

European Commission

DG Research 1.3.

*Strengthening the role of R&D in boosting
eco-innovation and eco-efficiency*

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**Need of indicators to monitor
progresses towards a 'green(er)
economy'**

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Why to monitor/measure?

From the background paper:

- 'Policy demand' for 'green' and 'eco' is running **faster than** measurement capacity

⇒ Weak basis for 'selection' and 'incentives' by policy

⇒ Risk of misallocating support to all allegedly green/greener/eco products

Why to monitor/measure?

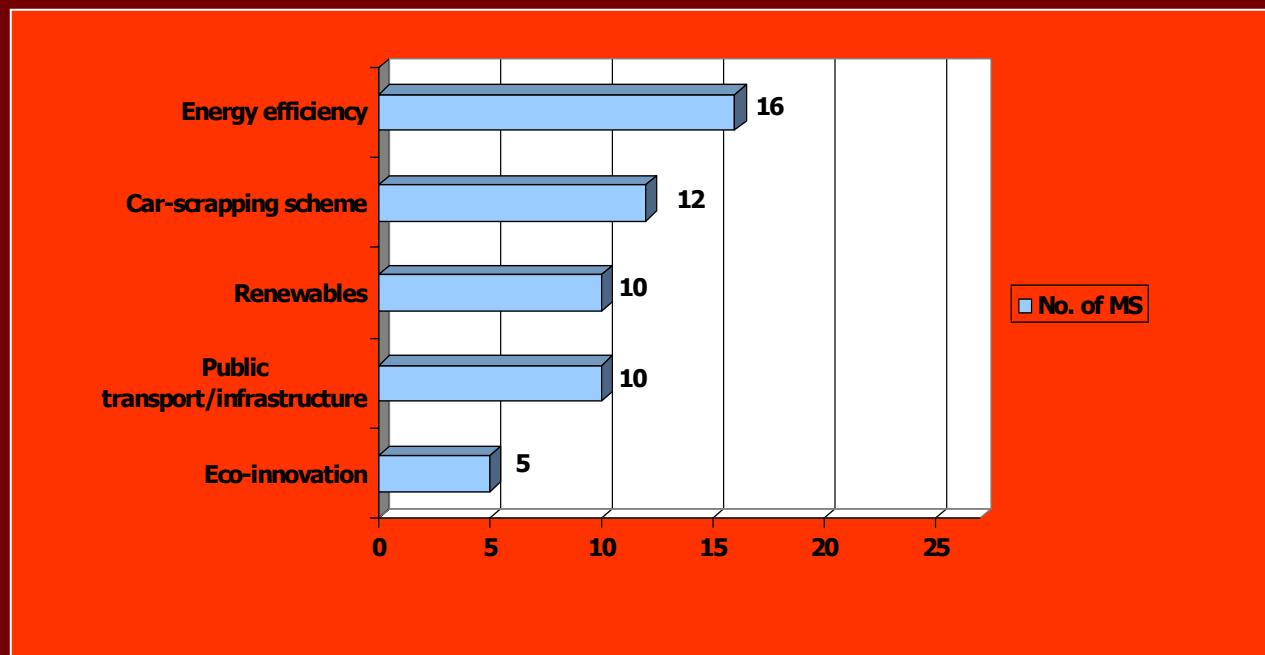
1. Crisis, 'green growth', Green recovery packages

- **'Green economy/growth'**: A different social model (bottom-up) or a direction of economic policy (top-down)?
- **Crisis**: High-level political demand of 'green'-'greener'-'low-carbon' investments/products:
 - EERP 2008
 - OECD countries Declaration on Green Growth
- **'Green recovery packages'**: difficult to detect what is green or not, and true environmental impact of measures

Why to monitor/measure?

1. Crisis, 'green growth', Green recovery packages

- Makela (2009): "green measures" in RPs: energy efficiency, infrastructure/public transport, renewable energy, car scrapping schemes and eco-innovation
- Greenness difficult to analyse, lack of detailed information, no single definition of green measures, etc.



Green measures" adopted in EU recovery packages (number of adopting Member States by type of measure) (Makela, 2009)

Why to monitor/measure?

