Third Conference on Degrowth, Ecological Sustainability and Social Equity
September 19-23th 2012, Venezia
Working group 16. Degrowth and/or sustainable human development

Future Sustainable Innovation: The "+Zero" Indicator

Sabina Scarpellini - University of Zaragoza (Spain) / CIRCE Research Center for Energy Resources and Consumption
Miguel Marco - CIRCE (Spain)
Jesus Valero - CIRCE (Spain)
Francesca Salviato – FISAC CGIL Venezia (Italy)

Keywords: *SUSTAINABILITY - INDICATORS - INDUSTRIES – DEGROWTH - INNOVATION – RESEARCH INSTITUTES*

Abstract

Is it possible to de-growth through the promotion of eco-innovation for a sustainable human development?

Given the internationalization of innovation forced to respond to the need for resources, this paper proposes a system of indicators in order to measure the impact of innovation projects, processes and investments for a future sustainable growth or a "degrowth-innovation".

Eco-innovation related activities have been classified, analyzed and measured through a set of balanced indicators in order to define a multi-criterion indicator system, called "+ Zero". The results of the application of the proposed indicator are explained in order to identify projects and innovations able to balance the company's competitiveness, the environmental improvements and the social needs.

As case study, the "+Zero" system of indicators has been applied to different activities carried out by research institutes and in order to validate the methodology and different technologies have been analyzed. In this sense, eco-innovation can have a critical role in the sustainability of the planet. The use of specific indicators in needed in order to analyze and evaluate the future potential effect of the innovative measures once they have been introduced in processes and products.

The "+Zero" indicators will enable industry in a more long-term vision based on eco-innovation criteria being encouraged to obtain a "zero, but positive growth" maintaining the balanced business for a sustainable quality of life.

1-. Introduction

It was evident decades ago that many of the current environmental problems are due to the fact that resources are scarce [Samuelson and Nordhaus 1985] and it would be erroneous to think that sustainability is a "social" problem that does not concern the economy [Fussler and James 1998].

In this sense it is necessary to advocate the defence of economic growth that is ecologically compatible and based on productive transformations that limit the expansion of the economic subsystem without undermining the integrity of the environment that sustains it. As highlighted by [Ehrenfeld 2005] the big changes facing the planet earth may be such that gradual improvements to our productive system could be not only highly limited, but also too late [Ehrenfeld 2008]. In fact, due to the so-called "rebound effect" [Shipper 2000] the technological improvements in terms of efficiency result in an increase in activity. To decouple economic growth from environmental degradation it is a priority. A sustainable civilization does not meant a primitive society. On contrary, it can be a society based on advanced technology [Naredo and Valero 1999].

The last decades of global economic and industrial development at an ever increasing scale, and its consequences in terms of environmental and social impact, have recently become one of the major concerns of developed countries, and, especially for European Union members.

In facts, sustainable innovation became one of the European Union's priorities before the economic crisis and, in the last years, the European Lead Market Initiative (LMI) (7 European Commission 2007) recognised it as a promising area, promoting the Eco-Innovation Observatory (EIO) [8 European Commission 2010) launching the "Eco-Innovation" Program [9 European Commission 2011], the Directive 2009/125/EC on ecological design applicable to energy-related products and the ecological innovation guidelines [European Commission 2011.a] as well as other initiatives [European Commission 2006 12]. Nevertheless, it can be stated that in the EU there is still a lack of investment in all issues related to eco-innovation. According to Bleischwitz 2009 "turning the EU budget green shall be the basis for accelerating eco-innovation".

For our analysis, eco-innovation is "all innovation based on and striving for eco-efficiency" according to the principles of the Brundtland Report [1987] and taking into account social aspects as well. The problem arises precisely when measuring the eco-innovation impacts because the evaluation of investments in eco-innovation may be different as the considered as main criteria is the environmental impact, the economic value or the social impact.

In summary, we can consider that eco-innovation is one of the direction to make progress towards a sustainable innovation promoting a green economy and degrowth, as well as a sustainable life from the social point of view. Many public and private actors seem to share this common point of view and agreement on the benefits of implementing eco-innovation for a green economy. If this is the case, why eco-innovative activities are still exceptional and exemplary instead of being the usual reasoning and inspiring driver for all kind of actions?

