chain? Is it the customer who requires LCA, carbon footprint or the environmental declaration of the product? What are the reasons and incentives for the actor to be a forerunner or innovator [7]?

Other drivers, like corporate social responsibility, stakeholder pressure, non-governmental organizations and general public pressure, will also affect the final decision. Such pressures have led companies to increasingly accept environmental standards. The reporting practices are also changing in more complex directions

like corporate social responsibility, activities impacting on the environment, consumers, employees, communities, stakeholders and citizens from previously an approach focussing solely on only environmental performance. These issues do act as drivers towards joining industrial ecology networks [8].

In Integrated Product Policy paper [1] includes some tools for improving life-cycle thinking: voluntary agreements, standardisation, environmental management system (EMS), Eco-design (e.g. Eco-design of energy using products EuP), labelling and product declarations, greening public procurement, green technology and legislation (e.g. Waste legislation).

On the July 2008 the commission gave action plan on sustainable production and sustainable industrial policy. They also came out with the proposal for a regulation revising the EU Ecolabel scheme, proposal revising the European Management and Audit Scheme (EMAS), proposal for a revised Eco-design products directive and a communication on the implementation of green public procurement [6].

Business is a key target of the most environmental policies [9,10]. Traditionally environmental legislation has regulated mainly the most polluting manufacturing industries such as pulp and paper and metal. However as the IPP takes the product life cycle as its starting point, the amount of actors targeted increases considerably: instead of large industrial units, the whole product chain from raw materials extraction via manufactures, retailers and consumers to waste management can be made directly or indirectly responsible for the environmental protection.

4 Industrial case study - experiences from metal and food sector

Environmental consciousness seems to be one of the most important reasons for starting LCA. Also the existence of an environmental management system is another supporting factor for LCA. Other important drivers for LCA are product-related environmental problems, cost-saving and other improvement opportunities and emerging green markets. A long-term proactive orientation of companies supports the start of LCA because with LCA the company is able to analyze and describe possible future problems and risks of products [5].

LCA is generally applied to some products but not to all products and it is also mostly used for a few existing products and it is not used for green products only. Also the point of view is more frequently a retrospective way than a prospective one, since LCA is applied more to existing products than to new ones. LCA is not yet used as a routine procedure for product innovation, nor for environmental product innovation in particular [5]. However, businesses that look ahead and actively manage their ecological risks and opportunities can gain a strong competitive advantage. The different environmental footprints are being used to help corporations improve their market foresight, set strategic direction, manage performance and communicate their strengths [11].

Population growth, climate change and a rising standard of living will lead to an increase in the demand for food and to changes in consumption habits [12]. Food accounts roughly for one-third of the environmental impact of Finnish consumers – even more than traffic and housing [13,14]. Water consumption is one of the biggest global environmental challenges. Clean, drinkable water is becoming a scarce resource worldwide. Life cycle thinking may emphasise the environmental impacts of products that have not traditionally been considered as environmental harmful such as food [2,13].

In next table (e.g. Table 1) we have a general view of the drivers for the life-cycle based information. Experiences are from metal industry. The main driver was very clearly money; at first investments and secondly competitive advantage and new business opportunities. Also possibilities were more or less related to business: additional value inter-company and for the customers, possibility to develop the process and increasing the market value.

Tab.1: Life-cycle based information – drivers and possibilities.

Drivers	Possibilities
global pressure	additional value (information)
water consumption	additional value for the customer
energy efficiency	development of the process
material efficiency	stand out from the competitor
saving	good imago and brand
competitive advantage	selling the solution
new business opportunities	competitors are not doing lca
improve the value of the company	
lca fits in the company´s strategy	
increase the market share	

From the point of view of the company the environmental information like LCA is always useful also inside the company. It is a fact that results of LCA cannot easily be applied immediately and that benefits receiving from LCA seem to be long-term ones. It also seems that the benefits depend on the possibility of diffusing results externally [5]. Besides possibilities companies see some challenges and risks to produce more life-cycled based information. (e.g. Table 2)

Tab.2: Life-cycle based information – challenges and risks

Challenges	Risks
measurement	only greening
difficulty to get information from the subcontractor	no one are interested in
different ways to do LCA (definition)	no profit
interest is depending on customer	competitors are not doing lca
profit decreasing	Knowing the problem, but no solution
lack of the rules	
reliability of the information	
boundaries	
understanding through the company	
resource (financial and man-years)	

One of the main challenge and risk is lack of the rules and boundaries. Current (and under development) LCA standards are too generic from the point of view complex modelling and systems and needed practical solutions. Reliable measurements requires both time and expertise. In addition, it is also very important to understand the phenomenon and their significance [15]. Number of databases and LCA tools have been developed in support of management, but challenges still exist.