1. Crisis, 'green growth', Green recovery packages

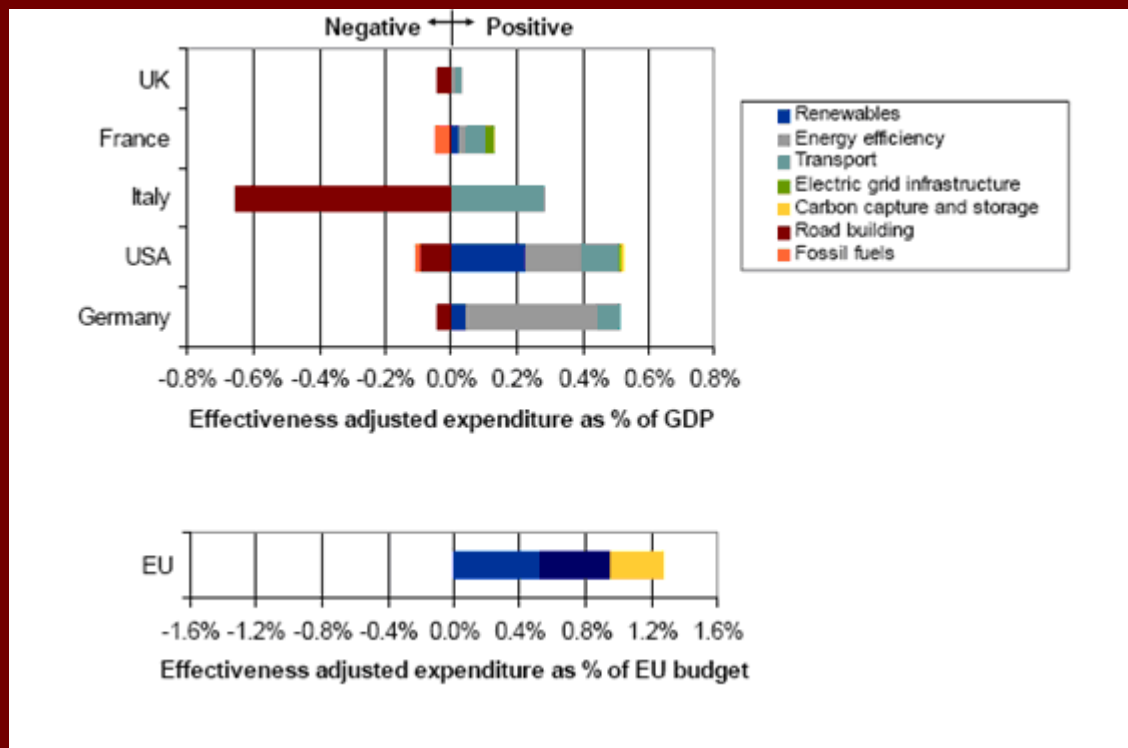
- Elaborating on data from Saha and von Weizsäcker (2009):
 - “Environmentally sensitive” measures (potential positive or negative environmental impacts, e.g. infrastructures): up to 40%-80% of total RPs funds
 - Unambiguous or “explicit green measures”: max 5% of total RPs funds (countries considered)
 - Community level: explicit ‘green measures’ 27% of extra spending and 42% of extra credit

- Various open question on ‘green-ness’:
 - E.g. Are car scrapping schemes ‘green measures’? Strong public support
 - E.g. Is CCS really green? Old-minded engineering solution, high infrastructural burden ... Strong public support

Why to monitor/measure?

1. Crisis, recovery packages, green growth

- Germanwatch and Ecofys (2009): EU countries recovery packages with “effectiveness factors” in term of CC
- Effectiveness factors positive (e.g. renewable energy) and negative (e.g. roads)
- “Effectiveness weighted measures”: potential environmental impact of funds allocation
- *Authors stress: very preliminary, information base uncertain Too rough*



Why to monitor/measure?

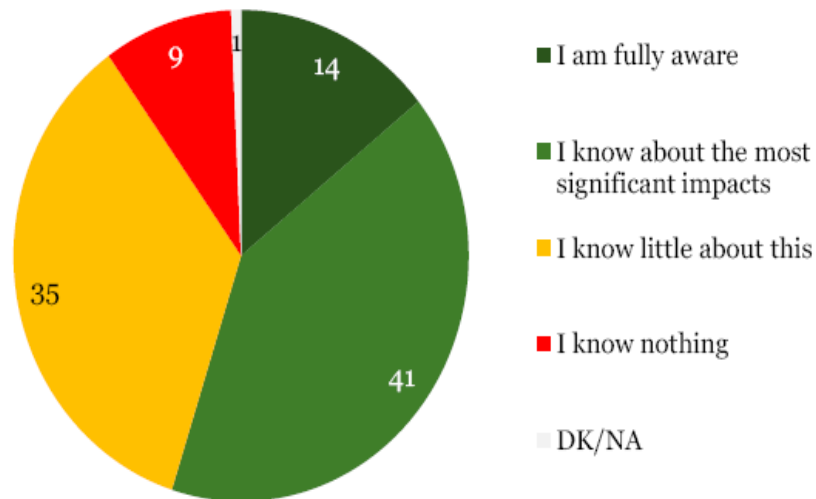
2. Green consumption *(or protecting the Consumer)*

