Sustainable materials management for a resource efficient Europe

Integrated approaches within reach

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Executive summary

This working paper on sustainable materials management (SMM) serves as a basis for debate at the informal environment Council of 12-13 July 2010 under the Belgian EU Presidency. The paper explains why sustainable materials management is urgently needed and what SMM entails. It also provides a number of cases, indicating how SMM can concretely be implemented. The paper ends with suggestions for further policy developments on SMM at EU level.

This working paper draws information from several sources, amongst others a study by Sustenuto, KULeuven and Wuppertal entitled 'Sustainable Materials Management for Europe: from efficiency to effectiveness'[1] and a number of studies carried out in the context of the OECD work on SMM[2].

1. Why is SMM needed?

The current pattern of materials use in Europe endangers the availability of the natural resources on which our welfare is based. In addition, the European materials use as it is today has a negative impact on the quality of air, water and soil, on human health, on climate change and on biodiversity. This environmental degradation occurs both within and outside the EU. Therefore, the EU and the Member States urgently need to manage materials more sustainably and work towards a decoupling of environmental impact from rise in well-being.

2. What is SMM?

Developments in materials management over the past decades can be roughly divided in three shifts, moving from narrower to more integrated approaches.

> *Reaction*: In a first phase, mainly end-of-pipe reactions on pollution and damage occur. Waste management and eco-efficiency are central to business activities. The focus is on the improvement of production processes (clean technology).
>
> *Redesigning*: In a second phase, a shift can be observed towards rethinking and redesigning products, and addressing challenges in cooperation with other stakeholders along the chain. Closing the loop and life-cycle assessment become of concern to business activities, whereby new product-service concepts emerge.
>
> *Reframing*: The latest shift – which is only beginning to emerge – implies a systemic change towards cyclical and fully integrated ways of addressing materials use, towards sustainable materials management in its most ambitious sense.

SMM, as the Belgian Presidency wants to promote it, aims at the efficient and environmentally responsible use of materials, independent of whether they are raw materials, products or waste. SMM takes a life-cycle approach as its basic premise and includes sustainable extraction, ecological design, eco-efficient production, sustainable consumption, and sustainable waste management. The aim of SMM is to reduce the negative environmental impacts of materials use and preserve natural capital along the whole chain. SMM takes into account ecological, economic and social gains. Because environmental policies cannot be built in isolation from other policy fields, SMM seeks policy integration.

The further evolution towards SMM in the 21st century also entails:

[1] Rossy et al. (2010).

[2] Five Winds International (2009); Fiskel (2010).

-Responsible, fair extraction of natural rersources and use of materials, including responsible land and water use, safeguarding soil quality and biodiversity;
-Establishment of absolute decoupling of materials & resources use (including production of waste and emissions) from economic growth ('beyond GDP');
-Behavioural changes in the production *and* consumption patterns.

Sustainable materials management is closely linked to the flagship initiative on resource efficiency included in the EU 2020 Strategy[3]. The EU 2020 Strategy aims at the delivery of smart, sustainable and inclusive growth and stresses the need for a resource efficient Europe in which economic growth is decoupled from the use of resources. Resource efficiency implies using natural resources, raw materials, products, and waste as efficiently and as environmentally responsible as possible. A resource efficient, green and competitive European economy is one in which we overcome the traditional divisions between environmental, energy, economic, competitiveness and innovation policies; and in which we move beyond the recovery of waste to material cycles that are managed in such a way that they deliver the services we need without irreversibly damaging our ecosystems.

3. Examples of SMM

Telling examples of SMM are presented to demonstrate how an innovative and integrated approach addressing the full life-cycle of materials can help find solutions for depletion and environmental degradation as a result of materials use. The examples come from business, government and other societal actors worldwide. The diversity of SMM examples demonstrates that sustainable materials management can be implemented in various ways and can concern various materials chains.

Twelve clusters of SMM examples are described:

1. Selective waste collection and recycling
2. Re-use and repair
3. Collection and re-use/recycling/recovery of industrial residues
4. Closed loop industry systems for residues
5. Ecodesign
6. Product Service Systems
7. Cradle to Cradle
8. Choice Editing
9. Biomaterials and natural ecosystems
10. Transition Towns
11. Knowledge Networks for Transitions
12. IT in SMM

4. Future policy directions for SMM

Systems innovation is required to achieve the sustainable management of materials. This requires high-level political support and action, as these systemic changes cannot be accomplished at local levels or by market mechanisms and citizens alone.

Because of its large footprint, Europe has an obligation to work towards a more sustainable management of materials. Policy measures at EU level are also necessary to avoid fragmentation of the Internal Market.

The following policy directions at EU level are suggested to promote SMM:

Integration: from dispersed policy domains and decisions towards better integration and synergies

-Move from waste policies to materials policies covering the full life-cycle.

[3] EC (2010).

-Deploy the appropriate mix of policy instruments (enable, encourage, engage, exemplify).
-Strengthen coherence between existing EU initiatives related to natural resources, products, production & consumption and waste, with the aim of establishing a comprehensive materials policy at EU level.
-Pay attention to SMM in existing and new EU programmes indirectly related to SMM, such as the EU2020 Strategy, the revised EU Strategy on Sustainable Development and the forthcoming Eco-innovation Action Plan.
-Encourage cross-departmental cooperation on SMM in the European Commission and the Council.
-Promote an international dialogue on SMM at the UN.

Vision: from short-term policy and narrow indicators to long-term objectives and comprehensive indicators for SMM

-Set long-term strategic objectives and targets for SMM.
-Continue with the development of a reliable SMM indicator set, necessary for sound decision-making on and measuring of policy progress towards SMM.
-Continue the 'Beyond GDP' debate on how to complement GDP with social and environmental aspects.
-Take into consideration SMM in the Sustainable Impact Assessments used by the European Commission to forecast economic, environmental and social impacts of proposed legislation.

Innovation: from incremental technological innovation to fundamental systems innovation

-Finance R&D aimed at systems innovation that goes beyond an increase in productivity and supports multi-disciplinary networks and initiatives.

The three ways forward towards SMM identified above - integrated approaches, long-term goals for SMM and systems innovation – could all be stimulated by the establishment of a **European, multi-actor transition platform on sustainable materials management**. This platform could develop a joint future vision on SMM; identify transition pathways towards this SMM vision; and launch experiments which go beyond established practices and contribute to the envisioned systems changes.

1 Why do we need to manage materials more sustainably?

The energy and climate problem is high on the political agenda nowadays. Comparable problems related to non-energetic resources have received less attention. Our knowledge on the environmental impacts related to materials use still needs considerable development. Yet the information currently available already provides some insights in the dimension of the challenges ahead.

