GREECO
Territorial Potentials for a Greener Economy

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Sector Report

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This basic report exists only in an electronic version.

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I. Executive summary

Waste is generated in most economic activities and at all stages of the material cycle. Greening the waste sector is closely associated with the EU waste hierarchy enriched with a zero-waste/industrial ecology vision as a second priority after prevention. Greening is the transformation of the waste treatment from the least to the most desirable methods accompanied by a strong awareness of job creation potentials of each method. NACE classification is only a proxy for measuring the green performance of the waste sector as it does not capture prevention and circular economy and treats all methods in a similar way.

From a GREECO perspective the optimal situation during a transition period to zero-waste society is a steadily decreasing nominal quantity of different waste streams (absolute decoupling) and rapidly increasing shares of re-used, recovered and recycled waste. Waste which is not recovered, recycled and reused is a waste of material resource. This could be achieved if the EU Member States and most importantly individual regions and municipalities continue with ambitious national and local-level policies, a mixture of waste prevention incentives, technological modification, innovative policies, economic instruments and awareness raising.

The territorial dimensions of the waste sector are closely linked with the territorial dimensions of the waste producing sectors: agriculture, forestry, industry, tourism, construction and manufacturing. In most cases, cities and regions hold the key to solving their waste problems to a great extent. Cities are the main generator of Municipal Solid Waste (MSW) and industrial waste as the population density is high and cities or industrial parks next to the cities are home to a number of industries. Subsequently, the main solutions and innovations like industrial ecology should be generated in cities. Regions could play an important role in waste management and they do play such a role in a number of countries. Regions are very often the right geographical level for coordinating the efforts of individual municipalities and setting up systems for integrated waste management.

Waste management is classified as a non-market activity according to the Environmental Goods and Services Sector (EGSS) classification but it is acquiring stronger market dimensions through the market of recyclables which is constantly growing.

Better management of agricultural and food waste is one of the dimensions of greening the agricultural sector. This concerns mainly the agricultural producers who need to invest in better post-harvest storage handling and processing equipment. Improving market access infrastructures is another aspect of the issue. These would be effective in reducing food losses and waste.

Tourism puts a pressure on waste generation. One of the aspects of greening the tourist sector includes improved waste management in tourist areas. These are normal urban areas where pressure increases during the tourist season or dedicated resorts which need their own waste management services. Adequate waste collection and recycling has to be in place in all tourist resorts and settlements and there is a need for more frequent service in peak season.

Waste and transport are connected in several through construction of transport infrastructure and through treatment of end-of-life means of transport. Increased transport activities are associated with increased waste and littering generation in the transport corridors. This is valid for road transport and marine transport.

The building sector is a major waste generator of Construction and Demolition (C&D) Waste. During the construction phase of the building it is possible to use recycled C&D waste through material substitution. This is closely linked to the concept of urban mining where demolition activities are regarded as a source of construction materials. Improved material efficiency during construction of buildings leads to less waste generation.

Waste and energy are linked in several ways. First, all or most of the activities associated with energy generate waste. This is valid for mining activities (coal, lignite, uranium and thorium ores); extraction activities (crude petroleum, natural gas and peat); manufacture of coke and refined petroleum products; electricity, gas, steam and air conditioning supply. For example, the coal extraction is associated with the removal of large quantities of soil and the generation of soil wastes.

The link between the manufacturing sector and waste management is extremely solid as industry is the main generator of waste in the world. Waste is a negative externality of the manufacturing sector. Therefore, all analysis in the report is on waste prevention, recycling and reuse of generated waste is applicable to the manufacturing sector. The concept industrial ecology should be highlighted here as an attempt to manage waste in industry in a closed loop mode.

There is a strong correlation between the nominal quantities of waste and the GVA and jobs which can be potentially generated through its management. Experience has demonstrated that recycling creates more jobs than landfilling. However, waste prevention would mean waste jobs but it is a trade-off which should be accepted.

Generation of waste in EU-27 is growing very slowly and there is a relative decoupling between waste generation and GDP growth. The purpose of EU policy is to achieve absolute decoupling. Construction and mining and quarrying are responsible for 2/3 of the generated waste in Europe. Manufacturing, households and energy production are smaller generators in terms of quantity but equally important in terms of the waste complexity.

There is a clear division in Europe in terms of waste treatment. The division is between the West and the North on one hand and the East and the South – on the other hand. The former has made huge strides towards full utilization of waste through recycling, reuse and incineration with energy recovery. The latter still relies to a big extent on landfilling although there is a slow progress towards better compliance of landfills but also diversion of waste from landfills.

Waste is an example of the importance of multi-level governance. Good multi-level governance is key to a successful waste management system. This means good policy making on national level, strong regional coordination and innovative local solutions. Strong vertical links are indispensable in this system. Additionally, cities generate huge quantities of waste and hold a key to better waste management through awareness-raising and separate collection of waste.

The EU waste policies developed in the past 20-30 years have changed the way waste is handled and therefore the waste-related green economy dramatically. Due to the variety in waste types and the way it is managed the European Union has adopted a relatively big number of waste acquis addressing waste treatment operations, separate waste streams, etc. Cohesion policy has the potential to contribute to greening the waste sector although so far the main focus has been the construction of sanitary landfills. The report analyses in detail the territorial implications of sectoral policies and their potential for greening the sector.

EU countries are relatively on track in terms of achieving recycling targets for different waste streams: packaging, plastic, glass, metal, C&D waste and WEEE. However, 100% recycling remains the only genuine green goal and the distance to this target represents a potential for greening the sector.

Waste policies have been the major driver for greening the waste sector. Legal pressure on countries and companies has translated into concrete measures for improving waste treatment, increasing recycling, tightening waste management within companies and improving environmental norms of waste installations like landfills and incinerators.

There are also other groups of drivers which are divided into: technical and market drivers including different treatment capacities like incineration and composting but also development of level playing field in the waste market; administrative drivers include the capacity of administrations to manage implement and enforce policies as well as to design smart economic instruments; knowledge drivers are associated with individual awareness and with the understanding of businesses that good waste management influences the economic bottom line; economic drivers include different waste taxes and prices of recyclables influencing the market behavior.

There is a trend for increasing employment in the waste sector with the increasing of recycled quantities although a direct correlation is not possible to detect. Attention should be paid to the quality of jobs. The principal business opportunities in waste management are in collection, brokering, processing, end-use, remanufacture and recycling technologies.

There are little regional data on the GVA generation from waste management and research into this area should be further advanced. The prices of recyclables have been slowly growing for the last 10 years. On the other hand, traded volumes have increased significantly. Job creation and GVA generation are directly correlated to the level of implementation of the existing waste legislation.

II. Introduction

1. Definition and waste hierarchy

Waste is generated in most economic activities and at all stages of the material cycle: extraction; production and distribution; consumption; and even treatment. (SOER, 2010) The main focus of current EU waste policy is waste minimization and ultimately waste prevention through change of consumer and producer behavior, change in design, packaging and industrial processes. The waste hierarchy has been adopted as a mainstream representation of preferred approach to waste management.

Figure 1 EU Waste hierarchy

Source: EC website

As indicated in the UNEP Green Economy Report 'greening the waste sector refers to a shift from less preferred waste treatment and disposal methods (at the bottom of the pyramid) to the most prefered ones (at the top)'. The combination of most prefered methods is often refered to as the three Rs: Reduce, Reuse and Recycle. This approach is also known as Integrated Solid Waste Management (ISWM).

2. NACE classification, Eurostat Environmental Goods and Services Sector

The two tables below provide the scoping of the waste sector according to Eurostat. The first table lists the waste-related NACE 3-digit codes, related general activities and concrete activities. The second table provides an additional classification – Environmental Goods and Services Sector (EGSS) – enumerating the waste-related environmental specific services, connected services, connected goods, adapted goods, end-of-pipe technologies and integrated technologies.

Table 1 Classification of NACE activities

NACE codes (3 digits)	Name of activities	Concrete activities
38.1.	Waste collection: non-hazardous and hazardous	- collection of garbage within a local area from households and businesses by means of different containers, may include mixed recoverable materials; - collection of recyclable materials; - collection of refuse in litter-bins in public places; - collection of construction and demolition waste - collection and removal of debris such as brush and rubble; - collection of waste output of textile mills; - operation of waste transfer facilities for non-hazardous waste This class also includes: collection of hazardous waste, such as: used oil from shipment or garages; bio-hazardous waste; nuclear waste; used batteries etc.
38.2	Waste treatment and disposal (of non-hazardous and hazardous)	- Among others it includes treatment and disposal of: organic waste; dumping of refuse on land or in water; disposal of used goods such as refrigerators to eliminate harmful waste; disposal of waste by incineration or combustion. Included is also energy recovery resulting from waste incineration process. - operation of landfills for the disposal of non-hazardous waste; - disposal of non-hazardous waste by combustion or incineration or other

		methods, with or without the resulting production of electricity or steam, compost, substitute fuels, biogas, ashes or other by-products for further use etc. - treatment of organic waste for disposal
38.3	Materials recovery (dismantling of wrecks and recovery of sorted materials)	- mechanical crushing of metal waste from used cars, washing machines, bikes etc. - shredding of metal waste, end-of-life vehicles etc. - cutting, pressing to reduce the volume - reclaiming metals out of photographic waste - reclaiming of rubber such as used tyres to produce secondary raw material - sorting and pelleting of plastics to produce secondary raw material for tubes, flower pots, pallets and the like - processing (cleaning, melting, grinding) of plastic or rubber waste to granulates - crushing, cleaning and sorting of glass, demolition and demolition waste to obtain secondary raw material, etc.
39.0	Remediation activities and other waste management services	- decontamination of soils and groundwater - decontamination of industrial plants or sites - decontamination and cleaning up of surface water - cleaning up oil spills and other pollutions on land, in surface water, in ocean and seas, including coastal areas - asbestos, lead paint, and other toxic material abatement - other specialised pollution-control activities, etc.

Source: Eurostat, NACE Rev.2, Statistical classification of economic activites in the European Community

Table 2 Environmental services of the waste sector according to EGSS

Waste management	Environmental specific services	- any activity which designs, operates systems or provides other services for waste handling and for the separation, sorting, treatment, disposal, management, storage and recovery of hazardous and non-hazardous waste. It includes the collection and transport of waste, separate collection and transport of waste fractions so as to facilitate recycling and the collection and transport of hazardous waste. - administration, management, training, information and education activities specific to waste.
	Connected services	Installation of facilities and equipment for waste management.
	Connected goods	- Equipment aimed at controlling and measuring the generation and storage of waste, its toxicity, etc. - Equipment or specific materials for the collection, treatment, transport, disposal and recovery of hazardous and non-hazardous waste. - Bin bags, bins, rubbish containers, compost containers are included.
	Adapted goods	- New goods which produce less waste or less hazardous waste. All the goods designed to produce less waste or less harmful waste, such as biodegradable plastic bags, and end-of-life-goods more easily recyclable (e.g. packaging, cars, electric and electronic equipment, etc.).
	End-of-pipe technologies	- Facilities for waste management, such as waste treatment, storage and disposal facilities (e.g. landfills, incinerators, etc.), hazardous waste management facilities or recycling facilities.
	Integrated technologies	- Equipment that minimises waste generation. This includes recycling processes and technologies replacing an existing production process with a new one designed to reduce toxicity or the volume of waste produced during the production process, including by separation and re-processing.

Source: Eurostat, 2009, Environmental Goods and Services Sector

3. Scoping

It has to be clearly stated that in the long-term, the economies of countries and regions where waste is approached in the best and most desirable possible way, i.e. prevented, will lose waste-related economic activities and jobs (as defined in NACE). Given the multiple environmental, economic and health benefit of waste prevention, from a GREECO point this is a desirable trade-off.

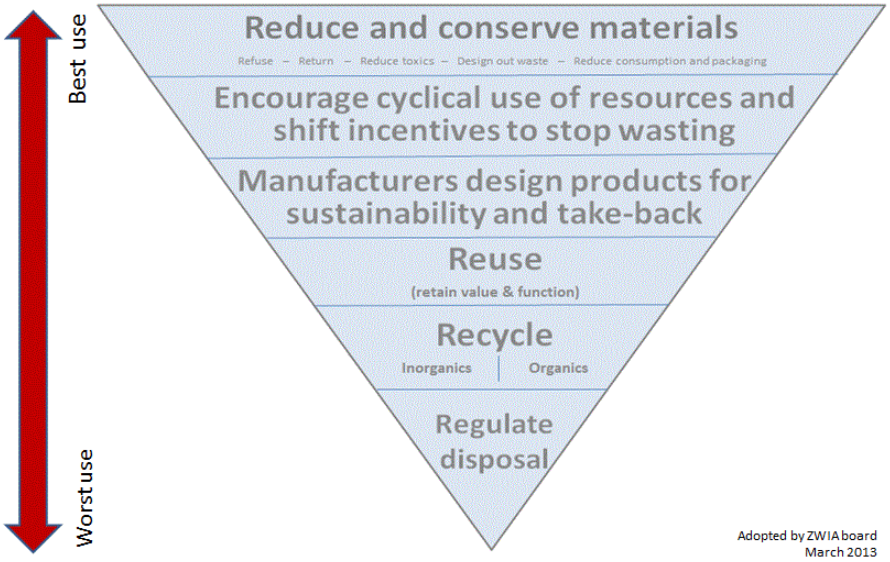
At the same time, waste is being generated and will continue to be generated in the foreseeable future while technologies, processes and designs improve and behaviour changes on a household and company levels take place. During this period, GVA and employment will shift from landfilling to recycling and other treatment methods. In the future all or most waste will hopefully be eliminated. GREECO also considers waste as a valuable resource whose economic value should be fully utilized.

4. GREECO vision

From a GREECO perspective the optimal situation during a transition period to zero-waste society is a steadily decreasing nominal quantity of different waste streams (absolute decoupling) and rapidly increasing shares of re-used, recovered and recycled waste. This could be achieved if the EU Member States and most importantly individual regions and municipalities continue with ambitious national and local-level policies, a mixture of waste prevention incentives, technological modification, innovative policies, economic instruments and awareness raising.

However, the ultimate GREECO vision is based on a zero-waste approach that aims to eliminate rather than manage waste. It is a philosophy that shifts the mode of operation from a resource use and disposal culture to a 'closed-loop' circular system. (ZeroWin, 'Approaches to Zero Waste'). GREECO has adopted the view that the less waste a sector or the economy produces the more resource-efficient and ultimately economically efficient companies are. As noted by the UNEP Green Economy Report, in order to achieve a vision of a circular economy 'radical changes are needed to supply-chain management and industrial design'.

Figure 2 Zero-waste hierarchy



Source: www.zerowasteeurope.eu

GREECO's main goal is exploring the territorial dimensions of green economy. Therefore, the current report will have as strong a territorial perspective as possible. It will look into the territorial implications of policies as well as the role of territories to improve waste management and to benefit from opportunities generated through different waste treatment measures.

The idea that waste which is not recovered, recycled and reused is a waste of material resource will underpin the analysis of the sector. In this way GREECO is aligning the analysis with the EU efforts to become a recycling society and subject its policy efforts to the waste hierarchy (prevention, reduction, recycling, recovery and disposal). There are green economy opportunities at every stage of the hierarchy. The amount and share of waste recycled gives an indication of whether the economy is moving closer to being a recycling society or closed-loop economy.

5. Green economy potentials in the waste sector

According to UNEP, the green economy potential of the sector comes through resource conservation; waste reduction; waste collection and segregation; waste reuse; waste recycling; energy recovery; landfill avoidance; construction and maintenance of waste infrastructure and application of 3R technologies and associated activities (UNEP, 2011). Waste prevention is not reflected in monetary terms but all other activities generate GVA and jobs and can therefore be measured. Waste management is relevant to all three pillars of the green economy: environment; social (job creation); economic (a significant GVA is generated through various waste related operations, technology development, etc.).

Improving waste management prevents waste of precious resources: organic waste (loss of clean energy); paper and cardboard (loss of timber and forest); waste plastics (loss of petroleum and natural gas used to manufacture them); metal waste (loss of embodied energy); industrial waste (reflects inefficiencies of industrial processes). Additionally, significant pollution is avoided: surface and ground waters; land pollution and contamination of sites;

Other benefits of good waste management include avoiding emission of air pollutants and GHG; avoiding health impacts; and impacts on wildlife. All of the above represent economic gains for society in terms of avoided costs and therefore remain at the nexus of the green economy dimensions: environmental, social and economic.
(Draft Guidance Document of the Development, Review and Updating of National Waste Management Strategies, UNEP, 2012)

6. Waste types addressed in the report

Waste comes in a huge variety of types. In this report, GREECO will mainly address significant waste streams like Municipal Solid Waste (MSW) (coming mainly from households); packaging waste (coming both from households and businesses); Construction and Demolition (C&D) waste. It will also touch upon waste types coming from industrial processes and agriculture. This choice is conditioned by the other sectors reviewed by GREECO and the need to analyse the intersections between those sectors and waste (generation and prevention) from a territorial point of view.

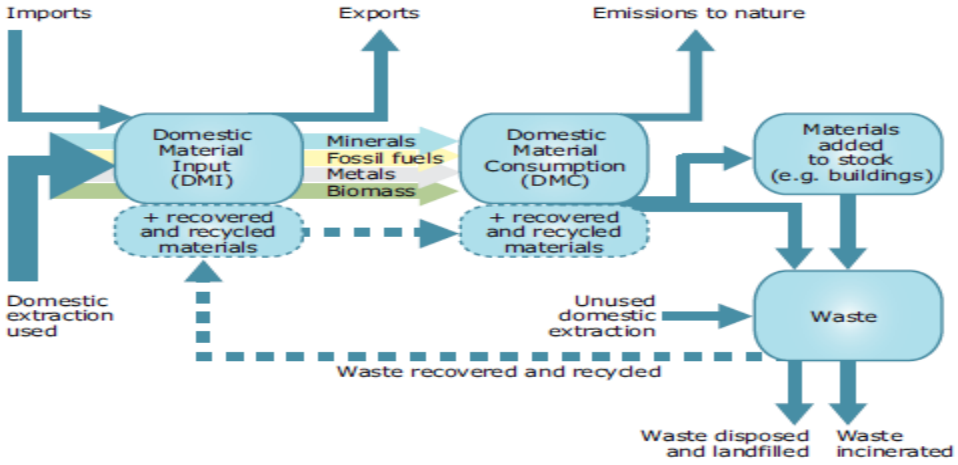
Table 3 Sources of waste (GREECO sectors) and waste streams

Sources of waste and GREECO sectors	Waste streams
▪ Households ▪ Building sites (construction) ▪ Industrial facilities (manufacturing) ▪ Sewage treatment facilities (water) ▪ Mines and mineral processing facilities (energy) ▪ Agriculture and food processing (bioeconomy) ▪ Energy production plants (energy) ▪ Hotels (tourism)	▪ **Municipal solid waste** ▪ **Packaging (steel, aluminium, glass, plastic, cardboard, etc)** ▪ **Automotive waste (oil, tyres, end-of-life vehicles)** ▪ **Paper and cardboard** ▪ **Agricultural waste** ▪ Textiles ▪ Mining waste ▪ Iron and steel ▪ Other metals (aluminium, copper, lead) ▪ Construction and demolition waste ▪ Medical and health care waste ▪ Hazardous waste ▪ Sewage sludge ▪ Garden and green waste ▪ Batteries ▪ Food and organic waste

7. Production and consumption perspectives of the sector

For the sake of analysis and in order to conform to international terminology GREECO will use the term waste generation for the production of waste. It will also use the term waste treatment for the 'consumption of waste'.
Using material resources and generating waste are closely linked. In recent years, EU policies have called for 'breaking the linkages between economic growth and resource use' (EC, 2002) — and Europe has indeed recorded some success in decoupling resource use from economic growth. (EEA Indiactors Report 2012) However this decoupling has been relative and not absolute.