2-. Choices in Priority and Measurement

It must be noted that, in general terms, eco-innovation could be measured like any other innovation process. Nevertheless eco-efficiency's intrinsic components bring about the fact that social, environmental and economic indicators must be considered simultaneously, which complicates the measurement systems to be used. Moreover, the effects can expand the scope to several decades or even centuries and to various economic and social sectors and often provide qualitative effects for other parallel activities.

The indicators currently available for the activity of innovation are not particularly indicated for measuring progress in sustainable innovation in the private sector and, in particular, in SMEs, which shows the lack of measurement in this area, which implies limit the use of the sustainable development indicators to their economic and environmental dimensions, disassociating social aspects.

At present, there is a generalized tendency to limit the measurements of the different factors in pairs using indicators, measuring mostly economic and environmental

dimensions, disassociating social aspects and disaggregating the problem. As an example, considering the ratio between the economic value of a product or services and the environmental impact caused by them [Huppes and Ishikawa 2005] we can evaluate the relation between economic and environmental factors. However, it can be clearly seen that, as social factors are particularly hard to separate, a deep analysis has to be developed for each specific technology, product and process in order to aggregate all fundamental factors of the analysis.

In terms of eco-innovation, we could focus the analysis depending on the dimension and the factor that is considered as a priority, outlined as follow:

FOCUS ➔	Social Priority	Economical Priority	Environmental Priority
FACTORS🡻			
Social		Economy vs. Social	Environmental vs. Social
Economy	Social vs. Economy		Environmental vs. Economy
Environmental	Social vs. Environmental	Economy vs. Environmental	

Table 1. Choice in Priority of Eco-innovation Factors

It has to be taken into account that the scenario for eco-innovation is defined, without doubt, by its intrinsic goal of "achieving the implementation of innovation". For eco-innovation it means to prioritize investments in order to pursue maximum profits considering social and environmental aspects as well. Another important aspect of Innovation is that it requires the initiatives of private sector, where the economic dimension has to take into account for any investment. This means that, in a new "green" dimension of economy, private investors have to consider also the other factors together with the benefit, as they are determinant for social sustainability and degrowth.

In this context an adequate and specific measurement system can be the key in order to change the mentality and obtain the "zero" growing but based into a "positive perception of the change" by population and private companies.

When making any measurement in this field, it must be taken into consideration that many of the actions for implementing eco-innovation will have a direct or indirect

impact over time, beyond what can be measured with results indicators. As Lozano (2008) proposed, a new way of depicting sustainability is needed. The effects can expand their scope to up to several decades or even centuries and to various economic and social sectors and often provide qualitative effects for other parallel activities.
Changes of habits and production systems, the reduction in emissions, etc., and all actions that the measurement of the socioeconomic effect of investigation entails are particularly hard to quantify, and while investment in R&D and innovation can be measured (although is not exempt from interpretations that limit its reliability as far as the classification of activities is concerned), determining the relationship between activities and investments made and the future results it leads to, in terms of degrowth, is a highly complex task (Löhr, 2010; O'Neill, 2010 and Alcott, 2010).

The main obstacles to the correct evaluation of progress in eco-efficiency stem from the fact that there are external factors that directly affect the success of the actions, such as the moment it occurs, the marketing times, the periods to achieve an economic return on a new product or service (Palmberg, 2006), etc. In this sense, the evaluation systems commonly used in the current situation for R&D and innovation actions are inappropriate to quantify the effort and the effects of eco-innovation in companies.

For eco-innovation, it is actually a priority to analyse the difficulties faced (Murillo-Luna et al., 2011) and the deciding factors for its implementation, both in industry and SMEs, that are not equally defining in typical R&D activity, such as for example the organisational capacities of companies, the focus on the users of their production system, the yield of accounts by means of corporate social responsibility reports, the capacity for planning and analysis of the environmental opportunity costs or the familiarity with the mechanisms of increased demand arising from social requirements in terms of product sustainability (Fussler and James, 1999). It is necessary to measure the challenge to create a 'win-win' solution, or to at least handle more optimally any trade-offs that arise, makes proficient groundwork arguably even more crucial for management of environmental new product development (Devashish, 2004).