1.1 Environmental degradation and depletion of stocks as a result of materials use

The main problems related to materials use are twofold[4]:

1. The environmental impact generated by the current pattern of materials use.

The extensive use of natural resources to generate energy and to produce products causes direct and indirect environmental problems and pressures such as the destruction of fertile land and loss of biodiversity due to extraction; pollution of air, water and soil during production and waste management; the negative effects of transport; global warming. In short, our use of materials and the related production of damaging greenhouse gas, toxics and non-degradable waste are more extensive than the planet's capacity to maintain healthy ecosystems.

2. Scarcity caused by the current pattern of materials use.

The current pattern of production and consumption and materials use in Europe endangers the availability of the natural resources on which our well-being is based. Natural resources use in Europe exceeds availability, and Europe heavily relies on the import of natural resources. Worldwide population growth and economic development lead to an increasing demand for natural resources, many of which are finite. This implies that growing global competition for natural resources is adding to the concerns about the future availability of natural resources for Europe.

There are concerns that certain natural resources will have to be extracted in lower concentrations and from difficult locations, leading to higher energy consumption and increased pressure on the environment.

One example of critical materials from the point of view of availability are so-called high-tech metals. Platinum, cobalt, titanium, indium and others are needed for the development of environmental technologies aimed at boosting energy efficiency and reducing greenhouse gas emissions. The EU is faced with a supply risk for high-tech metals, due to amongst others a high import dependence. The EU will not master the shift towards sustainable production and environmentally responsible products without such high-tech metals.[5] Better management of the flow of these materials could contribute to addressing scarcity. High-tech metals are often not appropriately retrieved from end-of-life products such as scrap batteries or scrap electronics.

[4] For detailed figures: see Rossy et al.(2010), 13-24.

[5] EC (2008a), 3.

1.2 Europe's responsibility[6]

Europe, in particular, has to manage materials more sustainably and work towards a decoupling of environmental impact from rise in well-being. If each inhabitant of the world would adopt a consumption pattern equal to that of the average European, the ecological carrying capacity of our planet would be exceeded by far.

Because the consumption of natural resources in Europe exceeds availability, Europe's dependence on natural resources from elsewhere is increasing. The European economy has an impact on the rest of the planet, as extensive demand on natural resources may cause degradation of the ecosystems in the countries providing them. Put simply, while Europe imports natural resources, it risks exporting environmental pressures.

The EU has gone through considerable efforts in the last 20 years to improve material efficiency, mainly through technological development. Nevertheless, this has not been sufficient to reverse fundamentally unsustainable consumption and production trends. We have, in other words, achieved a relative improvement in resource efficiency. However, absolute levels of resources use continue to grow, as we are producing and consuming ever-increasing amounts of services and goods (rebound effect). In order to obtain true sustainability, far higher levels of absolute decoupling are required. Generally speaking, in the OECD countries an absolute reduction of the environmental load of around 90% ("Factor 10") is required within the next three to four decades.[7]

Ecosystem services and natural resources are crucial to the functioning of the economy and to our quality of life. Managing our materials more sustainably, with the aim of preserving natural capital and limiting the impact of our production and consumption on ecosystems, in other words, is not a pastime for environmentalists. It is paramount in the development of a sound and sustainable socio-economic system. In order to significantly reduce Europe's environmental impact and avoid a further liquidation of global natural capital, EU environmental policy needs to move beyond emission and waste control towards sustainable materials management.

[6] For detailed figures: see Kazmierczyk (2010).

[7] Rossy et al. (2010), 5.

2 What is sustainable materials management?

The environmental degradation caused by our current consumption and production patterns, as well as the depletion of natural resources, demonstrate that a shift towards a more resource efficient European economy in which materials are managed sustainably is becoming ever more pressing. In this chapter, the concept of sustainable materials management (SMM) will be further clarified. Developments in thinking on materials management will be outlined and the term SMM will be clarified, using the definition developed by the Organisation for Economic Cooperation and Development (OECD) as a starting point.

2.1 Developments in materials management[8]

Three main phases of materials management can be distinguished, moving from a narrower to a more integrated view. When considering the evolutions in materials management over the last 40 years towards more integrated approaches, we have to bear in mind that advancements in scientific knowledge on the one hand and real business practices and actual governmental interventions on the other hand do not necessarily emerge at the same time. Moreover, while moving towards a more integrated management of materials, earlier approaches directed towards, for instance, environmentally responsible waste management and more efficient production processes remain valuable.

Reacting: end-of-pipe solutions and efficiency gains along the (linear) supply chain
Initially, the focus is on particular polluting substances and waste streams primarily affecting health. Environmental problems, e.g. those related to hazardous waste, landfills, large combustion plants and waste water treatment plants, are often addressed *post facto* and end-of-pipe.

Gradually, waste prevention, re-use and recycling start receiving more attention. Eco-efficiency becomes a more central concern, aiming at the development of cleaner technology and industrial processes.

We also witness a shift from an internal, technological focus on the product and/or industrial process itself towards a broader, more sector-wide approach, in which the effects along the linear supply chain are taken into consideration and cooperation with external stakeholders, both upstream and downstream, takes place.

Redesigning: closing the loop
In the past decade our understanding of materials management has changed, from a focus on industry processes and product efficiency to a recognition of the need to reduce materials use and related impacts in the whole chain.

Attention goes to designing products from a life-cycle approach, where responsible extraction and materials use are as much a concern as what can be done with products after the end-of-use stage. The 'Cradle to Cradle' concept, for instance, seeks to keep materials in closed cycles, either biological or technical.

Policies on the management of materials and waste are becoming more integrated, aiming to reduce the environmental impacts of products throughout their life-cycle and to close the

[8] This subchapter is adapted from Rossy et al. (2010), 9-12.

loop of materials. The concept of waste as such changes, as waste comes to be seen as a valuable resource. After use, materials maintain value and can be re-used or remanufactured in new products, without constantly extracting additional natural resources from the earth.

In this context, product-service concepts are explored, which provide consumers with the same level of performance while lowering the environmental impact. For consumers, product-service systems imply a shift from buying and owning a product to buying a service via leasing and renting concepts. For producers, product-service systems mean a higher degree of responsibility for the full life-cycle of a product, as such encouraging ecological design (e.g. reduction of materials use, design for re-use and recycling), efforts to prolong the life-span of products and increase their repairability, the closing of material cycles via take-back systems and recycling, etc.

Reframing: towards an integrated systems approach
Considering the enormous challenges we face in the 21st century on resource scarcity, climate change, food insecurity, etc. the need for reframing becomes more apparent. Slowly but steadily, a systems approach to materials management is taking shape, recognising that materials use is closely intertwined with ecosystems and societal well-being, here and elsewhere, today and tomorrow. Reframing implies a fully integrated approach, which addresses the shift of burdens at three levels: between generations, between geographical areas, and along the whole supply chain and between different sectors.