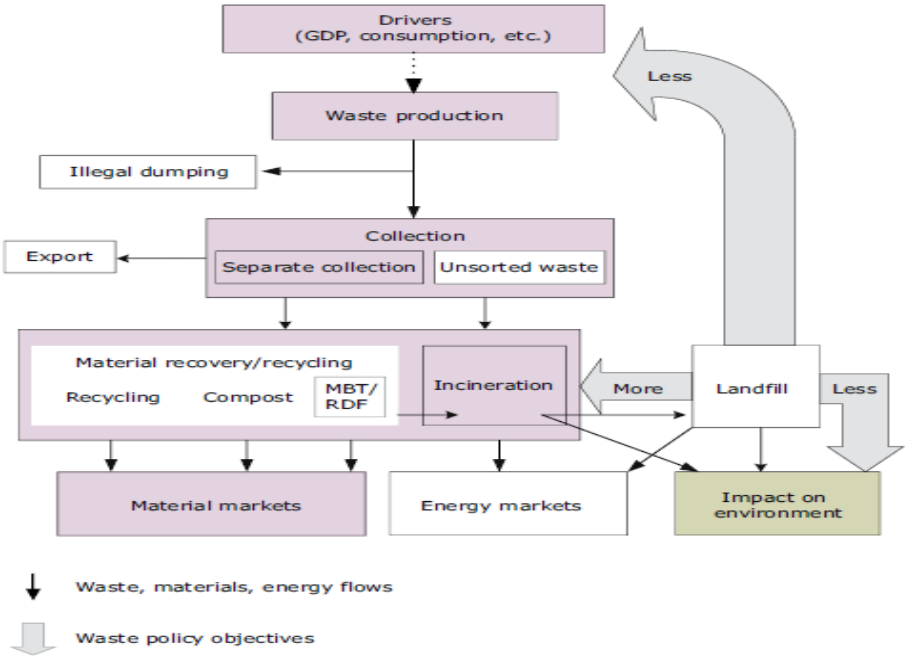
Figure 3 Links between the material resources and waste generation in an economy



Source: EEA

On the figure, it is possible to see that waste recovered and recycled feeds back into the loop as an input to Domestic Material Input (DMI). Landfilled waste is a waste to societies in terms of resources, a potential health threat and it has an impact on land used. Lost resources are spread between different economic sectors. (UNEP, 2012)

Figure 4 A simplified sketch of the waste management system



Source: EEA, 2009, Diverting waste from landfill

The figure above illustrates the economic potentials at every stage of waste handling and treatment: collection including separate collection and collection of unsorted waste; material recovery through recycling and composting which feed the material markets; incineration with energy recovery which feeds the energy markets; and landfilling.

8. Territorial characteristics

The territorial dimensions of the waste sector are closely linked with the territorial dimensions of the waste producing sectors: agriculture, forestry, industry, tourism, construction and manufacturing. In most cases, cities and regions hold the key to solving their waste problems to a great extent:

- Agricultural regions are the main producer of agricultural waste;
- Industrial areas are the main producers of manufacturing waste.
- In regions with high number of tourist waste production is particularly high during the tourist season. The governance of these places is particularly important.

8.1. Cities as important actors in waste management

Cities are the main generator of Municipal Solid Waste (MSW) and industrial waste as the population density is high and cities or industrial parks next to the cities are home to a number of industries. Subsequently, the main solutions and innovations like industrial ecology should be generated in cities.

Table 4 Examples for the role of cities for greening the waste sector

Increasing the eco-efficiency of production relies on regional systems

- **Connect waste and energy.** Kalundborg in Denmark is the most well known example of the economic gains that can be achieved by connecting waste and energy exchanges in an eco-industrial park, with annual estimated savings of US $ 12-15 million.

- **Local services to facilitate access SMEs to innovation knowledge**. SMEs will also depend even more on knowledge flows and institutional support available within their region. Even if technologies to increase energy efficiency are available "globally", SMEs can fail to adopt them without "locally" available public services to facilitate access.

- **Link between SMEs and research.** There is the need to consolidate the effort of universities and public research centres to engage with SMEs, providing problem-solving and auditing services. Several tools, such as innovation vouchers, are being developed at the regional level and should be analyzed with a comparative approach.

- **Behavioural changes.** The transition to green economy will also depend on how fast firms and people learn to appreciate their added value. These changes and learning processes happen at the local level. Strengthening the regional dimension of innovation policy would thus provide an opportunity to exploit real differences between regions with respect to capacity to adapt and to push forward systemic changes.

Source: Interim report on OECD Green Growth Strategy, 2010

8.2. Waste responsibilities of regions. Examples

Regions could play an important role in waste management and they do play such a role in a number of countries. Regions are very often the right geographical level for coordinating the efforts of individual municipalities and setting up systems for integrated waste management. It is common knowledge that modern waste management has started on municipal level but countries have realized that in many cases regions are the more cost-effective way of establishing an integrated system.

Table 5 Examples for the role of regions for greening the waste sector

Flanders (Belgium)

- Sets voluntary agreements with municipalities;
- The Waste Plan is a key policy instrument because once approved by the government its provisions apply to all public authorities.

Germany

- For waste generated by households, the Recycling Management and Waste Act assigns responsibility to the local public waste disposal authorities (in most federal states these are the districts and towns). Their responsibility covers collecting and transporting waste, measures to promote waste prevention and recovery, and planning, constructing and operating waste disposal facilities.
- Municipalities have more practical tasks such as providing sites for waste collection.

Italy

- The regions prepare regional waste management plans based on criteria defined in the national legislation and the provinces develop waste management plans in conformity with the regional plans.
- The regions issue regulations in compliance with the national legislation and define the 'optimal areas for the management of waste' (ATOs) that are responsible for meeting the targets on landfilling BMW and separate collection of municipal waste. The ATOs are supposed to represent a geographical entity where waste management is economically feasible and generally correspond to province boundaries. Every region must also formulate a plan for reducing landfilling of biodegradable waste. The regions define the waste streams to be collected separately and issue permits on constructing new treatment capacity and upgrading existing plants.
- The provinces coordinate the municipalities' waste management and identify instruments for separate collection, enhancing implementation of the regional waste management plan. Municipalities are in charge of municipal waste collection and disposal and collect charges for managing waste.

Finland

- Municipalities are responsible only for ensuring that sufficient capacity is available for treating municipal waste but not for guaranteeing capacity for particular types of treatment. As a result, municipalities can fulfil their responsibility by providing landfill capacity.
- Because many municipalities are small, fragmented and sparsely populated, policy-makers realised in 1993 that municipalities would manage waste better if they united to form inter-municipal companies. By 2000, 65 % of municipalities (covering 80 % of Finland's population) cooperated in such companies. There is no legal obligation to cooperate but it enables municipalities to establish treatment capacity that would otherwise be more costly and take advantage of economies of scale.
- Where the responsibility for managing a waste stream — including planning, collecting, providing treatment capacity and financing — is very clear and combined with clear targets for recovery and recycling, it has produced good results in diverting waste from landfills. Good examples are tyres and waste paper.

Source: EEA, 2009, Diverting waste from landfill: effectiveness of waste management policies in the EU

Table 6 Territorial factors of the waste sector

WASTE Are the following *territorial factors* important in relation to greening of the sector:		
1. ***Settlement types***	***y/n***	***Why? Why Not?***
i. Urban areas	***Y***	There are more and more cities which are adopting strategies for greening their performance. Waste collection and recycling are an integral part of such strategies. On one hand densely populated cities are more efficient than other settlement patterns but on the other hand the sheer quantity of waste poses a huge challenge. It also offers the possibility for innovative solutions. An urban setting, which tends to support a diverse and compact pattern of production and consumption, is further advantageous to advance the notion of 'industrial ecology' (Lowe and Evans 1995). By optimizing and synergising different industrial sectors and resource flows, outputs of one sector that become the input of another create a circular economy (McDonough and Braungart 2002). Principles of symbioses can also help minimise or recycle waste. Sao Paulo's Bandeirantes landfill, for example, is sufficiently large to provide biogas that generates electricity for an entire city district (ICLEI Local Governments for Sustainability 2009a). First, there is considerable policy interest in urban and peri-urban agriculture (Smit and Nasr 1992, Baumgartner and Belevi 2001). Green urban agriculture can re-use municipal wastewater and solid waste, reduce transportation costs, preserve biodiversity and wetlands, and make productive use of green belts. Additionally, costs for setting up waste management systems are inferiour to the costs for similar infrastructures in other geographical and special patterns. It is also to be mentioned that governance is a major factor for embarking on a green city road. Solutions are produced by the concerted actions of different actors such as national, regional and city level, civil society, the private sector, academia and interest groups. Setting more ambitions regional and local in terms of recovery and recycling is a major driver. For example London has set targets for 45% municipal recycling/composting by 2015; 70% commercial recycling/compsting by 2020 and 95% of C&D waste by 2020. These territorial factors are more ambitious than national and EU targets.
ii. Rural areas	***Y***	Very often, the location of landfills, incinerators, MBT installations or other waste management and disposal installations are located in rural areas. Rural areas are also main generators of agricultural waste;
iii. Urban-rural interactions	***Y***	The interaction takes place through transportation from urban areas which are the main generators of Municipal Solid Waste on one hand but also all types of industrial waste on the other hand.

2. ***Land and land-based resources***	***y/n***	***Why? Why Not?***
i. Land consumption or dependence	***Y***	Space for construction of MSW landfills is directly correlated with the territorial origin of waste and is usually contained in the region of its origin in order to optimize transport. However waste, especially hazardous waste, is increasingly a subject to transboundary movement and despite efforts of the international community to regulate it, there are multiple health and environmental issues associated with it. Different waste treatment methods can be influenced by factors such as urban population density and availability of space. In places of higher population density and limited space such as in the cities of Northern Europe, most waste is incinerated. In places of lower population density and greater availability of space controlled sanitary landfilling is more acceptable. Land use policies may determine the availability of land for landfills and other facilities (UNEP, 2012). Throughout the history of waste management there has been strong resistence from local population against construction of landfills and incinerators. The NIMBY (not-in-my-back-yard) syndrome was particularly strong when landfills and incicnerators were traditionally associated with increased health risks. However, increasing safety requirements for landfills (Waste Landfill Directive) and for incinerators (Waste Incineration Directive) has made location choices easier.
ii. Material Consumption or dependence	***Y***	Strictly speaking waste represents imperfect material consumption. Waste prevention and reduction are directly correlated with decrease in material consumption. The same is valid for recycling whereas recycled materials substitute vurgin raw materials.
iii. Energy consumption or dependence on specific energy systems	***Y***	Similar to material consumption, waste embodies energy as any waste has previously been produced through technological processes requiring energy. Waste prevention would save energy resources. On the other hand, waste management is a consumer of energy which, ideally is reflected in the price of the waste management option. The analysis of relative energy consumption of different waste management options
iv. Management of ecosystem services	***N***	
3. ***Market relations (Production; consumption; export,***	***y/n***	***Why? Why Not?***

	import) and innovation		
	i. Local/regional markets	***Y***	According to EGSS classification, waste management is a non-market activity. However, waste has many market aspects, i.e. through the markets of recycled goods, the competition between recycled materials and virgin raw materials (in construction). The different price of different waste management options also introduces market elements in the system. The competition between waste operators for collection and waste treatment is also one dimension of the market. If it is considered that industrial ecosystems have market dimension then the regional level is the more appropriate one than the national.
	ii. National markets	***Y***	The market aspects developed above can be extended to a national level depending on the volume of recycled material, its quality as well as on the level of development of the given market channels. A more complex industrial ecosystem may include industrial from the whole country.
	iii. EU markets	***Y***	If waste is 'exported' out of the region the environmental impact in the receiving region is much higher than the environmental impact of waste treatment in the region of origin (BIO Energy) This is the reason why EU waste policy, through the principle of proximity, calls for treatment of waste as close as possible to the place of its generation. According to the EU treaty, there should not be a difference between national and EU markets. However, in practice there must be non-market barriers. For example, if the quality of pellets produced from biowaste is too low in one country the market in another country might not accept them.
	iv. Global market	***Y***	The EU is a party of the Basel Convention on Controlling transboundary movements of hazardous waste and their disposal.
4.	***Inter- and intra-territorial relations***	***y/n***	***Why? Why Not?*** Waste is a perfect example where multi-level governance is extremely important. Cities hold the keys to awareness raising and separate waste collection. Regions are better placed to organize functioning regional waste management systems. Being bigger in size and having a bigger diversity of industries – generators of waste but also users of recycled material – they are in the position to drive more innovative waste management solutions, naturally in cooperation with the national and local level. It has to be kept in mind though that there is a danger of policy fragmentation and confusion therefore waste management should be well coordinated between different governance levels.

i. Within territories (place based; local cultures; relating to territorial/national policies)	***Y***	Tradition in waste management is very important. Some countries, like Germany, have started separate collection and recycling in the 1970s and were the frontrunners in the sector. Therefore, it could be said that Germany has a tradition in this respect. Separate collection is also related to the habits of the population and it takes time to change. For example, separate collection of biowaste had a difficult time to take off in Estonia in the 2000s because of required specific habits. However, the situation has improved over the years.
ii. Between territories (networks; competition)	***Y***	Governance networks such as the EU Covenant of mayors are perfect examples of cooperation and exchange between territories, especially in terms of creating routines (systematizing implementation of policy) and sharing best practices. Cooperation between municipalities is also of utmost importance as very often the integrated waste management systems are regional. This requires an advanced level of cooperation culture which should not be taken for granted. The development of waste management has shown that the optimal territory for modern waste management is the region and not the municipality (with the exception of big cities).
iii. Across territories (cross-border supply and demand)		There is an increasing traffic of waste across borders especially hazardous waste. This report does not cover the topic because of its complexity. However, the EU waste policy emphasizes the proximity principle meaning that waste should preferably be treated close to the place of its generation. Cross-border movement of waste additionally increases its negative impacts through higher GHG emissions from transport.

5.	***Place-based factors***	***y/n***	***Why? Why Not?***
i.	Competitiveness through strong local economies	***Y***	The link between better waste management within a company and its better financial result is increasingly being demonstrated. Therefore, we can assume that such a link exists. Additionally, closed loop regional industrial ecosystem might further boost the financial bottomline of companies.
ii.	Multi-functionality		
iii.	Tacit/experiential knowledge		As mentioned above tradition and local knowledge is a strong factor for successful waste management. Separate collection and recycling require strong awareness in individuals. The same is valid for waste management on company level.
iv.	PROXIMITY	***Y***	In strategic documents and directives (i.e. the Waste Framework Directive) the EU emphasizes the need of waste treatment within the proximity of its generation. For common waste streams this approach has been proven to be the most cost efficient and the most sparing for the environment. Hence, the big regional responsibilities for better waste management.

6. ***Consumer relations***	***y/n***	***Why? Why Not?***
i. Are development and innovation consumer-demand driven?	***N***	Development and innovation are mostly policy-driven. Naturally, once a given market is established for recovery and reuse of a certain waste stream, subsequently there is a market demand for the continuation of the system.
ii. Are development and innovation producer driven?	***Y***	In the case of companies generating (producing) waste innovation can be producer-driven.
iii. Are development and innovation based on well-defined territorial conditions or on open access?	***N***	
7. ***Accessibility and mobility***	***y/n***	***Why? Why Not?***
i. Transport connections (transport of materials; transport of labor)	***Y***	Waste management is closely linked to transport. All waste streams are more or less bulky therefore moving them in space costs money and is a waste of energy resources. Hence, the interest of rationale of treating waste as close as possible to its place of origin. Optimisation of collection and transport is one of the main challenges when designing integrated regional waste management systems.
ii. Regional Accessibility (access to markets; access to supply of materials; access to public services)	***Y***	Waste treatment is more problematic in places which are relatively difficult to access. It is also more costly because of longer transport routes to treatment facilities.
iii. Information connections (use of communication and information services; need of interaction; questions of consumer and producer cultures)		Waste management is to a big extent a matter of consumer culture. While policy drivers and established systems are important nothing can replace a positive citizen attitude to waste prevention, waste minimization and waste separation at source. This has been demonstrated in certain New Member States where, despite the existing policy pressure, positive waste management practices are hard to pick up.
8. ***Policy and governance by territorial level***	***y/n***	***Why? Why Not?***
i. Scale of sector-based policy support		***Overall policy is the most important driver in waste management. Therefore, territorial implications of individual policies are described under the policy section.***
• From the EU Level	***Y***	Through directives: by waste stream (i.e. packaging) and waste management method (incineration)
• From the national level	***Y***	On one hand national policies transpose EU legislation. On the other hand, countries are free to use economic instruments freely in order to steer waste management in a given direction.

