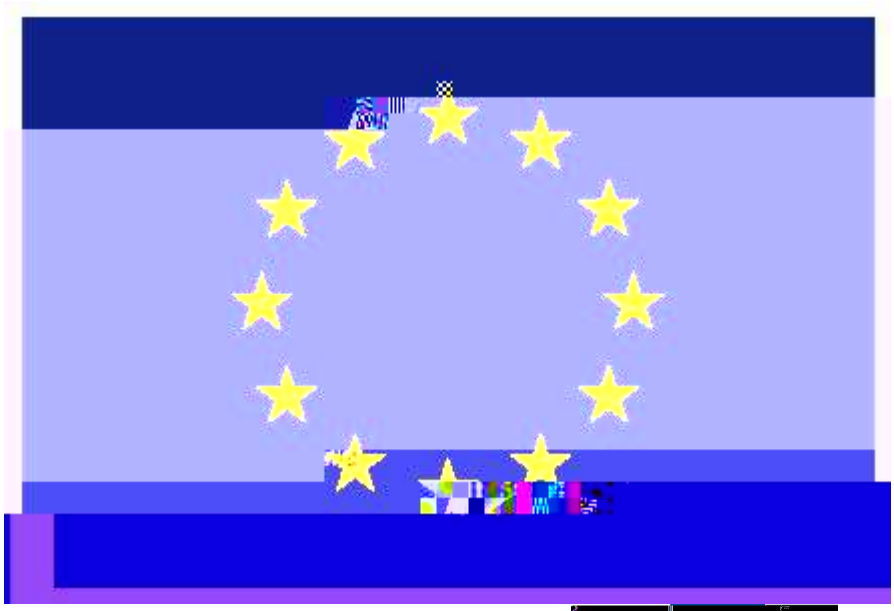
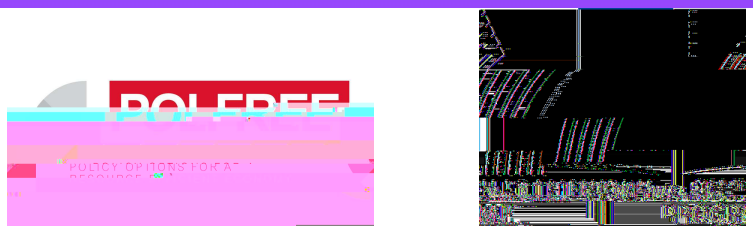




Grant Agreement no. 308371

ENV.2012.6.3-2 - Policy Options for a Resource-Efficient Economy

- Collaborative project -

D2.1
Report about synthesis of new concepts

WP 2 - New concepts and paradigms for policies for resource efficiency

Due date of deliverable: Month 8

Submission date: 26 / 07 /2013

Start date of project: 1st October 2012 Duration: 42 months

Lead beneficiary for this deliverable: TNO

Last editor: Arnold Tukker

Contributors: Teresa Domenech, Paul Ekins (UCL), Jill Jäger, Franziska Hartwig (SERI), René Kemp (UNU Merit, ICIS)

The research leading to these results has received funding from the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 308371.

Dissemination Level		
PU	Public	X

PU

1 Introduction

POLFREE (Policy Options for a Resource-Efficient Economy) is a major EU funded project that aims to design policy pathways towards a resource efficient Europe. The project is next to a Management (WP5) and Dissemination (WP4) Work package divided in the following main Work packages and tasks (see also figure 1.1):

1 Why have resources been used inefficiently?
  1.1 Analytical framework

2 Goals of a resource-efficiency policy

2.1 Introduction

This section reviews goals that a resource-efficiency policy at minimum should strive for, in terms of planetary boundaries that must be protected, key groups of resources as a starting point and targets of a resource policy, etc. We will approach this topic as follows.

First, it has to be acknowledged that resource-efficiency is closely related to sustainability in general. Resource-efficiency policies, like any sustainability policy, can have an environmental, social and economic dimension. As for resources, there is in particular a huge strand of policies related to development in resource-rich countries, to security concerns and to issues of human rights. Those issues can hardly be separated from resource efficiency policy, and one can assume a number of trade-offs between the various related goals. Further, it has to be noted that any such goals cannot be set entirely in an objective manner. Section 2.2 will hence discuss various sustainability perspectives. Third, using mainly an ‘maximum tolerable impacts’ perspective, section 2.3 will introduce goals a resource-efficiency policy at minimum should strive for, in terms of planetary boundaries that must be protected and other resource-related goals. This will be dealt with in more detail in WP

used concepts such as strong and weak sustainability and relate loosely to the individualist, hierarchist and egalitarian perspectives in Cultural Theory (Thompson et al, 1990; WRR, 1994).

Box 2.1: Sustainable development as a contested concept hiding from view real tradeoffs

In essence this chapter is an attempt at capturing sustainable development analytically through the use of principles, components and indicators. Here we should pause to think about an important social fact which is that policy choices and individual decisions (about choice of transport and diets) are almost never based on such elements. The labelling of particular options as green or sustainable is having more of an influence on decisions of consumers, producers and policy makers but the term green and sustainable usually hide from view the negative environmental impacts and problems related to resource use. The Prius car is widely viewed a green car but its emissions are above those of small gasoline cars. A diesel car is more fuel efficient, popular under those who want to drive a lot and now can afford to do so.

Information about environmental performance may help to dispel simple ideas about greenness but in any life cycle assessment different aspects must be weighted: lower greenhouse gas emissions from battery & hybrid electric vehicles have to be weighed against the possible depletion of dysprosium a rare earth material used in batteries. Science cannot weigh the two things and cannot even determine the likelilhood of depletion and the costs of this to society. The substantial content of sustainable development cannot be scientifically determined as 'objective knowledge' but will always incorporate normative valuations that only become ascertained in the process of social interaction (Voss and Kemp, 2006). It is important recognise the limits of knowledge and the importance of subjective valuation. From a governance perspective such disagreement is an essential part of sustainable developments, one that makes operationalisation difficult:

- there are different ideas of what sustainable development amounts to for actors in various sectors (energy, transport, agriculture, food systems, waste management);
- existing solutions tend to be sustainable within these sectors rather than across the whole of society
- new developments bring new risks that cannot be anticipated;
- it is a long-term, open-ended project that precedes and supersedes limited term, democratically elected governments;
- it involves making choices and perhaps trade-off decisions on highly contested issues (which is to say that in some cases the notion of a 'trade-off' might prove to be no more than a euphemism for fundamental irresolvable dilemmas). (Farrell et al. 2005, p. 132)

Policies for resource efficiency are likely to be contested and resented in society because of uncertain knowledge, different views and valuation and because people always will resent government interference with their lives. Given the low salience of resource efficiency in society, it may be necessary for resource efficiency policies to draw on things people actually value: greater well-being, lower energy costs, better systems of transportation, tasty food. Relatively easy wins may be obtained this way, but it should not stop at that. To decouple well-being from resource consumption, political choices must be made about the phase out of fossil fuels, the implementation of energy improvement programmes for the built environment, use of nuclear power and compulsory targets for recycling and re-use.