Such an integrated, systems perspective on materials management should take into consideration:
-how natural resources can be extracted in a responsible, fair and just way, and how this is related to land use, the maintenance of soil quality and biodiversity;
-how absolute decoupling between economic growth (GDP) and materials & natural resources use, production of waste and emissions can be established;
-how materials use relates to our (Western) consumption patterns and concepts of comfort;
-what the global impacts are of European materials consumption;
-how consumption and production systems and the associated materials management can be organised more effectively in providing quality of life.

SMM, in the longer term, thus implies the complementation of GDP with social and environmental indicators, a shift in taxation from labour towards environment, a systems approach towards sufficiency, factor 10 decoupling, and the establishment of a macro-economic model that is not dependent on minimum consumption growth for its stability.

2.2 Delineating SMM

After having described the developments in thinking on materials management over the past decades, the term SMM will be further clarified using the OECD definition as a starting point. In addition, a role for SMM in realising the proposals on a resource efficient Europe in the EU2020 Strategy will be outlined.

2.2.1 OECD definition of SMM and related concepts

Before entering into the details on what SMM means, it is worthwhile clarifying what is implied by ‘materials’ in this background paper. A material is understood as each substance which is extracted, processed, produced, distributed, used, discarded or recovered or each object that is produced, used, discarded or re-used, including the resulting waste streams.

'Materials' do not have exactly the same scope as 'natural resources'. In the EU Thematic Strategy on the sustainable use of natural resources, natural resources include "raw materials such as minerals, biomass and biological resources; environmental media such as air, water and soil; flow resources such as wind, geothermal, tidal and solar energy; and space (land area)". Materials are raw materials, products or wastes. The impact of materials use on water, air and land is a central concern in SMM. They are seen as resources that need to be preserved by sustainable materials management, to such an extent that they can continue to support a high quality of life on our planet. Water, air, soil and land as such are not considered materials, however. Natural resources do not include products or wastes, but they do encompass environmental media.

Energy sources are considered as falling within the scope of materials. EU policy on sustainable energy use is already in full development. Therefore, the focus here will be primarily on the sustainable use of non-energy materials for which policy is less advanced.

The OECD working definition of SMM states:
"Sustainable Materials Management is an approach to promote sustainable materials use, integrating actions targeted at reducing negative environmental impacts and preserving natural capital throughout the life-cycle of materials, taking into account economic efficiency and social equity."

Following explanatory notes accompany this working definition:

- 'Materials' include all those extracted or derived from natural resources, which may be either inorganic or organic substances, at all points throughout their life-cycles;
- 'Life-cycle of materials' includes all activities related to materials such as extraction, transportation, production, consumption, reuse, recovery and disposal of products and materials;
- An economically efficient outcome is achieved when net benefits to society as a whole are maximised;
- A variety of policy tools can support SMM, such as economic, regulatory and information instruments and partnerships;
- SMM may take place at different levels, including firm/sector and different government levels;
- SMM may cover different geographical areas and time horizons.[9]

Commonly used concepts closely related to SMM are: Integrated Product Policy (IPP), sustainable use of natural resources, and Sustainable Consumption and Production (SCP). These concepts are used more often at EU level, while the OECD prefers SMM.

The EU's IPP aims at 'greener' products, looking at all phases of the life-cycle. The EU Thematic Strategy on the sustainable use of natural resources wants to ensure that the consumption of natural resources and their associated impacts do not exceed the carrying capacity of the planet and decouple economic growth from resource use. The EU Action Plan on SCP has as its objective to improve energy and environmental performance of products and foster uptake of 'green' products by consumers.[10]

All these concepts have in common that, each from a different angle, they advocate the development of an integrated approach covering the entire material chain. All these concepts share a concern for e.g. (c)lean production, life-cycle thinking, resource efficiency, waste

[9] OECD (2007).

[10] EC (2003). EC (2005a). EC (2008b).

reduction, 3R's (reduce, reuse, recycle), ecodesign, eco-innovation, industrial ecology, sustainable goods & services, sustainable supply chain.

The focus of sustainable materials management is somewhat different from that of sustainable management of natural resources. The latter has the preservation of natural resources such as biotic and abiotic raw materials, land, water, air, renewable and renewable energy sources as its main focus. Sustainable materials management places more emphasis on the way materials are handled by different economic actors within a life-cycle and tries to achieve environmental, social and economic gains by promoting more cooperation between actors in a chain and bringing about systemic changes to the way material flows are managed. The two concepts are widely overlapping, but sustainable management of natural resources concentrates more on "what" should be done (preserving natural resources), whereas SMM concentrates more on the question "how" this can be done (how to handle materials in such a way that natural resources stocks are no longer depleted).

The background paper uses the OECD definition on SMM as a basis as it provides the broadest vision of these four concepts. SMM aims at the efficient and environmentally responsible use of materials, independent of whether they are raw materials, products or waste. The idea is to move beyond the recovery of waste to material cycles that are managed in such a way that they deliver the services we need without depleting or irreversibly damaging our natural resources. Sustainable materials management can help overcome the traditional divisions between environmental, energy, economic, competitiveness and innovation policies. Sustainable materials management can help mitigate climate change, halt biodiversity loss, prevent pollution and protect human health. Moreover, sustainable materials management can become an engine for sustainable growth. It contributes to the creation of jobs, boosts competitiveness, fosters innovation and reduces Europe's dependence on primary resources. In short, a sustainable materials management policy can help reduce Europe's demand on nature while maintaining or improving its competitiveness.

To summarise:
-The aim of SMM is to reduce the negative environmental impacts of materials use and preserve natural capital;
-SMM takes a life-cycle approach as its basic premise;
-SMM takes into account ecological, economic and social gains;
-SMM seeks integration since environmental policies cannot be built in isolation from other policy fields.

2.2.2 SMM: efficiency and sufficiency

Mainstreaming sustainable materials management is a necessary condition for realising the resource efficiency improvements aimed at in the EU2020 Strategy and for moving towards a truly sustainable and 'green' European economy. One of the 7 flagship initiatives in the EU2020 Strategy works towards the establishment of a resource efficient Europe in which economic growth is decoupled from the use of resources.[11] In the context of EU2020, it is important that the European Commission and EU Member States agree that sustainability implies both efficiency and sufficiency.
-An efficiency strategy aims at producing as much output as possible with a minimum of input (natural resources, energy).
-A sufficiency strategy is necessary to avoid that efficiency gains are outdone by an increase in total consumption (rebound effect). Sufficiency implies that we need to consume differently. The idea is to generate an equally high or higher quality of life without pushing the impacts of materials use beyond the carrying capacity of our planet.

[11] EC (2010).