Currently we have methods to conceive eco-innovative products that can be partially measured, like the ones suggested by Justel-Lozano (2008), indicators designed for this purpose (Horbach and Rennings, 2007) or other specific studies related to the subject

(OECD, 2009). For instance, Foxton and Pearson (2008) offer the adaptation of innovation systems theory and its indicators to the measurement of eco-innovation However, when we are trying to measure the efficiency of the activities aimed at implementing innovative solutions based on the principles of eco-efficiency, it can be clearly seen that there are some process factors that are particularly hard to separate, from a qualitative point of view, although this is done with efficiency output indicators when, in the majority of cases, the social aspects from a comprehensive perspective are no taken into account.

It is necessary to obtain a balance between economic efficiency and social welfare in terms of eco-innovation (Kondo, 2001) without forgetting the external environmental factors of the process (de Burgos and Céspedes, 2001). From here the need arises for macro-indicators and meso-indicators capable of providing complete measurements that simultaneously take into consideration the economic, environmental and social aspects, without overlooking the problems generated by global technology spillovers in the innovation process (Watanabe, 2001).

4-. Methodology and Case Study

The main aim of the work was to launch a dynamic instrument that can make a substantial difference regarding the information provided by the existing measurement systems and demonstrate the level of "pro-activity" in eco-innovation, considering the "+Zero" as an "idea" able to change in positive the participation of all the involved parties in which is applied.

The methodology of design and implementation of the instrument was developed in 4 different phases that can be synthesised as follows:

- PHASE I- Classification of the specific activities in an eco-innovation implementation process.
- PHASE II - Analysis and definition of specific indicators for the measurement of eco-innovation activities.
- PHASE III – Selection of a set of indicators that can be balanced
- PHASE IV - Analysis and measurement of different innovation projects and new technologies that are enhanced for eco-innovation for obtaining the most balanced result of growth.

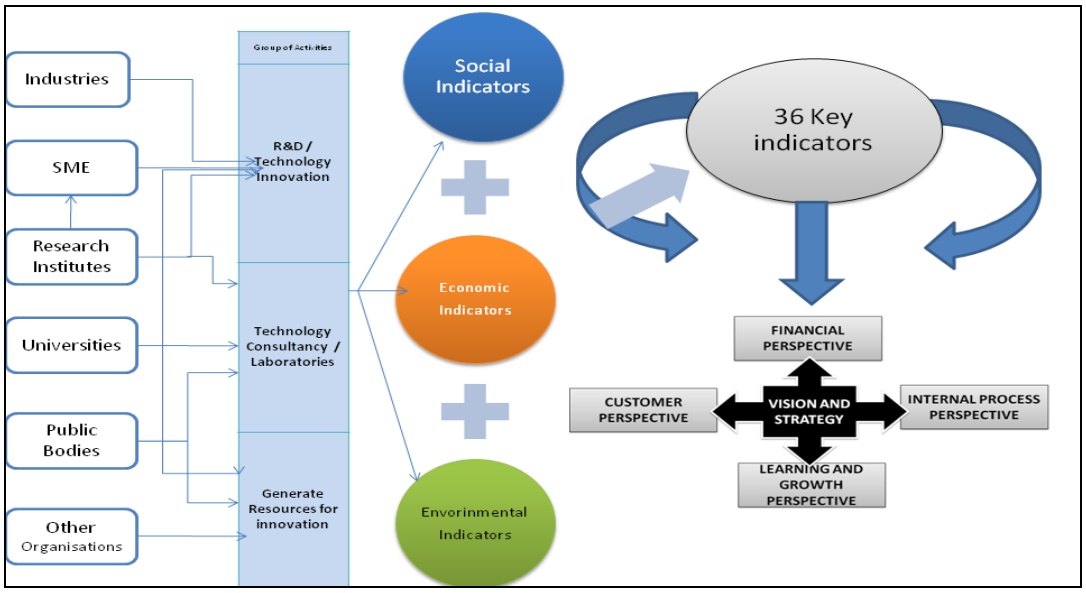

Figure 1: Methodology Phases (Authors compilation)

Once the types of organisations and the most frequent activities carried out for the implementation of eco-innovation have been classified, in view of subsequent selection, indicators for each of the aspects to be measured are considered: Social, Environmental and Economic.