2.2.2 Weak sustainability: maintaining the productivity of manufactured, human, social and ecological capital

Some authors operationalised the concept of sustainability as a number of interrelated capital stocks, for instance manufactured, human, social and ecological capital (Ekins, 1992). Wealth is created by production of a flow of products and services making use of this (total) capital. Weak sustainability assumes that such stocks are – to a certain extent – exchangeable. What matters is that the productive value of this capital (determined by its quality and quantity) must be kept intact (or better: increase) to ensure the inter-generation sustainability meant by Brundtland (compare Solow, 1992). The famous 'sustainability triangle', portraying sustainability as interrelated development along economic, social and environmental axes, reflects this approach.

Figure 2.2: Sustainability triangle

The so-called 'weak sustainability' view accepts a

    - A free, global market for resources should exist and security of supply should be arranged to should be strived for (e.g. EC, 2010);
- Social aspects: basic human rights and labor rights should be honoured;
- Environmental aspects: some basic environmental standards (e.g. emissions) have to be adhered to.

This framing is likely to rely significantly on market-based solutions, and emphasise the 'private good' benefits of a resource-efficiency policy: lowering economic costs, and enhancing competitiveness. There is probably a role for authorities to protect public goods, but it is much less prominent as in the next frame.

POLFREE

Harvesting of renewable resources should not exceed regeneration rates;
Waste emissions should not exceed renewable assimilative capacity;
Nonrenewable resources should be exploited, but at a rate equal to the creation of renewable substitutes.

Table 2.1: Potential resource constraints

Type of resource	**Fraction of global resource extraction**

POLFREE

on the regime may become so high that rapid change may become possible (niches 'scaling up'). The regime breaks down, and niches plus the remnants of the existing regime will develop new structures, which eventually will stabilise and form a new regime (cf. Geels, 2005; Kemp and van den Bosch, 2006).

This theory has been applied quite successfully to analyse a variety of changes in socio-technical systems, as indicated typically with a time horizon of 50 to 100 years. It is however

3.3.2 *Individualist*: 'Sustainability through the market '

The individualist basically has an optimistic view of the world and human nature, and believes

It is in a way interesting to see that the Fatalist and Egalitarian modes usually are followed by more traditional top-down or market based policies. A largely bottom-up ‘egalitarian’ process after some time can lead to the following situations:

- Actors in the system start to understand their role in the transition, start to understand the benefits that taking up this role has (or create the boundary conditions for benefits), and learn the skills to take up this role (which then basically leads to a shift to the ‘individualist’ mode);
- Actors in the system start to accept that a single actor or a group of actors take up a leading and dominant role in guiding the transition (which then basically leads to a shift to the ‘hierarchist’ mode)

And if one is bogged down in a ‘fatalist’ situation an external event or disaster might make it possible to switch swiftly to a governance style from another quadrant. The feeling that the US was losing the space race after the launch of the Soviet built Sputnik in 1957 and above all the launch of Yuri Gagarin as first human being in space in April 1961 prompted President Kennedy in May 1961 to announce the dramatic and ambitious goal of sending an American safely to the moon before the end of the decade (fatalist to hierarchist). Scandals in the Dutch building sector put it under so much pressure that there might now be an opportunity to investigate how a the transition to a more dynamic, innovative and client-oriented building cluster can be made (fatalist to egalitarian).

Figure 3.3: Governance modes for Factor X transitions

4 Concepts, classification and mapping of strategies

4.1 Introduction

- Small is beautiful / appropriate technology

4.3 Classification and mapping

4.3.1 Dimensions for classification

In Annex 2 we review some classifications for sustainability concepts developed in other contexts. For instance, the European Eco-innovation observatory uses as dimensions the Scope of change (system components or systems) and the Degree of change (in terms of incremental and radical). The OECD's Eco-innovation work again uses Scope of change but then different system elements as targets. In a project on sustainable consumption and production Tukker and Tischner (2006) use the Scope of change as parameter, by discerning the production and consumption side, next to the Degree of change (incremental and radical). One study use a social and environmental dimension in combination with Degree of change, whereas another classification is ultimately portrayed in a figure with an environmental, social and economic dimension and also a Degree of change.

It is not difficult to end up with dozens of criteria on which new concepts with regard to resource efficiency can be evaluated. A drawback of using many criteria is that one easily loses oversight. We hence prefer to reduce the number of criteria or parameters to at maximum three, allowing to plot concepts in a three-dimensional graph. We think that for the analysis of concepts in this paper at least the following dimensions are relevant, and propose to use a 3 point scale to define positions on these dimensions:

Scope of change. The scope with regard to which system is covered plays a role in virtually all researched classification systems, and seems also relevant given the long list of concepts mentioned in chapter 4. Some concepts focus on parts of the value chain, such as responsible mining. Others aim at transforming whole systems. We propose to classify initiatives in one of the following three categories

- Scope is a specific industry sector (e.g. mining)
- Scope is a value chain
- Scope is societal (sub)-systems (e.g. food, energy, mobility)

Ambition with regard to the (paradigmatic) degree of change. This resembles the degree of change found in many of the classification systems, but deliberately adds the adjective 'paradigmatic' to it. As discussed in chapter 2, currently the sustainability discussion is often still framed in the utilitarian, economic rationality that has dominated Western society since enlightenment and the industrial revolution. Many concepts simply still adhere to this existing paradigm. Other concepts however see the existing paradigm as a root cause of the sustainability problem, and hence argues that an upheaval in values, institutions, etc. is essential, towards a direction that some have dubbed 'Buddhist Economics'. This goes significantly further as the differentiation in incremental and radical change, which often just is focused on technical aspects. We see further that within the existing paradigm of utilitarian, economic rationality of use of nature there is a diffeerey22(s)-0.295585( )-2.164g( )-2.164g( )-2.164g( )-2

•

Table 4.1: Evaluation dimensions and scoring criteria for concepts

	Low (-1)	**Medium (0)**

Table 4.3: Concepts with a high plausibility of pathways of change

	S213e 14 25a6ge	Para7ig 8 a9i2 7egree	Pla:;ibili9< 14 3a95;
* a;9e Preve69i16	&	&	1
EPR	&	'1	1
S:33l< 25ai6 8 a6age 8 e69	&	'1	1
* ea= ;:;9ai6abili9<	1	'1	1
S9r16g ;:;9ai6abili9<	1	&	1
E21 l661va9i16	1	&	1
Gree6 gr1>95	1	'1	1
Gree6 e21618<	1	&	1
Clea6er 3r17:29i16	&	'1	1
E21'e44i2ie62<	&	'1	1
P1ll:9i16 3reve69i16 3a<;	&	'1	1

organising society in a sustainable manner, but simply having an appealing idea – even if embraced by various groups in society - is by far not sufficient to foster revolutions that can overcome the resisting powers mentioned before. The transition management concept hence indicates that the existing system and parties with power in it must already be under significant pressure before they ‘crack’ and a real revolution becomes possible. It seems hence that all the concepts we analysed in fact just managed to be convincing on one or two of the three aspects relevant for far-reaching change.