In order to achieve SMM, more is needed than merely changes in the products and the production processes. It is not just a matter of using less material in existing products, being more efficient, or avoiding waste. SMM is about innovations on the systems level to tackle the challenge of living within the capacity of one planet. It is about finding ways to ensure quality of life for everyone without overusing the natural resources capacities of our planet; about a transition to living better and more equally, within planetary limits. This will require not just efficiency gains understood as using fewer resources to produce one unit of economic value, but changes in governance and in lifestyles and behaviour.

3 Sustainable materials management in practice[12]

This chapter describes a number of interesting examples of SMM from business, government and other societal actors worldwide. SMM initiatives come in many forms, at different scales, from different domains, and reflect a wide spectrum of possibilities. Cases vary in terms of the level of 'integratedness', viz. the move from end-of-pipe thinking and waste management; towards eco-design and full responsibility for the products throughout the chain; up to completely closed loop material and product systems that integrate renewable energy and resource use, responsible extraction, avoid polluting and toxic substances and enable continuous use of materials.

The following 12 clusters of SMM examples will be further described:

1. Selective waste collection and recycling
2. Re-use and repair
3. Collection and re-use/recycling/recovery of industrial residues
4. Closed loop industry systems for residues
5. Ecodesign
6. Product Service Systems
7. Cradle to Cradle
8. Choice Editing
9. Biomaterials and natural ecosystems
10. Transition Towns
11. Knowledge Networks for Transition
12. IT in SMM

The presented clusters demonstrate the great variety of ways to implement SMM and the potential to gradually move towards genuinely integrated SMM approaches.

As will become clear from the cases, fully mature SMM cases are not mainstream, mainly because:

- They are not yet sufficiently backed by appropriate policy actions for up-scaling and mainstreaming;
- They imply further changes at system level, including a change of mind-set and behaviour, new business and welfare models, etc.;
- Further inter- and transdisciplinary research is needed to develop the potential of these promising examples.

Cluster 1: Selective waste collection and recycling

Selective waste collection refers to differentiating the collection of the various fractions of waste for the purpose of recycling them. Selective collection and recycling save scarce resources. Soil is conserved, because of the reduced need for landfilling. In addition, energy savings can be realized when using recyclables compared to the manufacturing of products from virgin raw materials.

One weakness of the system is that the success of recycling may trigger rebound effects. Another possible weakness of a collective system, involving third parties who take over responsibility for selective collection and recycling, is that this can result in a decrease in responsible behaviour of the party originally producing the waste. There is no direct incentive

[12] This chapter is adapted from Rossy et al. (2010), 25-50.

to prevent waste from arising. In addition, the fact that the one producing the waste is not directly responsible can lead to contamination of the selectively collected fractions.

Some ways in which policy could further support selective collection and recycling are: Harmonise regulations at EU level and raise the level of collection and recycling systems to that of the best performing Member States. Introduce Enhanced Producer Responsibility schemes, which make producers financially responsible for the proper management of their products once they have reached the end-of-life stage. Strengthen product responsibility of producers. Set minimum standards to cut the "dirty end" of toxic products/parts/materials. Develop and implement 'waste prevention indicators' to enable assessment of waste avoiding performance.

Cluster 2: Re-use and repair

Re-use implies that, with little or no processing, materials are kept out of the waste stream. Re-use can take different forms: selling the good in a second hand shop; re-using part of the good in a comparable application; or using the good for an entirely different purpose without the need for re-processing. Repair is a method of fixing an item, which may appear to have lived its useful life, so that it can still be productive, thereby extending its lifetime.

Re-use and repair are easy to implement, can bring direct environmental and social benefits and therefore are worth encouraging. Re-use and repair discourage disposal of products, as such reducing landfill or incineration and environmental impacts associated with end-of-life treatment. New purchases of the same product are avoided and thus material is saved. Weaker socio-economics groups can reap benefit from schemes which sell re-usable goods at reasonable prices. Re-use schemes also provide opportunities for different business models, such as social entrepreneurship and social economy.

However, mainstreaming of this approach will be confronted with cultural barriers (e.g. quest for novelty). Furthermore, re-use and repair as such do not change the products or the production processes. This approach only delays the disposal phase of the product and does not adopt a more far-reaching understanding of SMM. Furthermore, if extended to a large scale it could be met with resistance from more traditional business.

Some ways in which policy could further support re-use and repair are:
Develop standards for refurbished products (especially electronic products). Integrate re-usability criteria in e.g. the EU Ecodesign Directive.

Cluster 3: Collection and re-use/recycling/recovery of industrial residues

The industrial system is a source of various residue streams. These residues include for instance construction and demolition waste (concrete, fibreglass, asphalt, bricks, plaster, wallboard etc.), residues from industrial landfills (slags, fly ash, construction and demolition waste) and residues from high temperature processes (steel and non-ferrous industry, waste incineration, coal-fired electricity plants and others).

SMM implies that these residues are reintegrated into the technosphere, thereby contributing to the closing of material loops. The relevant industries for the acceptance of these material streams are, amongst others, the concrete and cement industry, the heavy clay ceramics industry, the producers of glass ceramics and stone wool and the construction sector. The reintegration into the technosphere can be based on, in decreasing order of preference, re-use (re-employment of the materials for the same purpose for which they were conceived), recycling (reprocessing waste into raw materials to be used for the original or other applications), or recovery (mainly reprocessing waste into materials that are to be used as fuels).

Rising raw material and energy prices, scarcity of metals, climate change and other environmental concerns stimulate the need to transform waste streams to high value products. Major landfilling costs are thus avoided, the use of primary resources and net CO_2 emissions can be drastically reduced, while obtaining innovative materials with sustainable environmental and technical properties. However, this waste-to-product transition is hampered by both technical barriers (e.g. unsuitable process technologies, unstable and inferior quality of the material) and non-technical barriers (e.g. unfair competition from under-taxed primary raw materials, underdeveloped legislation and markets, different legislation in EU member states, poor societal experience with industrial ecology).

Some ways in which policy could further support collection and re-use/recycling/recovery of industrial residues are:
Provide more funding for interdisciplinary and transdisciplinary research in the field of residue valorisation. Harmonize EU legislation with respect to the use of secondary raw materials are essential. Introduce novel fiscal incentives to promote the use of secondary raw materials.

Cluster 4: Closed loop industry systems for residues

The reintegration of residues – such as construction and demolition waste, residues from industrial landfills or high temperature processes, and biological residues – into the technosphere can be based on linear schemes (see cluster 3) or fully integrated processing routes. In the latter case one can refer to the concept of "industrial symbiosis". This implies that waste streams are combined with other material streams in order to obtain innovative products with high added value. The closing of the material loops occurs in a more complex way. Synergies between material streams are now actively sought. By combining two by themselves low or medium value material (waste) streams, a high value product can be developed, given that certain requirements are met. This is the case, for example, when bricks are produced from slags and CO_2.