As a case study, the measurement system designed based on a deep analysis of the 98 Spanish Research Institutes registered in 2009.

Based on the described methodology **36 KEY INDICATORS** were selected in order to measure the eco-innovation activities, organised in three categories (12 environmental indicators; 12 economic and 12 social) synthesised in the following table:

Innovation process STAGES	Group of activities	Main Activities for Eco-innovation	CLIENT Private Companies	CLIENT Public Administrations	OWN ACT. Research Centre
Know-How Generation or Acquisition	R&D and Technology Innovation	1- R&D&I of incremental Eco-Innovation – WASTE	ME01	MA01	EC01
		2- R&D&I of incremental Eco-Innovation - RESOURCES	ME02	MA02	MC02
		3 - R&D&I Disruptive Eco-Innovation - PRODUCTION	ME03	MA03	MC03
		4- Actions to promote Innovative technology	EE04	SA04	EC04
Implementation on Process, products and Services		5-Demostration advanced eco-innovation technology		EA05	EC05
	Technology Consultancy, Laboratories	6-Support on innovation strategy and technology planning	EE06	EA06	EC06
		7- Design and measurement products and processes	ME07		
		8- Experimental laboratories		SA08	MC08
		9- Fostering collaborative working environment		SA09	EC09
Management		10- Supporting eco-innovation management	SE10		
	Generate Resources for Innovation	11- Technology surveillance	EE11	SA11	EC11
		12- Human Resources training in processes and innovation	SE12	MA12	
Marketing		13- Participation in investment (spin-off)	EE13	EA13	EC13
		14- Spread knowledge for eco-innovation	SE14	EA14	MC14
		15- Encourage creativity and entrepreneurial spirit	SE15		EC15

Table 2: Indicators allocation per clients and innovation process stages (Authors' compilation)

In the previous tables, analysing the relationships according to groups of beneficiaries and typologies of the selected indicators for each phase and activity of the innovation process, you can see the basic differences between the environmental (initial letter "M"

in the indicator code and white background), economic (initial letter "E" in the indicator code and grey background) and social measurements (initial letter "Y" in the indicator code and striped background). The 36 key indicators selected are divided between the three aspects of the eco-efficiency process to be measured simultaneously, as can be observed in the following table:

36 Key Eco-innovation indicators		
Environmental Indicators	**Social Indicators**	**Economic Indicators**
ME01	SA04	EC01
MA01	SC04	EE04
ME02	SC06	EA05
MA02	SA08	EC05
MC02	SA09	EE06
ME03	SC09	EA06
MA03	SE10	EE11
MC03	SA11	EC11
ME07	SE12	EE13
MC08	SE14	EC13
MA12	SE15	EA14
MC14	SC15	EA15

Table 3: Indicators classification (Authors compilation)

This scheme allows selecting for each analysis a specific set of indicators balancing the three kinds of metrics, or using all of them in order to compare different projects or technologies. The final result of the application of this method (expressed in % terms) is called "+Zero" because the three principal aspects of sustainable development are balanced in order to get an average of zero as a "positive" result, instead of looking for a continuous growth.

This instrument, in the specific application to the case study, has direct benefits for its companies and for the public administration, as well as indirect benefits for society in general, as the R&D Centers act as eco-innovation vectors once their mission and strategy is correctly focused.

Some general considerations gathered throughout the design and implementation of the instrument can be synthesised as follows:

- A simplified measurement system based on a short list of 36 indicators can be of great use as it provides an image of the impact caused, in terms of eco-efficiency, in the current system of R&D and innovation, providing agents with

comparable data useful for defining objectives and priorities and monitoring of progress over time.

- Eco-efficiency must be included in the main objectives of Governments and represent a pillar of the sustainable growth, especially in SMEs.
- It is necessary to implement specific education and training plans for managers, directors, technical staff and technicians to transform the staff's way of thinking in the industries.
- It would be useful if the R&D Centers were to implement specific plans to promote eco-innovation aimed especially at SMEs.

