FINDINGS FROM THE TASK 2 REPORT ON A REVIEW OF STATE-OF-THE ART METHODS

1st Stakeholder meeting - June 30th 2016, Brussels

AIMS AND STATUS OF THE REPORT

Aims

- To conduct a review of state-of-the-art methods
- To describe and assess a variety of multi-criteria environmental impact assessment methods and points-systems based decision making models
- To examine their characteristics and assess their potential applicability for adaptation and use in the appraisal of Ecodesign requirements for complex products

Status

- Current version published on-line in May
- This is a provisional and incomplete draft
- After receiving stakeholder feedback a revised and complete draft will be issued later this year

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METHODOLOGICAL APPROACH

Description

- In this task an inventory of existing methodologies that could be applied or adapted for the derivation of a points-systems approach for complex products under the Ecodesign Directive is made, based on desk research and stakeholder consultation
- Initially the net is cast wide to collate information about as many types of potential approaches as possible
- This first stage entails a systematic searching of sources including: EU regulations and Directives, MS initiatives (e.g. the French trial of environmental labelling) EN/ISO standards, green public procurement procedures, trade and professional bodies guidelines and documents, the academic literature and any other appropriate sources

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LIST OF CASES EXAMINED – CASES 1 - 5

System considered	Assessment area	Short explanation
ISO 14040 and 14044	Life cycle assessment principles, framework and guidelines	International standards on Life cycle assessment, principles and framework (ISO 14040) and requirements and guidelines (ISO 14044)
Product Environmental Footprint (PEF)	Multi-criteria environmental impact life cycle assessment of products	PEF is a Life Cycle Assessment (LCA)-based method to calculate the environmental performance of a product. The method was developed by the European Commission's Joint Research Centre and is currently being tested in a pilot phase
Field trial of environmental labels in France	Multi-criteria environmental impact life cycle assessment of products	A labelling trial to supply full life cycle environmental impact information using a multi-criteria approach
Common framework of core performance indicators for resource efficiency assessment in the building sector	Multi-criteria environmental impact assessment of buildings	A common framework of indicators to assess the sustainability of buildings being developed by the European Commission
Material based environmental profiles of building elements (MMG)	Multi-criteria environmental impact life cycle assessment of building elements	Methodology and database for life cycle assessment of building elements

LIST OF CASES EXAMINED – CASES 6 - 10

System considered	Assessment area	Short explanation
Methodology to integrate cost effectiveness in determining the performance of a technology in the framework of Strategic Ecological Support (STRES)	Multi-criteria environmental impact life cycle assessment of investments	Methodology to determine the cost effectiveness of an environmental or energy-related investment.
Environmental impact assessment - Hybrid LCA methodology	Multi-criteria environmental impact life cycle assessment of goods, processes and services	Hybrid conventional LCA methods and input-output economic modelling for more comprehensive and rapid LCA analysis
BREEAM	Environmental assessment of buildings	System originates in UK, but used all over the world. Designers have to achieve a certain numbers of points related to concepts and efficiency/ design factors, in order to claim certain design levels.
LEED	Environmental assessment of buildings	System originates in US, but used all over the world. Designers have to achieve a certain numbers of points related to concepts and efficiency/ design factors, in order to claim certain design levels.
DGNB	Environmental assessment of buildings	German system for the sustainability evaluation of construction projects.

LIST OF CASES EXAMINED – CASES 11 - 15

System considered	Assessment area	Short explanation
ISO 14955-1: Machine tools	Energy efficiency of machine tools	A methodology for the design of energy efficient machine tools
Points system Machine Tools	Ecodesign of complex products	Option of ranking machine tool energy in use performance via a points system inspired by the BREEAM system for buildings.
AHP technology portfolio assessment techniques	Multi-criteria evaluation framework applied to technology investment decisions	AHP-type hierarchical decision modelling applied to multi-criteria assessments of technology investment portfolios in businesses
Points systems used for eco-labelling	Multi-criteria environmental impact evaluation framework	Examination of Ecolabelling systems and relation to points systems
Points systems used for green public procurement	Multi-criteria environmental impact	Examination of Green public procurement systems and the use of points systems in procurement

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LIST OF CASES EXAMINED – CASES 16 - 20

System considered	Assessment area	Short explanation
The EU "installer energy label" for heating systems	Energy labelling of complex products	Applies an extended product approach to develop a heating systems energy label
Life Cycle Management (LCM)	To be added	To be added
Points schemes applied to market surveillance	To be added	To be added
The Europump Extended Product Approach	Ecodesign for complex products	Applies an extended product approach to develop Ecodesign proposals for various pump systems
Ecodesign Lot 37 lighting systems investigation	Ecodesign of complex products	A methodology which considers the product scope as a holistic system

METHODOLOGICAL APPROACH

Description

- The inventory of methods requires consistent comparative analysis to establish their relative suitability for adoption or adaption to form the basis of an Ecodesign points system or related appraisal system for complex products
- The project reviewed the inventory of existing methods for assessing the energy and environmental performance of products and services
- It analysed them to determine their salient characteristics and to consider their potential suitability for appraising the relative performance of complex products within the Ecodesign framework
- It began by classifying the methods into those that appear to be candidates for being appropriate, applicable and enforceable; those that use methodologies that could be readily adapted for use in an Ecodesign appraisal system; those that contain methodological elements that could be incorporated within an Ecodesign appraisal system and those that have little apparent relevance

METHODOLOGICAL APPROACH

Description

- » A standardised template has been developed and used to report the findings on each method in a structured way
- » methods are grouped into sets of basic types and then analysed to establish the most pertinent exemplars of each type included in the detailed assessment
- » This is to enable classes of methodologies to be scrutinised and evaluated for their suitability
- » The process for doing this entails:
- characterising and establishing the degree of commonality of methodological elements used within the various points system and related methodologies
- characterising and establishing the degree of commonality of environmental performance and system factors being appraised

Comparison matrices are used to facilitate this

METHODOLOGICAL APPROACH

Description

An essential aspect of the evaluation is the focus and process of comparing the methodologies against key performance criteria. The key comparative assessment criteria considered are:

- Effectiveness
- Accuracy
- Reproducibility
- Enforceability
- Transparency
- Ease and readiness of application
- Capacity to be implemented within the legal, procedural and analytical rubric of the Ecodesign and Energy Labelling Directives

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METHODOLOGICAL APPROACH

Effectiveness

» the extent to which the methodology would stimulate the intended ecodesign improvement potential and especially be fair and representative of the actual savings reductions that adoption of a set of ecodesign technology design options would produce

Accuracy

» the degree to which the inputs and results are measureable and quantifiable and the likely extent of variance in such measurements, which in turn has a bearing on tolerances

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METHODOLOGICAL APPROACH

Reproducibility

» The degree to which were the same method to be applied by different actors to assess the same product that they would attain the same result. In part this concerns the degree of simplicity and thoroughness/clarity of the methodology and its procedure; however, while simplicity usually aids reproducibility, if a method is too simplistic it will usually not explain how to address complexity found in the real world application of the method and hence will reduce reproducibility

Enforceability

» The extent to which a methodological approach produces results which are enforceable

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METHODOLOGICAL APPROACH

Transparency

» the degree to which the methodology used within the system is in the public domain, is properly documented, has an open and documented rationale and is readily intellectually accessible. This last point is essentially an evaluation of the systems complexity, noting that the greater the complexity the less the transparency but also noting that there is usually a trade-off between simplicity and accuracy and effectiveness