Rather than focusing on highly innovative products incorporating waste residues, the closing of the loop can also be performed by planning for so-called "eco-industrial parks" (EIPs). An eco-industrial park is an industrial park in which businesses not only cooperate with each other, but also involve the local community. EIPs intend to increase economic gains and improve environmental quality. Collaborative strategies not only include by-product synergy ("waste-to-feed" exchanges), but also take the form of wastewater cascading, shared parking, shared logistics and shipping & receiving facilities, multi-partner green building retrofit, district energy systems, etc.

Finally, the closing of the material loop can be extended in time, when old or future material streams are integrated with one another, as is the case in e.g. enhanced landfill mining. The purpose of enhanced landfill mining is to recycle materials and recuperate energy from landfills, while gradually restoring the original natural surroundings.

Economical and environmental concerns stimulate the need to transform waste streams (from old and novel sources) to high value products while also achieving net CO_2 benefits. However, as is the case with cluster 3, this waste-to-product transition is hampered by both technical barriers and non-technical barriers. In the case of EIPs, barriers arise when trying to convert existing industrial sites into EIPs. Planners are confronted with the historical legacy of poor land planning choices. Other potential barriers may arise due to the fragmentation of various policy domains.

Some ways in which policy could further support the development of closed loop industry systems are:

Harmonize EU legislation on waste-to-product transition and provide more support for interdisciplinary and transdisciplinary research. Invest in the greening of existing industrial parks. For new parks, make EIP's the default choice in the planning procedure.

Cluster 5: Ecodesign

The aim of ecodesign is to design products with social and environmental considerations in mind from the beginning (start-of-pipe solution). This means using sustainable materials (especially avoiding toxicity), designing for all stages of the life-cycle (e.g. design for re-use, design for recycling) and reconsidering the product itself in terms of the service it provides (leading to service systems rather than more products).

Mainstreaming ecodesign remains difficult. While change first and foremost has to develop organically within the business community, governments can act as catalysts by providing incentives and investing in awareness-raising on the ecodesign approach.

Some ways in which policy could further support ecodesign are:
Extend the scope of the EU Ecodesign Directive, include SMM related criteria (resource efficiency, re-usability, etc.), and provide for mandatory supply of product data by companies and sectors in order to monitor progress.

Cluster 6: Product Service Systems (PSS)

PSSs replace ownership of products by usership. Rather than owning the product (e.g. car, washing machine, copying machine), the customer is guaranteed a smooth access to the relevant equipment. Considering that the producer remains the owner of the product, the driving force for ecodesign (modularity, high efficiency, durability, etc.) and closed loop systems (re-use/recycling of components) is strongly enhanced.

The EU SCORE!-network has noted that PSSs systems are able to reduce the environmental impact of particular consumption types with a factor 2-3.[13] However, changing the ownership structure along the product life-cycle does not guarantee major sustainability benefits, as traditional car leasing demonstrates. Systemic changes are needed in the structure of consumption-production interactions and novel ways of delivering function. The ability to do so depends on the creation of new organisational models (e.g. car sharing) or on adjusting existing regulatory and normative frameworks.

Some ways in which policy could further support PSS schemes are:
Promote the use of social marketing techniques to gain wider acceptance of especially Business-to-Consumer (BtC) PSS schemes. Provide more funding for social marketing research, for example in future calls of the EU Framework Programme for Research and Technological Development. Local authorities should provide more stimulating environments for BtC PSS schemes.

Cluster 7: Cradle to Cradle (C2C)

Central to the Cradle to Cradle (C2C) concept is the closed loop approach. There is no more waste, as all materials are nutrients for other products and applications. Products and materials stay in either a biological or a technological metabolism. Materials are biodegradable or used as high quality resource in other industrial processes. C2C creates a transition from the current industrial model, that 'takes, makes and pollutes', to a system with healthy & safe products and materials that stay in cycles. This also implies a shift from

[13] Tukker et al.(2008).

ownership to usership. Products are used by consumers only for the time needed, after which the product returns into the remanufacturing chain.

The C2C concept has some potential weaknesses. The first is related to its 'technofix' character. It is assumed that a smart C2C design in itself can fully mitigate the ecological impact of consumption. Limits to consumption are in this view, therefore, no longer necessary. Secondly, C2C does not yet sufficiently address other key sustainability issues for SMM such as restrictions in phosphates, and water and land availability. Thirdly, for C2C to work well an abundance of cheap renewable energy is needed (to close material cycles). On the short term, this is clearly not the case. In an energy-constrained world, C2C should, therefore, focus on closing materials cycles in a smart way (thereby minimising the use of energy). Finally, one also has to realise that it is physically impossible to obtain a 100% efficient materials loop, as there will always be some losses in materials due to corrosion, wear, dilution, irreparable contamination etc.

Some ways in which policy could further support C2C are:
C2C will need further support at R&D level. There is need for more knowledge sharing and awareness raising.

Cluster 8: Choice editing

One of the simplest ways in which governments and business (particularly retailers) can contribute to making the economy more sustainable is through 'choice editing'. In the words of the British Sustainable Development Council (SDC) choice editing "is about shifting the field of choice for mainstream consumers: cutting out unnecessarily damaging products and getting real sustainable choices on the shelves."[14]

Choice editors can simply remove environmentally offensive products from commercial consideration (e.g. incandescent light bulbs), while at the same time providing more sustainable alternatives (e.g. LEDs). Another choice editing strategy is to slowly trim away the worst products and practices by labelling and tightening product norms (cf. Japan's top runner program for energy efficiency). A third strategy makes offending choices less attractive or increasingly difficult, by using taxation and product placement strategies.

An additional choice editing strategy is the creative use of sustainable public procurement. It is acknowledged that transforming government procurement is essential, not only because of the current scale of its environmental impacts, but also as a symbolic and highly visible signal of changing habits.

There remains immense potential for choice editing to drive fundamental changes in consumption. However, at least two obstacles stand in the way. The first is the belief that product labelling alone can do the job. Labelling places the burden on the consumers who are expected to drive the needed social and ecological change with their buying behaviour. A second, possible limitation to the power of choice editing is its focus on 'consumption shifting' rather than 'consumption reduction'. Nevertheless, EU policy should be used to phase out unsustainable and unethical products as soon as possible, without necessarily entering the more fundamental debate about biophysical limits to growing consumption levels.

Some ways in which policy could further support choice editing towards sustainable behaviour are:
Revise public procurement policies in order to make sustainable public procurement the default choice for all authorities (local, national and EU level).

[14] SDC (2007), 3.