• From the regional level	***Y***	Regions are often the operators of integrated waste management systems through Regional Associations. They are the one to coordinate the efforts of municipalities. They are the ones which fix for example the landfill fee. The level of landfill fee is one of the major drivers from diverting waste from landfills. Regions are also the right governance level for establishing industrial ecology systems whereas the waste from one industry is used by another industry. This can be done through voluntary agreements.
• From the local/municipal level	***Y***	Municipalities are the basic level of waste generation and for many years waste management has taken place on municipal level. It is still the case in big municipalities. However, it has been demonstrated that a group of municipalities (region) is better place to manage waste in a more cost effective way.
ii. Role of other EU policies with territorial dimension		Please check in the policy section where the territorial dimension of each policy is explicitly spelled out.
iii. Private versus public sector – led development. Are consumer organizations advocating for developing the green economy. At what political scale are they located?		The development of the waste sector is mainly public-driven through policy. However, the role of the private sector is very important through operation of collection and transportation services, operation of landfills and incinerators as well as any other waste management facilities. The private sector is also well-placed to create markets for recycled goods. Waste management technologies are developed by the private sector.

Table 7 Territorial outcomes of greening the sector

Territorial outcomes of greening the sector:	
Inter- and intra-territorial relations	Regions will be more competitive through closed-loop industrial ecosystems and strong companies with good waste management. Environmental and health pressure will diminish because of less landfilling.
Settlement types	Cities are the biggest waste generators and in a way hold the key to developing new paradigms for waste management.
Land and land based resources	Landfilling is the waste treatment option which is the most land consuming. With decreasing of landfilling the demand for land will diminish.
Market relations (Production; consumption; export, import) and innovation	It is of utmost importance to create and nurture markets for recycled waste. Transportation of waste between regions should be decreased as much as possible. Waste treatment should take place as close as possible to the place of waste generation. Consumers of recycled materials should be sought as close as possible to the producers of recycled materials.
Place-based factors	
Accessibility and mobility	
Policy and governance by territorial level	Waste is a perfect example of the importance of multi-level governance. Cities are instrumental to awareness raising, industrial ecology, separate collection and recycling. Regions are better placed to organize functioning regional waste management systems. National level is in charge of overall policy making.

III. Links with other sectors

1. Bioeconomy

Better management of agricultural and food waste is one of the dimensions of greening the agricultural sector. This concerns mainly the agricultural producers who need to invest in better post-harvest storage handling and processing equipment. Improving market access infrastructures is another aspect of the issue. These would be effective in reducing food losses and waste (Lindberg, 2012) Green agriculture is also related to household consumption of meat and dairy products and food waste resulting thereof.

Agriculture and waste are also connected through the waste generated by the EU food manufacturing sector and households. About 90 million tonnes of food is wasted annually or 180 kg per person, not taking into account losses in agriculture and fisheries. (Lindberg, 2012)

Proper management of waste resulting from agricultural and farming processes is necessary to ensure that nitrates are not leaked into soil and water which is a main source for pollution, eutrophication.

Bio waste can also be used for the production of bio gas.

2. Tourism

Tourism puts a pressure on waste generation. One of the aspects of greening the tourist sector includes improved waste management in tourist areas. These are normal urban areas where pressure increases during the tourist season or dedicated resorts which need their own waste management services. Adequate waste collection and recycling has to be in place in all tourist resorts and settlements and there is a need for more frequent service in peak season. Increased waste generation should be factored in when designing waste treatment installations and landfills. Internationally recognized eco-certification programmes, such as Green Globe provides a framework for tourism operators to green their business by measures such as better waste management practices (Tepecik Dis, 2012) It is extremely difficult to collect data on tourism and waste generation both on national and regional level.

3. Transport

Waste and transport are connected in several through construction of transport infrastructure and through treatment of end-of-life means of transport. Increased transport activities are associated with increased waste and littering generation in the transport corridors. This is valid for road transport and marine transport.

4. Building

The building sector is a major waste generator of Construction and Demolition (C&D) Waste. During the construction phase of the building it is possible to use recycled C&D waste through material substitution. This is closely linked to the concept of urban mining where demolition activities are regarded as a source of construction materials. Improved material efficiency during construction of buildings leads to less waste generation. The possibilities and potentials for using recycled materials for construction are described in detail in GREECO Building sector report.
The link between the construction and waste sectors can be also found in example where incinerated waste is used for heating buildings. A similar example is given in the

GREECO Building sector reports of Stockholm's Hammerby Sjostad where waste is a source of electricity and biogas. (Weber, 2012)

5. Energy

Waste and energy are linked in several ways. First, all or most of the activities associated with energy generate waste. This is valid for mining activities (coal, lignite, uranium and thorium ores); extraction activities (crude petroleum, natural gas and peat); manufacture of coke and refined petroleum products; electricity, gas, steam and air conditioning supply. For example, the coal extraction is associated with the removal of large quantities of soil and the generation of soil wastes.

Secondly, certain types of waste can be used for electricity production. This is valid for any incineration with energy recovery. Also residues from wood mills and pulp and paper factories are recovered and used as a source of energy (Galera-Lindblom, 2012). The electricity production from biomass and renewable wastes in EU-27 has grown from 40,000 ToE in 1990, to slightly more than 50,000 ToE in 2000, to almost 85,000 ToE in2010. (Eurostat) The MSW corresponds to some 7% of all biomass utilized for energy generation.

Waste from energy production, especially nuclear waste, can be highly problematic. The EU Nuclear Illustrative Programme emphasizes the need for a common approach to management of nuclear waste.

6. Manufacturing and eco-innovation

The link between the manufacturing sector and waste management is extremely solid as industry is the main generator of waste in the world. Waste is a negative externality of the manufacturing sector. Therefore, all analysis in the report is on waste prevention, recycling and reuse of generated waste is applicable to the industry sector. The concept industrial ecology should be highlighted here as an attempt to manage waste in industry in a closed loop mode.

The European Union's waste minimization framework is formed by the Integrated Pollution Prevention and Control (IPPC), producer responsibility legislation and all other directives on waste streams where industry is a main generator of waste.

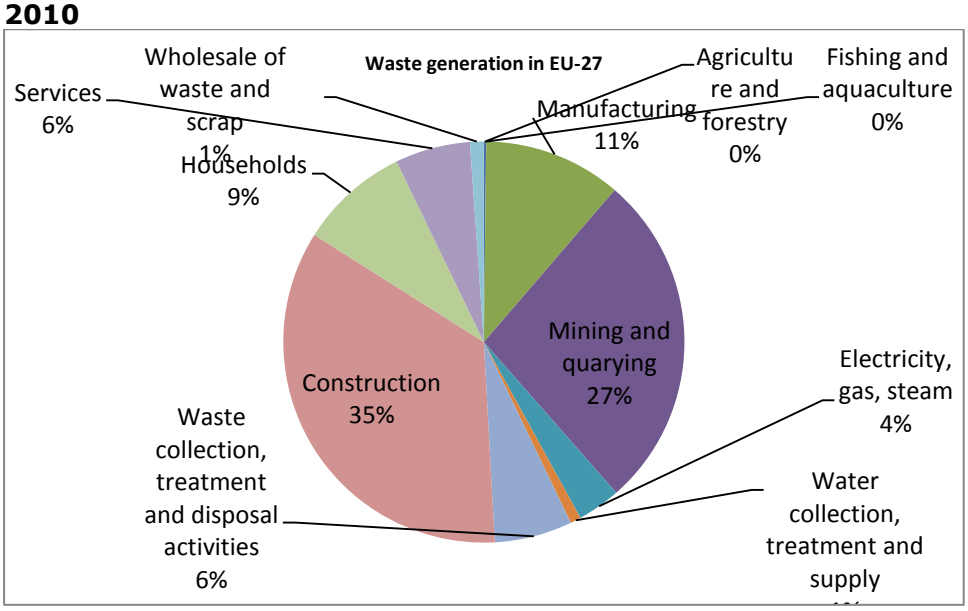
Currently, the main challenge of the waste management efforts in industry is to achieve absolute delinking between GVA growth in industry and waste generation. GREECO industrial report elaborates further on this issue.

IV. Current state of performance in the waste sector. Links between waste and other sectors through generation and management

1. Overall trend in waste generation and waste treatment

Waste generation is linked to both population and income growth, the latter being the more powerful driver.
Sectors that are of interest for GREECO are agriculture, manufacturing industry, energy activities, construction and demolition activities and households. From Figure 4 it is obvious that construction and demolition waste takes up more than one third of all waste. It is a heavy and inert waste. Mining and quarying is responsible for almost another third of all waste volume. The remaining third is divided between all other wastes the waste from manufacturing and Municipal Solid Waste) households having the most prominent position.

Figure 5 Total waste generation in the EU-27 and Croatia by source, 2010



Source: Based on Eurostat data

The table below is important as it contains the nominal quantities of waste per country and there is a strong correlation between the nominal quantities of waste and the GVA and jobs which can be potentially generated through its management. In these countries and regions with high waste generation, no matter in which sector, the potential for waste prevention activities is also high. For example, we can see that in terms of total waste the countries with big populations and big manufacturing sector produce the biggest quantities – Germany (Western provinces) and France. In agriculture and forestry the two countries generating the biggest quantities and therefore having the biggest potential for greening the subsector are France and the UK followed far behind by all other countries. In manufacturing Germany, France, Italy and United Kingdom are the biggest producers of waste which is not surprising. In energy production we can observe Estonia being the unequivocal leader because of electricity production from shale and the associated shale waste. Both in construction waste and in waste from households there is a strong correlation between the size of the country and the generated waste. Countries like Germany, Italy and France lead the ranking of biggest generators.

Unfortunately, regional data are missing for generation of waste but it is to be expected that these data would have a strong territorial dimension meaning that regions with big urban centres would have high household and manufacturing waste generation while agricultural regions would score high in agricultural waste. The 'hot spots' in waste generations tell us a whole lot about where the biggest opportunities for greening the waste sector are and also GVA and job generation.

Table 8 Total waste generation by country and by economic activity in 2010 (tonnes)

	Total waste	Of which hazardous	Agriculture and forestry (2008)	Mining and quarrying	Manufacturing	Electricity, gas, steam and air conditioning supply	Construc-tion	House-holds
EU-15	1,682,920,000	73,950,000	850,000	850,000	21,000,000	1,610,000	15,930,000	2,890,000
EU-27	2,284,300,000	101,340,000	930,000	13,980,000	26,160,000	8,100,000	16,190,000	3,050,000
Austria	30,259,980	1,472,864	63,290	6,833	350,969	27,573	50,808	98,274
Belgium	57,858,497	4,478,949	23,186	9,057	1,434,344	18,814	1,524,806	68,391
Bulgaria	164,806,321	13,542,175	2,448	12,933,980	591,041	7,343	203	0
Cyprus	1,911,523	37,311	711	174	1,377	1,265	13,751	14,095
Czech Republic	20,423,326	1,362,864	7,364	15,951	550,382	37,141	97,917	5,029
Germany (until 1990 - FRG)	327,233,384	19,931,452	2,717	27,641	4,951,318	819,399	6,465,570	422,263
Denmark	18,529,439	1,784,177	1,415	4,287	188,472	25,532	600,050	40,749
Estonia	18,569,696	8,961,708	9,145	990	2,453,177	6,399,473	9,695	9,457
Greece	65,235,186	291,773	:	1,219	107,564	7,159	1,677	0
Spain	114,320,717	2,991,152	18,504	5,233	1,365,731	22,914	179,423	38,330
Finland	102,656,181	2,559,417	231	649,000	1,428,305	9,773	18,212	45,000
France	325,774,659	11,538,134	401,290	24,632	2,682,719	67,007	2,569,930	194,970
Croatia	3,157,672	72,553	85	105	60,125	622	653	0
Hungary	12,870,527	540,599	7,795	16,627	239,718	17,959	24,033	17,757
Ireland	18,077,558	1,972,204	0	3,292	337,934	5,972	8,123	57,618
Iceland	:	:	:	:	:	:	:	:
Italy	126,148,697	8,543,415	9,579	26,986	3,639,828	92,954	446,301	171,007
Lithuania	4,321,679	110,273	4,305	648	16,898	2,513	3,863	18,852
LU	10,054,619	378,690	90	5,534	64,355	612	193,221	6,209
Latvia	804,187	67,906	675	3	11,004	194	57	35,804
Malta	1,150,038	17,184	0	0	1,625	536	407	5,678
Netherlands	110,183,009	4,421,266	3,278	19,635	835,754	18,907	2,183,068	277,656
Norway	7,204,389	1,763,033	13,410	287,611	640,189	16,722	11,658	153,968
Poland	150,568,238	1,491,845	3,068	8,596	691,672	14,117	66,466	11,442
Portugal	32,883,758	1,624,788	1,070	13,508	514,520	58,593	149,947	736

Romania	212,702,820	702,745	3,274	146,272	309,505	821	953	23,353
Sweden	113,580,201	2,515,410	17,456	4,067	489,874	230,686	644,301	366,754
Slovenia	4,431,404	120,141	108	82	74,655	3,998	4,408	14,982
Slovakia	8,825,606	437,099	42,199	383	218,725	5,357	45,710	5,427
Turkey	753,835,179	3,226,050	0	2,310,375	852,557	19,541	0	48
United Kingdom	230,119,752	9,447,085	308,059	53,996	2,604,122	207,774	889,714	1,104,173

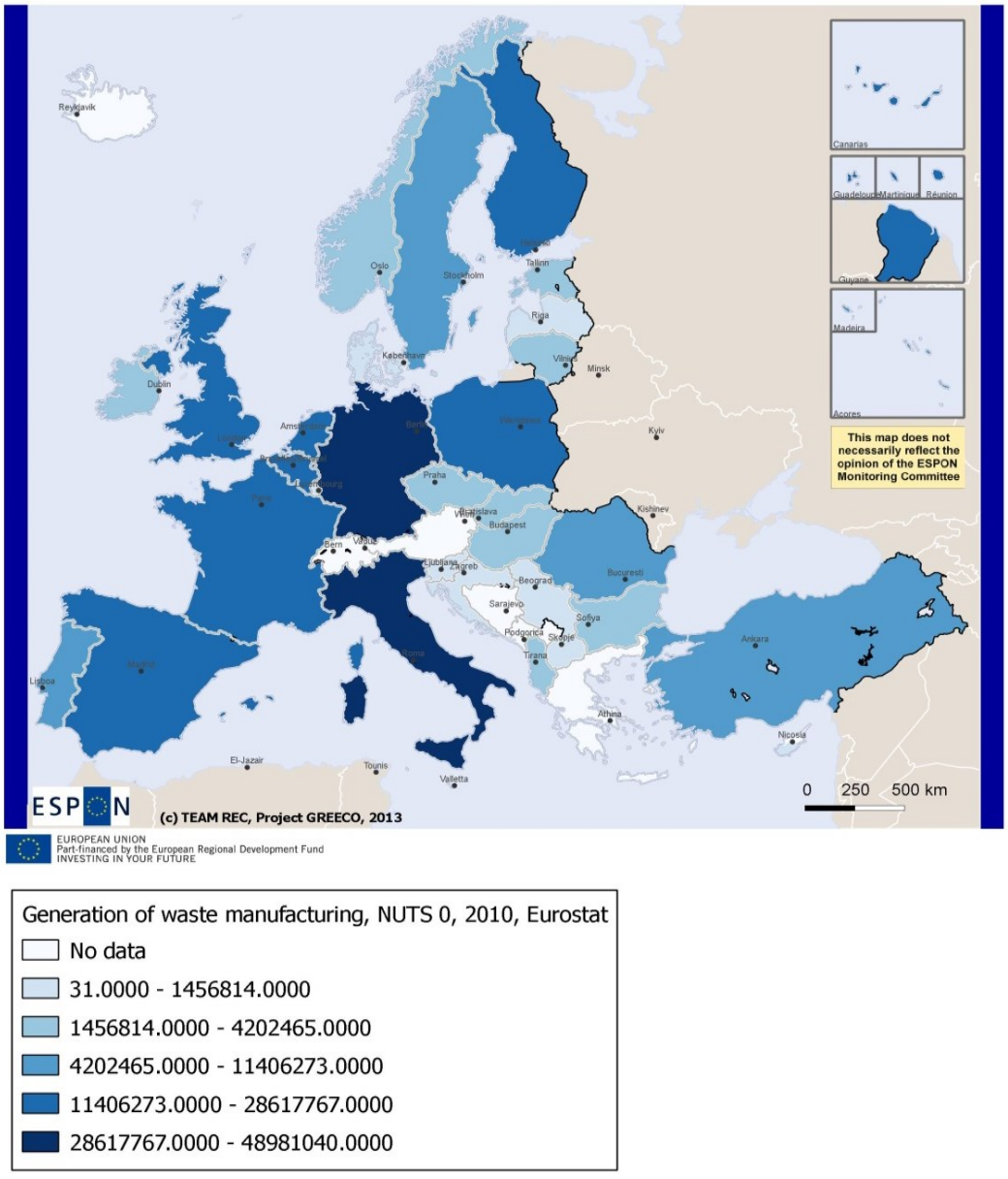
Source: Eurostat

1.1. Generation of waste

1.1.1. Generation of waste in manufacturing

The biggest quantities of waste are generated in the big industrial countries of Western Europe Germany and Italy followed by Spain, France, UK, Belgium, the Netherlands and Finland. From the Eastern European countries only Poland is in this group of countries, A second group of countries comprises of relatively strong economies like Sweden or big countries like Romania. The figures are not eloquent as they do not reflect the absolute or relative decoupling between waste generation and GVA growth. Such a map is available in the GREECO industry report.