Ease and readiness of application

» determine the degree of difficulty likely to be encountered by stakeholders, especially product designers and producers, in implementing the methodology

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METHODOLOGICAL APPROACH

The capacity to be implemented

- a) the need to ensure that the methodology would be legally permissible within the relevant Directives through satisfying the appropriate legal constraints within these Directives
- b) how well the development and application of the methodology for any specific product group would fit within the Ecodesign and Energy Labelling procedural and decision-making process
- c) the extent to which it would work with and complement the MEErP analytical process embedded in the Preparatory Studies, including compatibility with the Ecoreport tool

METHODOLOGICAL APPROACH

Assessment rankings

- The project team assessed the methodologies against each of these criteria and applied a ranking for each criterion (on a 0 to 10 scale) to permit a coherent, at a glance, comparison when the findings are presented within the summary matrices
- The methodology used is that the project team describes the performance of the method against the assessment parameter and based on this ascribes a score from 0 to 10 for each specific assessment parameter-method pairing
- These rankings are simply the best effort of the project team to assess the methods by each criteria and thus are necessarily subjective

LCA ISO 14040 and 14044

The general framework for LCA is described in two ISO standards:

- ISO 14040:2006: Environmental management – Life cycle assessment – Principles and framework
- ISO 14044:2006: Environmental management – Life cycle assessment – Requirements and guidelines.

The framework proposed by the ISO standards consists of the following elements:

- Selection of impact categories, category indicators and characterisation models
- Classification: assignment of inventory data to impact categories
- Characterisation: calculation of category indicator results
- Normalisation: calculating the magnitude of the category indicator results relative to a chosen reference information dataset
- Grouping: sorting and possibly ranking of the impact categories
- Weighting (valuation): converting and possibly aggregating indicator results across impact categories using numerical values based on value-choices.

Evaluation of ISO 14040 and 14044

Effectiveness

» Life cycle assessment is already part of the MEErP methodology. The methodology is already used to simulate the intended Ecodesign improvement potential. Making use of the EcoReport tool, the methodological steps of classification, characterisation and normalisation (against shares in EU totals) take place

Accuracy

» Some issues and using the EcoReport tool in MEErP has some impacts

Reproducibility

» reproducibility of the method attains an acceptable level when using EcoReport tool

Enforceability

» In principle any impact parameters that are measureable via existing methodological and test standards can be independently verified and hence are enforceable

Transparency

» The method is transparent in principle

Evaluation of ISO 14040 and 14044

Ease and readiness

» there are numerous cases of the implementation of aspects of the ISO 14040 and 14044 standards including those already applied within the Ecoedesign regulatory process. The ease and readiness of implementation varies among these cases

Capacity to be implemented

» A priori the LCA methods within ISO 14040 and 14044 are consistent with the legally enshrined methodological aspects of the Ecodesign regulations and fit within the Ecodesign and Energy Labelling procedural and decision making process. It is broadly compatible with the MEErP and Ecoreport tool approaches, which constitute slightly simplified implementations of a full LCA approach

Product Environmental Footprint

- In April 2013 the Commission launched a Recommendation on the use of common methods to measure and communicate the life cycle environmental performance of products, also known as Product Environmental Footprint (PEF) as part of their Single Market for Green Product's initiative
- The method was developed by the Joint Research Centre based on existing, extensively tested and used methods
- A three-year testing period has been launched through an open call for organisations to volunteer to participate in a PEF pilot programme The call is addressed to stakeholders who wanted to propose a product category for which to develop specific Product Environmental Footprint Category Rules (PEFCRs)
- The Commission published recommendations on the PEF in the form of guidelines in 2013 (CEC 2013) which set out the process by which specific PEFCR are to be developed

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Product Environmental Footprint

- The PEF is essentially aiming towards a points system application of the LCA process as set out in ISO 14040 and 14044
- The process of: selection of impact categories, category indicators and characterisation models; classification: assignment of inventory data to impact categories; characterisation: calculation of category indicator results; normalisation: calculating the magnitude of the category indicator results relative to a chosen reference information dataset; grouping: sorting and possibly ranking of the impact categories; and weighting (valuation): converting and possibly aggregating indicator results across impact categories using numerical values based on value-choices is akin to the elements found in a standard AHP model

PEF impact categores

EF Impact Category	EF Impact Assessment Model	EF Impact Category indicators	Source
Climate Change	Bern model - Global Warming Potentials (GWP) over a 100 year time horizon.	kg CO_2 equivalent	Intergovernmental Panel on Climate Change, 2007
Ozone Depletion	EDIP model based on the ODPs of the World Meteorological Organization (WMO) over an infinite time horizon.	kg CFC-11 (*) equivalent	WMO, 1999
Ecotoxicity for aquatic fresh water	USEtox model	CTUe (Comparative Toxic Unit for ecosystems)	Rosenbaum et al., 2008
Human Toxicity - cancer effects	USEtox model	CTUh (Comparative Toxic Unit for humans)	Rosenbaum et al., 2008
Human Toxicity – non-cancer effects	USEtox model	CTUh (Comparative Toxic Unit for humans)	Rosenbaum et al., 2008
Particulate Matter/Respiratory Inorganics	RiskPoll model	kg PM2,5 (**) equivalent	Humbert, 2009
Ionizing Radiation – human health effects	Human Health effect model	kg U^{235} equivalent (to air)	Dreicer et al., 1995
Photochemical Ozone Formation	LOTOS-EUROS model	kg NMVOC (***) equivalent	Van Zelm et al., 2008 as applied in ReCiPe
Acidification	Accumulated Exceedance model	mol H+ eq	Seppälä et al.,2006; Posch et al., 2008
Eutrophication – terrestrial	Accumulated Exceedance model	mol N eq	Seppälä et al.,2006; Posch et al., 2008
Eutrophication – aquatic	EUTREND model	fresh water: kg P equivalent marine: kg N equivalent	Struijs et al., 2009 as implemented in ReCiPe
Resource Depletion – water	Swiss Ecoscarcity model	m^3 water use related to local scarcity of water	Frischknecht et al., 2008
Resource Depletion – mineral, fossil	CML2002 model	kg antimony (Sb) equivalent	van Oers et al., 2002
Land Transformation	Soil Organic Matter (SOM) model	Kg (deficit)	Milà i Canals et al., 2007

(*) CFC-11 = Trichlorofluoromethane, also called freon-11 or R-11, is a chlorofluorocarbon.
(**) PM2,5 = Particulate Matter with a diameter of 2,5 µm or less.
(***) NMVOC = Non-Methane Volatile Organic Compounds

Evaluation of Product Environmental Footprint

Effectiveness

» The method is effective for the indicators which can be reliably measured but not so much for those which are difficult to measure or whose impacts are challenging to quantify. In deriving an aggregate score the PEF should be effective in driving eco-design in principle. Nonetheless usually the biggest challenge for complex products is the derivation of the functional unit and this is likely to be more important than the number of impact categories provided that good background data is available for each of these

Accuracy

» The accuracy is good for readily measureable impact parameters and less so for those that are less readily measured or established

Reproducibility

» should be reasonable when the impact parameters are readily measureable but this is not always the case

Enforceability

» reasonably enforceable from a technical perspective when the impact parameters are readily measureable with an acceptable degree of accuracy; however, this is not presently the case for all of the impact parameters

Evaluation of Product Environmental Footprint

Transparency

» The method is transparent in principle

Ease and readiness

» methodology is not yet finalised and hence is not fully ready for implementation