Concerning food sector in Finland, in the late 1990 and beginning of 2000, the first food sector LCA studies were done more with curious starting point; does the LCA fits in the agriculture and food at all? First food LCA results were not utilised so much in the companies, and companies did not use it for external communication at all. However, already at that time part of the companies realised that results pointed out some specific improvement options. Some of these pilot companies started energy efficiency operations based on LCA and what is even more interesting, some companies realised already 2003, that they have to start thinking to replace some of the animal based raw materials with vegetable based raw materials. Before the project there were no this kind of ideas or objectives in the companies at all.

The next phase of Finnish Foodchain LCA studies (2004-2007) continued e.g. with chicken broiler production. During the project a huge iterative data collection process was conducted meaning hundreds of hours spent with data generation in broiler houses, fodder industry, industrial producers of food and packaging, as well as in logistics and retail companies. People from different cross-functions (production, R&D, marketing, environmental experts, logistics, packaging, management, etc.) were working together in a new way. Additionally, the inventory process of this project pointed out direct improvement possibilities, and a separate spin-off project on energy saving measures in the industrial broiler chicken production. However, these measures did not have big effect on the overall environmental impact of the supply chain. The project strengthened the cooperation between many operators in the chain as well as between industry and research. Finally, the project was probably one of the largest steps for the broiler chicken manufacturer and entire meat company towards modern environmental awareness as well as responsibility in overall in terms of CSR more as strategic issue in business.

The food industrial company Raisio involved in the first Finnish LCA studies between 2000-2003, but results were not published. Until, they realised that environmental issues are becoming more and more important, and consumers are willing to get more information about products and factors behind carbon footprint. In year 2003 they published first LCA results, which were later taken for the basis for first climate label in Finland. Raisio is also the first food company in the world, which add an H2O label to product packaging, indicating the total water consumption of the product [16].

Since then, now 2011, situation has totally changed. Now Finnish food companies are putting carbon labels on their packaging, and almost every bigger company has realised that they have to know better their supply chain, origin of raw materials and related environmental impacts. This is because media and citizen attention has been raised heavily, and responsible company have to, at least, know where and how much the impacts are coming from their products and food chains. Altogether 6 six food companies in Finland are now claiming their product carbon footprints in packaging or at their home pages.

This year 2011, when employees of Raisio were interviewed they acknowledged that 10 years ago, they were more or less by accident, on board with first LCA studies. Nowadays they are learning from all the LCA studies and using the results of LCA to improve production and products. The company has received positive feedback on their climate labels and the sales of labelled product categories have

been increased remarkably. Now when asking what they have been most surprised, they answer that the fact that still so few companies have followed their example, because they realise that they have gained so much positive, in terms of learning, improvements and goodwill with that.

5 Results

Since environmental impacts are closely connected to flows of materials and energy, at least manufacturing companies, it seems very important for the company to encompass life cycle based information to planning, development work and business strategy. So, life cycle -thinking and supply chain management are becoming more and more important. It is not only a question of one product's impacts but of the whole production chain. Responsibility for the impacts of the whole supply chain belongs with all the actors in the chain.

Environmental consciousness is one of the reasons for starting LCA. However, one of the main driver to start LCA-activities seems to be cost savings. Other important driver is product specific environmental discussion, development of production and possible new business opportunities.

Identification of drivers and challenges for the LCA and respective data production in food sector are based on 10 years observations and many interviews along the years within active Finnish food companies and carbon footprint related expert workshops held 2010 in the food sector. All the observations during the last 10 years in food clearly shows that there are now much more needs and expectations to produce and utilise LCA tools.

The one of the major difficulties or challenges for LCA is data collection, quality of data and databases and especially reliability of the data. Another challenges seemed to be a question of system boundaries and allocations. In order to improve the comparability of results, calculation methods and product category rules international standardisation and harmonisation is needed not only in the general LCA standardisation level but also in more practicable product category level, especially now when consumer communication of carbon footprints of food products is becoming common practice worldwide.

6 Conclusions

Earlier environmental policies were focused more on pollution, such as industrial emissions or waste management issues. During the last ten years, the EU has begun to rethink policies relating to the environmental impacts of products. It is becoming clear that the whole production chain and the environmental impacts of the product´s life cycle and environmental impacts of consumption in general and consumption patterns are coming more and more important.