- Growing consumer demand for 'green products' + Growing marketing on 'green attributes' (e.g. 'Zero CO₂')
- Towards a new mass-level, public knowledge (and beliefs) driving mass behaviours
- 'Asymmetric information': Risk of confusing/deviating/disappointing the consumer
- Reliability of green-ness an open issue in the SCP process

Why to monitor/measure?

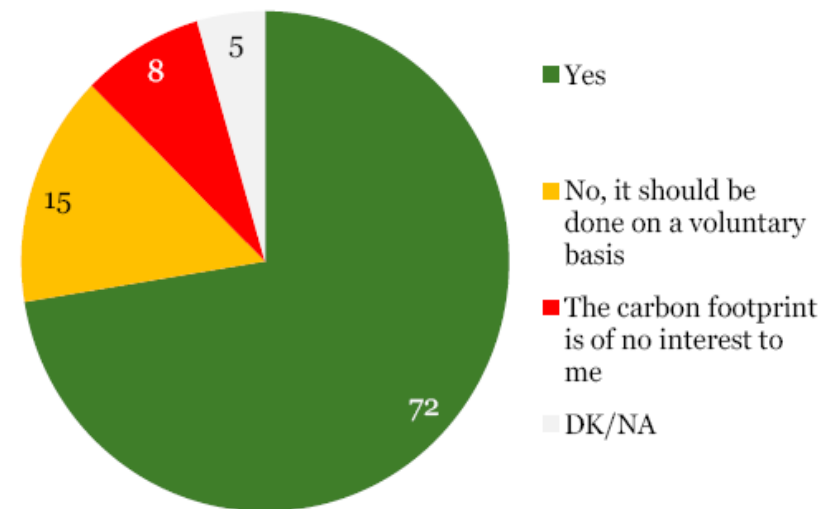
Eurobarometer, Europeans' attitudes towards the issue of sustainable consumption and production, Analytical report, 2009

Awareness about the environmental impact of products bought or used



Q1. In general, how much do you know about the environmental impact of the products you buy and use?
Base: all respondents, % EU27

Should a label indicating a product's carbon footprint be mandatory?



Q5. Should a label indicating the carbon footprint of a product be mandatory in the future?
Base: all respondents, % EU27

How to monitor/measure?

Background paper + 'SECTORAL INNOVATION WATCH IN EUROPE. ECO-INNOVATION FINAL REPORT', MAY 2008

- *"Recent EU funded studies on eco-innovation measurement methods **have not produced a fully-fledged methodological approach** (see CML et al. 2008, UNU-MERIT et al 2008)."*
- *"It is argued that in general **the knowledge base for eco-innovation is insufficient to develop policy**. One of the reasons for this is that eco-innovation has not been recognised as an official 'sector' or a policy field and as such has not benefited from the tailored approaches in indicator development process (UNU-MERIT et al 2008)."*
- *"In general, the authors underline the need to **further develop indicators and statistical systems in order to allow a more in-depth analysis of eco-innovation**. Similarly, in its most recent report on monitoring EU sustainable development strategy, EUROSTAT (2007) lists **indicator on 'eco-innovations' among a list of indicators 'to be developed'**."*

How to monitor/measure?