Capacity to be implemented

» the large number of diverse impact parameters add complexity and will always make it more challenging to implement than standard Ecodesign regulations which are focused on a narrower set of parameters

Common framework of core performance indicators for resource efficiency assessment in the building sector

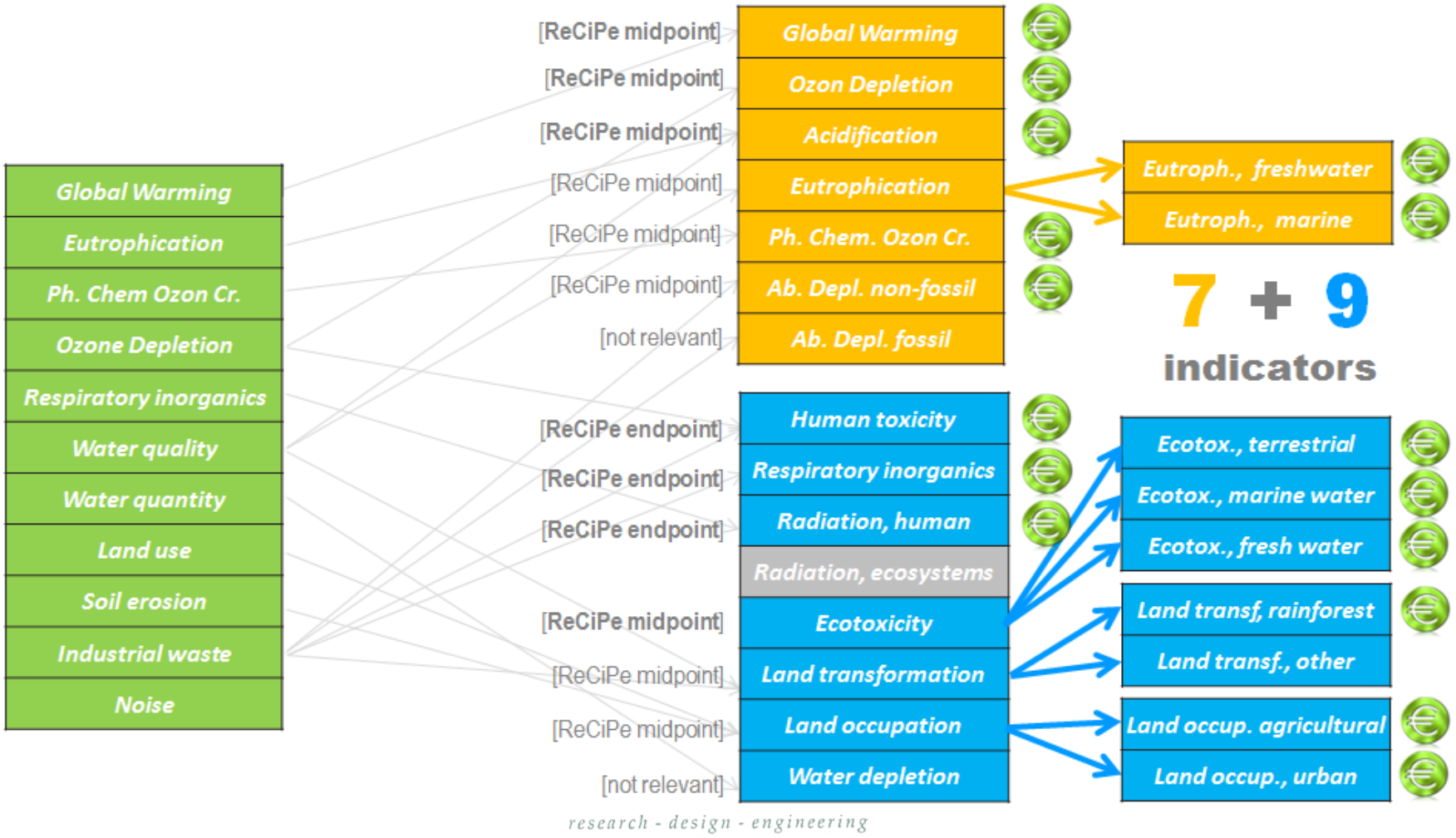
- In 2014 the EC adopted the Communication on Resource Efficiency Opportunities in the Building Sector (COM(2014)445)
- This identified the need for a common European approach to assess the environmental performance of buildings throughout their lifecycle, taking into account the use of resources such as energy, materials and water
- A study to identify a common EU framework of indicators to assess the environmental performance of buildings is being carried out by the JRC, during the period of 2015-2017
- The aim of the study is to develop a common yet flexible framework of indicators that may be integrated into existing and new schemes addressing building environmental impacts, or might be used on its own, although the intention is not to create a new standalone building certification scheme
- This project is ongoing and so far has not led to the derivation of a points system therefore it is premature to assess its structure at this juncture

Material based environmental profiles of building elements (MMG)

- MMG is a life cycle assessment based expert evaluation tool used for the assessment of the environmental impacts associated with the choices of building materials at the material element/whole building level
- The structure used in the MMG points system is to define environmental impact categories and then to aggregate the points to give an overall total via the application of monetised weightings to the impact category scores
- This structure can be said to be akin to a standard AHP model using impact category weightings. It is a fully quantified approach and thus follows an objective logic
- The only subjectivity arises due to how the monetised values ascribed to the environmental impacts are determined but this method applies a consistent and detached methodology for assessing these and hence does not carry risk from policy bias more closely related to the specific decision being assessed

LCA METHODOLOGIES

MMG indicators



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Material based environmental profiles of building elements (MMG)

Effectiveness

» The method is effective for the indicators which can be reliably measured but not so much for those which are difficult to measure or whose impacts are challenging to quantify. In principle the MMG is an effective instrument from a technical methodological perspective and creates an internally consistent framework for making assessments across environmental impacts.

Accuracy

» good for readily measureable impact parameters and less so for those that are less readily measure

Reproducibility

» should be reasonable when the impact parameters are readily measureable with an acceptable degree of accuracy

Enforceability

» reasonably enforceable from a technical perspective

Transparency

» The method is transparent and documented

Material based environmental profiles of building elements (MMG)

Ease and readiness

» there are numerous cases of the implementation of aspects of the ISO 14040 and MMG appears to be straightforward to apply except for the need to assess a relatively large number of impact parameters. The method is existent and ready to use. It does not require extensive training to be able to use

Capacity to be implemented

» A priori the LCA methods used within the MMG are consistent with the legally enshrined methodological aspects of the Ecodesign regulations and fit within the Ecodesign and Energy Labelling procedural and decision making process. It is broadly compatible with the MEErP and Ecoreport tool approaches, which constitute slightly simplified implementations of a full LCA approach. The application of environmental impact criteria aggregator functions based on monetised weightings is not precluded within the Ecodesign Directive

» however, this would require agreement at the EU level on the methods to be used to determine monetised impact values and extensive research effort to establish such values

LCA METHODOLOGIES

Methodology to integrate cost effectiveness in determining the performance of a technology in the framework of Strategic Ecological Support (STRES)