In the implementation stage, the application of the described eco-innovation balanced scorecard demonstrates its utility on three different levels:

- For the industries, in the promotion of a long-term view that allows them to keep their competitiveness according to eco-efficiency criteria in a global market.
- For the public administrations, providing an accurate image of the complex regional systems of Science, Technology and Society, serving the policy makers when making decisions about R&D and innovation strategy for the implementation of eco-innovation.
- For the very organisations where it is implemented, the Research and Technology Institutes in the case study, in the definition of their focus for their positioning in a global system of R&D and innovation that requires them to respond to the decentralisation of innovation processes, the dissemination of information in an environment of "open science", and the demand for technological resources in the territory.

Having a complete image of the actions to carry out and of the results to achieve for each of the activities of the process is not enough if we do not have a measurement system that permits the measurement of the three aspects of eco-efficient innovation for a "degrowth": social, economic and environmental.

5-. Conclusions

Innovation is the way for changing the society, the economy rules and the planet status. Due to the complexity of the implementation of technological solutions based on eco-innovation and to the long temporary perspective of degrowth, the processes must be

analysed in their full complexity so that all the organisations include in their plan not only short- and medium-term objectives in response to demand, but also a "long-term conceptual vision" promoting eco-efficiency in all their actions, projects and investments.

The final goal of the Plus Zero indicators' system proposed is to arise for a quantitative and qualitative measurement which allows us to identify the following aspects:

- HOW and HOW MUCH can companies "eco-innovate" depending on the nature of the activities and projects carried out and the beneficiaries/clients to whom they are aimed?
- HOW and TO WHAT EXTENT can we bring down the barriers that currently hinder the implementation of green economy and degrowth in the companies?
- HOW can the different activities carried out in the complex process of changing the paradigm can be measured?

In this sense, the instrument described is mainly designed to making long-term decisions and its implementation is considered a priority due to its economic accessibility, ease of handling and measurement efficiency, providing a simplified view of the performance of all kind of organisations in terms of eco-efficiency.

Society as a whole is responsible for degrowth and the implementation of a new mentality about innovation. Going in depth into the reasons why eco-innovation techniques are not broadly spread, the main one is the lack of internalization of this attitude in all the everyday actions taken by companies and employees, for instance in the form of Social Responsibility.

Nevertheless, there is a disconnection about the public opinion in terms of eco-innovation and the technological measures implemented by industries. In order to overcome this disconnection, increasing opportunities for sustainable eco-innovation projects we formulated a "+zero growth indicators system".

6-. References

Alcott, B. 2010. Degrowth and unemployment: Guaranteed jobs? 2nd Conference on Economic Degrowth. Barcelona.

Archibugi, D., Pianta, M. 1996. Measuring technological through patents and innovation surveys. *Technovation,* 16(9) (1996) 451-468.

Armbruster, H., Bikfalvi, A. Kinkel, S., Lay, G. 2008. Organizational innovation: The challenge of measuring non-technical innovation in large-scale surveys. *Technovation* (2008) Volume: 28, Issue: 10, Pages: 644-657

Barge, A., Santamaría, L., Modrego, A. 2008. *Complementarities between universities and technology institutes. New lessons and perspectives.* DRUID Conference. Copenhagen, Denmark. http://www2.druid.dk/conferences/viewpaper.php?id=3352&cf=29. Accessed 16 May 2008.

Bleischwitz, R.2009. Eco-innovation - putting the EU on the path to a resource and energy efficient economy, Wuppertal Institute. MPRA Paper No. 19939. http://mpra.ub.uni-muenchen.de/19939/ (Accessed 04.11)

Chun-hsien, W.,Iuan-yuan, L.,Chie-bein, C. 2008. Evaluating firm technological innovation capability under uncertainty. *Technovation*. Vol. 28 (6) (2008) pp.349.

De Burgos J., Céspedes J. 2001. Environmental performance as an operations objective. *International Journal of Operations & Production Management*, Vol. 21 Iss: 12, pp.1553 – 1572

Devashish P. 2006, Eco-innovation and new product development: understanding the influences on market performance. Technovation Volume 26, Issue 1, January 2006, Pages 76-85

Ehrenfeld, J. 2005 Eco-efficiency: Philosophy, Theory, and Practice, Journal of Industrial Ecology, Vol. 9, pp 6-8.