5 Summary and conclusions

This deliverable analysed drivers for a resource-efficiency policy. It further evaluated over 25 popular sustainability concepts that could contribute to the resource agenda, such as degrowth, the circular economy, green growth, and cleaner production. For each concept the report

d) Metal ores and industrial minerals. Here we encounter a very mixed situation, where some materials may indeed see absolute scarcity in the next decades, but where in most cases supply disruptions are caused by geopolitical factors or market instabilities rather than real scarcity[9]. In such cases, simply learning better how to manage a market characterised by uncertainties in future demand, long lead times for opening mines, and dealing with geopolitical factors, can reduce many of the problems that exist today.

Overall, it seems hence that strong or unavoidable drivers based on absolute scarcity that can support radical improvements of resource-efficiency are not so dominantly present as sometimes assumed. It is unlikely that scarcity problems by themselves will drive a broad, strong resource revolution in the next decades, apart from maybe a number of specific metal ores and industrial minerals, next to a need for incremental resource-efficiency improvements

6 Annex 1: Definitions with regard to resource-efficiency[10]

6.1 Introduction

The concept of eco-efficiency was introduced to describe a broad management objective to decouple economic activity from natural resource use and pollution (Schmidheiny, 1992). Since then, it has been the subject of considerable discussion and analysis (see, for example, DeSimone and Popoff, 1997, where it was defined as relating to "activities that create economic value while continuously reducing ecological impact and the use of natural resources" [p.xix]), and has gained ground in many different countries and disciplines.

Resource (or eco-) productivity, resource efficiency, and resource intensity are all terms that are also used in this field, and can be seen as specific indicators of the broader concept of eco-efficiency, although in some instances resource efficiency is interpreted as a measure of resource productivity. In reality, the many related terms and concepts tend to be used rather indiscriminately and interchangeably. While the diversity and scope of application are encouraging, it is also obvious that eco-efficiency has become an umbrella term, under which many different measures and practices confusingly co-exist[11]. As eco-efficiency practices spread, and more disciplines and practitioners get involved, the lack of clear-cut definitions is likely to give rise to more confusion and cross-purpose communications.

In particular, there is often a need to differentiate between eco-efficiency measures which look at trends in economic output per unit of physical input or polluting output (such measures are closest to the definition of eco-efficiency in DeSimone and Popoff 1997, cited above), and measures which examine trends in physical output per unit of physical inputs. Both these types of measure are important indicators, as they highlight aspects of eco-efficiency that are qualitatively very different.

In order to bring some clarity to the terms in this field, and bring some consistency and coherence to the terminology of eco-efficiency indicators, all of which are basic ratios between two variables, this project will distinguish between *resource efficiency*, *resource productivity* and *resource intensity*. These distinctions in terminology also capture whether the indicators have numerators in monetary or physical units.

6.2 Resource efficiency

Resource efficiency is defined by Dahlstrom and Ekins (2005) as a basic ratio of two resource variables of the same kind, that is, the ratio is dimensionless. For example, material efficiency is measured as a ratio between useful material output, M_o, and material input, M_i, such as useful material output per total material input:

M_o/M_i = material efficiency

[10] This section is adapted from, but follows cloR12 9.96 Tf 0.9993896 titi,s iviufin ioap 5187(n)5.u tm24fR12 9.96 T.1i6(t)05d.

And energy efficiency is useful energy output, E_o, per input of energy, E_i:

E_o/E_i

This definition is also analogous to the concept of labour productivity, which is measured as GDP or value added per worker, L, and is a key indicator of economic productivity at the national level:

Y_o/L = labour productivity

However, while productivity as a term is associated with a welfare outcome, in a broader sense it obviously just refers to the production of some (desirable) factor (the numerator) by some other factor (the denominator). For example, we might wish to examine not just the economic output per worker, but also the useful material output per worker:

M_o/L = material productivity of labour

or the useful material output per input of energy:

M_o/E_i = material productivity of energy

Sometimes, of course, the various indicators might be linked. For example, in mining or smelting one might expect a good quality mine or ore to have a relatively high material productivity of energy (M_o/E_i), implying high relative material output per unit of energy input, along with a relatively high material efficiency (M_o/M_i), implying relatively low mining waste or furnace slag.

Other definitions of resource productivity include:

- Bleischwitz et al. (2007): Resource productivity describes the relation between economic outputs in monetary terms (Y – numerator) and a physical indicator (M – denominator) for material or resource input.
- OECD (2008): According to the OECD (2008) the term 'resource productivity' is […] put in a welfare perspective and is understood to contain both a quantitative dimension (e.g. the quantity of output produced with a given input of natural resources) and a qualitative dimension (e.g. the environmental impacts per unit of output produced with a given natural resource input).

6.4 Resource intensity

Resource intensity is defined as the inverse of resource productivity, so that labour intensity would be measured as L/Y_o, and energy intensity as E_i/Y_o. It can also refer to the production of some undesirable output (often resulting in pollution) by some other factor, for example carbon dioxide output, C, per unit of energy input:

C_o/E_i = the carbon (emission) intensity of energy (which, assuming no abatement of carbon emissions, is the same as the carbon intensity of the energy inputs, C_i/E_i)

or the output of pollution or waste, P, per unit of material inputs:

P_o/Y_o = the pollution intensity of output

For carbon emissions, with no carbon abatement, the carbon (emission) intensity of output, C_o/Y_o, is the product of the carbon intensity of the energy inputs and the energy intensity of output, i.e. $C_o/Y_o = C_o/E_i \times E_i/Y_o$.

6.5 Eco-efficiency

Returning again to the term 'eco-efficiency', this is sometimes applied to the ratio Y_o/P_o, the inverse of the pollution intensity of output, to capture the fact that pollution may be thought of as having a negative impact on the natural capital base that supports economic production and human welfare. In other words, although this eco-efficiency indicator actually relates two *outputs* from production, one desired the other undesired, the P_o term is intended to act as a proxy for an undesirable impact on production *inputs*, so that the indicator serves as a ratio of output to input as in the uses of the term efficiency above. Clearly eco-efficiency in this sense will increase when, other things being equal, production increases or pollution declines.

6.6 Summary

Box A1.1 summarises the above discussion of the ter

Box A1.1: Summary of terminology for Resource Efficiency Indicators

8 Annex 3: Natural constraints with regard to resource use

The fear that humans will run out of natural resources is not a new phenomenon. Centuries ago, Malthus feared that humanity inevitably would face a period of starvation since in his time, population growth was quicker as the growth of agricultural production. Limits to Growth (Meadows et al, 1972) warned for a collapse of society due to overexploitation of resources, something that at least until now did not yet materialise.

Some statistical evidence however provides at least food for thought. In the past fifty years humans have consumed more goods and services than in all previous generations put together. The Earth's natural resources are used at an unprecedented, and still fast rising rate (see Figure A3.1). And we still have billions living in poverty, implying that material economic growth is essential to create decent lives for all. A simple estimate indicates we need to quadruple the current global GDP from 50 trillion US$ to 200 trillion US$ to eradicate poverty by 2050:

a) There are currently 1 billion people in the rich OECD with an average GDP/capita of 50.000 US$, and another 1-2 billion in fast growing economies in the process of becoming part of this 'global middle class' (WBCSD, 2009; Meyers and Kent, 2004). Unless we reduce income in the OECD and aspirations in the BRICS countries, which form a political 'no-go area', this implies an income of some US$100 trillion in total by 2050;
b) By 2050 there will be 7-8 billion people in poorer economies, who would need some US$10-15,000 per capita, which is persistently shown in the literature as the minimum for countries to arrive at reasonable life spans, human-development indices, etc. (Layard, 2005, Abdallah et al., 2009; Jackson, 2009). This results in a further US$ 100 trillion in total by 2050.