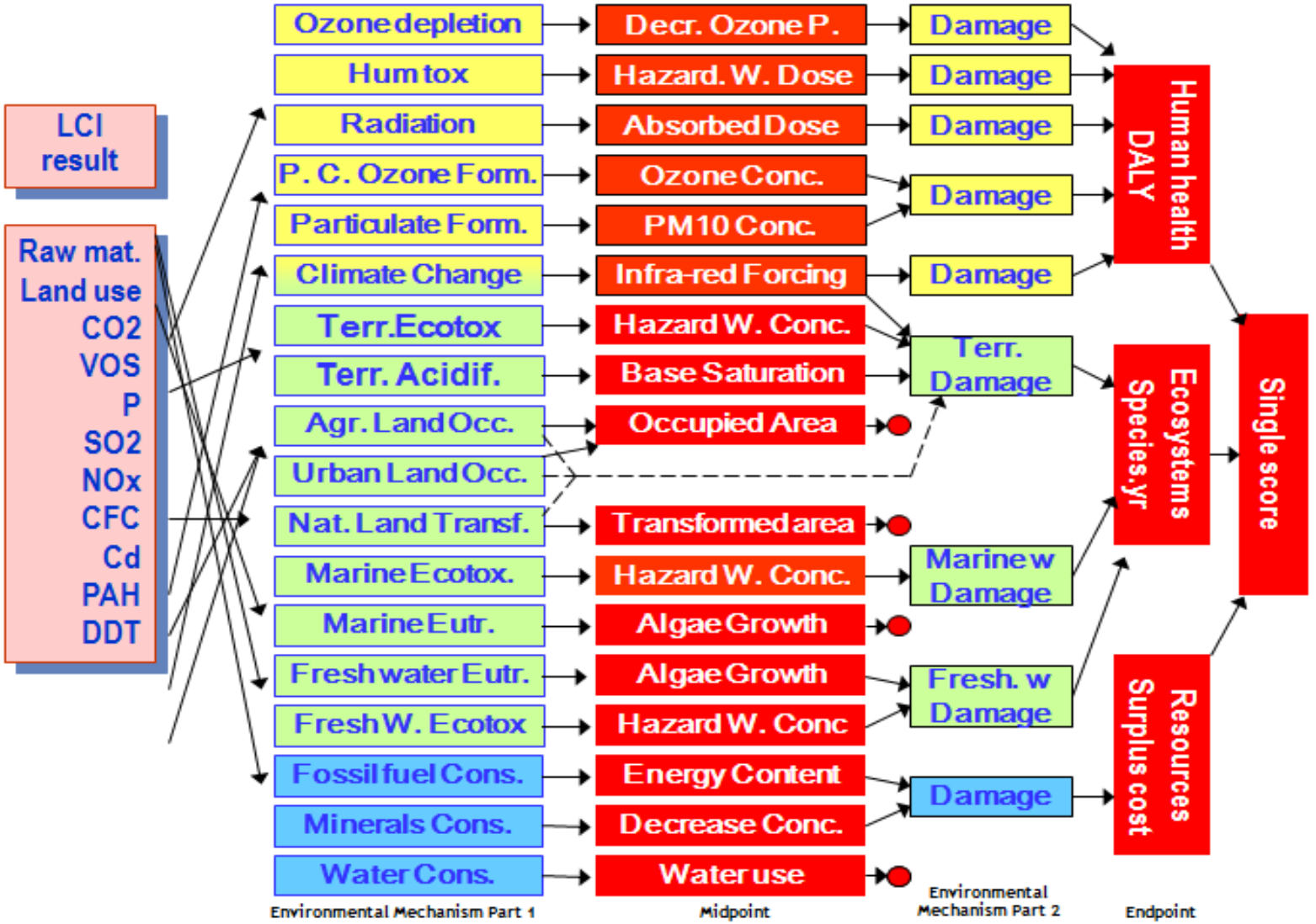
- Developed for the Flanders government STRES is a methodology to calculate the environmental and energy-related benefits of company investments
- The intention is to incorporate this method into a pre-existing framework for the evaluation of requests for subsidies for environmentally friendly investments
- The methodology is also intended to assist in defining the extent (magnitude) of the subsidy to be granted. Subsidies will be granted based on the 'Eco class' in which a product is classified. There are four different Eco classes ranging from A to D
- The structure used in the STRES points system is to define cost effectiveness from environmental point of view of an investment compared to a standard technology. It is a fully quantified approach and thus follows an objective logic. Subjectivity arises due to how the endpoint indicators are determined in the ReCiPe method and the panel weighting given for aggregated points-scores across the endpoint indicator categories

STRES

- Companies have to submit information on the process inputs (for both the standard technology and environmentally friendly technology) for: material inputs, water inputs, energy inputs, emissions, waste and difference in the transportation distance of raw materials
- The environmental impact of both the standard technology and the environmentally friendly technology is calculated, based on the information provided, for the production and in-use life cycle phases
- The ReCiPe endpoint method is used in this process, for which the endpoint indicators are Human Health, Ecosystems and Resources
- Based on input output LCA modelling of each of these categories points are awarded for both the standard technology and for the environmentally friendly technology

LCA METHODOLOGIES

Relationship between LCI parameters (left), midpoint indicator (middle) and endpoint indicator in ReCiPe



Kick-off POINT

STRES

Effectiveness

» The method is effective for the indicators which can be reliably measured but not so much for those which are difficult to measure or whose impacts are challenging to quantify

Accuracy

» The accuracy is good for readily measureable impact parameters and less so for those that are less readily measured or established

Reproducibility

» It is very likely that the cost effectiveness will be different when calculated by different companies for the same investment. The reason for this is that a lot of input data need to be gathered. Moreover they have to be assigned to a certain category

Enforceability

» STRES should be reasonably enforceable from a technical perspective when the impact parameters are readily measureable with an acceptable degree of accuracy.

Transparency

» The method is transparent and documented

STRES

Ease and readiness

» STRES appears to be less straightforward to apply that some methods due to the need to attribute costs to a large number of sub-components and to assess a relatively large number of impact parameters

Capacity to be implemented

» A priori the LCA methods used within STRES are consistent with the legally enshrined methodological aspects of the Ecodesign regulations and fit within the Ecodesign and Energy Labelling procedural and decision making process. It is broadly compatible with the MEErP and Ecoreport tool approaches, which constitute slightly simplified implementations of a full LCA approach.

» The application of environmental impact criteria aggregator functions based on panel-method or monetised weightings is not precluded within the Ecodesign Directive; however, this would require agreement at the EU level on the methods and weighting to be used and this would not be a trivial exercise

Environmental impact assessment via a hybrid IO-LCA methodology

- In a hybrid life cycle assessment of any given economic activity or good, environmental impact data concerning a manufacturing or economic process are combined with Input Output (IO) data on economic and environmental impact flows
- Input-output economic activity databases describe the sale and purchase relationships between economic sectors (agriculture, industry, services) within an economy. Within IO environmental impact models these economic value flows are linked to the environmental impact flows resulting from these economic activities
- Monetary units such as Euros or dollars are then used to express the environmental flows per economic sector i.e. monetary flows are used as a proxy for environmental impact flows
- In a hybrid LCA-IO methodology, IO data are used to fill data gaps which are present in LCA databases

HYBRID LCA METHODOLOGIES

Environmental impact assessment via a hybrid IO-LCA methodology

- The hybrid LCA-IO methodology of environmental impact assessment is not a points system but otherwise is constructed and behaves in a similar manner to a standard LCA assessment as might be used in accordance with ISO 14040 and ISO 14044
- This means that it could be incorporated within a multi-criteria environmental impact points system and used to more rapidly derive impact parameters when full LCA data is either missing or is too time consuming to assess
- Its assessment is thus very similar to for ISO 14040/14044

BUILDING METHODOLOGIES

BREEAM

- Evaluation of the building in with over 100 criteria grouped in 10 environmental sections
- Weighted aggregation of the criteria within the sections and to the overall result.
- Most criteria are treated as discrete threshold or yes/no variables
- Several criteria are mandatory to attain certification
- The overall result is a 6-level rating ranging from “unclassified” (fail grade) over “pass” to “outstanding”

