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Recycling and Sustainable Materials Management

Analytic paper for the Danish Ministry of the Environment

With particular emphasis on the following policy options:

- **Phosphorous scarcity**
- **Critical/Rare metals in EEE**
- **Reduction of landfilling**

Copenhagen Resource Institute (CRI) has been commissioned by the Danish Ministry of the Environment to prepare background analyses investigating possible ways to green the European economy and contribute to reaching the objectives set out in the Europe 2020 strategy of smart, sustainable and inclusive growth. This is part of a broader collaboration between the Danish Ministry of the Environment and the European Environment Agency on gathering knowledge on greening the economy.

To serve this purpose, a series of three analytical papers have been prepared on the following thematic areas: 1) Sustainable, Resource Efficient Production, 2) Sustainable Consumption and Products and 3) Recycling and Sustainable Materials Management.

This paper assesses some specific options within the broader policy area of Recycling and Sustainable Materials Management. The objective of the paper is to briefly present a background and current policy context for each option, examine its feasibility and give a rapid qualitative assessment of the potential environmental and socio-economic impacts resulting from its implementation.

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1. Key Challenges and Solutions

Increasing recycling and improving sustainable material management is a top priority within EU, emphasised with the launch of the EU 2020 Strategy (EU2010a) – in which Resource Efficiency is one of seven flagship initiatives – and the subsequent EU Resource Efficiency Roadmap (EU 2011a).

Waste is a key environmental, social and economic issue. Rising consumption and wealth are putting increased pressure on waste management and prevention strategies that aim to reduce the negative effects on the ecosystem and public health.

Recent EU policy instruments and strategies in this area, such as the revised Waste Directive (2008/98/EC), the Thematic Strategy on the Prevention and Recycling of Waste (EU 2005) and the 6th Environmental Action Programme (EAP) (EU 2002) prioritise waste prevention and decoupling of waste generation from economic growth and environmental impacts.

The EU 2020 strategy's flagship initiative on resource efficiency (EU2010a) stresses the importance of more efficient/effective recycling. The importance of recycling is also stressed in the European Commission's Action Plan on Sustainable Production and Consumption and Sustainable Industry (EU2008a), which states the need for reduced dependency on raw materials and the encouragement of optimal resource use and recycling. In the Commission's Communication "The Raw Material Initiative – meeting our critical needs for growth and jobs in Europe" (EU2008b) recycling is highlighted as one of the important measures to enhance the sustainable supply of raw materials.

The security of supply aspect is further underlined in the Commission's report on Critical Raw Materials for the EU (EU, 2010c) and in the Commission's Communication on tackling the challenges in commodity markets and on raw materials (EU, 2011 d).

Recently the EEA has documented that recycling has multiple benefits for many areas of the economy providing raw materials, creating jobs and encouraging business opportunities and innovation (EEA, 2011c).

The Roadmap towards a Resource Efficient Europe describes the overriding objective within this area as "to reduce the environmental impact of energy and material use in production and consumption through significantly increasing waste prevention and recycling of waste in order to secure the supply of resources in the future and in addition to take the global lead on green technologies in the area" (EU2011a).

The European Commission's on a Roadmap towards a Resource Efficient Europe outlines a vision for 2050 and milestones for 2020 for a number of different themes relevant to the broad policy area of resource efficiency. One of these themes is in the area of *'Treating waste as a resource.'* (EU2011a).

The milestone for this sub-theme is that***: 'By 2020, waste is managed as a resource. Waste generated per capita is in absolute decline. Recycling and re-use of waste are economically attractive options for public and private actors due to widespread separate collection and the development of functional markets for secondary raw materials. More materials, including materials having a significant impact on the environment and critical raw materials, are recycled. Waste legislation is fully implemented. Illegal shipments of waste have been eradicated. Energy recovery is limited to non recyclable materials, land filling is virtually eliminated and high quality recycling is ensured.'***

For this milestone to be met, a number of changes are required in different policy areas that involve a large number of stakeholders.

To summarise, the following theme areas and measures to promote recycling and sustainable materials management in the coming years are among the policy options that could be considered for further assessment and development in future European environment policy.