Ehrenfeld, J.2008. Sustainability by design: a subversive strategy for transforming our consumer culture, Yale University Press.

European Commission 2007. Innovation: A Lead Market Initiative For Europe, http://ec.europa.eu/enterprise/policies/innovation/policy/lead-market-initiative/index_en.htm#h2-what-is-a-lead-market? (Accessed 04.11)

European Commission 2010. http://www.europe-innova.eu/web/guest/eco-innovation-observatory/overview (Accessed 04.11)

European Commission 2011. Environmental-Ecoinnovation Programme 2011 http://ec.europa.eu/environment/etap/ecoinnovation (Accessed 04.11)

European Commission 2011.Official Journal of the European Union, 2008/C 82/01, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2008:082:0001:0033:EN:PDF (Accessed 04.11)

European Commission. 2006. Towards a more effective use of tax incentives in favour of R&D, COM(2006) 728 final.

European Parliament 2009. Directive 2009/125/EC http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:285:0010:0035:en:PDF (Accessed 04.11)

Fussler, C. and James, P. 1998 Eco-Innovación. Integrando el medio ambiente en la empresa del futuro, Ed. Mundiprensa, Madrid.

Hoecht, A.,Trott, P. 2006. Innovation risks of strategic outsourcing*. Technovation* Vol. 26 (5) (2006) pp.672-681.

Huppes, G. Ishikawa, M. 2005. Eco-efficiency and Its Terminology. *Journal of Industrial Ecology* Volume 9, Number 4.

Huppes, G., Ishikawa, M.2005. Eco-efficiency and its terminology, Journal of Industrial Ecology, Vol. 9, No. 4., pp 43-46.

Justel, D. y Lozano, 2008. *Metodología para la eco-innovación en el diseño para desensamblado de productos industriales. Departamento de Ingeniería de Sistemas Industriales y Diseño*. Universidad Jaume I (2008)

Karlsson, M.,Trygg, L.,Elfstrom, B.O. 2004. Measuring R&D productivity: complementing the picture by focusing on research activities. *Technovation* Vol. 24 (3) (2004) pp.179-186.

Löhr, D.2010. Zero growth and zero interested rate: The revival of an old idea. 2nd Conference on Economic Degrowth. Barcelona.

Naredo, J. M. and Valero, A. 1999. Desarrollo económico y deterioro ecológico, Ed. Visor, Madrid.

O´Neill, D.W. 2010. Measuring Progress: Indicators for Degrowth. 2nd Conference on Economic Degrowth. Barcelona.

Palmberg, C. 2006. The sources and success of innovations -Determinants of commercialisation and break-even times. Technovation Vol. 26 (11) (2006) pp.1253-1267.

Reinders, M., Frambach R., Schoormans J. 2010. Using Product Bundling to Facilitate the Adoption Process of Radical Innovations†. *Journal of Product Innovation Management* - Volume 27, Issue 7, pages 1127–1140.

Reiner, R. 2006 *Eco-Innovation in Europe*. Innova Workshop "Lead Markets and Innovation" June 29th, 2006, Munich, Germany archive.europe-innova.eu/servlet/Doc?cid=6020&lg=EN (checked in March 2011)

Samuelson, P. A. and Nordhaus, W.D. 1985. Economics, NY, McGraw-Hill.

Shipper, L. 2000. On the rebound: the interaction of energy efficiency, energy use and economy activity. An Introduction, Energy Policy, Vol. 28, pp 351-353.

Watanabe C., Zhu B., Griffy-Brown C., Asgari B., 2001. Global technology spillover and its impact on industry's R&D strategies. *Technovation* Volume 21, Issue 5, May 2001, Pages 281-291

WCED United Nations World Commission on Environment and Development. 1987. Our Common Future, Chapter2: Towards Sustainable Development (also known as the Brundtland Report) .Annex to General Assembly document A/42/427. http://www.un-documents.net/ocf-02.htm (Accessed 04.11)