EXAMPLE OF BREAM RATING OVERVIEW

BREEAM section	Credits achieved	Credits available	% of Credits achieved	Section weighting (fully fitted)	Section score
Management	10	20	50.00%	0.12	6.00%
Health and wellbeing	17	21	80.95%	0.14	11.33%
Hazards	1	1	100.00%	0.01	1.00%
Energy	16	34	47.05%	0.19	8.94%
Transport	5	11	45.45%	0.08	3.63%
Water	5	9	55.56%	0.06	3.33%
Materials	10	14	71.43%	0.125	8.92%
Waste	3	13	23.07%	0.075	1.73%
Land use and ecology	5	5	100.00%	0.10	10.00%
Pollution	5	7	71.42%	0.065	4.64%
Surface water run-off	4	5	80.00%	0.035	2.80%
Innovation	2	10	20.00%	0.10	2.00%
Final BREEAM score					64.32%
BREEAM Rating				VERY GOOD	

Evaluation of BREEAM

Effectiveness

» Straightforward approach integrating a broad range of criteria

Accuracy

» Discrete choice variables neglect information, due to the number of criteria, this is of lower importance

Reproducibility

» Discrete choice variables allow an easy reproduction

» For some variables (energy use etc.) proprietary tools with rather complex input variables are required.

Enforceability

» No formal legal requirements exist

Transparency

» The method is well documented in public documents with one exception:

» Some criteria require proprietary tools, which are not sufficiently documented

Ease and readiness

» The method has been used for more than 20 years

OTHER BUILDING METHODOLOGIES

LEED and DGNB

- Similar approach to BREEAM
- DGNB also incorporates economic critera and requires a full LCA of building materials

  → more holistic approach

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ISO 14955: MACHINE TOOLS

Steps of the environmental evaluation of machine tools

1. General life cycle assessment to decide whether the use-phase is most relevant for the product.
2. Description of the generalized machine tools functions and sub-functions
3. Assignment of machine components to the generalized machine tool functions or sub-functions
4. Identification of machine tool functions relevant for energy consumption during the use phase
5. Mapping of relevant machine tool functions to machine components
6. Comparison of relevant machine components or subsystems, their control and their contribution with a previous generation

Evaluation of ISO 14955

Effectiveness

» Potentially high effectiveness due to the integration into the design process

Accuracy

» Rather generic approach, impact assessment is left to the user

Reproducibility

» Low reproducability due to the large freedom for the user

Enforceability

» No formal legal requirements exist

» Only procedural requirements

Transparency

» The method is well documented as an ISO Standard

Ease and readiness

» Ready to use, but no out-of-the box solution

Machine Tool Mandatory Point Scheme Proposal

» The working document for the Ecodesign Consultation Forum meeting on machine tools and related machinery (ENTR LOT 5), 6 MAY 2014 proposed a points system for a specific range of machine tools

» It reports to be loosely based on the BREEAM methodology, however, there are many specific aspects and differences, as follows:

- under the mandatory Ecodesign proposals of this Policy Option, MT manufacturers would be required to reach a certain level of expected energy savings in order to demonstrate their compliance
- the underlying principle is that MT manufacturers are free to use any mix of measures to reach the specified level of energy savings, and that the energy savings percentage achieved is denoted by a certain amount of equivalent points
- the method was proposed exclusively for metal working machine tools (Base cases 1 to 4 in the preparatory study and working document) and Stone and Ceramic cutting machine tools (Base case 10) and was not considered for other types of machine tools such as wood working machine tools

Machine Tool Mandatory Point Scheme Proposal

- the focus is solely on the energy-in-use mode and no other environmental impacts or lifecycle stages are considered
- the methodology ascribes points for the inclusion of specific energy savings design options such that 4 points are awarded for each design option which is expected to improve in-use energy efficiency by 1%
- each of these design options are clustered into one of several design option categories and within each category a maximum 20 point cap is imposed on number of points that can be awarded for the category (i.e. no design option category is rewarded for design options that lead to savings beyond a 5% energy efficiency improvement)
- the energy savings design options which may be considered are defined in a table of specific options which is taken from Annex A of the ISO 14955-1 standard and the preparatory study
- the relative savings per category are then mapped to a discrete point scale
- in contrast to the BREEAM methodology (and being closer to the LEED concept) no relative achievement target has to be calculated, but rather the points are simply added up to create an overall score

MACHINE TOOLS

Machine Tool Mandatory Point Scheme Proposal

Ascribed % energy savings for measure	Maximum possible allocated points by category	Points achieved by example machine	Allocation for those systems not present on the machine (the average of the other scores)
Overall Machine	19	7	
Drive Units	16	4	
Hydraulic System	5	4	
Pneumatic System	20		8 (=27/70 x 20)
Electric Systems	4	2	
Cooling lubricant	7	3	
Cooling	3	1	
Power Electronics	6	2	
Peripheral	2	0	
Control	4	2	
Grand Total	86	33 Points	

Comments

- the decision to cap the maximum efficiency improvement associated with any specific grouping (category) of design options to 4% seems arbitrary and is not substantiated
- this decision does not appear to afford the possibility that an innovative and disruptive technology might occur which could lead to much greater savings
- tying the points allocation to the list of design options within the ISO 14995-1 standard is pragmatic; but, the list of options within the working document does not include all the options mentioned within ISO 14995-1 and the system as currently specified would offer no encouragement or reward to innovative design options
- there is a lack of documentation to substantiate the magnitude of energy savings impacts expected from the listed design options
- the method treats the energy savings (efficiency gains) as being additive when in most cases they would be expected to be multiplicative (i.e. if five sets of design options all lead to a 4% efficiency gain their net effect would generally be expected to be and efficiency gain of =100*(1-0.96*0.96*0.96*0.96*0.96) %= 19% and not 20% as a simple summing would imply
- the technical basis behind the grouping (categorisation) of the design options is not reported and thus is unsubstantiated – as a result the degree to which the categorisation is sound and how robust this is for all types of metal working machine tools is unclear

Machine Tool Mandatory Point Scheme Proposal

Effectiveness

» by using a straightforward approach covering the different design aspects of the machine tools, the methodology could be effective in achieving design improvements; however, there is considerable uncertainty about: whether the right design options are being addressed, about the ability to capture future innovations, about the degree to which the method treats functional units effectively and the extent to which higher efficiency design options are awarded appropriately

Accuracy

» the different technological options are assigned deemed saving values based on generic technological criteria. Obviously, they do not reflect the real savings, but are a generic characterisation of the technology. The effects resulting from the combined implementation of measures are not considered at all, nor is there compelling evidence to support the magnitude of projected savings

Reproducibility

» using a deemed savings approach on a technical measure basis, the reproducibility should be reasonably high

Enforceability

» If used in the context of Ecodesign implementation, the enforceability should be reasonable in principle; however, the fact that it requires performance declaration and verification of system modules and components will certainly add complexity

Machine Tool Mandatory Point Scheme Proposal

Transparency

» implementation of the method is very transparent as the assessment can be followed step by step. Nevertheless, in their actual state, the deemed savings allocated are neither transparent nor consistent

Ease and readiness

» the method seems to be rather straightforward to implement, however, it's far from being ready for implementation

Capacity to be implemented

» The lack of detail on how to implement the scheme suggests that it is a work in progress and hence currently has a low capacity to be implemented