Various sources estimate that despite relatively decoupling of economic growth from resource

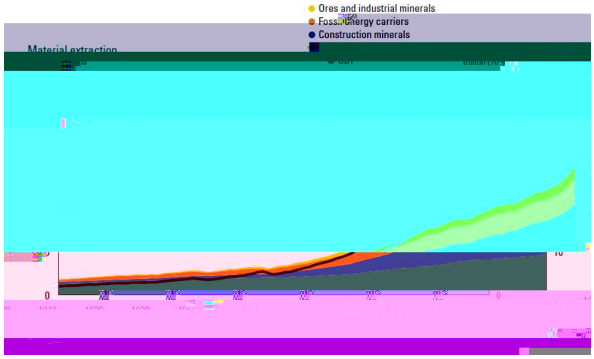


Table A3.1: Potential resource constraints

Type of resource	Fraction of global resource extraction	Basis for planetary limits	Potential limit

- Fossil fuels: As such they are not scarce (yet). Particularly coal and shale gas is still available for decades to centuries (IEA, 2012). The real constraint with regard to their use are the now obvious limits of the atmosphere to store CO_2. In absence of massive diffusion of storage technologies like CCS, this implies the need for a fast reduction of use of fossil fuels. Meinshausen et al., 2009 estimated that to stay within a 2^oC between 2000 and 2050

locally also mining can be an important user of water and source of water quality problems (Bleischwitz et al., 2012).

Finally, GWS (2013). developed a classification of 'Green Growth' strategies on on the basis of some 16 criteria. They ultimately map all strategies in a three dimensional framework that discerns an economic, environmental, and social axis, and the emphasis that is given to each of this aspects. For the economic axis, interestingly not only emphasis on growth is made visible, but also if a strategy emphasizes negative growth or 'degrowth'.

Figure A4.5: Classification of Green Growth strategies (GWS, 2013).

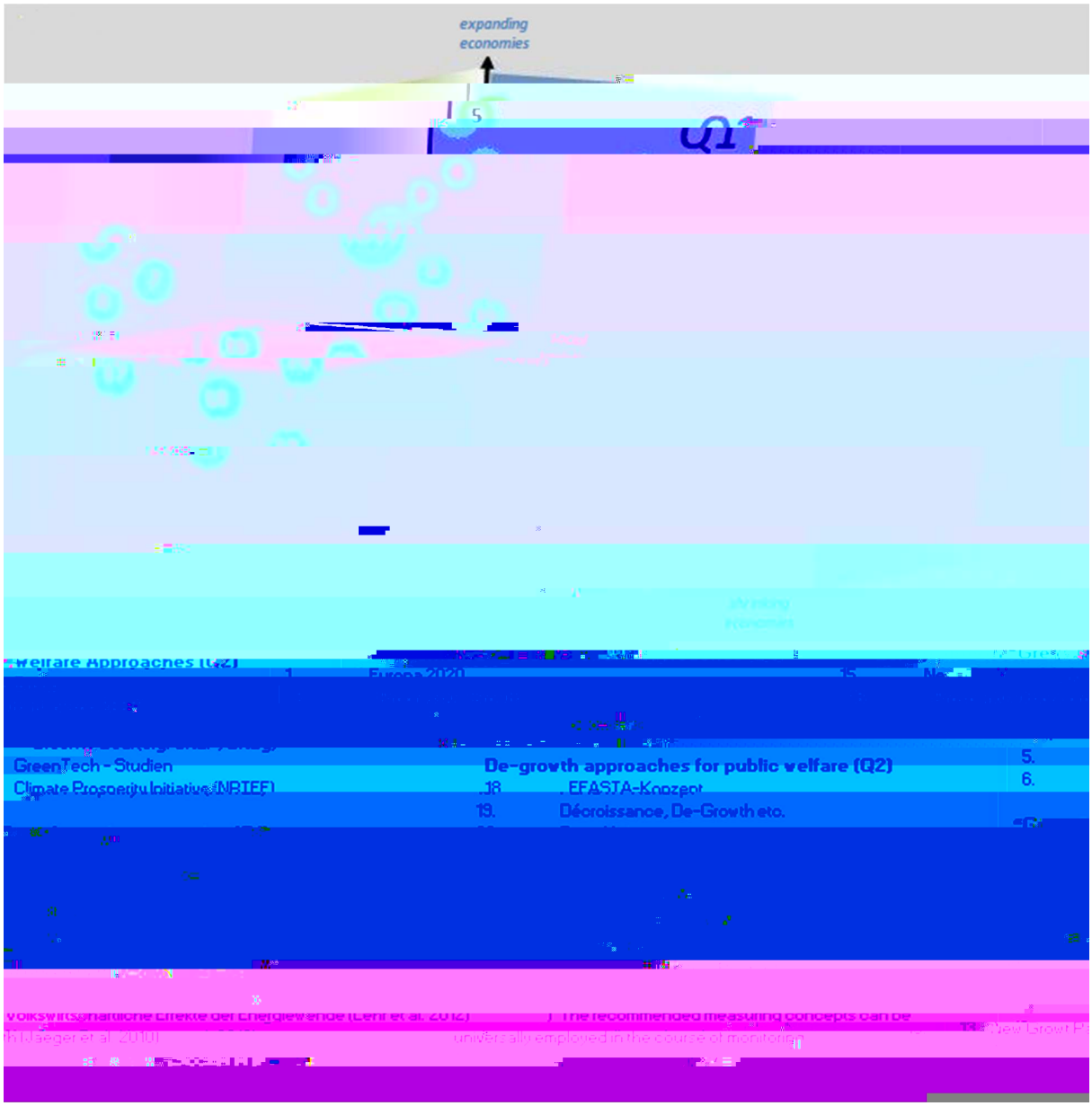
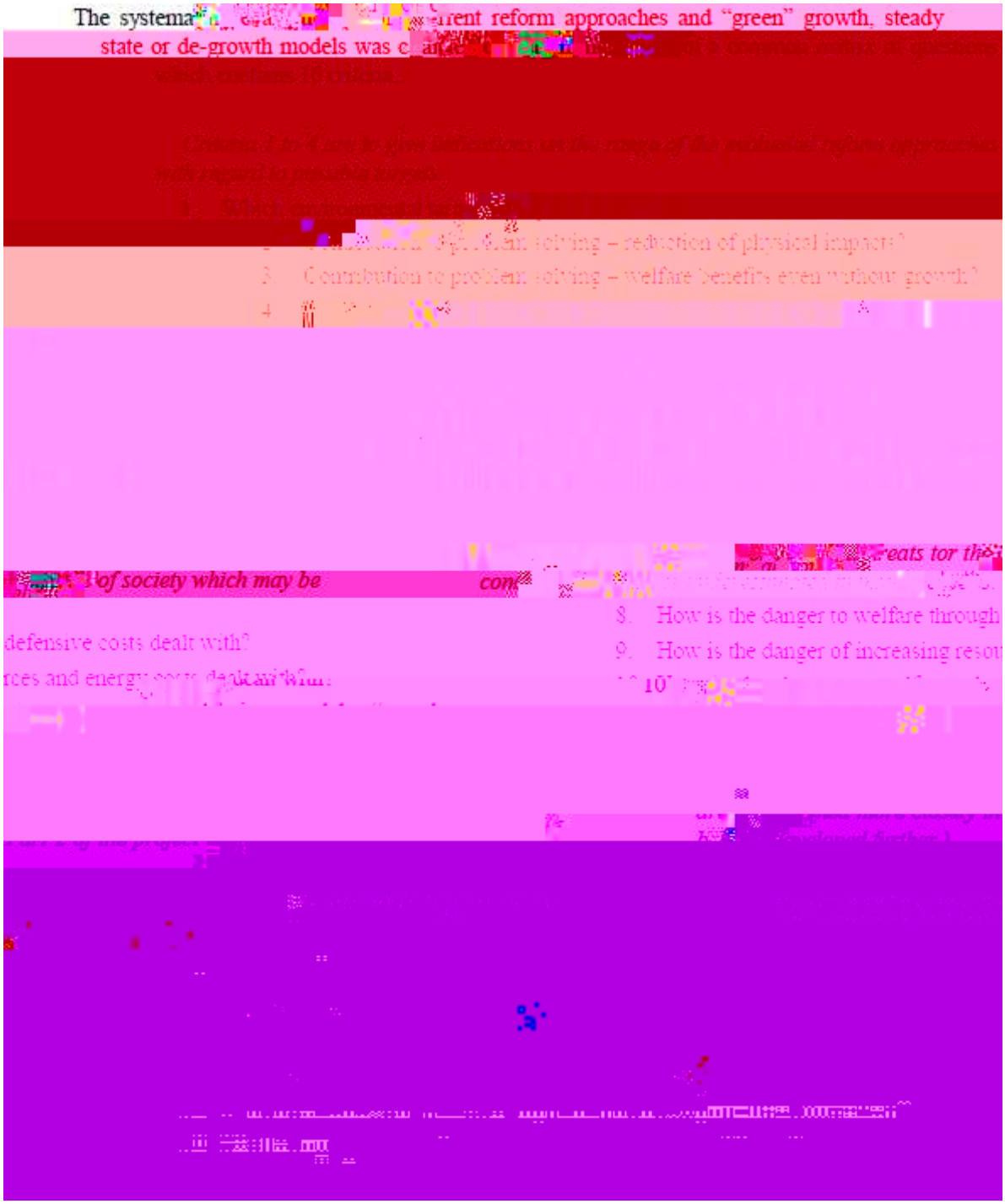