Figure 6 Generation of waste manufacturing, NUTS 0, 2010



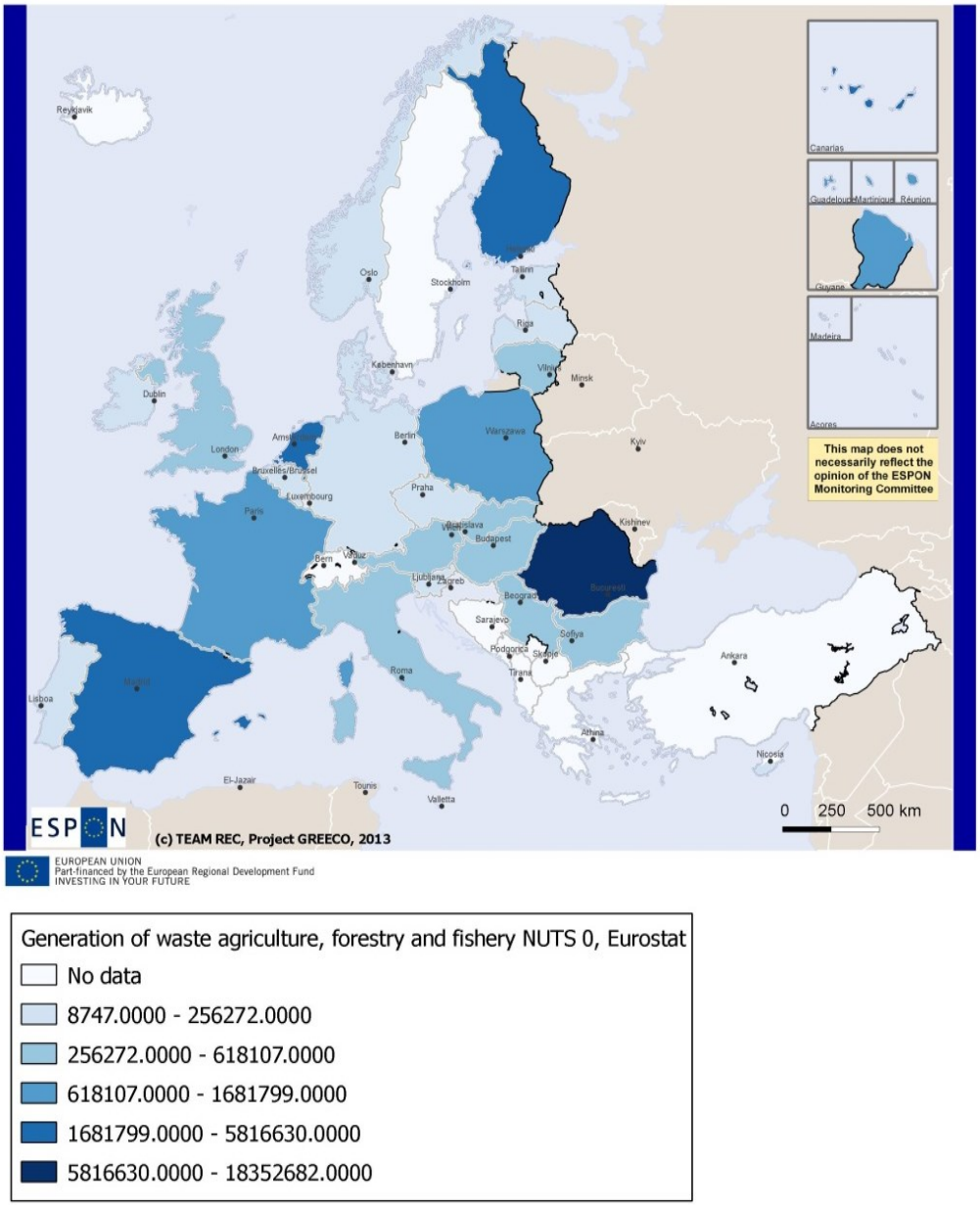
Source: Eurostat

Solid regional data are missing but they would tell us where the manufacturing centres are and where the potential for prevention lies but also the potential for establishing industrial ecology systems.

1.1.2. Generation of waste in agriculture and forestry

The biggest nominal generators of agricultural and forestry waste are Romania followed by Spain, Finland, the Netherlands, France and Poland. Traditional agricultural countries like Italy and the Eastern European countries follow suit.

Figure 7 Generation of waste in agriculture, forestry and fishery, NUTS 0, 2010, Eurostat



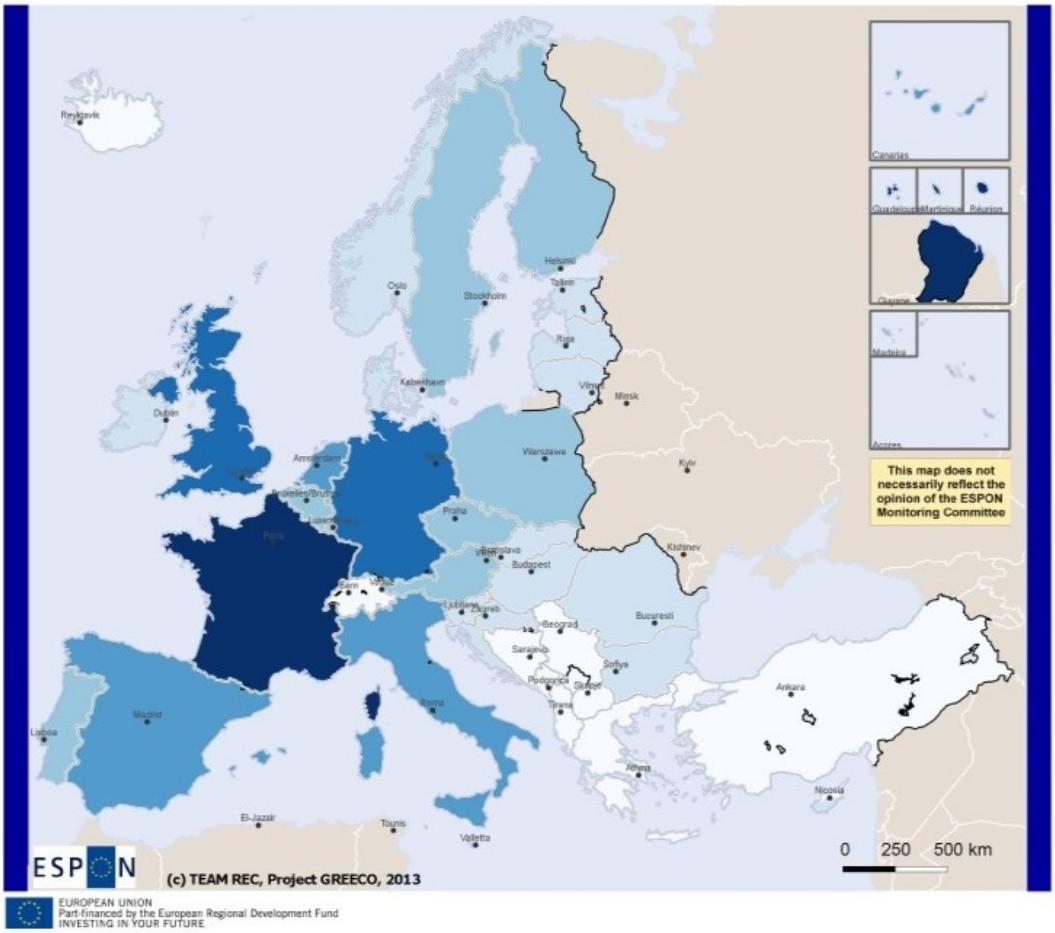
Source: Eurostat

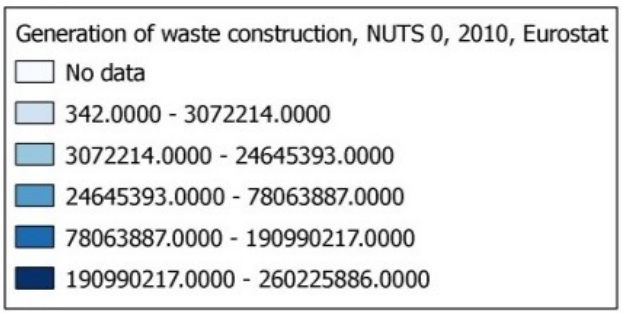
Food habits and waste

The EU food manufacturing sector and households alone waste about 90 million tonnes of food annually (without agriculture and fisheries). This represents huge waste of resources and significant efforts should be directed at waste reduction. (Lindberg, 2012)

1.1.3. Generation of waste in the construction and demolition sector

Figure 8 Generation of waste in construction sector, NUTS 0, 2010, Eurostat





The generation of construction and demolition waste is closely related to economic activity in the construction sector and therefore is subject to variations in the sector. This waste consists mainly of inert materials such as bricks, tiles, asphalt, concrete, and to a lower extent others such as wood, plastics and metals, resulting generally in comparably low impacts on the environment per tonne of waste. However, construction and demolition waste is relevant because of its large quantity. National data shows that in 16 out of 20 EU and EFTA countries, construction and demolition waste amounts increased between 1995 and 2006 (different time-series) but again with large differences between countries (ETC/SCP, 2009a). The recent economic downturn is likely to have reduced the generation of construction and demolition waste but data are not yet available.

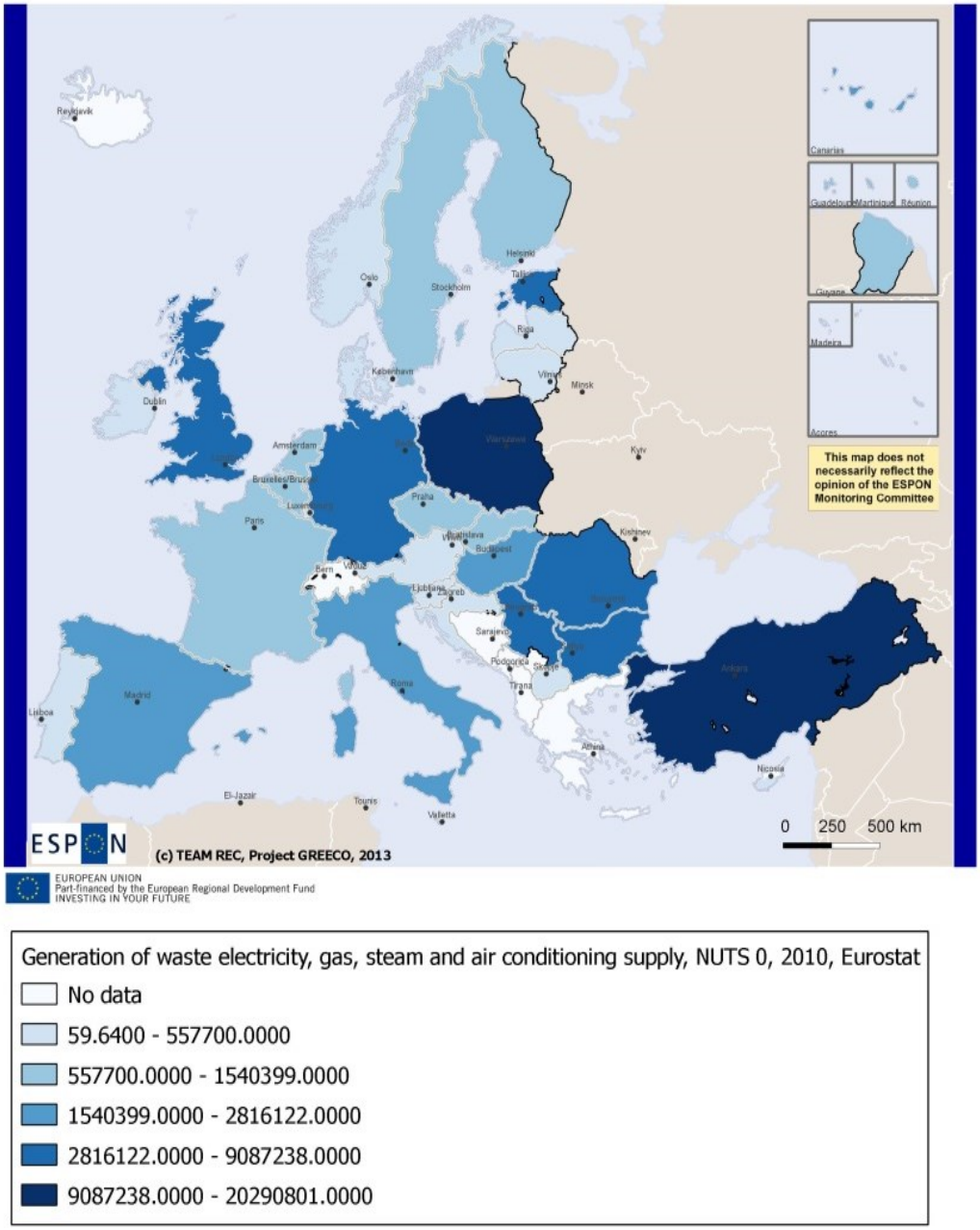
The concept of urban mining is at the intersection between construction and recycling of C&D waste. Its development depends on the changing approach of the construction sector. Urban mining depends on reseource prices, volatility of prices and stable policy environment. (Weber, 2012)

The biggest producer of C&D waste is France followed by Italy, Spain, Germany and the UK. Regional data would show the regions where the biggest potentials and opportunities lie in terms of reutilisation of C&D waste.

1.1.4. Generation of waste in the energy sector

The generation of waste in the energy sector is closely related to the structure of energy generation in the country. We can observe that Poland is in dark blue because of heavy reliance on coal-powered thermal plants. Estonia, despite of being a small country, generates a huge quantity of shale waste. UK, Bulgaria and Romania are also heavy producers of energy sector waste.

Figure 9 Generation of waste in electricity, gas, steam and air-conditioning supply, NUTS 0, 2010



Source: Eurostat

1.2. Treatment of waste by treatment technologies

For the last 15-20 years there has been significant but still not sufficient progress in the way waste is treated. For example, in EU-27 and Croatia 55 % of all waste is recovered or incinerated. The share is even higher in EU-15 – 63% but much lower in EU-12 – 28%. Some 59 % of packaging waste is recycled, and 12 out of 19 countries recycle or recover more than half of their construction and demolition waste. (State of the Environment Report, 2010)

Figure 11 Waste treatment by method EU-27 and HR, 2010, Eurostat

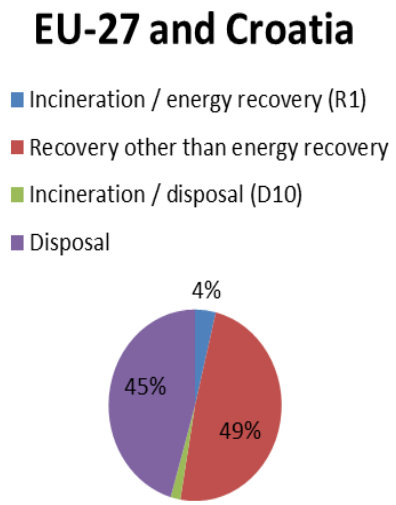


Figure 10 Waste treatment by method EU-15, 2010, Eurostat

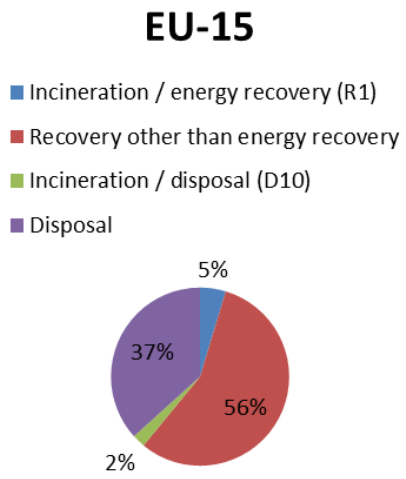
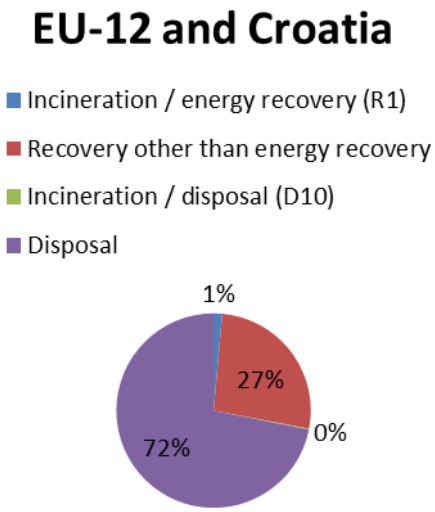
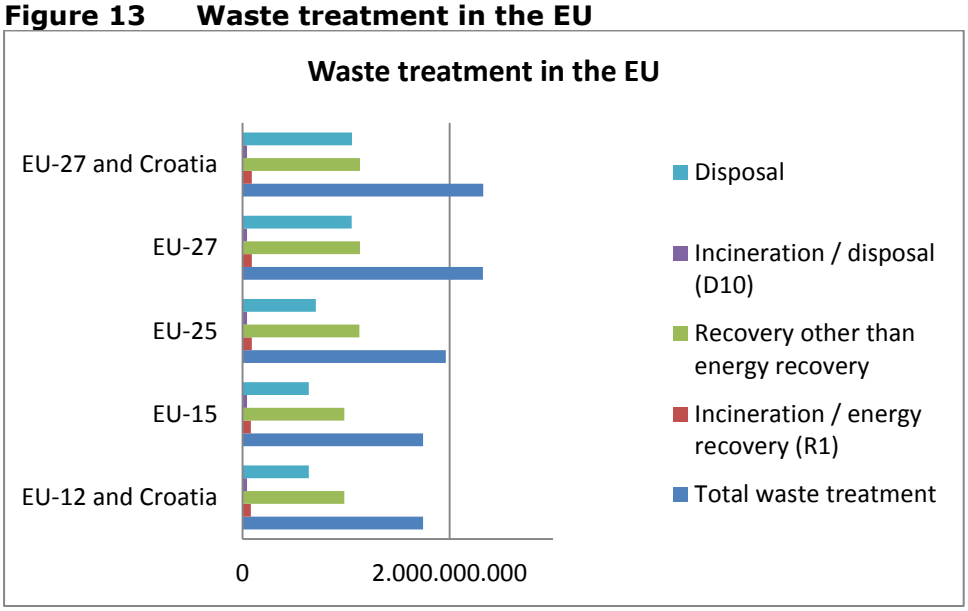


Figure 12 Waste treatment by method EU-12 and HR, 2010, Eurostat



Despite the progress, for total waste, as of 2010, for EU-12 disposal was still at 72%.

Figure 13 Waste treatment in the EU



Source: Based on Eurostat

From the table below it is possible to get an idea of the overall quantities of treated waste by method of treatment. There are no regional data.

Table 9 Total waste treatment by country and operation in 2010 (in 1000 t.)