Strategic objectives could include:

- Promote a waste prevention society.
- Decouple material use and waste generation from economic growth and environmental impacts.
- Phase out the landfilling of recyclable materials.
- Increase recycling of materials in general and especially critical/rare metals and phosphorous; stimulate research on substitutes of these metals.
- Stimulate closed-loop recycling in order to increase the quality of recycling and avoid downcycling.
- Promote the eco-design of products and improve product design to facilitate material separation.
- Phase out hazardous substances in order to promote reuse and recycling of products and materials.
- Increase the turnover and number of green jobs in the recycling and reuse sector.
- Develop recycling and reuse technologies for existing and new products.
- Better demonstrate the win-win potential of recycling in relation to creating jobs and decrease greenhouse gas emissions.
- Support improved implementation of waste legislation.
- Support better enforcement of waste shipment regulation and work to eliminate illegal shipments of waste.

The three options below were among those identified as having potentially large impacts, potentials for supporting economic growth and job creation, being timely and potentially feasible.

- **Phosphorous scarcity**
- **Critical/Rare metals in EEE and improved implementation and enforcement in relation to export of WEEE**
- **Reduction of landfilling**

These are presented and assessed in more detail below.

2. Phosphorus scarcity

2.1. Background

Phosphorus is essential for food production, but its global supply is limited. Despite this, Phosphorus has received only limited policy attention compared to other important agricultural inputs like nitrogen and water.

The mineral phosphorus reserves (rock phosphate) are limited. It is not clear exactly how large these reserves are and how commercially viable they are. The commercially viable reserves have been predicted to last from 235 years to only 48 years (Rosemarin et al. 2010). A growing global population changing towards more western, meat-rich diet and an increased production of bio-energy crops needing fertilization are important factors towards quick exhaustion of the phosphorus reserves.

Because of the vital role of phosphorus in food production, any consideration of food security needs to include an informed discussion concerning more sustainable use of this limited resource (UNEP 2011). The EU food system is highly vulnerable to future phosphorus scarcity; without phosphorus, agricultural production would be lower and consequently less food would be produced. Nearly 90% of phosphorus use is in agriculture, mainly as fertilizers and the EU is highly dependent on imported phosphate for the fertilizer industry. Five countries (Morocco, China, the US, South Africa and Jordan) control 85% of the global reserves, making the EU, as an importer, vulnerable to geopolitical tensions in these countries and to volatile prices (Schröder et al. 2010). Morocco (incl. West-Sahara) is predicted to be the totally dominant supplier of phosphorus in the future (Rosemarin et al. 2010).

As with other natural resources, it appears likely that as cheap and cleaner resources of phosphate rock are used up, low quality resources with higher cadmium contents will be accessed. This poses new environmental problems in terms of greater environmental cost at the point of extraction, but also subsequent cadmium pollution of EU soils (EU2011b).

The status of phosphorus use differs between individual member states. In countries with an intensive livestock production, the main source of phosphorus can be found in the import of feed materials. For other countries, the primary source the phosphorus input comes via fertilizers (Schröder et al. 2010).

The amount of phosphorous in European soil is highly differentiated between countries. In some countries with concentrated and specialised livestock farming like Denmark, the Netherlands and the UK, most soils are saturated with phosphorous and there is actually a need to reduce the phosphorus surplus. In other countries, soil phosphorous is continuously depleting and requires regular replacement. Breaking this cycle of intensive livestock farming, high manure production and soils saturated with phosphorus is both financially very costly and structurally difficult (EU 2011b).

Only about one-fifth of the mined phosphorus is eventually eaten by humans. Phosphorus losses between farm and fork exceed the phosphorus losses between mine and farm, so major efficiency improvements are need on farms and between farm, gate and fork. A considerable fraction of the losses of phosphorous between the mine and the plate leaches into water bodies leading to eutrophication and loss of water quality. Use of phosphorus is linked to other unwanted environmental effects such as the loss of landscape quality, green house gas emissions, excessive fresh water consumption, radioactivity, cadmium accumulation and fluorine emission, further underlining the need to reduce losses (Schröder et al. 2010).