Table A4.1: Criteria used to evaluate green growth models (GWS, 2013).



9.3 929. Dim2

The Eco-innovation observatory uses as dimensions the Scope of change (system components or systems) and the Degree of change (in terms of incremental and radical). The OECD again uses Scope of change but then different system elements as targets. Tukker and Tischner too use the Scope of change as parameter, by discerning the production and consumption side, next to the Degree of change (incremental and radical). Hopwood et al. use a social and environmental dimension in combination with Degree of change. The GWS classification is somewhat more complex, but ultimately portrayed in a figure with an environmental, social and economic dimension and also a Degree of change.

As the GWS study indicates it is not difficult to end up with dozens of criteria on which new concepts with regard to resource efficiency can be evaluated. A drawback of using many criteria is that one easily loses oversight. We hence prefer to reduce the number of criteria or parameters to at maximum three, allowing to plot concepts in a three-dimensional graph as exemplified in Figure A2.5. We think that for the analysis of concepts in this paper at least the following dimensions are relevant, and propose to use a 3 point scale to define positions on these dimensions:

Scope of change. This plays a role in virtually all researched classification systems, and seems also relevant given the long list of concepts mentioned in chapter 4. Some concepts focus on parts of the value chain, such as responsible mining. Others aim at transforming whole systems. We propose to classify initiatives in one of the following three categories

- Scope is a specific industry sector (e.g. mining)
- Scope is a value chain
- Scope is societal (sub)-systems (e.g. food, energy, mobility)

Ambition with regard to the (paradigmatic) degree of change. This resembles the degree of change found in many of the classification systems listed above, but deliberately adds the adjective ‘paradigmatic’ to it. As discussed in the main report, currently the sustainability discussion is often still framed in the utilitarian, economic rationality that has dominated Western society since enlightenment and the industrial revolution. Many concepts simply still adhere to this existing paradigm. Other concepts however see the existing paradigm as a root cause of the sustainability problem, and hence argues that an upheaval in values, institutions, etc. is essential, towards a direction that some have dubbed ‘Buddhist Economics’. This goes significantly further as the differentiation in incremental and radical change, which often just is focused on technical aspects. We see further that within the existing paradigm of utilitarian, economic rationality of use of nature there is a differentiation between approaches that emphasise predominantly the business opportunities and benefits for being sustainable and resource efficient – the role of authorities then simply is to remove market failures - and approaches that see also a threat to public goods – with authorities then having a role of protecting them. This leads then to the following three categories:

- No paradigmatic change, focus on market-based solutions
- Intermediate paradigmatic change in the sense that there is his 73117( )-2.16192(c)-0.ntht fc8712

paradigmatic changes, Kuhn (1962) already noted that these are not frequent and only happen

Table A4.2: Classification dimensions and scoring criteria

	Low	**Medium**	**High**
Scope of change	One specific industry	Various parts of value chains	Societal (sub) systems
Paradigmatic degree of change	Focus on market-based solutions	Recognition of 'public goods' and related right of government to act in public interest	Seeks an alternative for the utilitarian and rational economic approach to life and nature
Plausibility of pathways of change			

10 Annex 5: Description and classification of concepts

10.1 Industrial Ecology

	Description
Main aim / origins /history	The concept of industrial ecology (IE) proposes a system-oriented view to analyse the interactions between human and natural systems. In an attempt to minimize the impact of production and consumption processes on natural systems, "*IE seeks to optimize the total industrial materials cycle from virgin materials to the finished product to ultimate disposal of waste*" (Graedel, 1994). Generally, the origins of the concept are attributed to Frosch and Gallopoulus (1989) that in their seminal paper Strategies for Manufacturing, allude to what has been later termed as the "*ecological metaphor*", the idea that industrial systems should mirror the efficiently functioning of natural systems, where waste of process becomes a resource for another process or organism. In the same year, Ayres (1989) published a paper on Industrial Metabolism defining some of the key ideas and pillars of the field. IE proposes a profound restructuring of production and consumption systems from a mainly linear design where raw materials are extracted from natural systems, transformed and consumed and then released to the biosphere, to a circular, closed-loop system where resources are cascaded and recycled within the system, "*favouring an industrial metabolism that results in reduced extraction of virgin materials, reduced loss of waste materials, and increased recycling of useful ones*" (Ayres, 1989).