» The method, to the extent it is described, is not inconsistent with the legally enshrined methodological aspects of the Ecodesign regulations. It could be readily made to fit within the Ecodesign and Energy Labelling procedural and decision making process. It has no conflict with the MEErP and Ecoreport tool approaches

Ecolabelling

- The EU Ecolabel covers a wide range of product groups, from major areas of manufacturing to tourist accommodation services
- Key experts, in consultation with main stakeholders, develop the criteria for each product group in order to decrease the main environmental impacts over the entire life cycle of the product. Because the life cycle of every product and service is different, the criteria are tailored to address the unique characteristics of each product type
- Every four years on average, the criteria are revised to reflect technical innovation such as evolution of materials, production processes or in emission reduction and changes in the market
- The intention is that the EU Ecolabel will represent the highest environmental performance for the product or services it is applied to

Ecolabelling

- Ecolabel criteria are binary in the sense that a product/service either satisfies them and hence is eligible to apply for the use of the ecolabel, or it doesn't and hence is ineligible
- In all instances of the label as currently implemented all the criteria have to be met for a product or service to be eligible for the label. However, not all the criteria are quantitative. For example, some many concern the presence or absence of a feature or service.
- Thus for most products the Ecolabel criteria are similar in structure to Ecodesign criteria but will tend to address more environmental impact parameters
- The EU criteria are developed by an ad hoc working groups established for each product of interest and are subject to approval by the Ecolabel board, which is comprised of a set of notified bodies. In consequence, the criteria are developed using a "panel type" assessment process and thus involve an implicit hierarchical decision making process
- The EU schemes do not appear to use points but some national ecolabelling schemes do, in a structure somewhat similar to the BREAM approach with minimum scores per criteria and for aggregate scores

Green public procurement

» The 2004 Procurement Directives (2004/17/EC and 2004/18/EC) explicitly allow for the inclusion of environmental considerations in procurement

» There are different mechanisms through which environmental impacts can be factored into public procurement, as follows:

- Life cycle cost assessments
- Functional specifications: also called: performance-based or outcome based specifications.
- Green contract variants where suppliers are asked to submit greener variants for the same product and the contracting authority set minimal technical specifications for all bids to comply with

Green public procurement

- These factors, along with all the traditional elements considered in public procurement can be evaluated and ranked via a hierarchical decision process such as AHP
- This typically involves establishing the award criteria and grouping them where appropriate, devising scoring systems per criteria which are either, bounded within groups and simply summed to attain an aggregate score across the groups, or are summed within groups and weighted across groups to produce an aggregate score
- In Malta, for example, specifications for a new school building required it to be energy self-sufficient through the use of on-site renewable energy production. Tenderers were able to present different solutions for achieving this goal. Minimum levels of energy and water efficiency were specified, with additional points available for even better performance during the award stage

The “installer energy label” for heating systems

» The space heating installer energy label is innovative compared to conventional energy labels in two principal respects:

- it is essentially an extended product approach which ranks and displays the energy efficiency of the heating system as a system and not just for each individual component within it
- it is to be implemented by the installer of the system using component ratings supplied by the product component manufacturers.

» The method used considers the seasonal heating efficiency of the boiler at the location in isolation, it then adds efficiency credits depending on the nature of controls used (note these only concern the direct control of the boiler not the control of the heating distribution system, which is often where larger energy savings are possible), the impact of using an additional boiler, the impact of using a solar heating device, the impact of using a heat pump, the impact of using a solar heating device and a heat pump, and takes all of this through a calculation structure to derive an overall heating system efficiency score

The “installer energy label” for heating systems

- This approach is a classic example of a modular approach to determining the energy efficiency of a system
- It indicates how the energy performance of individual system modules (components) can be assessed in isolation and then their collective performance, as a specific assembly of components within an overall heating system, can be determined via a set of logical calculations (using credits and multiplicative efficiencies)
- Although each component has a distinct function and a distinct efficiency in performing that function this does not prohibit their collective efficiency from being estimated in a sufficiently robust manner to permit and overall energy labelling class to be determined for the heating system

Seasonal space heating energy efficiency of boiler → 1 'I' %

Temperature control
From fiche of temperature control
Class I = 1 %, Class II = 2 %, Class III = 1,5 %, Class IV = 2 %, Class V = 3 %, Class VI = 4 %, Class VII = 3,5 %, Class VIII = 5 %
→ + 2 [ ] %

Supplementary boiler
From fiche of boiler
Seasonal space heating energy efficiency (in %)
([ ] − 'I') × 0,1 = → ± 3 [ ] %

Solar contribution
From fiche of solar device
Collector size (in m²) [ ]
Tank volume (in m³) [ ]
Collector efficiency (in %) [ ]
Tank rating [ ]
A⁺ = 0,95, A = 0,91, B = 0,86, C = 0,83, D-G = 0,81
('III' × [ ] + 'IV' × [ ]) × 0,9 × ([ ] /100) × [ ] = → + 4 [ ] %

Supplementary heat pump
From fiche of heat pump
Seasonal space heating energy efficiency (in %)
([ ] − 'I') × 'II' = → + 5 [ ] %

Solar contribution AND Supplementary heat pump
Select smaller value
0,5 × 4 [ ] OR 0,5 × 5 [ ] = → - 6 [ ] %

Seasonal space heating energy efficiency of package → 7 [ ] %

Seasonal space heating energy efficiency class of package

G	F	E	D	C	B	A	A⁺	A⁺⁺	A⁺⁺⁺
< 30 %	≥ 30 %	≥ 34 %	≥ 36 %	≥ 75 %	≥ 82 %	≥ 90 %	≥ 98 %	≥ 125 %	≥ 150 %

Boiler and supplementary heat pump installed with low temperature heat emitters at 35 °C?

From fiche of heat pump 7 [ ] + (50 × 'II') = [ ] %

The energy efficiency of the package of products provided for in this fiche may not correspond to its actual energy efficiency once installed in a building, as the efficiency is influenced by further factors such as heat loss in the distribution system and the dimensioning of the products in relation to building size and characteristics.

Evaluation of "installer energy label" for heating systems

Effectiveness

» has only just entered into force and thus there is currently no evidence of its effectiveness, however, if it has even a modest proportion of the impact of other energy labels it will likely lead to energy savings and as a minimum it allows the energy efficiency of the heating system to be made visible

Accuracy

» the accuracy by which the quantifiable criteria used within the heating system energy label can be determined is similar to that experienced for other labelled products

Reproducibility

» similar to that experienced for other EU environmentally-related product regulations such as Ecodesign etc.

Enforceability

» similar to that experienced for EU environmentally-related product regulations such as Ecodesign except requires the installed system to be assessed

Transparency

» fully transparent and within the public domain

Ease and readiness

» teething issues can be expected in the early stages of the schemes deployment as a large number of heating systems installers need to become familiarised with the scheme

Capacity to be implemented

» satisfies all the capacity to be implemented criteria being considered in this assessment

The Europump Extended Product Approach

- The extended product is the pump, with the pump drive system (PDS) and the controls. In principle any Ecodesign implementing measures that are based solely on a Product Approach would only take the efficiency of the product into account (i.e. of the pump hydraulics alone in this case)
- This brings into play the aspects of the application the extended pump product system is being required to perform.
- The Extended Product Approach also takes the load profile and control method curve into account which allows the benefit of measures that allow reductions in the pump head to be taken into account and hence given proper credit
- In the case of water pumps, Europump estimate this will lead to a ten-fold increase in savings compared to product-only implementing measures.