In general, the recycling of phosphorus from waste (excluding manure) in the EU is low. Around 37 % of phosphorus in municipal sewage sludge is currently recovered and reused in agriculture (Milieu Ltd et al 2009). In countries with intensive livestock production, recycling of phosphorus from manure is important. For example, in Denmark the amount of phosphorus in manure is five times the amount contained in all other waste (household, industry etc.) (Jensen 2011). New technologies to recover phosphorus from surplus manure are under development in the Netherlands (Schoumans et al. 2010) Some countries already have policies specifically targeting phosphorous; for example Sweden aims to recover at least 60 % of phosphorus compounds in wastewater by 2015 for use on productive land, with at least half to be returned to arable land (EEA2011d).

Recycling of phosphorus is part of the solution. However, global scenarios indicate that recycling alone will not meet projections for long term global demand. As such, demand management measures will be required to reduce business-as-usual demand by an order of 70%: it is anticipated that the remaining 30% could be met through improving phosphorous recycling rates from all sources (Cordell 2010).

2.2. Current status

The Thematic Strategy on the Sustainable Use of Natural Resources from 2005 stressed the need for a sustainable use of resources, involving sustainable production and consumption as a key ingredient of long-term prosperity, both within the EU and globally (EU 2005). This is further underlined in the council conclusions from December 2010 on sustainable materials management and sustainable production and consumption: a key contribution to a resource-efficient Europe (EU 2010)

However, phosphorus has received only limited attention compared to other important limited resources. Until recently, phosphorus scarcity has only received explicit mention or assessment within official reports related to global food security or major global environmental change assessments and frameworks (Schröder et al. 2010).

Most recently, the Commission's Roadmap towards a Resource Efficient Europe stressed the need for action on phosphorus scarcity: "The commission will further assess the security of supply of phosphorus and potential actions towards its sustainable use (Green paper on sustainable use of phosphorus by 2012)" (EU 2011a).

2.3. The policy option in short

There is no single solution which can bring about a sustainable phosphorus cycle, but there are a number of current technologies and policy options at various stages of development that together could make a significant difference and deliver other environmental co-benefits on water quality. Therefore, a common European strategy for phosphorus would be useful.

A common European strategy for phosphorus must have a broad perspective. It should be an integrated strategy that seeks to increase the efficiency of phosphorus use throughout the food system while simultaneously seeking to recover phosphorus where loss is unavoidable. The policy options need to be integrated into a number of different policy areas such as the CAP reform, water policy, the marine strategy and sustainable food consumption. The strategy could facilitate the transformation to a phosphorus recycling society.

A strategy for phosphorus could include:

In the short term:

- Supporting awareness of the need for more sustainable use of phosphorus. Lack of awareness is part of the problem concerning inefficient use of phosphorus; provision of information and knowledge transfer via education must be part of the solution.
- Produce an assessment based on independent collection and monitoring of baseline data for phosphate rock reserves and trade.
- Continue analyses of options to reduce phosphorus losses in order to make phosphorus use more efficient.
- Produce a study on total phosphorus present in different waste streams (including manure) in the member countries and the recycling potential. The study could also propose solutions on how to cope with the surplus of phosphorus in manure in some areas.
- Produce a life cycle assessment and a cost benefit analysis associated with collection, storage, transport, treatment and recycling of phosphorus for different waste streams.
- Produce a study on potential regulatory measures and recommendation schemes to be used in order to increase sustainable use of phosphorus. The study would also have to survey different regulatory measures and fertilizer recommendation schemes already in use throughout Europe.
- Conduct a study on possible economic measures. This would include analysis indicating what kind of financial incentives, grants, taxes or fees would be needed to stimulate and sustain a more sustainable use of phosphorus. Special attention could be paid to the possibility of applying a deposit to the phosphorous in agricultural outputs with the aim of increasing recycling of the phosphorus removed with these outputs.
- Supporting the development and implementation of technologies for recycling phosphorus in biomass ashes, technologies for recycling phosphorus in sewage sludge and slaughtering waste, separation technologies for manure, optimal placement of fertilizers in agriculture, improving crop genotypes etc.
- Supporting research to assess the plant-availability of recovered phosphorus, related to different treatment methods, soil conditions and crops.

In the long term

- Consider the development of a directive on phosphorus linked to food security. The objective of such a directive could be ensuring short and long term availability and accessibility of phosphorus to farmers, allowing them to produce food while minimizing adverse environmental impacts related to phosphorus use.
- Consider promoting a global platform for effective governance of the phosphorus cycle. The platform should include key stakeholders and could be used to define clear roles and responsibilities for stakeholders at the global, EU and national level.
- Prepare a study on the influence of the human diet on phosphorus efficiency.