	Low	Medium	High
Scope of change	One specific industry	Various parts of value chains	Societal (sub) systems
Paradigmatic degree of change	Focus on market-based solutions	Recognition of 'public goods' and related right of	

	Low	Medium	High
Scope of change	One specific industry	Various parts of value chains	Societal (sub) systems
Paradigmatic degree of change	Focus on market-based solutions	Recognition of 'public goods' and related right of government to act	

re f 0 g q 8.33333 0 0115944(o)-.33333 0 0 8.33

10.4 Extended Producer Responsibility

	Description
Main aim/origins/history	The concept of extended producer responsibility (EPR) involves a "*shift in the responsibility of the end of life management of products to producers*" (Lifset et al., 2013). A widely used definition of EPR is the one provided by the Organization for Economic Cooperation and Development (OECD, 2001), which refers to it as "*an environmental policy approach in which a producer's responsibility for a product is extended to the post-consumer stage of a product's life cycle*". From the policy point of view, EPR schemes generally involve two related features (OECD, 2001): *"(1) the shifting of responsibility (physically and/or economically; fully or partially) upstream toward the producer and away from municipalities, and (2) (…) the incentives to producers to incorporate environmental considerations in the design of their products*". The origins of EPR concept can be found in the early policy developments in Sweden and Germany in the early 1990s of EPR schemes that aimed at providing an integrated strategy to tackle eco-design of products and to internalize the economic costs of end-of-life management, shifting its financial burden from public authorities to producers and consumers. Although in most cases concrete policy manifestations of the EPR schemes have fallen short of the initial aims of the strategy to focus on the expansion and funding of post-consumer recycling, EPR should in principle contribute to advance towards closing the loop of materials and resources and thus to enhance resource efficiency. Currently, the EU has introduced EPR schemes covering the following waste streams: batteries (Batteries Directive 2006/66/EC), packaging (Packaging Directive 94/62/EC), vehicles (end-of-life Vehicles Directive 2000/53/EC), electrical and electronic equipment (WEEE Directive 2002/96/EC). The recast of the waste framework directive (2008/98/EC) also includes a general provision to support the "design and production of goods which take into full account and facilitate the efficient use of resources during their whole life-cycle including their repair, re-use, disassembly and recycling". Article 8 from chapter II (General Requirements) specifically encourages Member States (MSs) to take legislative or non-legislative measures to ensure that producers of products have extended producer responsibility, including measures to accept returned products at the end of their use life and the waste associated with them. Producers should also have the financial responsibility associated with those activities. The directive also encourage MSs to take measures to ensure that design of products incorporate principles of environmental impact and waste minimisation and that, where possible, they are suitable for multiple uses and durable and suitable for proper and safe recovery at the end of their useful life.
Scope of change	EPR schemes, by creating a link between the products and the producers at the end of their use life, introduce significant changes to various parts of the supply chain, including, in some cases, reverse logistics and take back systems, to revert to the manufacturer the product at the end of its use-life. The scope of change can thus be considered medium.
Paradigmatic degree of change	Regarding the paradigmatic degree of change, even though it could be argued that different manifestations of EPR could lead to significantly divergent results in terms of paradigmatic changes operated at the core of the manufacturing system, the concept does primarily rely on the predominant utilitarian and rational paradigm in most of its current manifestations with a focus on internalizing the costs of end-of-life management. Moreover, the way schemes have been implemented at present are too fragmented to achieve a profound widespread effect on the manufacturing system.
Plausibility of pathway of change	The concept addresses real-life driving forces, such as resource scarcity, and provide clear pathways of change through the introduction of reduction targets, materials bans and market-based instruments to improve end-of-life management of products. Different initiatives and schemes tackling a variety of waste streams (batteries, vehicles, electronic waste) exist both at

10.7 Ecological Economics

	Description
Main aim/origins/history	

10.8 Natural step

	Description
Main aim/origins/history	The natural step is a framework to sustainability developed by a non-profit organisation founded by Karl-Henrik Robert in 1989. It proposes a number of system conditions that need to be fulfilled to lead to a sustainable society. The first three conditions are based on the thermodynamic laws, adding a fourth

10.9 Weak, strong and sensible sustainability

	Description
Main aim/origins/history	Although the concept of sustainable development can be traced back to the 1980s, it was the publication of the Brundtland report in 1987 (WCED, 1987), what which contributed to its popularisation and policy resonance, by providing reconciliation between growth and environmental protection. According to the report, sustainable development is a: '*development that meets the needs of the present without compromising the ability of future generations to meet their own needs*'. At a global level, the sustainable development concept and associated goals and principles have been refined over time during the United Nations Conference on Environment and Development at Rio in 1992 and the World Summit on Sustainable Development in Johannesburg in 2002. Most of the concepts suggest an environmental, economic and social dimension. The ambiguity contained in the term has given rise to different interpretations or "plethora of paradigms" (e.g. Fowke and Prasad, 1996; Fischer-Kowalski et al., 1994; WRR, 1994; Gallopín, 2003). Sustainable development has been conceived as a desirable goal for some and as a paradigmfe

	on strong sustainability though involves a radical change in existing values and institutions and the way in which environmental systems are considered and accounted for. Critical environmental system services and thresholds are key for the maintenance of economic and social systems. Also, aspects such as justice and equity, understood as intra- and inter-generational equity are at the centre of the approach.
Plausibility of pathway of change	The concept has materialised in ever-growing number of policy strategies and programmes around the world. From the Agenda 21, proposed at the UN Conference on Environment and Development in Rio 1992, there has been innumerable initiatives and programmes to pursue sustainable development at the global, supranational (EU sustainable Development Strategy), national (see, for example, Sustainable Development Strategy of Canada), regional, sectorial (see, for example, German Sustainability code or the cement sustainability initiative) and local level (see, for example, Local Agenda 21). Although the content and level of ambition of these initiatives varies considerably, they provide specific measures and instruments to move towards a more sustainable path of development.
Actors addressed (industry, government, civil society) environment/ social/ economic aspects	As a holistic approach, all societal actors are addressed, including industry, consumers, citizens, NGO's and Governments. A key pillar of the approach is the interconnection between economic, social and environmental dimensions.

Weak sustainability

	Low	**Medium**	**High**
Scope of change	One specific industry	Various parts of value chains	Societal (sub) systems
Paradigmatic degree of change	Focus on market-based solutions	Recognition of 'public goods' and related	