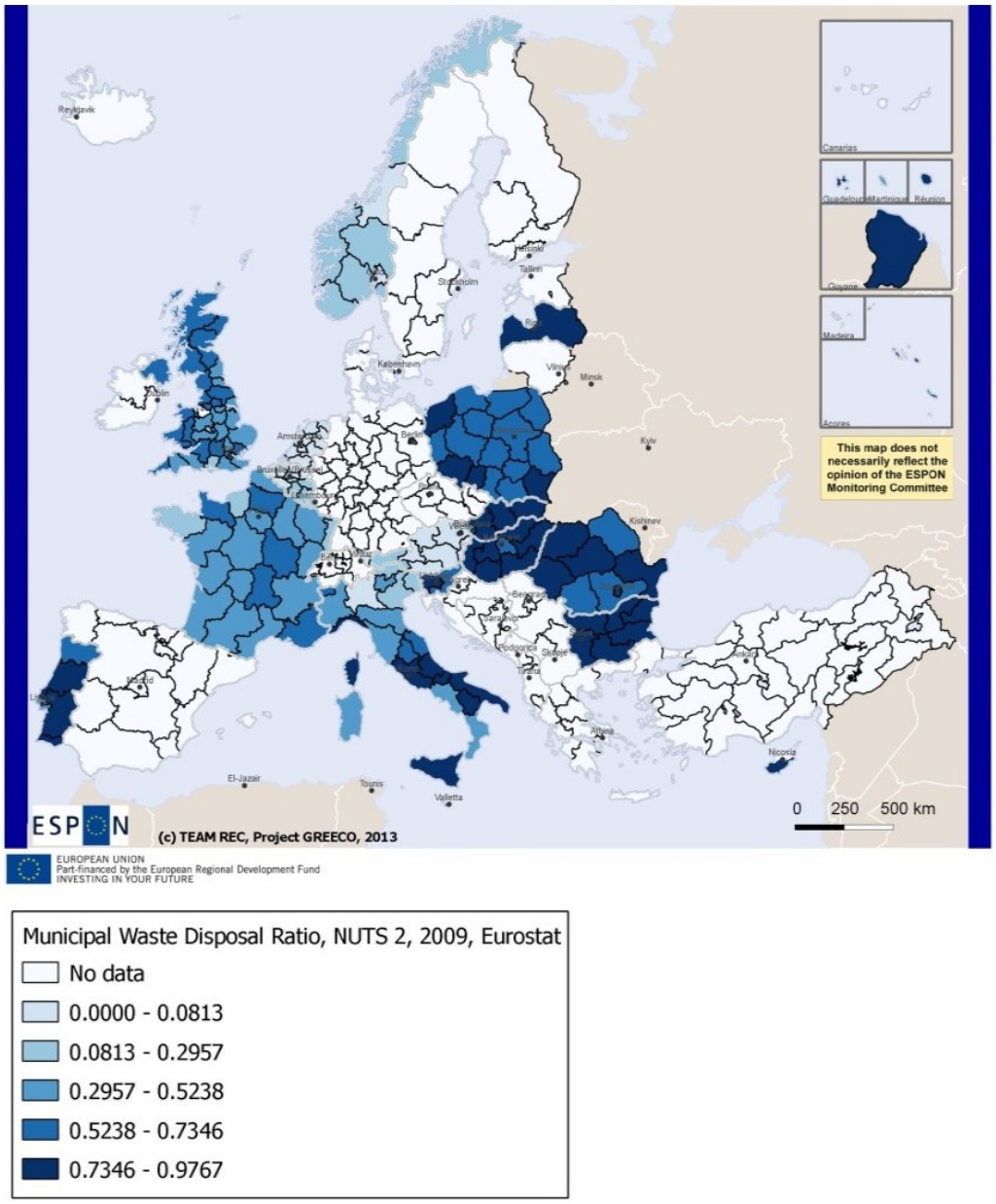
Country	Total waste treatment	Incineration / energy recovery (R1)	Recovery other than energy recovery	Incineration / disposal (D10)	Disposal
EU-27 and Croatia	2,323,940,000	89,660,000	1,135,840,000	42,490,000	1,055,940,000
EU-27	2,321,350,000	89,550,000	1,135,440,000	42,470,000	1,053,890,000
EU-25	1,964,130,000	87,880,000	1,126,980,000	42,230,000	707,030,000
EU-15	1,744,770,000	81,400,000	982,010,000	41,560,000	639,810,000
Belgium	30,357,625	4,797,276	20,413,752	1,974,862	3,171,735
Bulgaria	159,851,782	143,940	1,819,356	2,200	157,886,286
CZ	18,246,507	767,287	13,219,721	55,495	4,204,004
Denmark	11,342,950	2,748,758	6,766,675	0	1,827,517
Western Germany	349,563,855	28,422,963	241,563,259	12,645,738	66,931,895
Estonia	17,953,473	336,368	5,955,650	21	11,661,434
Ireland	9,420,759	167,689	3,356,440	42,828	5,853,802
Greece	70,389,644	126,148	11,722,265	21,309	58,519,922

Spain	132,687,982	2,523,031	80,288,909	411,749	49,464,293
France	336,020,706	14,240,602	200,677,448	7,808,720	113,293,936
Italy	127,156,431	2,372,758	93,036,713	6,092,114	25,654,846
Cyprus	2,371,086	7,481	1,380,904	6,856	975,845
Latvia	1,005,754	63,463	312,399	213	629,680
Lithuania	4,545,655	110,819	1,062,397	1,519	3,370,920
Luxembourg	12,546,488	31,630	6,285,725	124,138	6,104,995
Hungary	13,423,841	859,331	5,125,324	81,859	7,357,327
Malta	1,202,055	0	129,469	7,262	1,065,323
Netherlands	113,639,774	5,834,825	57,562,629	3,551,631	46,690,689
Austria	29,751,239	1,364,197	14,981,602	1,649,144	11,756,296
Poland	146,580,065	3,804,481	109,694,779	368,874	32,711,931
Portugal	20,114,979	2,343,177	7,582,610	418,633	9,770,560
Romania	197,376,444	1,524,142	6,637,606	242,179	188,972,515
Slovenia	5,638,491	282,493	3,884,622	35,335	1,436,041
Slovakia	8,386,596	255,085	4,210,492	108,795	3,812,224
Finland	105,630,419	9,847,135	31,998,572	389,417	63,395,295
Sweden	110,475,753	6,261,041	16,587,093	86,744	87,540,875
UK	285,674,242	315,911	189,183,039	6,342,879	89,832,413
Iceland	525,961	19,233	339,891	0	166,837
Norway	6,292,239	1,280,454	2,565,887	275,596	2,170,302
Croatia	2,584,714	110,067	403,242	23,573	2,047,832
FYROM	2,106,039	30	330,587	637	1,774,784
Serbia	33,058,590	25,977	565,350	1,028	32,466,234
Turkey	777,471,405	126,420	197,215,945	27,331	580,101,709

Source: Eurostat

The figure could be interpreted mainly as the possibility for changing the way of treatment to the better and greener option. For those countries and regions which already recover and recycle most of the waste, the green economy challenge is associated with waste prevention and industrial ecology.

Figure 14 Municipal waste disposal ratio, NUTS 2, 2009, Eurostat



1.2.1. Landfilling

The annual generation of municipal waste in the EU-27 is slightly over 500 kg per person and has decreased insignificantly between 2002 and 2010. Consumption has been the main factor of municipal waste generation but now there is a decoupling and municipal waste generation per person in the EU-27 stabilised between 1999 and 2007 while consumption expenditure in constant prices increased by 16.3 % per person and the number of people per household decreased by 5.6 % (Odyssee database). However, mainly as a result of the small growth in population, the total amount of municipal waste

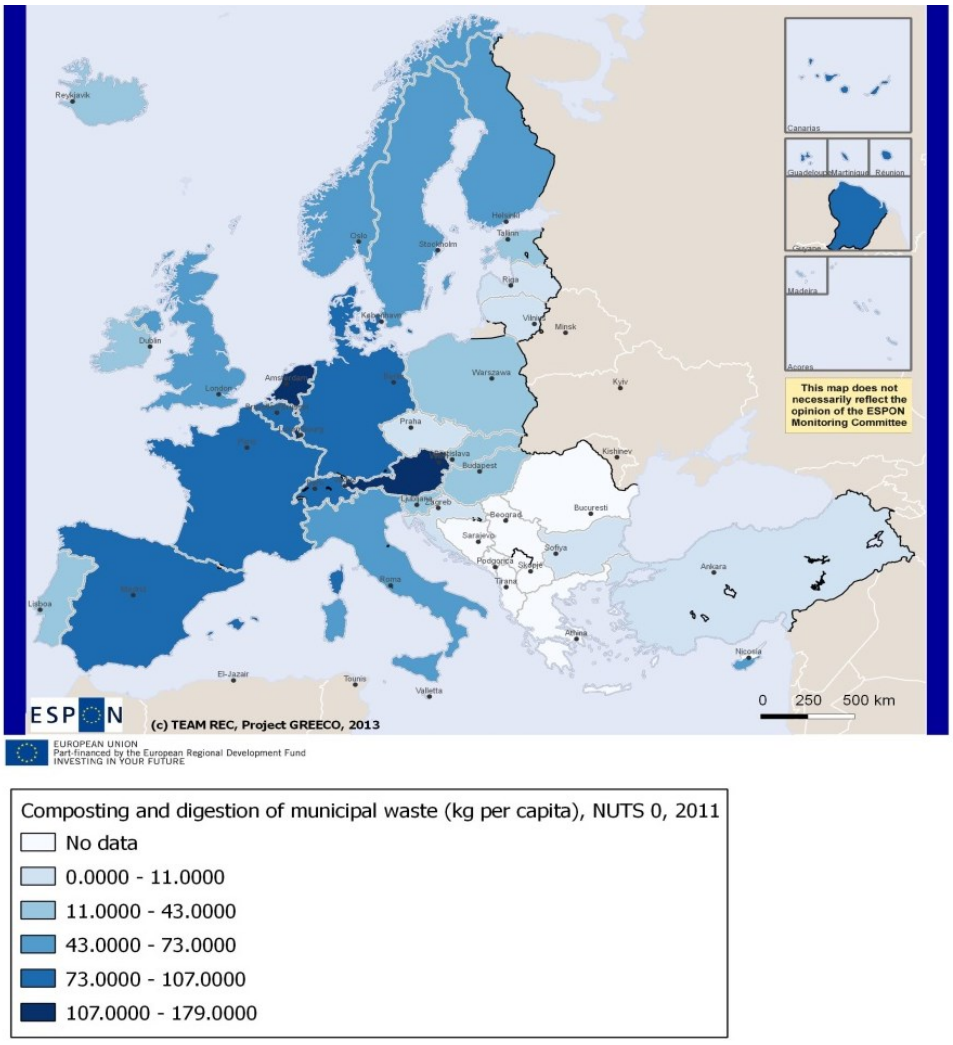
generated in the EU-27 over the same period increased slightly to 258 million tonnes (Eurostat data centre on waste, 2010). (SOER, 2010)

From the figure above we can see that some of the regions with the highest rates of landfilling are in Bulgaria, Romania, Hungary, Slovakia, Poland, Latvia, Portugal and certain regions in Italy. In all NMS and some other MS there has been an intense process of closing old landfills (late 1990s, early 2000s) and constructing new sanitary landfills (2000s). Both activities generate GVA and jobs and although they are formally labeled as green this is the least desirable method of waste treatment. On the opposite end of the spectrum Germany, the Netherlands and the Scandinavian countries have minimized landfilling to the very minimum.

1.2.2. Composting

Countries with the highest share of composted waste are Austria and the Netherlands followed by Spain, France, Germany and Belgium. The Scandinavian countries and Italy have high level of composting rates as well. Poland being a big country has the biggest quantity of composted waste despite the fact that only about 12% of all waste is composted.

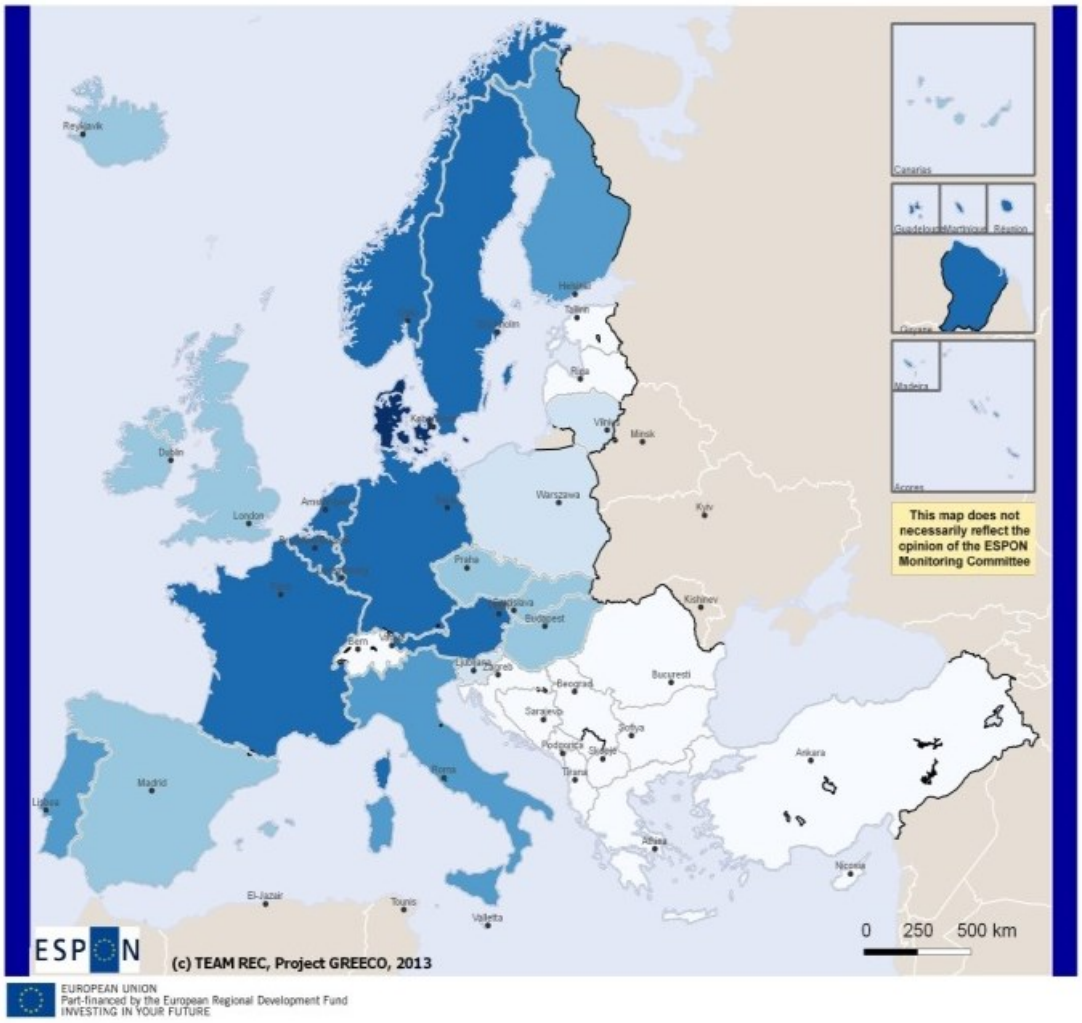
Figure 15 Composting and digestion of municipal waste (kg per capita)



Source: Eurostat

1.2.3. Incineration

Figure 16 Total incineration (including waste recovery), kg per capita, NUTS 0, 2011, Eurostat



Denmark is the country with the highest share of incinerated waste followed by France, Germany, the Netherlands, Austria, and Belgium. Factors such as available space, incineration gate fees and the cost of alternative treatment are the main factors for the share of waste which is incinerated.

1.2.4. Recycling

After waste prevention recycling is the most prefered option in the waste hierarchy. Together with industrial ecology it is also the major direction of waste management. As waste prevention is extremely difficult to measure and monitor the level of recycling of different waste streams is the most relevant measure of the regional green performance in the waste sector.

Recycling has been increasing through the years but still a small portion of our material consumption comes from recycled material. Depending on the material it is between 3% and 42%. Maximum waste recycling could cover between 6% and 61%.

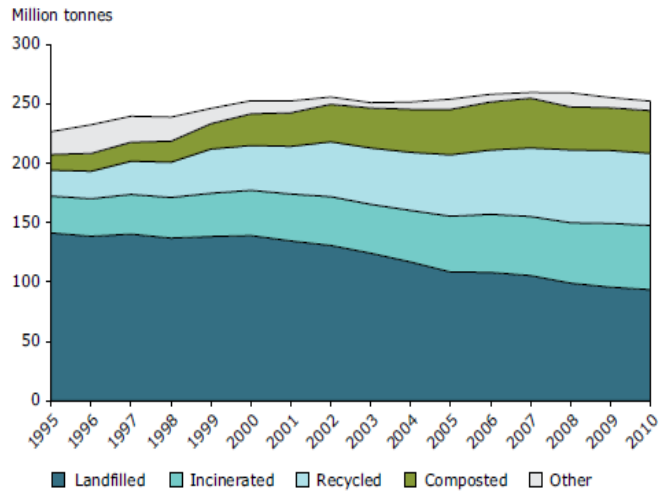
Table 10 Recycled amounts In EU-27 MS plus Nowary In 2006/2007 related to EU directives which include binding recovery targets

	Generation	Recycling rate
Packaging waste (2010)	78.6 million tonnes	63.3%
End-of-life vehicles (2010)	5.43 million tonnes	Varies between 77% in Ireland and 95.5% in Western Germany
WEEE (2006)	6.7 million tonnes	23%
Municipal waste	503 kg/capita	24.2%
Construction and demolition waste (2010)	859.7 million tonnes	53% (2006)

Source: Own calculation + calculated by ETC/SCO, based on data from Eurostat, March 2010 and ETC/SCP, 2009a

1.3. Development of municipal waste management

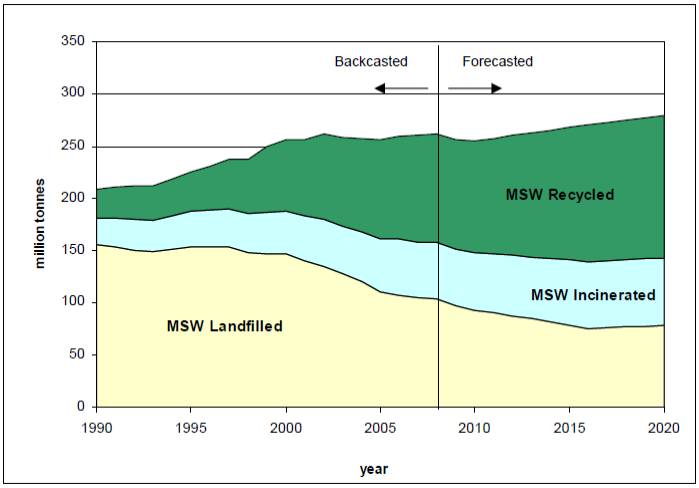
Figure 17 Development of municipal waste management EU-27, 1995-2010, Eurostat



From the figure on the left we can observe a very slight increase in waste quantities from 1995 to 2010. The quantities of landfilled waste are decreasing at the expense of all other treatment methods. The amount of recycled metals, paper and cardboard and glass waste in the EU increased by 4 million tonnes (3 %) between 2004 and 2008, whereas plastics recycling stagnated. Recycling of packaging waste and of waste electric and

electronic equipment (WEEE) is also increasing (CSI 17). These represent significant business and job creation opportunities.

Figure 18 Projected generation of management of MSW in EU-27, Norway and CH by 2020



While the projections reflect a slowing speed of waste generation, the quantities are still growing. On the positive side, mainly due to EU policy for prevention of waste from landfills, recycling is expected to keep growing. The share of waste recycled gives an indication of whether the economy is moving closer to being a recycling society or closed-loop economy.