2.4. Environmental impacts

There are significant medium and long term potential environmental gains of a strategy for sustainable use of phosphorus.

Better utilisation of phosphorus from mine to fork, together with significant improvement in recycling phosphorus, will ultimately improve access to phosphorus in the medium and long term perspective.

The largest environmental impact of phosphorus use in agriculture comes when it leaches into and damages the surrounding aquatic ecosystem functioning and biodiversity (Schröder et al. 2010). Diminishing loss and leakage of phosphorus will have a beneficial impact on aquatic ecosystems and the degree of eutrophication.

More efficient use of phosphorus may also decrease soil erosion and increase soil fertility.

2.5. Socio-economic impacts

It is difficult to assess the potential socio-economic impacts from a strategy for sustainable use of phosphorus. However, more efficient use of phosphorus in agriculture and higher recycling of phosphorus will lead to a decrease in demand for virgin phosphorus produced outside Europe and will ensure that Europe is less vulnerable to geopolitical tensions in the phosphorus producing countries and to volatile prices. Increased sustainable use of phosphorus will be a geopolitical benefit for Europe in the long run.

Increasing the sustainability of phosphorus use will add to food security. The long term availability of phosphorus for global production is of fundamental importance to the world population (UNEP 2011).

Higher efficiency in the use of phosphorus and increased recycling of phosphorus in EU are good opportunities for eco-innovation. New technologies need to be developed and implemented in order to increase the sustainable use of phosphorus in the entire life cycle of phosphorus. For example: recycling technologies to recapture phosphorus in biomass ashes, separation technologies for manure, optimal placement of fertilizers in agriculture, improving crop genotypes (Schröder et al. 2010).

Implementation of these and other technologies would require new treatment facilities, new logistics systems for collection of waste and manure, new arable practises etc. All these new activities will create new jobs. In some cases these new jobs will substitute existing jobs as current technologies are phased out, and in other cases it will result in a net surplus of jobs. For example, most phosphorus in waste from households currently ends up in landfills. Diverting the waste from landfills to phosphorus recovery facilities will create extra jobs (Friends of the earth 2010). Furthermore, phosphorus is mined outside Europe. Job losses in the phosphorous mining industry will not influence the number of jobs in EU. Therefore an increase in phosphorus efficiency and recycling within Europe will have a net effect on the job creation in EU.

Regulating phosphorus use and using economic instruments may increase costs in the short term, but may lower price of phosphorus in the long term. Taxes on inefficient phosphorus use may provide revenue for the state and have a positive impact on public finances. Ultimately, the overall effect will strongly depend on the level of implementation.

2.6. Feasibility

Phosphorus scarcity is an upcoming issue on the global agenda. The proposed activities might be integrated in the green paper proposed by the EU commission in 2012.

3. Critical metals in Electrical Electronic Equipment

3.1. Background

Critical metals are defined based on the security of supply and the demand for each metal. The term is broader than rare earth metals. Relevant examples of these metals are Coltan, Indium, Lithium, Silver, Tantalum, Tellurium, Tungsten, Beryllium, Gallium, Germanium, Gold, Palladium, Ruthenium and Rare Earth Metals (ETC/SCP, 2011). The metals are often found in Electrical and Electronic Equipment (EEE) and their waste (WEEE).

Limited availability of these metals will ultimately limit the possibilities of producing and using new technologies. This is particularly the case for sustainable energy technologies and information and communication technologies.

However, the critical metals are characterised by a dissipative use, that is to say used in small amounts in a multitude of application areas or products, and they are frequently alloyed. The existing recycling infrastructure for WEEE – comprising the current collection and recycling techniques - has not yet come to terms with the challenges this poses. As a result, many of the metals in WEEE are currently lost. Specific product groups within WEEE contain particularly high concentrations of these metals: mobile phones, personal computers (desktop computers), laptops and notebooks, TV and flat screen monitors, thin film and conventional crystalline solar power converters (photovoltaic cells) and rechargeable batteries (as contained in WEEE) (ETC/SCP, 2011).