Strong sustainability

10.10 Small is beautiful / appropriate technology

	Description
Main aim/origins/history	Small is beautiful proposes an alternative approach to mainstream economics, which criticizes the focus on output and technology while ignoring the limited capacity of natural systems and their irreplaceable role in sustaining society. Although the phrase came from Leopold Korh, author of the *Breakdown of Nations* (1957), where he rooted the cause of social misery in the concept of "bigness", it was a collection of essays by economist F.E. Schumacher entitled *Small is Beautiful: a study of economics asd if people mattered* (1973) that championed the idea of small, appropriate technology. Schumacher argues that the modern way of production is unsustainable, generating tensions both in the social and natural systems. This approach challenges the idea that big is better or that growth is good and proposes a new perspective on economics, that he termed Buddhist economics, that tries to overcome the materialist focus and where small, local, decentralised models of work and production are preferred. This approach entails a fundamental restructuring of all societal systems and the values behind them and proposes a vision of development that transcends materialistic realm to focus on the ethical maturity of human beings (Payutto, 1992). Pathways of societal change are rooted in a redefinition of the nature of human labour and the scale and modes of production. The local sphere gains relevance and the idea of maximising profits is substituted by that of minimizing suffering and non-violence to all living and non-living beings. Thus, resource management should focus on a very careful, planned use of resources, avoiding overexploitation of natural resources that is a form of violence that opposes the Buddhist principle of non-violence. Production needs to be locally adapted and where possible self-sufficient. Maximizing consumption is not a true measure of human happiness and thus it advocates for different measures of wealth such as the Gross National Happiness (www.grossnationalhappiness.com).
Scope of change	The scope of change is thus high, calling for an upheaval and restructuring of all societal sub systems and the basic principles of organising society.
Paradigmatic degree of change	The paradigmatic degree of change is also high as the concept seeks an alternative way of organising society and production, moving away from a materialistic focus, to a human-oriented approach, that redefines the nature of human labour and its connection with human dignity and the scale and mode of production, based on local, decentralised systems.
Plausibility of pathway of change	Pathways of change are discussed conceptually, pointing to possible avenues of social change, building around local alternatives of work organisation focused on self-subsistence and sustainability. These small-scale practical initiatives scattered around the world though are of a too limited scale to demonstrate the practicability of the approach at a wider context.
Actors addressed (industry, government, civil society) environment/ social/ economic aspects	The approach addresses all societal actors, including industry, citizens and governments. Decentralized and participatory models of government are though proposed. Environmental, social and environmental issues are considered intrinsically intertwined.

	Low	Medium	High
Scope of change	One specific industry	Various parts of value chains	Societal (sub) systems
Paradigmatic degree of change	Focus on market-based solutions	Recognition of 'public goods' and related right of government to act in public interest	Seeks an alternative for the utilitarian and rational economic approach to life and nature
Plausibility of pathways of change	Ignores factors making change un-necessary	Explains at best conceptually factors supporting change	

10.12 Transition management

	Description
Main aim / origins /history	"Transition management has rapidly emerged over the past few years as a new approach dealing with complex societal problems and the governance of these problems. In the

POLFREE

10.13 Green growth

	Description
Main aim / origins /history	Green Growth describes an alternative path to growth in contrast to the conventional paradigm of economic growth. The idea is that the environmentally necessary restructuring of the economy to include greater energy and resource efficiency and better management of natural capital can be a strong driver for growth. The thesis suggests that the inclusion of new green markets, the development of eco-innovations and the management of ecosystem services create both improved competitiveness and new business opportunities. The concept of green growth was coined in Asia and the Pacific. In 2005, at the Fifth Ministerial Conference on Environment and Development in Seoul, 52 Governments and other stakeholders from the region agreed In a Ministerial declaration to pursue a path of "green growth". They also adopted an implementation plan. This provided the starting point for the UNESCAP vision of green growth as a regional initiative to achieving sustainable development and the Millennium Development Goals (United Nations Department of Economic and Social Affairs). The Green Growth concept is also anchored in the OECD. The OECD (2011) defines Green Growth as “fostering economic growth and development, h alines

	Low	Medium	High
Scope of change	One specific industry	Various parts of value chains	Societal (sub) systems
Paradigmatic degree of change	Focus on market-based solutions	Recognition of 'public goods' and related right of government to act in public interest	Seeks an alternative for the utilitarian and rational economic approach to life and nature
Plausibility of pathways of change	Ignores factors making change un-necessary	Explains at best conceptually factors supporting change	Explicit and plausible

10.15 'Beyond GDP'

	Description
Main aim / origins /history	The aim of this initiative developed by the European Commission (2009) is to identify which indicators are best suited to measure societal progress. Usually societal progress is measured and compared using GDP, but is has been increasingly recognized that GDP does not capture whether well-being or prosperity (assets over and above financial assets such as health, social capital and security) has improved (see, for example, Jackson (2009)). Further the initiative identifies pathways for integrating these indicators into decision-making processes and public debate. The second key milestone after the Beyond GDP conference that took place at the end of 2007 is the communication entitled GDP and Beyond from August 2009. The communication sets out a concrete roadmap in the form of five key actions for the development of a new set of indicators for progress that can be used alongside GDP. The Sofia Memorandum on Measuring progress, well-being and sustainable development (2010), adopted at the 96th conference of the Directors General of the National Statistical Institutes considers that sustainable development and well-being are fundamental objectives of the "Treaty on European Union"(Article

10.16 Cleaner production

	Description

	Low	Medium	High
Scope of change	One specific industry	Various parts of value chains	Societal (sub) systems
Paradigmatic degree of change	Focus on market-based solutions	Recognition of 'public goods' and related right of government to act in public interest	Seeks an alternative for the utilitarian and rational economic approach to life and nature
Plausibility of pathways of change	Ignores factors making change un-necessary	Explains at best conceptually factors supporting change	Explicit and plausible

10.17 Eco-efficiency

	Description
Main aim / origins /history	"Eco-efficiency is a management philosophy that encourages business to search for environmental improvements that yield parallel economic benefits. It focuses on business opportunities and allows companies to become more environmentally responsible and more profitable. It is a key business contribution to sustainable societies. Eco-efficiency is achieved by the delivery of competitively priced goods and services that satisfy human needs and bring quality of life, while progressively reducing ecological impacts and resource intensity throughout the life-cycle to a level at least in line with the earth's estimated carrying capacity." (UNEP 2010) The term was coined by Stephan Schmidheiny, founder of the World Business Council for Sustainable Development (WBCSD), in his 1992 publication "Changing Course". Further, at the 1992 Earth Summit, eco-efficiency was endorsed as a new business model and means for companies to implement Agenda 21 (UN 1992) in the private sector.
Scope of change	Eco-efficiency is a concept that is targeted at changing various parts of the value chain to become more environmentally responsible. However, it does not aim at transforming the whole economic system. Therefore, its scope of change is medium.
Paradigmatic degree of change	The concept mainly focuses on business opportunities and related economic benefits and

aspects	

	Low	**Medium**	**High**
Scope of change	One specific industry	Various parts of value chains	Societal (sub) systems
Paradigmatic degree of change	Focus on market-based solutions		

10.19 Pollution prevention pays

	Description
Main aim / origins /history	Pollution prevention focuses on the source reduction of pollution and environmental impact. Waste is eliminated and reduced within the process and not end-of-pipe. Therefore waste treatment is not part of the concept. Pollution prevention pays addresses those pollution prevention which additionally saves money through avoidance of pollution and reduction of operating costs. The concept was first introduced in the US by the 3M company in their pollution prevention pays (3P) programme in 1975. Nowadays the terms pollution prevention, cleaner production and resource efficiency are often used synonymously while pollution prevention is more common in North America (UNEP 2013).
Scope of change	Pollution prevention focuses on parts of value chain: reducing waste within the process/at the source, not over the whole lifecycle. waste treatment is not part of the concept because it doesn't prevent the creation of waste.

of change	change un-necessary	conceptually factors supporting change	discussion of pathways of change