Limits of empirical indicators

- **Micro-level: Same issues as innovation *tout court***
- Mostly traditional/conventional indicators of '(eco-) innovation making', and propensity to invent/innovate
 - Inputs: E.g. Eurostat data on R&D by NABS
 - Most countries no data E.g. Total intramural R&D expenditure (GERD) by sectors of performance and fields of science (rd_e_gerdsc)
 - Outputs: OECD work on eco-patents
 - Selection criteria based on patents classes and massive examination of individual patents
 - Useful for understanding determinants and policy effects in target sectors
 - **Limits:** no information on impacts in application/diffusion, mostly useful in research policy
- **Macro/meso-efficiency indicators** (e.g. changing energy/material intensity)
 - Can capture ex-post system-level effects, including diffusion
 - **Limits:** very general, co-causation issues, limited use for policies (only strategic level)

Micro-level indicators: A shift in perspective

Need:

Measures/indicators usable in policies as a reliable basis for selection, discrimination, incentives

Response:

**From taxonomical measures guided by
'signals'**

- 'Nominal' attributes (e.g. some analyses on patents)
- 'Intentionality' (e.g. explicit aim of the inventor/innovator)
- Reference to specific 'sectors' (e.g. waste, RES)
- Existence of 'direct' impacts (e.g. air emissions)

Micro-level indicators: A shift in perspective

..... to measures of *substantive eco-attributes of all innovations* in a 'functional system of use' perspective

- 1. 'Eco-ness': a matter of degree of **all innovations**
 - No taxonomical or ex ante restrictions of scope (sectors, aims, etc.)

⇒ **Indicators/measures of 'Eco-ness' degree, based on the evolving state of knowledge**

⇒ **Key issue: *Certainty of impacts***

- Measurable *reductions* of *all* specific environmental impacts, compared to 'reference' processes/products, in a state-of-the-art 'cradle to grave' (LCA) perspective
- Extensive on-going research on scientific/technical grounds (*see background paper*)

Micro-level indicators: A shift in perspective

..... to measures of substantive eco-attributes of all innovations in a 'Functional system of use' perspective

- 2. In policy perspective: **eco-impacts in use more important than specific eco-attributes of single new product/processes**
 - Beyond narrow 'innovation-making' process indicators
 - Towards meso-level indicators for broader 'use systems'

⇒ Eco-attribute inside 'Functional systems' of use', in a 'Socio-technical dimension'

2. Socio-technical dimension in Functional systems of use

***Well-known features relevant for eco-efficiency impacts
(economics and sociology of innovation)***

- All technologies/innovations have **direct and indirect** (environmental) implications: Indirect often > important than direct, revealed in use
- All technologies **embedded in 'functional systems'** of use together with other technologies/knowledge: strong **complementarity** even in a 'substitution' framework
- **Inertia**: (in-)efficiency embodied in long-lived capital and infrastructural systems
- Many impacts **unexpected**, revealed by experience in use
- **Diversity/plurality** and **technological coexistence** in use, e.g. energy
- **Diffusion** (costs, social acceptance) critical for eco-efficiency scale: **'Technological transition'** a relevant concept

2. Socio-technical dimension in Functional systems of use

- *"Sustainability as to be defined as a socio-technical attribute of a development strategy. It cannot be formulated in purely ecological terms. It is an attribute in which man, nature and technology are inseparable parts"* (H. Brooks, 1980, referred to in Brooks, Sustainability and Technology, in *Science and Sustainability*, IIASA, 1992)
- (Eco-)innovation is a **change** in socio-technical attributes

Research needs 1

Socio-technical measures in Functional systems of use

Example 1: Process and product innovation

- Process innovation: generally 'efficiency-oriented', including for natural resource use, with 'rebound effects'
- Product innovation: generally 'market oriented', often 'irrelevant' innovations (market segmentation or incremental cumulative changes, e.g. ICT)
⇒ Risk of accelerated turnover of working goods = negative resource/waste implications
- E.g. Energy/emission-efficient products/technologies
 - Better resource/emissions standards = eco-efficient by themselves
 - Fast substitution on a large scale (same function) may mean 'anticipated' scrapping of working average-standard equipments (e.g. car scrapping) = non-eco-efficient in the socio-technical context
- Research needs: Useful technical and economic life of goods/processes (too underdeveloped ...)