Source: ETC/SCP Working paper, 2011, Projection of Municipal Waste Management and GHG

1.4. Matching production and consumption of waste

A much bigger part of the materials in the economy can come from recycled waste. However, the main challenge is to **collect the waste and prepare it for use**. For example, WEEE contains valuable materials, including gold, copper, aluminium and rare metals. In 2008, however, the collection rate (from households and other sources) was only around 33 % by weight of amounts put on the market in 2008.

Another challenge is to **make sure that the recycled materials match the quality demands of industry**. New recycling technologies and product design that enables easy and high-quality recycling and re.use will be essential to capture the full resource potential of waste.

1.5. Targets

Here is a short overview of the main targets in the waste sector in the EU. Each of these targets is analysed in the policy analysis section.

Table 11 Overview of specific targets for waste management in EU Directives

	Directive	Year	Recovery targets	Recycling targets	Collection targets
Packaging waste	1994/62 EC	2008	60%	55%	
Tyres	1999/31/EC	2006	Zero landfill or tyres		
Waste Landfill (biodegradable waste)	1999/31/EC	2006	Reduction of 75% of the amount generated in 1995		
		2009	Reduction of 50% of the amount generated in 1995		
		2016	Reduction of 35% of the amount generated in 1995		
End-of-life vehicles	2000/53/EC	2006	85% incl.reuse	80% incl reuse	100%
		2015	95% incl.reuse	85% incl reuse	100%
Waste electrical and electronic equipment	2002/96/EC	2006	70-80% depending on category	50-80% incl reuse depending on category	Min. 4kg per inhab per year
Batteries and accumulators	2006/66/EC	2012			25%
		2016			45%
		2011		50-75% efficiency	
Paper, metal, plastic, glass waste	2008/98/EC	2015			Separate collection
Waste from households	2008/98/EC	2020		50% of materials, at least paper, metal, plastic and glass	
Construction and demolition waste	2008/98/EC	2020	70% (incl.reuse)		

Source: ETC/SCP

2. Problem statement

On one hand, if left untreated waste can lead to serious environmental damage. On the other hand waste reflects imperfections in design and production processes and is a waste of resource and energy. At the same time waste management represents a huge potential for development of green economy through development of activities at all stages of the waste hierarchy with strong preference for the measures higher in the waste hierarchy. Waste is a perfect example where multi-level governance plays an important role with a significant current participation and future opportunities for regions and municipalities.

V. EU Waste Policy. Territorial implications. Effectiveness of waste policy as a driver for green economy

There has been a consensus among analysts that the EU waste policies developed in the past 20-30 years have changed the way waste is handled and therefore the waste-related green economy dramatically. Due to the variety in waste types and the way it is managed the European Union has adopted a relatively big number of waste acquis. The Waste Framework Directive 2008/98/EC and the Directive on Waste 2006/12/EC provide the overall frame, philosophy and definitions for the EC approach to waste.

There are several directives which address different waste treatment operations. The Waste Landfill Directive 1999/31/EC emphasizes the importance of preventing bio-waste from landfill and also bans the landfilling of such waste streams as tyres and ELV. The Waste Incineration Directive 2000/76/EC sets up strict exploitation standards for incineration plants whose environmental impact had been contradictory for a long time.

A number of directives deal with major waste streams: Packaging Directive 94/62/EC, End-of-life Vehicles Directive 2000/53/EC, Waste from Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC, Batteries and accumulators 2006/66/EC, Construction and demolition waste Directive 2008/98/EC. Waste from extractive industries is addressed in Directive 2004/35/EC on Environmental liability with regard to the prevention and remedying of environmental damage. Among other things Directive 2008/1/EC on Integrated Pollution Prevention and Control tackles industrial waste.

The methodology for analysis of the waste legislation consists of several steps:

- Description of the policy and the targets;
- Description of territorial implication of the policy;
- Characterization of territorial implication;
- Identification of indicators for measuring policy implementation;
- Assessing distance-to-target (if possible) with the help of existing data;
- If this is not possible, provide nominal figures for related GVA or related quantity of waste
- Characterization of region/country bin terms of distance to target;
- Assessment of the effectiveness of the policy as a driver of green economy;
- Identification of potential for development of green economy based on the above.

GREECO has included for analysis some of the major multi-sector policies in the EU which have clear implications on green economy in the waste sector. A number of specific waste policies with strong territorial and/or strong green economy implications have also been selected for analysis.

One of the main assumptions for this analysis is that legislation and associated targets are major drivers for the changing landscape of waste management. There is also a direct link between regulatory compliance, waste minimization and economic competitiveness. Significant cost savings could be achieved through better process management, reducing energy and water use and controlling waste. (SOER, 2010) The below analysis also includes insights of the territorial implications of the policies and highlights some territorial potentials.

1. Multi-sectoral policies with implication on waste-related green economy – regional and green economy implications

1.1. Europe 2020 Strategy

Table 12 Europe 2020 Strategy

Description and waste-related territorial	Sustainable growth has a strong regional dimension. Cities are centres of production and consumption and therefore – of waste generation. Cities and regions are and should be at the forefront of looking for

implication	solutions for getting closer to zero-waste loop economies. Waste prevention, waste minimization and sustainable waste treatment are all closely linked with the sustainability of cities.
Characterization of territorial implication	**Medium:** very little reference to territories but on the other hand calls for restructuring of regional innovation systems and of full use of Structural and Cohesion policy.
Potential for green economy development	• Shapes policies and instruments mainly through the call for a more resource efficient, greener and more competitive economy; • Also through the Resource-efficient Flagship Initiative; • Highlights the need for stronger economic governance; • Urge for innovations also include waste prevention technologies and related business employment opportunities; • Innovation Union Flagship Initiatives is expected to improve conditions for companies to innovate including waste prevention techniques; • It also urges the Structural and cohesion funds to channel funds in this direction as well as MS to reform their national and regional innovation systems; • Emission-reduction commitments are in line with preventing waste from landfills; • The Flagship Initiative: "An industrial policy for the globalisation era" encourages the industry for a transition to better resource efficiency, i.e. higher waste prevention; It also encourages development of such technologies; • Designing new financing instruments, in particular in cooperation with the EIB/EIF and the private sector, responding to hitherto unfulfilled needs by businesses;

1.2. Cohesion policy

Table 13 Cohesion policy

Name	**Common Strategic Framework, Regulation 2011/0276 on common provisions for ERDF, the Cohesion Fund, European Agricultural Fund for Rural Development and the European Maritime and Fisheries Fund**
Description	• 33% of Multiannual Financial Framework (2014-2020); • Closely linked to Europe 2020 priorities; • Relevant thematic objectives are: Shift towards a low-carbon economy and Environmental protection & resource efficiency; • Waste sector of less developed regions is a main target; • Waste infrastructure can be an investment priority within Thematic priority on resource efficiency; • Analysis of administrative capacities should be made in the Partnership Contracts; • Local development strategies analyses the development needs of the territory; • Major projects in waste (>50 MEUR) are funded from the Cohesion policy • Conditionalities for 2014-2020 Programming period: strengthening of administrative capacity (including for managing waste;
Territorial	There are strong territorial implications as regions and municipalities

implication	are the main project beneficiaries. Community-led local development is a main feature of the policy. Territories can influence the Cohesion policy through the programming process mainly and through spelling out clear waste management related priorities. The multi-level governance is a key principle and a requirement. The capacities of the local governments to identify problems and solutions in waste management and to prepare respective projects will be crucial for optimisation of Structural and cohesion funds.
Characterization of territorial implication	**Strong:** by definition Structural and Cohesion policy is regional.
Policy effectiveness as a driver	There are serious efforts on behalf on the EC to improve the efficiency of the policy in the 2014-2020 Programming period through better programming, better governance, thematic concentration, etc. For the current programming period 2007-2013 numerous sanitary waste landfills have been built in New Member States. This does not necessary mean that measures up the waste hierarchy have been implemented successfully. The policy has been a major driver for improving significantly waste infrastructure in New Member States, especially the construction of sanitary landfills.
Characterization	High especially in New Member States
Potential for green economy development	It is the main public financial instrument for the waste sector especially for establishing systems for integrated waste management including separate collection and recycling. The importance of Cohesion policy is bigger for less developed regions as it represents a much higher portion of public investments. Cohesion funding leverages other financing from the EIB as well as from national and local budgets.

2. Waste sector policies – regional and green economy implications

2.1. Thematic Strategy on the Prevention and Recycling of Waste

Table 14 Thematic Strategy on the Prevention and Recycling of Waste

Name	**Thematic Strategy on the Prevention and Recycling of Waste (COM(2005) 666 final)**
Description	• Acknowledges importance of waste in terms of economy and job generator; • Waste increasingly seen as resource; • Aims of EU waste policy: reduce overall environmental impact of waste; prevent waste and promote re-use, recycling and recovery; • Ultimate goal is for the EU to become a recycling society. Introduce level playing field for recycling: efficiency criteria for selected recovery processes, spreading good practices through minimum standards; • Focus on simplification and implementation of legislation; • Acknowledges the need to introduce life-cycle thinking in

	waste legislation;
Potential for green economy development	Without setting explicit targets it has been the strategy which inspired a number of concrete directives down the line. It states clearly that increased recycling creates jobs: recycling 10 000 tonnes of waste need up to 250 jobs compared with 20-40 jobs needed if the waste is incinerated and about 10 for landfill. It identifies a job creation trade-off taking into account reduced job creation in the extraction and production of virgin materials this should result in a limited net creation of jobs. It also calls for: less waste to landfill; more compost and energy recovery from waste; and more and better recycling. Therefore, it gives an impetus for green economy development in these particular waste sectors.

2.2. Directive 2006/12/EC on Waste

Table 15 Directive 2006/12/EC on Waste

Type of policy	Directive
Name	**DIRECTIVE 2006/12/EC ON WASTE**
Description	• Provides definitions of waste, producer, holder and management; • Encourages the development of resource-efficient clean technologies; • Encourages recovery of waste by recycling, re-use and reclamation; • Encourages the use of waste as a source of energy; • Provides for establishment of network of BAT disposal installations; • Holders of waste are obliged to dispose of it themselves; • Imposes the 'polluter pays principle' again; • In Annexes it provides a list of disposal and recovery operations;
Characterization of territorial implication	Weak territorial implications per se.
Potential for green economy development	Without setting targets for specific waste streams it holds a big potential for green economy development as it encourages Member States to set up a waste management system geared towards recovery and based on BAT. It also gives a large number of waste recovery options in Annex IIB. Each one of them gives rise to waste-related green economy activities.

2.3. Waste Framework Directive

Table 16 Waste Framework Directive

Type of policy	Framework Directive
Description	• Provides a number of definitions; • Lays down the waste hierarchy: prevention, preparing for re-use, recycling, other recovery i.e. energy recovery, disposal; • Introduces the concept of by-products (which are not wastes);

	• Introduces end-of-waste status, extended producer responsibility and polluter pays principle; • Requires drafting of waste prevention action plan to change consumption patterns by 2011; • By the end 2014 requires setting of waste prevention objectives for 2020; • Requires separate collection to facilitate recovery; • Requires MS to take measures for re-use, repair and recycling; • Introduces the principles of self-sufficiency and proximity – requires 'establishment of integrated and adequate network of waste recovery and waste disposal installations'. Possibility to limit incoming shipments of waste to protect networks. Does not mean MS should have the full range of final recovery facilities; • Encourages separate collection of bio-waste; • Requirement to establish waste management plans – should include geographical analysis and take into account the geographical level; • Requires adoption of waste prevention programmes by 12.12.2013 • Lists recovery operations in Annex.
Targets	• By 2020 preparing for re-use of minimum paper, metal, plastic and glass from households - minimum of overall 50% of weight. (analysis for reaching the target are under the Packaging Directive) • By 2020 preparing for re-use, recycling and other material recovery including backfilling of C&D waste – 70% of weight.
Territorial implication	• The principle of proximity brings the generation and treatment of waste geographically together. • Waste management plans 'translate' the requirements into geographical reality. • The PPP raises a Q: does it 'keep' in most cases the GVA of waste handling in the region? • Regional authorities have a major planning role to fulfil, including planning for new infrastructure in good time to enable targets to be met.
Characterization of territorial implication	Medium to strong
Indicators	Share of recycling of paper, metal, plastic and glass from households
Distance to target (graph)	Twelve out of 19 countries (EU, Norway and Switzerland) where data were available already recycle or recover more than 50 % of their construction and demolition waste, totalling an estimated 300 million tonnes (ETC/SCP, 2009a, BAFU, 2008).
Characterization	
Policy effectiveness	The WFD has been effective in gearing the national waste management systems in a certain desirable direction. This has mainly been the case for NMS which did not have sophisticated systems in place.
Characterization	High
Potential for green economy development	• It remains to be demonstrated if the measures higher on the hierarchy provide for biggest impact in terms of green economy (GVA, jobs). However, if this is not the case this is a desirable trade-off. • The concepts of by-products and end-of-waste status

	stimulate circular economy and protection of value. • EPR creates additional jobs and waste handling channels on behalf of the producers (does it mean more economy than the previous situation? • Separate collection is a whole subsector. Stimulates the creation of markets. • Stimulates GVA generation.

2.4. Waste Landfill Directive

Table 17 Waste Landfill Directive 1999/31/EC

Type of policy	Directive on waste treatment operation
Description	• It was adopted with the purpose of contributing to reduction of 'quantity and hazardousness of waste', 'facilitating handling and recovery', 'encouragement of treatment processes' and proper landfilling'; • The main objective is to lay down 'stringent operational and technical requirements on the waste and landfills'; • It defines classes of landfills for hazardous, non-hazardous and inert wastes; • Obligation to adopt **national strategies for the reduction of BMW**. They should contain national targets; • MS not allowed to accept to landfill: liquid, explosive, hospital, tyres; • Only waste that has been subjected to treatment can be landfilled; • Provides for full cost recovery including closure and after-care; • Provides for closing down of non-compliant landfills;
Targets	The **Landfill Directive** included targets to reduce the quantity of municipal waste landfilled. With 1995 as the reference year (100% by weight), biodegradable municipal waste to landfill must be reduced to: • **75%** in 2006 (2010) • **50%** in 2009 (2013) • **35%** in 2016 (2020) Zero landfill of tyres.
Territorial implication	• Underpinned by the principle of proximity and self-sufficiency on community level; • Location should take into consideration: distance to houses, hydrological conditions, risk of flooding, landslides and avalanches, protection of nature. • NIMBY 49syndrome; • Cooperation between municipalities or larger geographical units plays an important role in ensuring the necessary financial and human capacity to develop alternatives to landfill (EEA, 2009); • The residual landfill capacity and the land per capita are strong territorial factors; (EEA, 2009) • Regional authorities have a major planning role to fulfil, including planning for new infrastructure in good time to enable targets to be met; • Integrated waste management systems are usually regional. The regional 'approach' has developed through the years as it

	has been demonstrated that the biggest economies of scale can take place on such a level; • Additionally, municipalities are in charge of waste management and they usually group together in regional companies or associations. Benefits include possibilities to afford modern and compliant facilities and possibilities to pool human and financial resource together;
Characterization of territorial implication	**Strong**: Municipalities and regions are main actors
Indicators	Share of landfilled biodegradable waste
Distance to target (graph)	See table below
Characterization	Different for different groups of MS
Policy effectiveness	**High:** An assessment by an EEA study in Estonia, Germany, Finland, Italy, Hungary and Flanders (Belgium)
Characterization	Strong
Potential for green economy development	• Reduction of landfilling of biodegradable waste stimulates separate collection, sorting, recovery and recycling; • Improve technical standards – linked to and conditions the construction of new landfills; • The obligation for non-acceptance of waste forces authorities to handle this waste (create economy); • Ban on tyre landfill creates tyre treatment economy;
Other policy measures and related drivers	• Ban on landfilling parts of MSW (unsorted, organic, combustible); • Incineration tax; • Landfill tax; • Landfill diversion targets for BMW; • Limiting organic content of landfilled waste; • Separate collection of paper and biowaste; • Closing old landfill is an important driver for adopting other waste treatment options; • Sufficient incineration capacity; • Capacity for composting and existing markets for compost; • High level of gate fees prevents landfilling; • User charges for managing municipal waste; • Available MBT capacity favours diversion (EEA, 2009)

The Landfill Directive's success is due to long-term and intermediate targets providing a good framework for countries to innovate and landfill less biodegradable municipal waste. The directive's flexibility has allowed Member States the possibility to try out alternative policies, adjust measures to match national and regional realities (including existing waste management practices, institutional structures and environmental conditions), and adapt policies in the light of experience. (EEA, 2009, Diverting waste from landfill)

2.4.1. Recycling of Biodegradable Municipal Waste

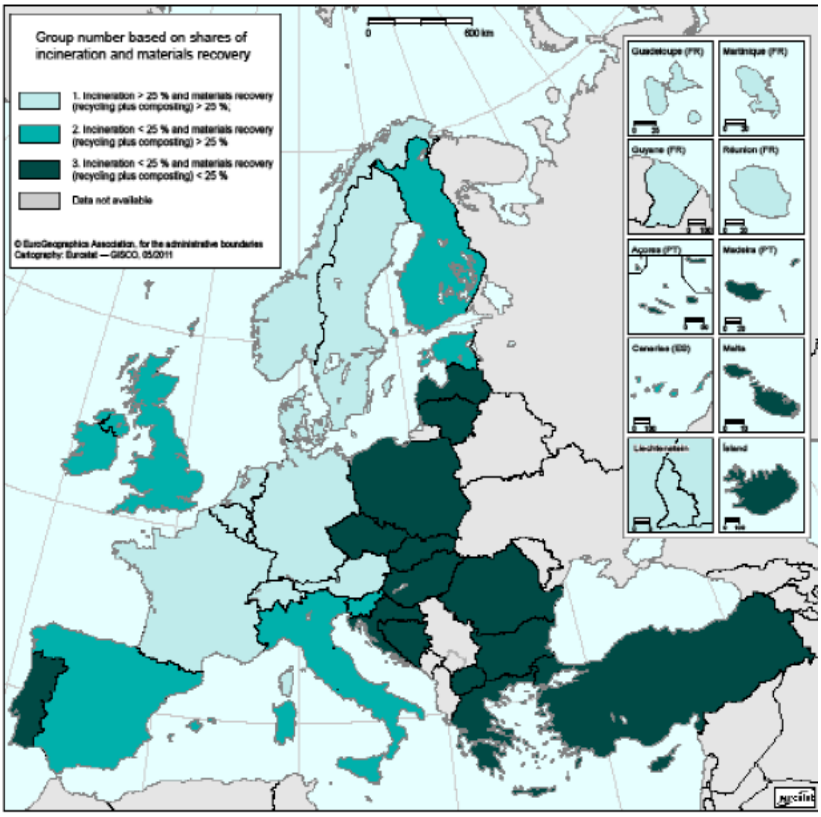
Table 18 Amount of BMW recycled per capita