Apart from the low quantities of critical metals within each product, other problems for the recycling of critical metals lie within the product design. Producers often provide only limited information about the quantity and location of critical metals within their products. This is not only because they are reluctant to provide such information, but also because manufacturers of final consumer goods are often unaware of the exact material composition of externally sourced components used in their products. EEE and WEEE are regulated by directives regarding content of heavy metals and treatment, but the WEEE Directive has had limited impact on design practices of EEE.

3.2. Current status

Three major weaknesses can explain the present low amount of recycled WEEE and of critical metals:
1) Low collection rate of WEEE in the EU,
2) Too much WEEE is exported to markets outside the EU as used products
3) The recycling process chain regarding critical metals is not sufficiently advanced. This is particularly true for dismantling and pre-processing; end-processing is better. However, end processing (smelting) is not cost feasible for some metal types.

The two first factors are relevant to WEEE in general, whereas the last one is specific only to the recycling of critical metals (ETC/SCP, 2011 a).

Around 3.1 million tonnes of WEEE were collected in the EU in 2008 compared to an expected generated amount of 7 to 8 million tonnes of WEEE: a maximum collection rate of about 40%. In reality, the actual treated amount is even lower- only 2.6 million tonnes in 2008. The ratio of collected volume of WEEE compared to the amount placed on the market of new EEE (10.1 million tonnes) was about 30% in 2008 (Eurostat, 2011). The collection rate is especially low for small appliances.

A large part the waste that should have been registered as WEEE seems to be exported out of the EU disguised as old or second hand products and is therefore not registered as WEEE. It is assessed that this amount is at least 300,000-500,000 tonnes per year (EEA, 2011).

Manual treatment in the dismantling and pre-processing stage, though more expensive due to labour costs, secures better results of recycling of critical metals. For example, the recovery rate for gold and palladium is about 50% when treatment is based on mechanical processing (75%) and non-manual processing (25%), but it is possible to achieve a recovery rate of 90% when manual pre-processing is used (Chancerel, 2010). At present, most recycling of WEEE is targeted on the more common metals such as iron, copper and aluminium.

Each stage of the recycling process introduces cumulative losses. For example, if the collection rate is 35%, the dismantling efficiency rate is 40%, the pre-processing efficiency 30% and the smelting efficiency is 95% - then the total recycling efficiency will only be 4%. Most of the critical metals are assessed to have an even lower recycling percentage (UNEP, 2011a). In other words, smart recycling of critical metals requires not only increased collection of WEEE, it also requires the initial product design to facilitate easier recycling and improvements in the WEEE recycling process.

3.3 The policy option in short

The new WEEE Directive targets for a minimum collection rate of 45% to be achieved within four years and a collection rate of 65% after seven years (nine years for some of the new Member States). The rate is calculated as a percentage of the average weight of EEE placed on the market in the three preceding years, but the revision of the directive does not include any special focus or initiatives on critical metals. Another new initiative in the revised directive is to better distinguish between used products (EEE) and waste (WEEE). Any holder of used EEE wanting to make transboundary shipments must provide documentation recording the testing of functionality of the used EEE. Both amendments are important, but further initiatives are necessary in order to increase the amount of recycling of critical metals in WEEE.

Furthermore, there have been calls for a strategy to improve the design of EEE to make it easier to dismantle and pre-process components in WEEE containing critical metals. Such design requirements could be included in the Eco Design Directive 2009/125/EC, which must be reviewed by the Commission no later than 2012. Specific initiatives could include:

1) Establish eco-design requirements of EEE regarding life span of the products, choice of materials, recyclability, durability, easy-to-repair and re-use etc.
2) Develop specific checklists or standards for calculating the potential for recycling of critical metals to fulfil the design requirements or ask the European Standardisation Committees to develop this.
3) A special focus on critical metals is needed when standards for recycling of WEEE are developed.
4) Support the development of new recycling technologies for critical metals, especially regarding dismantling and pre-processing.
5) Develop specific labelling requirements for each type of new EEE placed on the market that indicator the quantity and location of certain critical metal found in the product. An alternative to labelling could be the integration of an RFID chip in the products providing the same information. Both labelling and RFID chips would provide recycling enterprises with the information necessary to process the equipment correctly.