Research needs 1

Socio-technical measures in Functional systems of use

Example 2: Non-eco institutional-organisational innovation in ICT use, with positive eco-impacts, if

- Italy 2000s : Legislation on 'digital documentation' and 'digital PA',
e.g. certified email, digital invoices, etc.
- Estimated paper saving: 170.000-260.000 tons/year
- Estimated CO2 saving (LCA): 580.000-890.000 tons/years (+ saved toxicity, water, etc.)
- Other CO2/toxicity savings from toner savings
 - LC data from literature (EEA reports)
- Assumption: No additional software, hardware, and infrastructure needed;
just no printing, reduce material use for the same function
 - Realistic for some parts of 'digital documentation' systems
- Partial conclusion: DD is a 'green application' of ICT innovations

Research needs 1

Socio-technical measures in Functional systems of use

Example 2: Non-eco institutional-organisational innovation in ICT use, with positive eco-impacts, if

- **What if** additional ICT hard/software needed, *e.g. digital storage facilities on a large scale?*
- ICT and the environment: dematerialisation Vs demand for energy, hardware, WEE, etc.
- LCA of material savings **not enough** to define unambiguously 'digital documentation/PA' as a 'green application' of ICT
- **Research need:** 'Super-LCA' extended to the whole 'Functional system of use' (large part of service sector !) + understanding of social behaviour in use (e.g. non-printing, office organisation)

Research needs 1

(Some) Research questions

- How to carry out systematic **eco-monitoring of technologies in use** in a 'Functional system', 'Socio-technical' perspective? Which analytical/quantitative instruments, e.g. detailed I/O information?
- How to define **ex ante** eco-evaluation frameworks for innovations **not yet in use**, with uncertainty and surprise?
- How to map **complementarity** of innovations for eco-efficiency, e.g. materials and energy-saving?
- How to define **eco-optimal timing** of technology substitution and diffusion?
- How to define **business models** and '**eco-entrepreneurship**' for Eco-technological transitions?

Research needs 2

When an 'Environmental-Knowledge-Based Economy' (E-KBE) ?

- 'Sustainability' a pillar of Lisbon Strategy for the Knowledge-Based Economy (KBE): but KBE viewed as an ICT or 'skilled-labour' economy
- An *Environmental*-Knowledge-Based Economy (E-KBE): To incorporate all available environmental knowledge in all innovations
 - *Start from 'greening IPR'*

Research needs 2

'Green Intellectual Property Rights'

- IPR/patents: A social invention with a social aim: create (private) inventors' rent to stimulate invention/innovation (public good)
 - Social optimality issues: Length, Depth, Breadth
 - Three criteria: Invention activity, Novelty, Industrial use
 - Disclosure: full description of the invention (public good)
- **No explicit environmental requirements** in EPO procedures for patent application and granting:
 - Provisions on biotech innovations (legal regime)
 - Provisions on moral/ethical aspects

Research needs 2

- General legitimacy issues, changing social views
- Different scenarios for the future of patents (EPO 2008)

Comparing scenarios				
	Market Rules	Whose game?	Trees of Knowledge	Blue Skies
Big business and government	Close partners, but business sets the agenda.	New businesses in emerging economies are backed by government.	Lack of trust in both MNCs and government.	New innovative networks and partnerships.
Climate and environmental pressures	Environmental issues largely ignored, tipping points not yet reached.	There is too much competition to allow concerns to be addressed. Tipping points imminent.	Continue to mount, leading to social movements and widespread protest.	Energy and water issues become critical.
Ethical issues	Largely ignored.	Global ethics challenged by national and cultural norms.	Dominant concern, both globally and locally.	General societal pragmatism; a utilitarian approach.
Role of experts	Experts work closely with lawyers.	Expertise valued as a competitive weapon.	Experts overruled by popular perceptions.	Narrow expertise is misleading; cross-disciplinary essential.
Control of system	Clear rules and roles give the illusion of control.	Captured knowledge results in control.	Not controllable, occasionally foreseeable.	Determination of technological boundaries creates new arena of legal dispute.
Key skills required	Legal, commercial, managerial expertise.	Diplomacy and bargaining.	Negotiation and communication skills.	Legal, inter-disciplinary and negotiation expertise.
IP is...	A financial asset.	A tool of national competitiveness.	A moral issue.	A means to rapidly share technological solutions to complex problems.

Research needs 2

Research questions

- How to introduce '**disclosure**' of environmental implications of inventions in patent-granting processes?
- How to design '**green criteria**' of **patentability**: e.g. Non-worsening environmental impacts compared to existing products?
- How to make 'green criteria' **non-impairing** for inventors' freedom/creativity?
- How to make 'green criteria/disclosure' synergetic with 'eco-targeted' innovation and IPR-based **competitiveness** of 'green industries'?

Conclusion

- Eco-innovation: Same destiny of 'Sustainable Development'?
- Many definitions/measures/indicators but mostly heuristic value
- Let's try to avoid it