In fact, the challenge today is not lack of information. A key issue is to focus on useful content and deliver it to those who really need it and will get additional value of it to decision-making. Besides traditional formal reporting, environmental information is needed both for the company's own purposes and for the communication and public relations.

On the web pages of the food industrial company are listed the key challenges regarding food and sustainability: customers decide, they need information and small steps matter [17]. The most of these challenges fit also to other industry, especially small steps matter.

7 Acnowledgements

Research funding from the Academy of Finland Ketju Program, Fimecc Oy and MTT Agrifood Research Finland are gratefully acknowledged.

8 References

[1] COM (2003) 302 final, Communication from the Commission to the Council and The European Parliament: Integrated Product Policy, Building on Environmental Life-Cycle Thinking.

[2] Kautto, Petrus, Who holds the reins in Integrated Product Policy. An individual company as a terget of regulation and as policy maker. 2008.

[3] Katajajuuri, J.-M., Silvenius, F., Koivupuro, H.-K., Thun, R., Grönman, K., Soukka, R., Järvi-Kääriäinen, T., Ollila, M., Kuisma, M., Miettinen, O., Pitkänen, H. & Wessman, W., Preventing environmental impacts of products by proper packaging - Conclusions from LCA case studies as main rationale for packaging designer toolbox. Proceedings of the 17th

IAPRI World Conference on Packaging, Scientific Research Publishing, USA 2010: 480-483.

[4] Gröönroos, J., Seppälä, J., Maatalouden tuotantotavat ja ympäristö (Agricultural production systems and the environment), Helsinki. Suomen ympäristökeskus. Suomen ympäristö 431. 2000.

[5] Frankl, P.; Rubik, F., Life-cycle assessment (LCA) in business an overview on dirvers, applications, issues and future perspectives, Global Nest: the Int.. J. Vol 1, No 3, pp.185-194, 1999.

[6] Ekroos, Ari, Environmental Footprint, Workshop for metal industry 4.11.2010.

[7] Pajunen, N., Wierink, M.,Watkins, G., Heiskanen, K., Drivers and barriers for effective industrial material use. Sustainability through Resource Conservation and Recycling '11 Conference article, May 10th to 13th 2011.

[8] Salmi, O., Hukkinen J., Heino J., Pajunen, M., Wierink, M., Governing the interplay between industrial symbiosis and environmental regulation: the case of the Gulf of Bothnia heavy industries in Finland and Sweden. Journal of Industrial Ecology, In Press. 2011.

[9] Coen, D., Grant, W., Managing business and Government Relations. In Coen, D. and Grant, W. (eds.), Business and Government: Methods and Practise. Opladen and Farmington Hills: Barbara Budrich Publishers, pp.13-31. 2006.

[10] Radaelli, C. M., Whither better regulation for the Lisbon agenda? Journal of European Public Policy 14(2): 190-207. 2007.

[11] <http://www.footprintnetwork.org/en/index.php/GFN/page/footprint_for_business/> (Accessed 07.04.2011).

[12] Ammenberg, Jonas and Sundin, Erik: Products in environmental management systems: drivers, barriers and experiences, Journal of Cleaner Production, on May 2003.

[13] Seppälä, J., Mäenpää, I., Koskela, S., Mattila, T., Nissinen, A., Katajajuuri, J.-M., Härmä, T., Korhonen, M.-R., Saarinen, M. & Virtanen, Y., Environmental impacts of national material flows. SY20/2009 Suomen kansantalouden materiaalivirtojen ympäristövaikutusten arviointi ENVIMAT-mallilla. Suomen ympäristö 20/2009, 134 s. Suomen ympäristökeskus (SYKE). URN:ISBN:978-952-11-3460-9, ISBN 978-952-11-3460-9 (PDF). ISBN 978-952-11-3459-3. 2009.

[14] Katajajuuri, J.-M., Environmental impacts of different food products and their contribution to the environmental impacts of consumption. Abstract book of 4th International Conference on Life Cycle Management LCM. University of Cape Town. pp. 21-22. 2009. <http://www.lcm2009.org/Abstracts.pdf>, (Accessed 04.04.2011).

[15] Haijanen, J. ja Kanerva, T., Ympäristöraportoinnin haasteet, BAT-EMAS Ajankohtaiskatsaus 2008.

[16] < http://www.raisio.com/www/page/2440 >, (Accessed 04.04.2011).

[17] < http://www.raisio.com/www/page/2400>, (Accessed 04.04.2011).