Other relevant initiatives:

1) Create an EU Network for EEE producers and WEEE treatment enterprises. Designers need to know how to combine materials and what to substitute/reduce to enable optimal resource recovery from the WEEE treatment. The recycling enterprises can develop their treatment of WEEE by receiving information regarding the products' material content and composition.
2) An obligation to use innovative procurement when projects are funded wholly or partially by EU funds. Public procurers can, to a larger degree, demand environmentally sound EEE. This means that

procurers define the demanded performance and force manufacturers toward new processes and products.

3) Developing a deposit and refund scheme for small EEE in the EU. A deposit and refund scheme will ensure that a larger share of small EEE is brought back to proper recycling. A graduated deposit fee according to environmental performance can be used to promote green electronics.
4) Facilitate practical inspections of used EEE. Annex VI of the present proposal of the revised WEEE Directive, regarding shipment of used EEE, states that that Member States shall, in cases of used EEE and suspected WEEE, request evidence of evaluation or testing on every item. This may be very time consuming. However, Article 23 suggests that based on Committee procedure, the Commission is able to establish additional rules on inspections in order to secure uniform conditions for the implementation of Annex VI. One possibility of facilitating practical inspections according to Article 23 could be to establish an additional rule requiring that EU exports of used EEE (e.g. EEE older than four years) provide evidence of total functionality. Such an initiative would provide an incentive to export only fully functioning used EEE and reduce illegal shipments out of the EU.

3.4. Environmental impacts

The described initiatives will secure resources of critical metals and thus reduce environmental impacts from extraction of virgin materials. WEEE is not a homogenous waste stream. It can contain many different substances of which several are hazardous, such as mercury, cadmium, lead, polybrominated biphenyls (PBB) or polybrominated diphenyl ethers (PBDE). Therefore, WEEE can create many different environmental problems when not treated appropriately. Inappropriate treatment of WEEE to recover metals such as copper, gold and silver causes pollution of air, water and soil, and can also create serious health problems. Appropriate recycling of WEEE also reduces greenhouse gas emissions and ozone layer depletion.

3.5. Socio-economic impacts

Recycling of critical metals in WEEE will create both low skilled and high skilled jobs. Based on recycling figures and experiences from Germany (Remondis, 2005) and Switzerland (Sinha-Khetriwal 2005), it is assessed that one job in the whole recycling chain is created for every 70 to 300 tonnes of WEEE collected (taking into account collection, dismantling, pre-processing and smelting). If WEEE collection is increased from 30% to 65% of that placed on the market, then the amount will increase in the EU from about 3.1 million to 6.5 million tonnes. This is assessed to create a minimum of 12 000 new jobs. Furthermore, a greater emphasis on the qualitative and labour intensive part of the recycling of critical metals (dismantling and pre-processing), would result in an even larger increase in the number of jobs created. The estimated growth rate for the generation of WEEE of 3 - 5 % per year should also be taken into account, which could mean a doubling of the job potential within the next 15 years.

Improved collection rates of WEEE would also have positive impacts on the market for re-use. Reuse of different components contained in WEEE has positive social impacts: the sector is already employing 40.000 people and engaging 110.000 volunteers in Europe (EU, 2008d), mainly working on WEEE (usually these are long-term unemployed, handicapped or people at risk).

The average cost for separate collection and treatment of WEEE in the EU in 2009 was around €300 per ton (WEEE Forum, 2010), including direct costs for the collection, transport and treatment as well as operational costs for monitoring and administration. It has to be remembered that incineration or disposal of WEEE according to EU environmental standards costs from €40 to €100 per ton including landfill tax (CEWEP, 2011). The recycling costs differ dramatically between the different WEEE product groups. They are extremely high for products like energy saving lamps containing hazardous substances. For some categories, such as large household appliances or mobile phones, the revenues from recovered secondary raw materials more than compensate the costs of the separate collection and treatment creating a net profit. With rising amounts of collected WEEE, costs per tonne are expected to decrease. The net costs will also decrease as more of the value of critical metals in WEEE is recuperated.

The principle of extended producer responsibility in the WEEE directive implies that the producers must bear the financial responsibility for the end of life phase of their products. Comparing the turnover of the EEE sector and estimated costs for the collection and treatment, of WEEE, operating costs appear likely to be small, accounting for well below 1% of turnover (Risk & Policy Analysts Limited, 2001).