Cluster 9: Biomaterials and natural eco-systems

Biomimetics or biomimicry is the study of the structure and function of biological systems as models for the design and engineering of materials, processes, and products. Ecosystems have evolved to ever more effective nutrient and energy cycles, bringing enormous diversity while developing resilience, flexibility, and performance. New innovative products and systems can be developed that mirror nature without applying our current energy and resource intensive industrial processing of materials by for instance heating, pressure, or steam. Key to the concept is so-called 'cascading', using materials in a variety of applications in the natural chain. Interdisciplinary research is central to the work of biomimetics. Particularly the domains of agro/food and health care are frontrunners in the application of biomaterials and biological processes.

Some ways in which policy could further support biomimicry are:
Promote further inter- and multi-disciplinary R&D in order to find applications for nature's solutions and to enhance to necessary speed up for market introduction of new applications. Promote new application areas for biomaterial and natural ecosystem products and processes in countries through knowledge transfer programmes and cooperation. Assure that investments can be regained on international markets through preferential trade agreements.

Cluster 10: Transition Towns

Transition towns are local communities that create change from bottom-up and engage people to take the far-reaching actions that are required to mitigate the effects of peak oil and climate change. These initiatives are designed to result in a resilient life that is more fulfilling, more socially connected and more equitable.

Another model of transition towns, in this case called eco-cities, is a more top-down approach, where city councils and local government create a coherent and integrated sustainability policy for the whole city.

The strength is that 'ordinary' citizens unite and take on responsibility for the creation of their own sustainable community. There are several obstacles, however. It is often hard to receive loans or funding for projects, as most financial institutions or governmental bodies are not adapted to these kinds of clients and initiatives. The initiatives often conflict with existing (local) systems and regulations. Transition towns face the problem of efficient mainstreaming to all segments of the population, including the 'Honestly Disengaged' people. Without some type of top-down support, these bottom-up initiatives tend to stay locked in their niches (with only a small percentage of the population involved).

Some ways in which policy could further support transition towns and eco-cities are:
Public authorities, particularly at local and regional level, should invest in and develop sustainable urban planning. Furthermore, public authorities can enable the use of sustainable options, such as affordable and easy-use systems for public transport, cycling and walking, use of renewable energy (via e.g. subsidies), integrated water systems (rain water collection, natural and local purification), biogas production, etc.

Cluster 11: Knowledge networks for transition

Radical innovations and profound societal transformations are needed to reach a sustainable management of materials. The transition management (TM) approach can help to initiate and sustain the complex process towards SMM. The key features of transition management are:

-developing a long-term vision (more than one generation rather than the maximum of 5 to 10 years typical of traditional policy),
-experimenting in niches,
-learning from these experiments (learning-by-doing),
-stimulating radical changes instead of incremental developments,
-a stakeholder-oriented and participatory process which aims at mutual learning and new coalitions between actors.[15]

Since the transition management model is still young, practical experience with it is limited. A challenge will be to integrate transition management activities for SMM with existing policy initiatives. Some other potential hurdles transition management for SMM might face are a shift to technocratic approaches, lack of attention to social issues, and lack of democratic legitimacy.

Some ways in which policy could further support knowledge networks for transition are:
All authorities (from local to international levels) should provide additional funds for setting up knowledge networks for (sustainability) transitions. In particular, transition management (TM) arenas in vital domains such as SMM, mobility, food, housing and energy systems etc. should be set up. Authorities should allow regular policies to be inspired by the TM outcomes. To allow for maximum democratic legitimacy these arenas need to include all actors who will be affected by decisions. A Transition Platform for SMM could be established at EU level.

Cluster 12: IT for SMM

Technologies that optimise the tracking of supply chains can be important tools for SMM. They can facilitate efficient movement of products downstream, but also upstream (i.e. so-called reverse logistics). Reverse logistics refers to the flow of materials or goods back to the firm for the purpose of re-use or recycling, thus allowing for cost-savings and saving resources. For instance, electronic tags can be applied to re-usable or recyclable parts in products, as such making it easier to locate these parts during the dissembling process.

IT can give enterprises tools to effectively manage supply chains and to monitor the product and material flow up- and downstream, in turn allowing for material savings. In order to contribute to SMM, IT supply chain management instruments have to be combined with environmental management and monitoring. One of the barriers to IT for SMM seems to be the implementation of large-scale tracking technologies. On a smaller scale software is available for supply chain mapping, but especially SMEs may not have the resources to employ these tools.

Some ways in which policy could further support IT for SMM are:
Promote pilot projects on IT for SMM. Develop incentives for enterprises to implement the lessons learned from successful pilots and to use supply chain management tools in order to make their management of material flows more sustainable.

[15] Van Acker (2009), 3.

4 Future policy directions for SMM: transition to a resource efficient Europe[16]

Genuine systems innovation is required to achieve the sustainable management of materials. New business models, new management and marketing techniques, new consumption models and innovative ways of cooperation between actors in a material chain and between policy makers, industry and consumers have to be developed. This requires high-level political support and action, as these changes cannot be achieved at local levels or by market mechanisms and citizens alone.

As was indicated in Chapter 2, the EU largely outsources the natural resources extraction required to produce goods, thus exceeding self-sufficiency. The EU is likely to be increasingly faced with material supply problems. In addition, European consumption causes environmental degradation both inside and outside Europe. Because of its large footprint, Europe has an obligation to work towards a more sustainable management of materials. Policy measures at EU level are also necessary to avoid fragmentation of the Internal Market. Different kinds of, and sometimes even counterproductive, incentives and legislative measures, labelling systems, etc., prevent a level playing field for business.

EU policy has only recently begun to address the challenge of materials use and unsustainable consumption patterns, and the response to date has proved insufficient. The existing European IPP (2003) – with its focus on eco-labelling, product standards for energy-using products and the development of methodologies for life-cycle information – is geared mainly towards products. The Thematic Strategy on the sustainable use of natural resources (2005) is focused on developing a sound knowledge base, but contains few concrete actions to reduce the negative environmental impacts generated by the use of natural resources. The EU Action Plan on Sustainable Consumption and Production and Sustainable Industrial Policies (2008) reinforces and broadens the IPP approach towards green public procurement and suggests a limited number of actions to address consumer behaviour.[17]

However, current policies do not sufficiently address the underlying causes of unsustainable consumption patterns, tend to focus instead on mitigating impacts, are fragmented and are often strongly based on voluntary instruments.

In order to realise the ambition of the EU2020 Strategy to become a sustainable economy, several policy directions should be taken at EU level to stimulate and support the further transition to SMM. Three major areas for policy interventions at EU level are distinguished:

1. Integration
2. Vision
3. Innovation

4.1 Integration: from dispersed policies to integrated approaches

Integrated policy formulation is crucial in advancing SMM. Policy integration is about greater

[16] A number of the policy recommendations in this chapter are adapted from Rossy et al.(2010), 59-65.