10.21 Product-service systems

	Description
Main aim / origins /history	Product-service systems are a company related approach. The idea is to sell the service of a product rather than the product itself (Jasch et al. 2006). Consumers are interested in the comfortable warmth and not in the technical heating system. The concept has been developed in academic circles and some initiatives tried to transfer the PSS concept to industry but it is still not implemented widely. A product-service system represents the change from a focus on producing and consuming products to consumption approach, where the service components are increasingly replacing the more traditional material intensive ways of product manifestation (Jasch et al. 2006). A focus on service provides individuals and organisations with the possibility to fulfil needs through the provision of more dematerialised system solutions (Mont, 2000). Baines et al. (2007) explains that a product-service system proposes to extend the traditional functionality of a product by incorporating additional services. Here the emphasis is on the "sale of use" rather than the 'sale of product'. The customer pays for using an asset, rather than its purchase. The definition of product-service system reflects the development of the production systems in the society. The society went from focusing on products to discovering the surrounding factors of a product and its production system e.g. other products and services, drivers, stakeholders, factors that influence a product's performance, friendliness to the customer and environment, price, reparability, and all other parameters of the product's life cycle. The concept of product-service system indicates that society buys services instead of products, and that the service plays a very important role in customer satisfaction and again in product performance (Mont 2000).
Scope of change	The scope of change resulting from the increasing importance of product-service system can be considered high, as it significantly drives dematerialization and the change to a more service oriented economy.
Paradigmatic degree of change	The PSS concept is much related to the vision of a leasing society, in which people have acquired a ne944(t)-2..95711(u)4.32214(v)6.38387(4.3-4.32051(o)7 4 4 re347(c)-6.957494(e)-4.32051(t)-2.16107(y)6. s 0 0 32214(g)-4.32214(e)9.01884( )-2.11.1815(i)]Tu5944(e)9.01884(s)-6.01884(c)-6.15944(t)-2.15944(o)-4.32387(i)8.1 d

POLFREE

	Low	Medium	High

10.23 3R

	Description
Main aim / origins /history	The 3R concept is a core principle of the circular economy. It aims at promoting the "3 Rs" (reduce, reuse and recycle) globally so as to build a sound-material-cycle society through the effective use of resources and materials. Agreed upon at the G8 Sea Island Summit in June 2004, it was formally launched at a ministerial meeting in Japan in the spring of 2005 (UNEP 2010). Reducing means choosing to use things with care to reduce the amount of waste generated. Reusing involves the repeated use of items or parts of items which still have usable aspects. Recycling means the use of waste itself as resources. Waste minimisation can be achieved in an efficient way by focusing primarily on the first of the 3Rs, "reduce," followed by "reuse" and then "recycle" (UNEP 2010). Japan has embarked on continuous development of a legislative structure geared towards 3Rs, with the emphasis moving to the "front of pipe" or preventative, rather than "end of pipe" solutions to its waste problem. The development of a "Recycling Oriented Economic System" has created new policies and legislation aimed at overcoming the country's severe landfill shortage. Japan is revising from a sole focus on hazardous substances management to new phases of greening, especially in the home appliance and electronic sectors. The 3R Project is to be completed in three phases: • Phase 1: Elimination of hazardous chemical substances • Phase 2: Recycling • Phase 3: Green new product development
Scope of change	The 3R concept aims at transforming the economic system as a whole, initiating fundamental changes in other societal subsystems. Thus, its scope of change is considered high.
Paradigmatic degree of change	The focus is on business opportunities and economic benefits, so the degree of paradigma0.44 Td [(p)-4.32051(389( )11.1799(s)-6 0 0 1 506.52 -6. m 997 3735.67 l 997 3649.67 l 955 3649.67)-6 0 0

	society and scientists, viewing businesses and governments as barriers to change, which have to be overcome Degrowth pose the question of how the upcoming degrowth can be managed in order to avoid social and ecological collapse. As such it addresses all three pillars of sustainability.

	Low	**Medium**	**High**
Scope of change	One specific industry	Various parts of value chains	Societal (sub) systems
Paradigmatic degree of change	Focus on market-based solutions	Recognition of 'public goods' and related right of government to act in public interest	Seeks an alternative for the utilitarian and rational economic approach to life and nature
Plausibility of pathways of change	Ignores factors making change un-necessary	Explains at best conceptually factors supporting change	Explicit and plausible discussion of pathways of change

10.25 Hannover principles

	Description
Main aim / origins /history	The Hannover Principles are design principles for sustainable buildings and objects. They were formulated by William McDonough and Michael Braungart (1992) as principles for the design competition for the EXPO 2000 in order to guarantee design and construction in the understanding of sustainability. McDonough and Braungart propose that "designing for sustainability requires awareness of the full short and long-term consequences of any transformation of the environment. Sustainable design is the conception and realization of environmentally sensitive and

Plausibility of pathways of change	The concept has so far failed to provide clear pathways of change such as new legislations providing incentives for the design and construction industry to incorporate the Hannover Principles to their core business-activities.
Actors addressed (industry, government, civil society) environment/social/economic aspects	The Principles are to be considered by designers, planners, government officials and all involved in setting priorities for the built environment. They mainly focus on the environmental aspect: the rights for nature and interdependencies between human design and nature. However also the social and the environmental dimension of sustainability is incorporated in the 9 Hannover Principles.

	Low	**Medium**	**High**
Scope of change			

	Low	**Medium**	**High**
Scope of change	One specific industry	Various parts of value chains	Societal (sub) systems
Paradigmatic degree of change	Focus on market-based solutions	Recognition of 'public goods' and related right of government to act in public interest	Seeks an alternative for the utilitarian and rational economic approach to life and nature
Plausibility of pathways of change	Ignores factors making change un-necessary	Explains at best conceptually factors supporting change	Explicit and plausible discussion of pathways of change

11 References

Abdallah, Saamah; Sam Thompson; Juliet Michaelson; Nic Marks and Nicola Steuer (2009). The (Un)Happy Planet Index 2.0. An Index of Human Well-Being and Environmental Impact. London, UK: New Economics Foundation.

Andrews, G. (2008). The Slow Food Story: Politics and Pleasure. London: Pluto Press.

Ashford, N.A., Ayers, C., Stone, R.F. (1985). Using regulation to change the market for innovation Harvard Environmental Law Review 9 (2) , pp. 419-466

Ashford, N.A., Hall, R.P. (2011). The importance of regulation-induced innovation for sustainable development Sustainability 3 (1) , pp. 270-292

Assefa G. (no date), Leapfrogging Possibilities For Sustainable Consumption and Production in Africa - An

POLFREE

William McDonough Architects (1992). The Hannover Principles. Design for Sustainability. Prepared for EXPO 2000 The World's Fair. Hannover, Germanyhttp://www.mcdonough.com/wp-content/uploads/2013/03/Hannover-Principles-1992.pdf. Accessed 03 June 2013

Williams, C.C and A. C. Millington (2004): The diverse and contested meanings of sustainable development. The Geographical Journal, Vol. 170, No. 2, 99-104

Wittmayer, J., van Steenbergen, F., Quist, J., Loorbach, D., Hoogland, C., (2011) The Community Arena: A co-