3.6. Feasibility

Europe lacks geological stocks of critical metals and is highly dependent on imports. The importance of recycling critical metals is universally recognised, and since the suggested initiatives related to the Eco design Directive have still not been dealt with or included in the revision of the WEEE directive, the initiatives mentioned here stand a good chance of gaining the support of Member States and the Parliament.

4. Reduction of landfilling (targets on biodegradable municipal waste / landfill tax)

4.1. Background

The Landfill Directive (1999/33/EC) from 1999 introduced certain limitations on the quantity of biodegradable municipal waste allowed to be landfill in 2006, 2009 and 2016 respectively (EU, 1999). These quantities are a percentage of the amount of municipal biodegradable waste generated in 1995. Certain countries have a derogation period of up to four years.

According to the revised Waste Framework Directive, Member States (EU, 2008C) are to set up separate collection for at least paper, metal, plastic and glass waste by 2015. Furthermore, by 2020 preparing for re-use and recycling of these waste materials from households and other origins shall be increased to a minimum of 50% by weight, while a recycling target of 70% by 2020 has been set for construction and demolition waste.

The Commission's Report on the Thematic Strategy adopted in January 2011 (EU, 2011c) demonstrated significant differences between Member States in the implementation of EU legally binding minimum targets (recycling/recovery rates/landfill diversion targets) and clear links between the performance of Member States and the use of economic instruments. The Commission concluded that "Optimal combination of economic and legal instruments should be promoted notably through landfill bans and by applying the producer responsibility concept to additional waste streams on the basis of a common European approach".

Furthermore, in September 2011 the Commission mentioned in its Roadmap to a Resource Efficient Europe that they will review existing targets on prevention, re-use, recycling, recovery, and landfill diversion in 2014. This is a repetition of the obligations according to the Waste Framework Directive, but the target is now that there should be close to zero residual waste. Furthermore, the Commission will ensure that public funding from the EU budget shifts focus from disposal (landfill) to waste management options higher up in the hierarchy.

4.2. Current status

In the EU, 2.7 million tonnes of waste is generated per year, a minimum of 45% of which is landfilled (Eurostat, 2011). There are large differences between how much each Member State landfills and recycles. For example, 38% of all municipal waste is landfilled in the EU; however, 12 countries landfill more than 75% and, six countries landfill under 5%. Those States that have achieved significant reduction in landfilling have almost all implemented a landfill ban on combustible or biodegradable waste, obligatory pre-treatment before landfilling and often combined these initiatives with a tax on waste sent to landfills. The landfill of packaging waste and construction and demolition waste is similarly varied between countries.

Although some countries are not performing as well as others, there is no doubt that the EU recycling and diversion targets in the different waste directives have been a strong driver for diverting waste away from landfills. For example, some EU Member States with lower recycling rates of municipal waste such as Ireland, Italy, Portugal and United Kingdom have shown a reasonable high growth rate of recycling since 2000.

Additional initiatives to divert recyclable or recoverable waste away from landfill could therefore be seen as an important contribution to increase resource efficiency in Europe. Relevant waste types to focus on are metals, plastics, paper & cardboard, wood and other biodegradable waste. Although recycling of more common metals such as iron (77%), copper (70%) and aluminium (67%) is higher than for other waste types, there is still room for large improvements. The recycling of paper & cardboard is 67%, plastic is even lower (19%) (ECT/SCP, 2011b). All waste types are very important for a resource efficient economy, first of all as recyclables, but many of them also as an energy source.

4.3. The policy option in short

Since important recycling targets already have been set, further initiatives to divert more waste away from landfillls could be to introduce a landfill ban on biodegradable waste or on certain specific waste types or on non-pretreated waste by 2025, and to encourage Member States to apply tax on wastes to landfill. The introduction of obligatory minimum taxes would require unanimity among Member States (according to the treaty of the European Union). However, landfill taxes are used by 18 MS and many have reasonable low amounts of waste to landfill, whereas countries with high amounts in general have not introduced a tax, suggesting a relative effectiveness of this approach. In addition, a landfill tax can be used to support recycling initiatives or contribute to the national public revenue.