[17] EC (2003). EC (2005a). EC (2008b).

coherence of policies, in order to reduce redundancy, policy gaps and contradictions. Policy integration for SMM means integration horizontally (between policy fields), vertically (between policy levels), and along the full life-cycle.

Recommendations

1. Move from waste policies to materials policies

The EU and the Member States have to make the shift from waste policies to materials policies. Extensive legislation has been put in place to manage European waste more sustainably. Although 30 years of EU waste legislation have significantly improved waste management practices, total consumption and waste production volumes have continued to increase. A further strengthening and better implementation of existing EU waste is important and will undoubtedly contribute to limiting the degradation of ecosystems due to materials use and to conserving resources.

However, a policy that is limited to waste prevention and recycling is insufficient to significantly reduce Europe's footprint and avoid a further depletion of natural capital. Rather than focus on isolated aspects of material chains, such as the end-of-life stage, we need to manage complete chains from the extraction of natural resources, over production, distribution and consumption, to recycling and final treatment. Sustainable materials management elevates the focus of governments, industry and consumers from individual material, product or process attributes, to the entire system of material flows and associated life-cycle impacts. Understanding impacts along the chain is necessary in order to set the right priorities and target policy measures so that they can be most beneficial for the environment as well as cost-efficient.

2. Deploy the appropriate mix of policy instruments

A mix of instruments has to be deployed in order to make our materials use more sustainable. The so-called 4E model[18] can serve as a framework: a balanced policy approach to promote SMM simultaneously enables, encourages, exemplifies and engages. Below some examples of each of the 4 E's are provided, applied to an EU SMM policy.

Enable:

- Impose clear resource efficiency norms for all products, which gradually toughen in time (e.g. by expanding the scope of the EU Ecodesign Directive);
- Provide a regulatory environment where ecodesign, product-service systems etc. are facilitated;
- Provide convenient access to collection, re-use and recycling centres;
- Realign national and EU R&D programmes, so as to stimulate inter- and transdisciplinary projects focusing on the materials challenge.

Encourage:

- Make work of an ecological tax reform, targeting the internalisation of all externalities;
- Support sustainable material management pioneers, e.g. via compulsory labelling of goods similar to the A++ EU energy label.

Exemplify:

- Make sustainable public procurement the norm (in the areas of building/refurbishment, energy and lightening, IT, transport, electrical appliances, food and drink, etc.).

Engage:

- Invest in community change projects such as transition towns, eco-teams and eco-cities;

[18] The 4E model was developed by the British Department for Environment, Food and Rural Affairs (DEFRA) in cooperation with the Sustainable Development Council (SDC).

- Invest in trans- and interdisciplinary knowledge networks and transition arenas on SMM;
- Integrate SMM and SCP into education programs.

3. Strengthen the coherence between existing EU initiatives on natural resources, products, production & consumption, and waste, with the aim of establishing a comprehensive materials management policy at the EU level

Policy and efforts for a more sustainable use of materials are currently scattered, with a separate natural resources policy, a product policy, a waste policy, etc. In order to move towards sustainable materials management such breakdowns should be overcome and the following EU policy initiatives should be better aligned:

- EU Thematic Strategy on the sustainable use of natural resources[19]
- EU Thematic Strategy on waste prevention and recycling[20]
- EU Raw Materials Initiative[21]
- Communication of the European Commission on integrated product policy[22]
- EU Action Plan on SCP and a sustainable industrial policy[23]
- EU Ecodesign Directive[24]

4. Pay attention to SMM in existing and new EU programmes indirectly related to materials use, such as:

- EU Lisbon Strategy and EU 2020 Strategy
- EU Strategy for sustainable development
- EU Strategy for integrating the environment into EU policies (so-called Cardiff process)
- EU Competitiveness and Innovation Framework Programme (CIP)
- Commission Communication on public procurement for a better environment
- EU Environmental Technologies Action Plan (ETAP) and forthcoming Eco-innovation Action Plan
- EU Programme for clean and competitive SMEs
- Eco-Management and Audit Scheme (EMAS) Regulation
- Common Agricultural Policy (CAP)

5. Encourage cross-departmental cooperation on SMM within EU institutions

Policy makers in different policy fields – such as environment, energy, climate, innovation and economics – have to work together more intensively to make our material use more sustainable. At EU level, structures should be set up to allow for systematic and institutionalised cooperation on SMM challenges, both within the European Commission and in the Council. Such cross-departmental European structures should work on the development of a long-term vision on SMM and pathways to move towards a resource efficient Europe, as well as on the monitoring of progress made by the EU in terms of reducing resources and materials use and related environmental impacts.

6. Establish global SMM building blocks

Given the globalised nature of our economy and the global character of industrial supply chains, materials management is not just a European challenge, but a concern for the

[19] EC (2005a)
[20] EC (2005b)
[21] EC (2008a)
[22] EC (2003)
[23] EC (2008b)
[24] European Parliament and Council (2009)

international community. SMM must be looked at from an international perspective, since the outscourcing of manufacturing activities by developed countries to less developed ones may cause an inequitable distribution of environmental burdens. Moreover, continuing growth of the world population and economic development will generate increased demand and hence competition for materials.

Therefore, the EU should actively stimulate and contribute to the dialogue at UN level on SMM-related issues, e.g. at the UN Commission on Sustainable Development or at the International Panel for Sustainable Resource Management hosted by UNEP. In 2010/2011, the UN CSD will work on topics that are central to the SMM debate: e.g. changing unsustainable patterns of consumption and production; protecting and managing the natural resource base needed for economic and social development; mining; means of implementation and institutional framework for sustainable development.

4.2 Vision: from short-term policy and narrow indicators to long-term objectives and comprehensive indicators for SMM

The EU needs to analyse the challenge of materials use and develop a vision on how to deal with materials in a sustainable way, from a long-term and systems perspective. This long-term vision on SMM needs to be backed up by quantifiable targets and by a reliable and widely accepted indicator set on materials use and related impacts.

Recommendations

1. Agree on long-term strategic objectives and targets for SMM

The following advantages of establishing strategic goals and targets for SMM were identified in the context of the OECD work on SMM:
-Provide a future vision for action, which serves as a springboard from which to act;
-Coordinate action among various actors: goals and targets ensure that individual parts (actors, departments, levels, etc.) work in a coordinated manner towards a future vision;
-Provide a metric of success against which progress can be measured;
-Demonstrate that policy makers are concerned about an issue: setting goals and targets creates the expectation that action will be taken on the issue. In case no action is taken policy makers risk a loss of credibility.[25]

Strategic objectives or goals are broad in scope, qualitative, based on long-term timelines (e.g. by 2050), and typically provide a vision for a future state. Targets are more precise, quantifiable, attribute accountability, include dates for achievement, and allow for clear monitoring.[26]

At EU level, policy makers – in consultation with stakeholders - need to agree on a vision on how we should ideally deal with materials, taking a systems perspective and a long-term view as starting point. The EU should focus on long-term strategic goal setting for a European sustainable management of materials, addressing questions such as: What do we want our world to look like in 2050 and beyond in terms of our use and management of materials and

[25] Five Winds International (2009), 5.