The Europump Extended Product Approach

- The methodology characterises combinations of pump types (8 distinct types) and system types (closed loop systems or open loop systems, and constant flow systems or variable flow systems) within a matrix
- It proposes characteristic load profiles for closed loop systems or open loop systems depending on whether they are for constant flow or variable flow applications
- Following on from this functional mapping process a system is proposed to calculate the EEI based on each specific case found within the matrix
- A complication arises because with the exception of circulator pumps and ESCCI (End suction close coupled inline water pump) pumps there is no one-to-one mapping between the pump type and the system type (closed/open loop, constant/variable flow)
- As a result for pump types which are used in more than one system type, more than one EEI value needs to be calculated.

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Evaluation - the Europump Extended Product Approach

Effectiveness

» The system matches pump types with system types (open or closed loop, constant or variable flow) so the challenge is how to do this in a prospective mandatory regulation where the pump application is not necessarily known. For example, measures that might lead to large energy savings in variable flow applications may lead to some energy consumption increases in fixed flow applications

Accuracy

» the accuracy to which the quantifiable criteria used within the Europump extended product scheme can be determined is similar to that experienced for other products subject to Ecodesign or energy labelling requirements

Reproducibility

» As good as for other EU regulations

Enforceability

» Similar to other EU regs except appears to require the actions of system specifiers and installers, as well as component suppliers to be addressed

Transparency

» The method is well documented in public documents

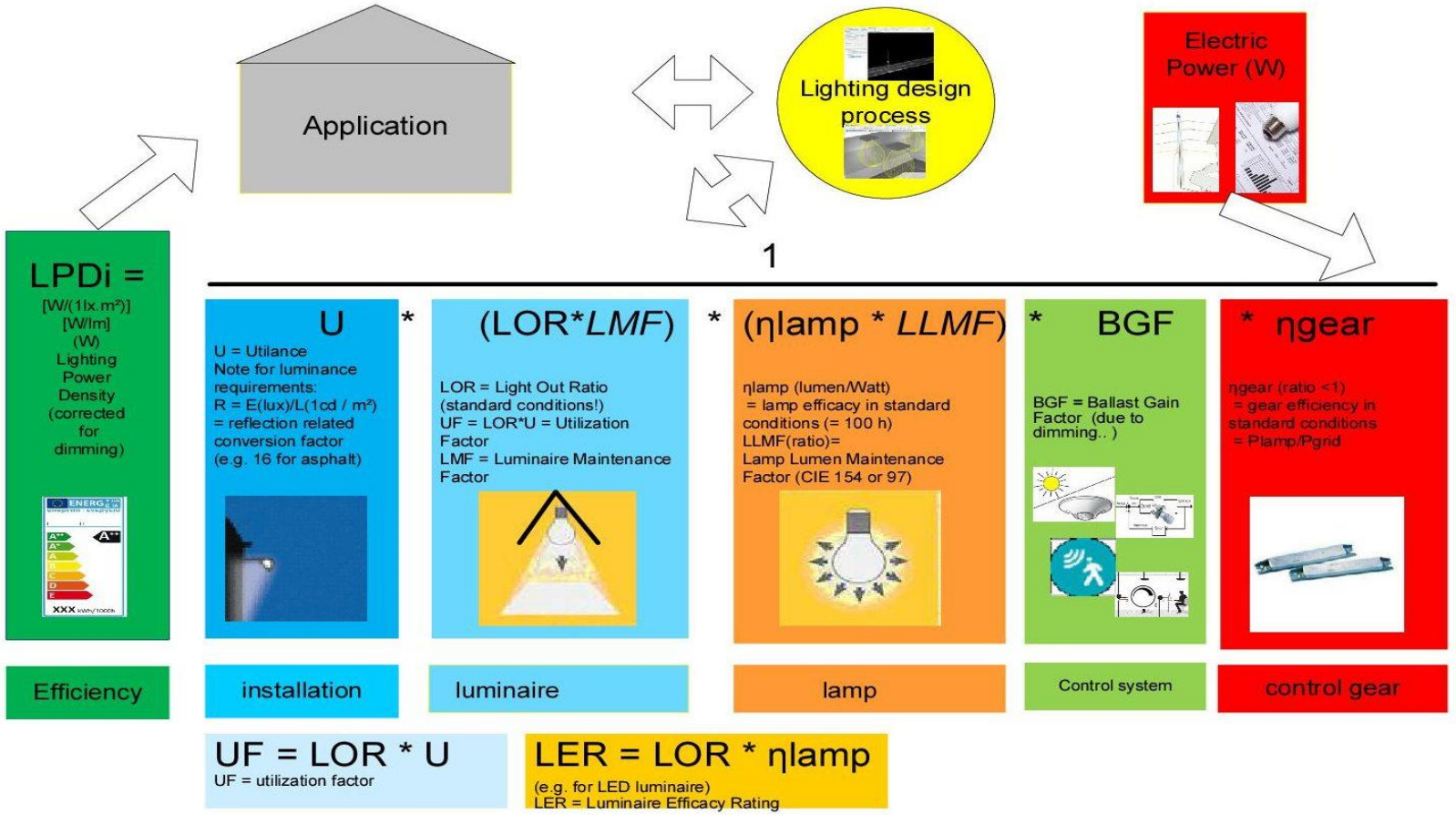
Ease and readiness

» Straightforward in principle

Capacity to be implemented

» No inherent legal or administrative process barriers to the adoption of the Europump extended product scheme within the Ecodesign regulatory framework

LOT37 LIGHTING SYSTEMS (ON-GOING)



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Lighting Energy Numerical Indicator (LENI) approach?

- By comparing the available average and best available technology (BAT) solutions for each application its possible to determine the range of viable LENI values per application
- If life cycle cost optimisation were to be incorporated into this process it becomes technically possible to devise a specific LENI target for each class of typical lighting system, in a manner that could meet the aims of the Ecodesign regulatory process
- However, a priori this would be applicable at the application level rather than the sub-system level and thus raises the question of on whom regulatory requirements could be placed
- The space heater energy label demonstrates that it is at least legally permissible for system labelling requirements to be imposed on installers and not just component manufacturers

LOT37 LIGHTING SYSTEMS (ON-GOING)

Effectiveness

» The LENI approach described above is already adopted in European standards, is incorporated in lighting design software and is embedded in some Member State building codes

Accuracy

» similar to that experienced for other products subject to Ecodesign or energy labelling requirements

Reproducibility

» As good as for other EU regulations

Enforceability

» Similar to other EU regs except requires the actions of system specifiers and installers, as well as component suppliers to be addressed

Transparency

» The method is well documented in public documents

Ease and readiness

» Straightforward in principle

Capacity to be implemented

» the LENI calculation method is readily available and relatively straightforward to use in principle. Nonetheless it is more complex than some less sophisticated lighting energy performance calculations

SUMMARY OF FINDINGS

- A broad variety of multi-impact criteria assessment methodologies were compiled and assessed to examine their inherent characteristics and explore their potential relevance for potential adaptation or incorporation within a points based approach for the Ecodesign of complex products
- As many (most) of these methodologies have not been designed with the Ecodesign regulatory process in mind they are not directly adapted or applicable to its use
- However, they share many elements that are of value in the conduct of Ecodesign-like assessments
- In the case of the methods that address multi-criteria environmental impact analysis these elements may include derivation of functional units, definition of environmental impact criteria, normalisation and benchmarking, grouping, weighting and aggregation
- In other cases they may share a structured hierarchical modelling framework to facilitate prioritisation and decision making when judgements are required based on multiple and distinct input criteria