Whereas all metals in principle can be recycled without loosing their material quality, this is not the case for plastic, wood, paper & cardboard and food waste. Some of the plastic waste is of such a poor quality that incineration with energy recovery is a better solution. For food waste, bio-digestion is often the best solution. Therefore, the following initiatives could be taken as a general preparation of the Commission's review of targets by latest 2014:

1. Assess in detail the potential, the practical possibilities and the costs of introducing a landfill ban on waste, on biodegradable waste, or on specific waste types such metals, plastics, wood, paper & cardboard and food waste.
2. Develop a strategy for introducing a landfill ban on biodegradable waste, on certain specific waste types, or on non-pre treated waste by 2025, including interim targets for the years 2019 and 2022.
3. Develop specific systems that Member States and landfills can use to monitor and check that the waste sent to landfill does not contain the banned waste types – for example, metal and plastic waste – and if necessary/possible develop easily manageable and inexpensive measuring technologies.
4. Develop standards how the Member States shall document the fulfilling of the new requirements.
5. Prepare and introduce a decision in the Waste Framework Directive that if a Member State does not fulfil recycling, recovery or landfill requirements in a directive there is a request (obligation?) to introduce a tax or other economic burdens on the waste sent to landfill. In principle, such a decision could also be introduced on the incineration of waste where the recycling targets are not fulfilled by a Member State.
6. Ensure that public funding from the EU budget to waste recycling or recovery initiatives gives priority to Member States or regions that have introduced a landfill tax on waste sent to landfill.

4.4. Environmental impacts

A landfill ban of metals, plastics and other recyclables will be extremely valuable for the environment. For example, GHG emissions will be reduced primarily by avoiding emissions through increased recycling. Recycling results in lower GHG emissions than the use of virgin materials for the same purpose. A rough estimate is that, compared to the benefits of the already decided initiatives in the Waste Framework Directive, and in the Landfill Directive and in different recycling directives, about an additional 50 million tonnes CO2 equivalents will be saved in annual emissions by 2025, if a landfill ban is implemented (Prognos, 2008). The EEA has calculated that a ban on municipal waste to landfill will result in an additional reduction of 16 million tonnes CO_2 equivalents by 2020 above and beyond the benefits of a full implementation of the Landfill Directive (EEA, 2011b)

A landfill ban will also produce other environmental benefits in form of reduced emissions of other substances to air and water.

4.5. Socio-economic impacts

The level of job creation from a landfill ban will vary widely between Member States, mainly because some countries have already attained high recycling rates and others have not. It has been estimated that if a target of 70% for recycling of key waste materials is met there will be more than 550,000 new jobs generated in the EU-27 by 2020 compared to 2004 (Friends of the Earth 2010). About 320,000 of the jobs will be created directly in the recycling industry and the rest will be indirect and induced jobs (Friends of the earth 2010). In 2007, Germany had about 180,000 direct jobs in the waste sector, of which half were related to collection of waste. It has been assessed that an additional 18,000 jobs can be created in the German waste sector by 2020 through improved waste management (Umwelt Bundes Amt, Germany, 2007). Scaling up the German figures to the EU-27 level indicates the potential generation of 110,000 new direct jobs in the sector. Further, since Germany already has a high recycling rate and a low land filling rate, it is reasonable to assume that between 200,000 -320,000 new jobs could be created direct if a landfill ban is introduced.

Introducing a landfill ban (or a ban on biodegradable waste or on certain specific waste types or on non-pre-treated waste) will require investments in recycling capacity, primarily in the regions with a currently low recycling rate. The operational (daily) costs may increase but not necessarily very much giving an anticipated increase in the price of virgin raw materials, which will reduce the relative costs for recycling. For the waste producer, the extent of the additional cost of recycling will depend on presence and amount of a landfill tax. If a landfill tax is in use, the additional cost of recycling will be lower for the waste producers.

4.6. Feasibility

According to the Waste Framework Directive the Commission is obliged to produce a review of new targets regarding treatment of waste including diversion of waste from landfills by 2014, it is very realistic to bring the above mentioned initiatives onto the agenda. The countries most dependent on landfill are expected to be most reluctant to introduce more ambitious diversion targets for landfilled waste. However, since the Commission has underlined that support from the EU funding will in future be focused on waste management options higher up in the hierarchy and less on landfills - there is an economic incentive for these Member States to support an increase in recycling.

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