[26] A potential strategic objective for SMM could be: By 2020 sustainable consumption in the retail sector and by pubic authorities has increased. A potential target for SMM could be: By 2015 waste prevention has increased with x % compared to 2010.

the relationship between materials consumption and well-being? How should our materials use and management look like within 30 years? Which transitions (e.g. in our energy, mobility and food systems) are necessary on the long-term in order to make our materials management sustainable? Which type of governance approach is advisable and which instruments can be deployed to move towards these long-term SMM goals?

After having determined the strategic objectives, which indicate the desired long-term outcome, it would be useful for EU policy makers to establish more specific targets for SMM. Strategic objectives tend to have a timeframe of 10, 20 or 30 years. Given the length of such a timeframe it can be difficult to spur more immediate policy action. Targets can provide a mid-term step towards reaching a future goal.

2. Develop a robust and widely agreed upon indicator set on materials use and related impacts

The saying 'You cannot manage what you don't measure' is also relevant for SMM. Measurement and indicator sets are crucial as they enable:

- Sound decision-making and monitoring of progress.
- Setting priorities and taking concrete steps and action to achieve the proposed objectives.
- Indicators support clear communication with stakeholders (on e.g. available resources, per capita consumption, overshoot and limits) and visualise gaps between current patterns and envisaged targets.[27]

Measuring on the basis of a sound indicator set allows tackling the most urgent impacts, identifying the most resource intensive sectors, measuring the impacts of consumption patterns, quantifying resource efficiency potentials and the related costs, and identifying trade-related burden shifting.

The European Commission (EUROSTAT) should put forward a robust set of indicators on materials use and associated impacts, based on an exploration of existing attempts at developing similar indicator sets undertaken by e.g. the European Environmental Agency and other institutions.

Because of the complexity of material life-cycles, analysis of SMM opportunities and policy implications will require a range of methodologies, including material flow analysis, life-cycle assessment, and other techniques for assessing the environmental impacts of materials use.[28] The following types of indicators could be included in the set: indicators on resource productivity, material and resource flows (natural resources, land use, water, energy), in/out-put models (socio-economic modelling), indicators for measuring total material flows and requirements (TMF and TMR), progress indicators, etc.

The chosen indicator set must take a life-cycle wide perspective and take into account burden shifting to other regions or between resources. In addition, the so-called hidden flows[29] have to be included in calculations. Ideally, all EU Member States support this SMM indicator set and data provision (regional and national) by Member States related to these indicators is made mandatory.

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[27] SERI (2009).

[28] Fiskel (2010), 1.

[29] The OECD defines hidden flows as "the displacement of environmental assets without absorption into he economic sphere, e.g. overburden from mining operations". OECD Glossary, http://stats.oecd.org/glossary/detail.asp?ID=6472.

3. Further explore the 'Beyond GDP' and 'Redefining Prosperity' debates

The need for new indicators to measure success and progress has been recognised, replacing quantity by quality as the touchstone of well-being or growth. The 'Happy Planet Index'[30] suggests that around the world, high levels of resources consumption do not straightforwardly produce high levels of well-being, and that it is possible to produce high well-being without excessive consumption of the earth's resources. The EU should, therefore, continue its reflection on how to complement current GDP with environmental and social indicators.

4. Reinforce EU Sustainable Impact Assessment (SIA) with SMM indicators

SIA is used by the European Commission to identify and assess the likely economic, environmental and social impacts of EU policies before they are introduced. Specific indicators for SMM should be added to the European Commission's 'Impact Assessment Guidance'.[31]

4.3 Innovation: from incremental technological innovation to fundamental systems innovation

Innovation is vital to identify possible improvements to goods and services in the form of lower environmental impacts and reduced use of resources across all life-cycle stages. Innovation policy tends to focus on technological innovations. Technological innovations often look at production processes isolated from the broader perspective of managing the whole material chain, from natural resource extraction to final disposal. SMM offers this broader perspective and opens doors towards innovation that goes beyond technological improvements and is more aimed at system innovations, such as the introduction of new business models, new logistical systems etc.

The EU can play an important role in promoting this type of systems innovation by channelling more European funding towards research on SMM and materials autonomy challenges.

Recommendation

Mobilise existing EU financial instruments to support innovation contributing to sustainable materials management

European research programmes are too often geared towards single-domain projects, while challenges related to sustainable materials management by definition require a transdomain approach. Substantially more EU means should be reserved for novel research approaches that focus on inter- and transdisciplinary learning networks and on systems innovation.

Future projects in the area of sound SMM progress indicators, integrated closed-loop industry systems, understanding drivers of unsustainable consumption patterns and options for behavioural change, etc. are essential for the transition to SMM. They should be subject of future calls of the EIT (European Institute of Innovation and Technology) and the European Community Framework Programme for Research and Technological Development, EU Structural Funds and specific European SME programmes.

[30] An index of human well-being and environmental impact that was introduced by the New Economics Foundation (NEF) in 2006.
[31] EC (2009).

4.4 European, multi-stakeholder SMM Transition Platform

The three ways towards SMM identified above - integrated approaches, long-term goals for SMM and systems innovation – could all be stimulated by the establishment of a European transition platform on sustainable materials management.

In the context of this background paper, a transition is a process instigated to achieve long-term changes in systems so that materials use challenges around the world can be addressed. Such a transition typically entails a wide complexity of interrelated developments in economics, technology, institutions, culture and the environment. The transition management approach can help to initiate and sustain the shift towards SMM.

As mentioned in chapter 3 (cluster 11), the key features of transition management are: developing a long-term vision; experimenting; setting up collaborative partnerships involving a variety of players in the material chain (suppliers, producers, retailers, consumers, recyclers and disposers) as well as policy makers, scientists and NGOs. In short, a transition arena seeks to solve a complex and multidimensional problem through cooperation, knowledge exchange and mutual learning among frontrunners from different disciplines.

A European SMM transition platform, involving businesses, authorities, NGOs, consumers and research institutes, would allow for a structured dialogue on how to achieve sustainability gains along the life-cycle of materials. This multi-actor platform could develop a joint future vision on SMM, identify transition pathways to SMM and launch experiments which go beyond established practices and contribute to the envisioned systems changes.

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