Country	Total BMW recycling per capita	Total MSW generation per capita	Total BMW recycling per capita	Total BMW recycling in % of total MSW generation	Recycled biowaste in % of total BMW recycling	Recycled wood waste in % of total BMW recycling	Recycled paper & cardboard waste in % of total BMW recycling	Biowaste recycling per capita	Paper & cardboard recycling per capita	Mandates for paper collection	Mandates for bio waste collection	Landfill bans	Landfill diversion targets
	Kg	Kg	Kg	%	%	%	%	kg	Kg				
DK	237	743	237	32	55	2	44	129	104	Y		combustables	
LU	215	705	215	31	57	10	33	122	71				
DE	207	564	207	37	45	10	46	93	94	Y	Y	max 5% carbon content	
IE	203	737	203	28	7	24	69	15	140				Y
AT	177	618	177	29	45	10	45	80	79	Y	Y	max 5% carbon content*	
SE	176	497	176	35	30	0	70	52	124	Y		combustables & organic	
NL	167	638	167	26	50	12	38	84	64	Y	Y	separately collected, combustibles	
NO	158	431	158	37	37	20	43	59	68			Y	
BE	145	477	145	30	49	8	43	71	63	Y	Y	unsorted waste	Y
FI	110	488	110	23	28	0	72	31	79	Y	Y	household waste without sorting BMW	Y
UK	88	590	88	15	65	0	35	57	31				Y
CZ	70	449	70	16	13	0	66	9	61			Paper, BMW	Y
IT	66	542	66	12	63	9	28	42	19	Y	Y	Y	Y
FR	63	577	63	11	90	0	10	57	7	Y	Y	Y	Y
PT	41	446	41	9	73	0	27	30	11		Y		Y
EE	33	436	33	8	0	2	98	0	33			unsorted waste	Y
LV	18	500	18	4	0	0	100	0	18				Y
CY	13	745	13	2	0	0	100	0	13				
ES	13	652	13	2	57	0	43	7	5		Y		Y
SI	11	432	11	3	100	0	0	11	0	Y	Y		Y
LT	3	345	3	1	0	92	8	0	0				Y

Source: ETC/SCP Working Paper 2011, Europe as a Recycling Society

From the table above it can be seen that the countries in blue have the highest rates for recycling while the countries in rose – the lowest. Countries in green and yellow are doing relatively well but still have a way to go to reach the targets.

Figure 19 Three country groupings defined by diversion strategy



Overall, countries in the EU can be divided in several groups from the point of view of their strategy to divert waste from landfilling. This is due to differences of waste management history, difference of priorities and waste management systems as well as in implementation of EU legislation. (EEA, 2009)

In the light blue countries both incineration and material recovery, recycling and composting are higher than 25%, in the medium blue countries incineration is < than 25% but material recovery, recycling and composting are higher than 25%. In dark blue countries in Eastern Europe, both indicators are lower than 25%.

Source: EEA, 2009, Diverting waste from landfills, Eurostat

2.4.2. **Prohibition** of untreated waste in landfill

This has been a strong driver (associated to the Waste Landfill Directive) forcing players in the waste sector to consider alternative waste management options higher on the waste management hierarchy as well and it has been introduced in a number of countries and regions.

Table 19 Landfill ban and year of introduction

Estonia	Ban on landfilling of unsorted municipal waste (2004)
Finland	Ban on landfilling of household waste and similar waste from industry & service, from which most of the biodegradable waste has

	not been collected separately; and non-pre-treated waste (1997)
Flanders (Belgium)	Ban on the landfilling of waste which cannot be prevented, recycled or incinerated (1998). The criterion to distinguish between combustible and non-combustible waste is a TOC content of 6% (EC 2005). Ban on incineration of certain waste streams (1998): separately collected wastes that can be recycled, except for some high calorific wastes for renewable energy purposes; unsorted industrial and household wastes.
Germany	Ban on landfilling of waste with an organic content, TOC < 3% (1993). Amended in 2001. Higher limit values are allowed for residues from MBT.
Hungary	Ban on landfilling of organic waste (2003).
Italy	Ban on landfilling of waste with a net calorific value of 13 GJ/tonne (2003) and a number of other waste streams in accordance with the Landfill Directive

Source: EEA 2009, Diverting waste from landfill

2.5. Waste Incineration Directive

Table 20 Waste Incineration Directive 2000/76/EC

Type of policy	Directive on waste treatment operation
Description	• Sets stringent operational conditions for incineration and co-incineration plants; • Guarantee of heat recovery and minimisation of residues; • Incineration with energy recovery is considered a recovery operation while without energy recovery – a disposal operation.
Targets	The environmental impacts associated with Energy from Waste processes are controlled by both the Waste Incineration Directive and the Large Combustion Plant Directive.
Territorial implication	It is difficult to have a correlation between the generation and incineration of waste. Traditionally, waste incinerators have faced the NIMBY syndrome.
Characterization of territorial implication	Weak
Indicators	Share of incinerated MSW from total waste
Policy effectiveness	The main objective of the directive is not to increase the share of incineration but to tighten technological standards.
Potential for green economy development	Stimulates the production and constant improvement of incineration technology in order to comply with the requirements of the directive. The Joint Research Centre (JRC) has developed a BAT Reference document (BREF) for the sector.
Other policy measures and related drivers	• Dedicated incineration capacity – the more capacity is available the more incineration is and would be a preferred waste treatment option. • Incineration gate fees – the level of gate fees is in direct correlation with incineration being chosen as a treatment option

Incineration capacity has increased significantly with the tightening of emissions standards and ensuing bigger public acceptance. In Germany and the Flemish Region of Belgium, dedicated incineration capacity accounts (as of 2009) for around 35 % of municipal waste generated. Factors slowing the shift to incineration include public

opposition, largely based on worries about the environmental and health impacts of emissions, and — in the case of Finland — difficulties integrating waste incineration into existing power and heating systems. Incineration capacity stands at around 15 % of municipal waste in Italy and less than 10 % in Finland and Hungary. (*EEA, 2009, Diverting waste from landfill*)

2.6. Packaging Directive

Table 21 Packaging Directive 94/62/EC

Type of policy	Directives on different waste streams
Description	• Lays down measures for prevention of packaging waste, re-use and recycling: national programmes, introduction of producer responsibility; • Requires MS to set up return, collection and recovery systems; Possibility to introduce producer responsibility; • May encourage re-use systems for packaging by improving market conditions (GE potential); • The EC will work towards standardisation of packaging – recycling methods, composting methods; • Consumers have to obtain the necessary information on return and collection; • MS are encouraged to use economic instruments to increase compliance with the PPP; • Annex III contains requirements on the manufacturing of packaging in view of minimising it, the nature of reusable materials and its recoverable and biodegradable nature.
Targets	• By June 2001 50-65% of packaging waste by weight to be recovered or incinerated with energy recovery; • by Dec 2008 – min. 60% • by Dec 2008 – 55-80% of packaging waste will be recycled; • Recycling targets by Dec 2008: 60% glass; 60% for paper and board; 50% for metals; 22.5% for plastics; 15% for wood. • Targets for NMS – 31.12.2012 for CZ, EST, CY, LT, HU, SLO, SK; 31.12.2013 – Malta; 31.12.2014 – Poland; 31.12.2015 – Latvia
Territorial implication	• Return should logically happen mainly locally. • Municipalities are obliged to arranGe the collection. (i.e. Estonia)
Characterization of territorial implication	Medium to strong
Indicators	Share of recycling of paper, metal, plastic and glass from households
Distance to target (graph)	See graphs below. Paper – target achieved for most countries. Metal – target achieved for EU-15 mainly and some NMS. Plastic – 1st stage target achieved by all but Greece; 2nd stage target achieved by all but Greece, Portugal, Bulgaria, Romania, Latvia and Lithuania
Characterization	Close to target
Policy effectiveness	
Characterization	Very effective.
Potential for green economy	• Requirements for re-use and recycling create new economic activities;

development	• Standardisation will boost recycling significantly as it will make it easier and more accessible to economic operators. • The better the information the higher the return and collection rate will be.
Other related drivers	• The effectiveness of deposit refund systems in enhancing the collection of refillable/one-way containers has been shown (Tojo, Lindhqvist and Davis, 2003) (AT, DE, CZ, SE, DK, FI, EE, LV, RO) • Recycling targets higher than the directive: Austria, Germany, Netherlands, Sweden, France, Italy, Finland • Fiscal measures on products: BE, CZ, IE, DK, FI, EE, PL, HU, LV • Producer responsibility/ voluntary agreement for waste paper

The recycling activity in the EU-15 grew from 1.8 to 4 million tonnes during 1998-2008 but the recycling rate has only increased by 50% mainly due to the high growth of packaging material. The recovery without recycling increased from 1.5 to 4 million tonnes which is a rise in share from 15% in 1998 to 30% in 2008. The increase of recovery without recycling has been higher than recycling alone.

In 2007, 59% of all packaging waste in the EU-27 was recycled and 14% - energy-recovered (EEA, 2010b). In 2007, 18 of the EEA countries have met the 2008 target of the Packaging Directive to recycle at least 55% of the generated packaging waste. Recycling rates differ for different materials (see below).

Paper

Paper and board recycling and recovery have taken place since 1980s and therefore rates were already high in 1998. The main recovery operations are material recycling and incineration with energy recovery. Until 2008 the volume of recycled paper and board packaging grew steadily. The incineration with energy recovery peaked in 2003 and has declined since then with a sharp drop in 2008.

At first, the amount of paper and board packaging which is not recovered (disposed), decreased from 31 % in 1998 to 10 % in 2008. In contrast the share of recycling has grown over the same period from 61 % to 82 %. The other recovery operations have contributed 8 % in 1998 and 2008 while they reported a peak of 13 % after 2003. All countries have exceeded the second stage recycling target of 60 % except Slovakia, Malta and Poland.

Figure 20 Paper and board recycling rate, 2010

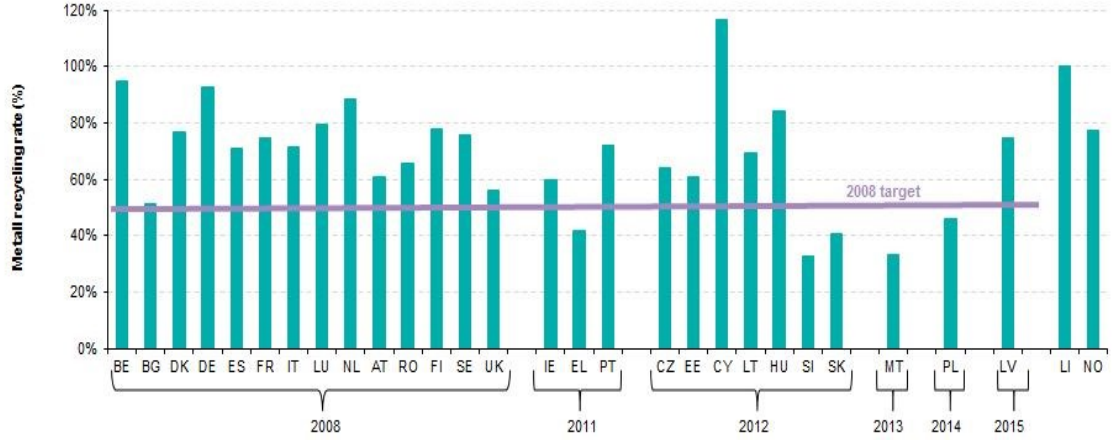
Source: Eurostat

In terms of green economy most of the Member States are steadily moving towards 100% recycling. Region's role is important in further strengthening their paper collection systems.

Metal

The metal packaging waste consists of steel and aluminium but the breakup of data is voluntary. The second stage recycling target for metal is 50% by weight. BG and RO also agreed to fulfil it by end of 2008. Countries which have not met the target include: Greece, Slovenia, Slovakia, Malta and Poland. A number of countries have reported rates well above the 2008 target – Belgium, Germany, the Netherlands and Cyprus.

Figure 21 Recycling rate of metal packaging waste, 2010



Source: Eurostat

Plastic

All countries except Poland have achieved the 2008 target. Still, there is a huge potential in plastic recycling economy as even the best performing countries (Slovenia, Czech Republic, Denmark, Belgium and Sweden) are at around 40-60%.

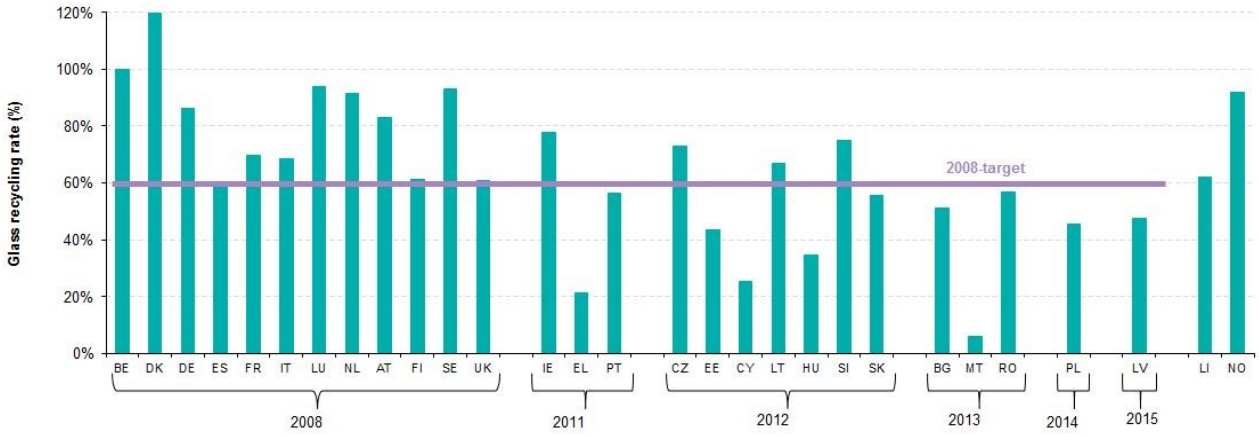
Figure 22 Plastic recycling rate

Source: Eurostat

Glass

Recycling of packaging glass is the main recovery operation for this waste material. The first stage target has been achieved by all MS except Malta which did not provide data in time. The second stage targets have been achieved by all countries which had agreed to fulfill the target by the end of 2008. Some countries – namely Ireland, the Czech Republic and Slovenia – are well above the 60 % recycling rate.

Figure 23 Glass recycling rate, 2010



Source: Eurostat

Glass recycling has been a success in a number of countries which are moving towards 100% recycling – Old Member States. There is a small group of countries, mainly NMS, which are yet to reach the 2008 target and benefit from these recycling activities – Greece, Estonia, Cyprus, Hungary, Slovakia, Bulgaria, Malta, Romania, Poland and Latvia..

2.7. End-of-life Vehicles Directive 2000/53/EC

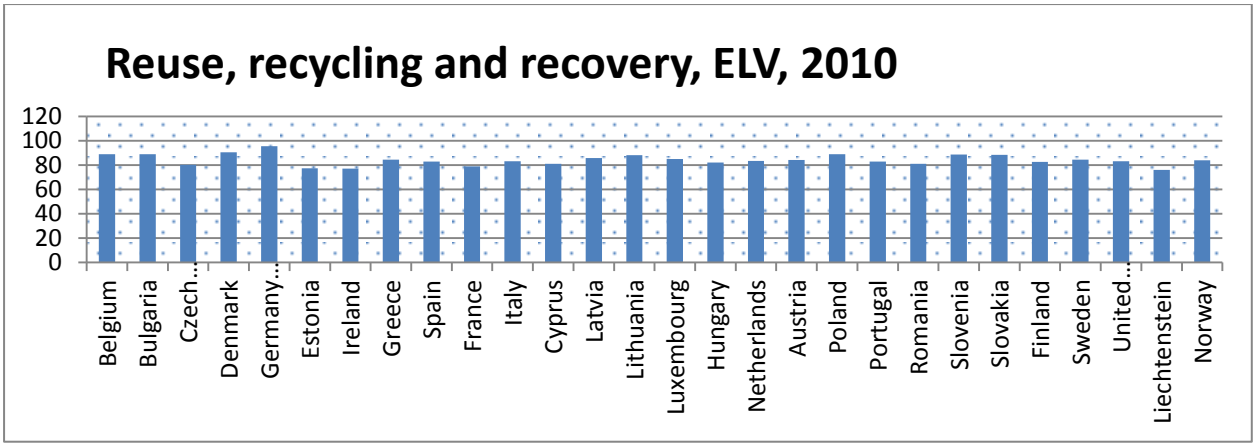
Table 22 End-of-Life Vehicles Directive

Type of policy	Directives on different waste streams
Description	• Requirements to economic operators to set up systems for collection, treatment and recovery of ELV. • MS should take measures that all ELV are transferred to authorized facilities. • Development of markets for recycled activities should be encouraged. • The recyclability and recoverability of vehicles should be promoted to producers. • Preparation of European standards, where appropriate, should be promoted • Ban on hazardous materials in vehicles. • Encourage the re-use of some components and recovery of those components which can't be reused.
Targets	• By 01.01.2006 the reuse and recovery min. 85 % by an average weight per vehicle and year. Reuse and recycling to a min. of 80 %. • 01.01.2015 – the above targets 95% and 90% • For NMS – 31.12.2011
Territorial implication	In bigger countries regions have bigger role in ELV policy implementation as systems for collection and treatment can be set up on regional and local level. In smaller countries installations cover bigger territories or the whole country.
Characterization of territorial implication	Medium – in bigger countries Small – in smaller countries
Indicators	Share of reused and recovered ELV
Distance to target (graph)	As of 2010 many countries have not yet achieved the 2006 target but they are very close to achieving it.
Characterization	Close to target
Policy effectiveness	
Characterization	High
Potential for green economy development	Every year ELV vehicle generate between 8 and 9 million tons of waste

A study revealed that 22 countries have adopted measures encouraging vehicle manufacturers and importers to set up systems for collection of ELV. Some 22 Member States indicated to have adopted measures in line with the waste hierarchy in order to promote the reuse of components which are suitable for reuse and the recovery of components which cannot be reused, with a preference for recycling. (*Report from the EC to the EU Council on the implementation of the ELV Directive*)

From the figure below it could be seen that almost all countries in the EU recycle around 80% or more of the ELVs. This means that countries are above the 2006 targets but still significantly below the 2015 targets of 95% and 90%.