SUMMARY OF TEAM'S ASSESSMENT SCORES PER METHOD

Method	Effectiveness	Accuracy	Reproducibility	Enforceability	Transparency	Ease and readiness of use	Capacity to be implemented
LCA ISO 14040 and 14044	5-10	5-10	7-9	2-10	6-10	4-9	7
Product Environmental Footprint	6	6	6	4	9	5	6
Material based environmental profiles of building elements (MMG)	8	8	7	4	9	7	7
Methodology to integrate cost effectiveness in determining the performance of a technology in the framework of Strategic Ecological Support (STRES)	8	7	5	3	9	5	6
Environmental impact assessment - Hybrid LCA methodology	5-10	5-10	7-9	2-10	6-10	4-9	7
BREEAM	8	6	7	4	4	8	6
LEED	8	6	6	4	4	7	6
DGNB	8	6	6	4	4	7	6
ISO 14955-1: Machine tools	8	7	6	7	8	8	8
Machine Tool Mandatory Point Scheme Proposal	6	3	6	4	3	3	8

SUMMARY OF TEAM'S ASSESSMENT SCORES PER METHOD

Method	Effectiveness	Accuracy	Reproducibility	Enforceability	Transparency	Ease and readiness of use	Capacity to be implemented
Points systems used for ecolabelling	6	8	7	6	9	7	8
Points systems used for green public procurement	8	8	7	6	9	7	6
The "installer energy label" for heating systems	8	8	7	7	9	8	10
Europump extended product scheme	6.5	8	7	7	9	8	9
Ecodesign Lot 37 lighting systems investigation	8	8	7	7	9	7	8

SUMMARY OF FINDINGS

- Most of the methodologies that address environmental impacts are more suited to the setting of specific thresholds
- Some of the methods contain elements that would be suited to setting generic Ecodesign requirements
- With two exceptions (the ISO 14995-1 energy efficient design methodology for machine tools and the EU Energy Label for space heating systems) the methods do not offer an approach tailored to managing complex functional units where the same component has more than one function
- The ISO 14995-1 standard facilitates this through its detailed mapping and attribution of functionality to product sub-systems for the specific case of machine tools
- The space heating energy label does similarly for space heating components that may both provide space heating and water heating services

SUMMARY OF FINDINGS

» Despite these methods being applied within diverse applications certain generic similarities and common characteristics are witnessed between many of them:

- about half are pure points-systems methodologies and the other half are methodologies that could be adapted for use as a potential component within a points system
- about half the methodologies include a classification system based on the number of points scored
- most employ a hierarchical decision making model
- the large majority involve prioritisation and aggregate scoring
- most permit the use of a prioritisation method of which the most common is the panel-method, but monetisation is used in one (MMG) and the Distance to Target method could also be used in some cases
- in all cases the process of conducting a multi-criteria assessment involves decomposition into sub-problem assessments, each of which can be analysed independently
- the majority of methods apply numerical weightings to sub-problem scores to establish a weighted hierarchy
- about half the methods entail some kind of pairwise comparison between alternatives
- some of the methods are potentially applicable to generic process evaluation

SUMMARY OF THE METHODOLOGICAL ELEMENTS USED

Method	Pure points system (P) or potential component (C) within one?	Classification based on points scored (Y/N)	Hierarchical decision aiding model? (Y/N)	Prioritistation and agregate score?	Prioritisation method (Panel, Monetisation, Distance to Target)	Multi-criteria assessment decomposed into sub-problem assessments, each of which can be analysed independently?	Application of numerical weightings to sub-problem scores to establish weighted hierarchy?	Pairwise comparison between alternatives?	Potentially applicable to generic process evaluation? (Y/N)
LCA ISO 14040 and 14044	C	N	N	Y	Any	Y	Y	N	N
Product Environmental Footprint	P	N	Y	Y	Any	Y	Y	N	N
French environmental label - field trials	C	N	N	N	NA	Y	N	N	N
Common framework of core performance indicators for resource efficiency assessment in the building sector	C	N	U	Y	Any	Y	U	U	U
Material based environmental profiles of building elements (MMG)	C	N	Y	Y	Monet-isation	Y	Y	N	N

SUMMARY OF THE METHODOLOGICAL ELEMENTS USED

Method	Pure points system (P) or potential component (C) within one?	Classification based on points scored (Y/N)	Hierarchical decision aiding model? (Y/N)	Prioritistation and agregate score?	Prioritisation method (Panel, Monetisation, Distance to Target)	Multi-criteria assessment decomposed into sub-problem assessments, each of which can be analysed independently?	Application of numerical weightings to sub-problem scores to establish weighted hierarchy?	Pairwise comparison between alternatives?	Potentially applicable to generic process evaluation? (Y/N)
STRES	C	Y	Y	Y	Panel/Monetisation	Y	Y	Y	N
Environmental impact assessment - Hybrid LCA methodology	C	N	N	Y	Any	Y	Y	N	N
BREEAM	P	Y	Y	Y	Panel	Y	Y	Y	N
LEED	P	Y	Y	Y	Panel	Y	Y	Y	N
DGNB	P	Y	Y	Y	Panel	Y	Y	Y	N

SUMMARY OF THE METHODOLOGICAL ELEMENTS USED

Method	Pure points system (P) or potential component (C) within one?	Classification based on points scored (Y/N)	Hierarchical decision aiding model? (Y/N)	Prioritistation and agregate score?	Prioritisation method (Panel, Monetisation, Distance to Target)	Multi-criteria assessment decomposed into sub-problem assessments, each of which can be analysed independently?	Application of numerical weightings to sub-problem scores to establish weighted hierarchy?	Pairwise comparison between alternatives?	Potentially applicable to generic process evaluation? (Y/N)
ISO 14955-1: Machine tools	C	N	N	N	NA	Y	N	Y	Y
Machine Tool Mandatory Point Scheme Proposal	P	Y	Y	Y	Panel	Y	Y	Y	N
AHP applied to technology portfolio assessments	P	Y or N	Y	Y	Usually Panel	Y	Y	?	Y
Points systems used for ecolabelling	C	Y	Y	Y	Usually Panel	Y	N	Y	N
Points systems used for green public procurement	P	Y	Y	Y	Usually Panel	Y	Y or N	Y	Y

SUMMARY OF THE METHODOLOGICAL ELEMENTS USED

Method	Pure points system (P) or potential component (C) within one?	Classification based on points scored (Y/N)	Hierarchical decision aiding model? (Y/N)	Prioritisation and agregate score?	Prioritisation method (Panel, Monetisation, Distance to Target)	Multi-criteria assessment decomposed into sub-problem assessments, each of which can be analysed independently?	Application of numerical weightings to sub-problem scores to establish weighted hierarchy?	Pairwise comparison between alternatives?	Potentially applicable to generic process evaluation? (Y/N)
The "installer energy label" for heating systems	C	N	Y	N	N	Y	Partially	Y	N
Europump extended product scheme	C	N	Y	N	N	Y	N	Y	N
Ecodesign Lot 37 lighting systems investigation	C	N	Y	N	N	Y	N	Y	Y

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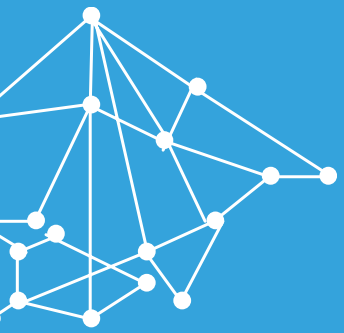

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