Figure 24 Reuse, recycling and recovery, ELV, 2010



Source: Eurostat

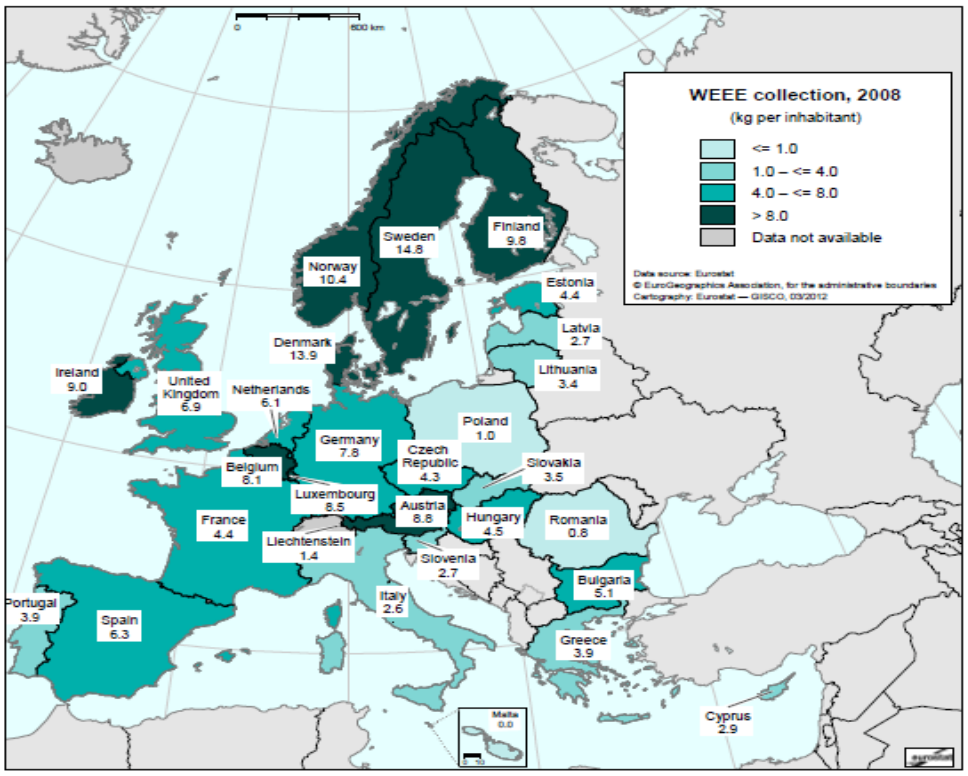
2.8. Waste from Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC

Table 23 Waste from Electrical and Electronic Equipment Directive (WEEE)

Type of policy	Directives on different waste streams
Description	• Provides definitions and categories of WEEE; • Encourage cooperation between producers and recyclers with regards to product design; • Adopt separate collection to minimize the disposal of WEEE; • Disposal of collected WEEE without treatment is prohibited; • Provides for proper treatment of collected WEEE;
Targets	• In 2016 min collection rate of 45%; in 2019 – 65%; • Collection target – min 4kg inh/year • Depend on WEEE categories but vary between 75% and 85% for recovery and 55-80% for re-use and recycling by 2015
Territorial implication	It has been revealed that the top three countries that have achieved more than 50% collection rate engage the municipalities in collection activities;
Characterization of territorial implication	Strong Municipalities are physically responsible for collection of WEEE from households in all countries except: Cyprus, Finland, Hungary, Slovakia, Greece and Poland. (ETC/SCP, 2011)
Indicators	Share of collected WEEE; Share of recovered, re-used and recycled WEEE; WEEE collected in kg per inhabitants
Distance to target (graph)	
Characterization	As of 2006, close to target except Poland, Spain, Lithuania, France and Italy
Policy effectiveness	
Characterization	Medium to strong
Potential for green economy development	• Significant potential having in mind the precious metals contained in electronic equipment and the high rate of turnover.

The figure below demonstrates that there is a significant difference in the quantity of WEEE collected per capita varying from 14.5 kg/inh. in Sweden to 0.8 kg/inh in Romania. As the difference in consumption are much smaller than that in most EU countries there is a huge potential for increasing the collection and recycling rate.

Figure 25 WEEE collected in 2008 in kg per inhabitants, Eurostat



It can be seen from the figure that most countries (except Portugal, Italy, Slovenia, Poland, Latvia, Lithuania and Greece) have already reached the collection target. The fact that some of the most advanced countries in this respect have managed to collect more than 10 kg per inhabitant speaks of the significant potential for the re-use and recycling of this waste stream.

Table 24 WEEE collection and recycling rate in EEA member countries

Country	WEEE collection rate (%)	Total WEEE collection per capita (kg)	WEEE collection from private households per capita (kg)	EEE put on the market per capita (kg)	WEEE reuse and recycling rate based on total collected (%)
SE	58.42	14.63	12.75	25.05	92.67
NO	54.33	21.90	13.99	40.31	80.11
LU	48.45	8.20	8.14	16.93	88.54
DE	41.04	9.15	8.61	22.28	79.59
AT	39.94	7.58	7.43	18.97	79.47
DK	34.73	11.10	10.84	31.96	79.90
ES	32.96	3.86	3.75	11.71	65.71
EE	31.96	4.35	4.31	13.62	N/A
BE	30.51	7.25	7.24	23.76	76.74
CY	30.21	5.88	N/A	19.48	N/A
FI	28.54	7.55	7.08	26.45	78.81
LT	18.68	2.73	2.64	14.63	63.44
HU	17.71	2.39	2.36	13.47	76.71
SK	16.71	1.60	1.54	9.56	83.65
EL	6.45	1.02	0.86	15.81	82.57
PT	3.42	0.40	0.40	11.66	89.51
PL	1.98	0.45	0.14	22.68	47.75
FR	1.02	0.24	0.09	23.52	26.92
RO	0.80	0.05	0.04	6.52	N/A
IT	N/A	11.52	2.20	N/A	43.53
NL	N/A	5.78	5.68	N/A	77.76

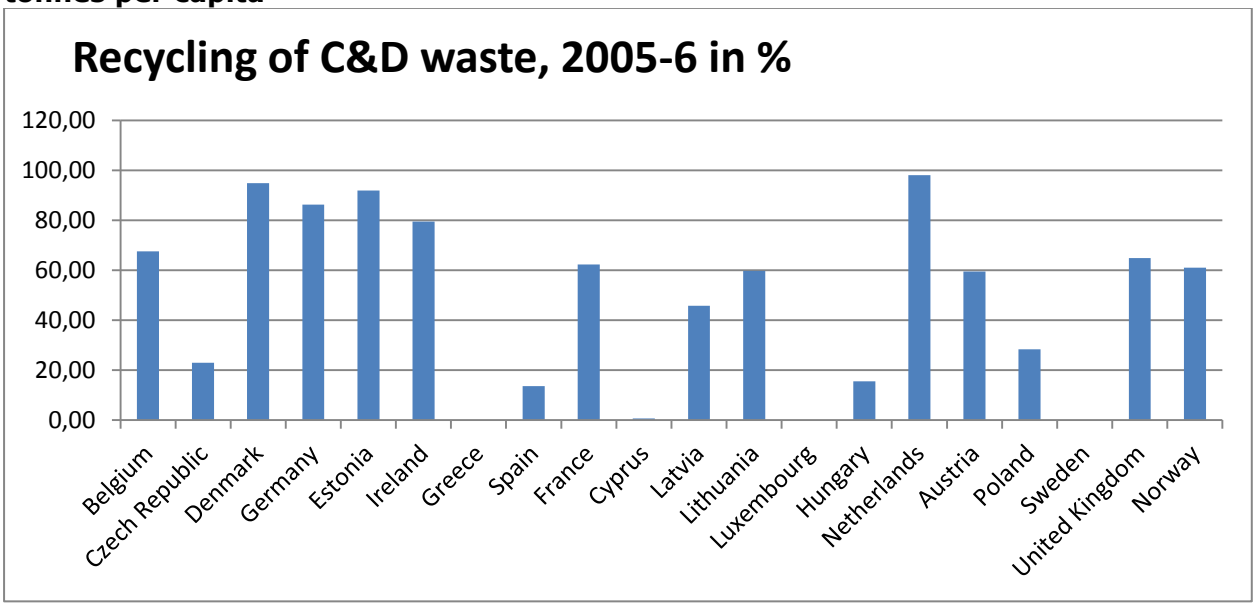
Source: ETC/SCP Working Paper 2011, Europe as a Recycling Society

2.9. Construction and Demolition Waste Directive 2008/98/EC

Table 25 Construction and Demolition Waste Directive 2008/98/EC

Type of policy	Directives on different waste streams
Description	• Taken care of in the Waste Framework Directive; • Represents 25-30% of all waste in EU • Consist of numerous materials such as concrete, bricks, gypsum, wood, glass, metals, plastic, solvents, asbestos and excavated soil, many of which can be recycled.
Targets	70% (incl reuse)
Territorial implication	Recovery and recycling happens close to the generation as transport is difficult. Regions which are bigger producers are pressured to be more efficient in recycling
Characterization of territorial implication	Strong
Indicators	Share of recycled C&D waste per streams: concrete, bricks and tiles; asphalt; wood, metals, plastics, gypsum; other mineral and C&D waste.
Distance to target (graph)	To be seen in the table below: some countries in light blue are above target; countries in green are close to target while the rest are far from target.
Characterization	Achieved: Netherlands, Denmark, Estonia, Germany, Ireland Close: Belgium, UK, France, Norway, Lithuania, Austria, Latvia Far: Poland, Finland, Czech Republic, Hungary, Spain, Cyprus
Policy effectiveness	N/A
Characterization	N/A
Potential for green economy development	The potential is huge given the big quantities of waste.
Other drivers	• Landfill bans; • Source separation mandate; • Reuse targets; • Recycling targets; • Producer take-back; • Landfill tax;

Figure 26 Recycling of construction and demolition waste in % and tonnes per capita



Source: ETC/SCP Working paper 2/2009 EU as a Recycling Society

2.10. Best Available Technique Reference Document within the IPPC Directive 2008/1/EC

Table 26 Best Available Technique Reference Document

Description	• More than 14,000 waste treatment installations in the EU • The document provides techniques such as: generic management of an installation; biological treatment; physico-chemical treatment; emission abatement treatments, etc. • Most of the 940 techniques are related to the improvement of the environmental performance of waste treatments, prevention or management techniques.
Potential for green economy development	The BREFs are obligatory in IPPC industrial installations and therefore their implementation is a significant contribution to the waste-related green economy.

3. Drivers and barriers for greening the waste sector (other than the policy ones)

3.1 Technical and market drivers and barriers

Table 27 Technical and market drivers and barriers

Description	**Infrastructure and capacity building:** There is a need for adequate capacity for separate collection and recycling. Balance between separate collection and treatment capacity. Systems for WEEE collection, disassembly and treatment. Dedicated incineration capacity

	The more capacity is available the more incineration is and would be a preferred waste treatment option. Compost capacity Composting capacity has increased significantly in several EU countries like Finland, Germany, Hungary and Italy. However, separate collection schemes have struggled to keep up with the increase. There is also the issue of introducing and keeping quality standards in order to ensure product quality (ETC/RWM, Diverting waste from landfill, 2009) **Market development**: A level playing field in terms of levies, fees, etc, so that waste shipments decrease. Development of markets for separately collected waste products. **Stimulate the recyclability of the products** and the integration of recycled materials into products; for example, the development of minimum requirements and criteria in the context of the eco-design directive, which will be supported by studies and the possible development of related standards. Many of the materials needed by EU industry can be increasingly obtained through recycling and recovery
Specificity for the green economy	The above factors are preconditions for greening the waste sector.
Provable impact on the green economy spheres	**Economic: positive impact (+)** The economic impact of technical and market drivers is unequivocally positive. On one hand the construction of the waste treatment infrastructure brings positive economic effects. On the other hand, its availability unblocks preferable waste treatment options which leads to job and GVA creation. **Environmental: positive impact (+)** The construction of any infrastructure (including waste management) takes a toll on the environment and modifies the landscape. However, once it is in place waste treatment becomes less environmentally damaging compared to landfilling. **Social: positive (+)** It has been demonstrated that more jobs are created in recycling than in landfilling. **Territorial: positive (+)** The construction of any of the above mentioned facilities necessarily has territorial argumentation and territorial meaning. The available capacities make certain territorial sense and in the planning phase waste generation within a certain territory (big city or region) is taken into consideration.
Trade-offs: mixed +/- impacts on green economic spheres?	The above mentioned waste treatment infrastructures are mutually competing/ For example, the good availability of incineration capacity within a region might divert the focus of policy makers from waste prevention and resuse.
Externalities:	Waste, being a horizontal sector, influences all other sectors studied

impact on other sectors / case studies	within GREECO. A better waste infrastructure would improve waste management in industry, building, agriculture and tourism. It will decrease the environmental pressures of the sectors and it could also create new dynamics within the sectors.
Interactions with other factors	Available technical capacity is closely interlinked with the policy and economic factors. Its functioning is closely dependent on the administrative capacity within the region/municipality.
Spatial level of operation (internal versus external factors)	Mainly regional or municipal (in the case of big cities). The technical characteristics of the installations in terms of volume of waste that can be treated dictate their territorial coverage/relevance.
Type of market force involved	The involvement of the private sector depends on the profit opportunities. Profit opportunities depend on the cost of the service in terms of gate fees which might be market or administratively driven.
Policy recommendations: making the link between policy and non-policy factors	Development of waste treatment infrastructure is a matter of policy drivers and available funding. For example, with the support of Cohesion policy, New Member States have recently built significant sanitary landfill capacities. Without any doubt a sanitary landfill is better than wild dumping or non-sanitary landfills. However, this development is ambiguous as available sanitary landfill capacities might divert policy attention to landfilling instead of other waste treatment options. Designing the right gate fees (landfill and incineration) will determine to a big extent the demand for the waste treatment method on one hand and the supply of capacity on the other hand.
64Possible indicators	• Available landfill capacity; • Available compost capacity; • Available incineration capacity;

3.2 Administrative drivers and barriers

Table 28 Factor: Administrative drivers and barriers

Description	**Administrative competence and capacity:** • availability of sufficient number of competent staff; • cooperation of implementation between different bodies; • training on new regulation. **Enforcement measures**: the monitoring, penalty imposition and prosecution of infractions contribute significantly to better policy implementation. **Non-legally binding drivers** • Voluntary instruments: EMS and EMAS, business projects that include environmental improvements, consumer information and education, eco-labels, green or full-cost accounting (Huhtinen, 2009) For example, local governments can enter in voluntary agreements with businesses to undertake special measures for the management of particular waste streams. • Corporate Social Responsibility – waste aspects

	Availability of standards for reusable products. (Huhtinen, 2009) If those are in place marker operators know what to expect and adapt their technical processes. **Agreements** between the government and industry sectors to engage into better waste management than required in by law. Technology spending programmes for regions and municipalities
Specificity for the green economy	Administrative capacity is key for good waste management as the waste management systems need to be created and later managed. These are not purely market-based system hence the importance of strong administrative waste management capacity.
Probable impact on the green economy spheres	**Economic: positive impact (+)** Properly managed waste management system unlocks market interactions. **Environmental: positive impact (+)** The administration is in the capacity to design such poilicies and economic instruments which drive waste management to less environmentally harmul treatment methods. **Social: positive (+)** **Territorial: positive (+)** Competent administration brings numerous benefits to the territory under its jurisdiction.
Externalities: impact on other sectors / case studies	Close link to the technical infrastructure but also regional/local policy making
Interactions with other factors	Enforcement and compliance goes hand in hand with regulatory drivers. If the enforcement is weak the effectiveness of policy drivers is also weak. There is a need to integrate waste policy with other sectors and not develop it in isolation (UNEP, 2012)
Spatial level of operation (internal versus external factors)	Usually, competences are on municipal (NUTS 3) level but depending on the waste management system in certain countries there are regional waste management structures such as regional waste management associations.
Policy recommendations: making the link between policy and non-policy factors	The level of implementation of policy depends on the size and quality of the administration. With the adoption of each new waste policy a respective administrative backing should be secured.
Possible indicators	• Number of staff responsible for waste management on local level; • Number of staff responsible for waste management on municipal level; • Number of inspectors dealing with waste issues. • Number of infringement procedures (measuring the

	enforcement capacity)

3.3 Knowledge drivers and barriers

Table 29 Knowledge drivers and barriers

Description	**Gaps of knowledge about state-of-implementation:** lack of reliable data on waste streams, volumes and management systems. New tools: waste management plans and waste prevention systems; Inspections need to target implementation deficits and training should focus on problematic areas; **Cooperation and stakeholder involvement.** Cooperation between bodies is a key driver; multiple stakeholders involved and therefore knowledge sharing is key; **Awareness raising**: important among general public and public authorities for policy implementation on local level; understanding of separate collection practices and waste products; communication campaigns to encourage participation in return, collection and recovery schemes, **Educational tools** Better waste management is also about change of mindsets of different stakeholders. It starts with the design of the product and its composition as well as the organisation of industrial processes. Consumers are a main target for awareness as they are an indespensble part of any waste management system through their efforts for prudent consumption, separation at source and recycling. Consumers can be urged and educated to make a variety of productive changes: reduce their purchases of products that contribute to the waste stream, eg by buying unpackaged or more lightly packaged goods; reuse or recycle goods rather than discard them; Compost food wastes at home; separate their wastes at source for contribution to recycling programs; and keep hazardous materials out of MSW. **<u>Networking</u>** **- Eurocities** (www.eurocities.eu). A network of progressive cities. There is a working group on waste which addresses the issues of waste recycling, bio waste and sludge. It contributes from the city perspective to European policy initiatives on prevention and recycling of waste. **The WG** analyses new European, produces case studies of waste reduction plans in European cities, and assesses the waste life cycle applied to case studies. It develops waste management practices, supervising and controlling in participating cities, coordinating and disseminating R&D activities. - The movement from Local Agenda 21 to **Local Action 21** ushers local governments from general sustainable development planning to work with local stakeholders address inter-related challenges to poverty and sustainability. ICLEI seeks to build **Sustainable Communities and Cities** by enabling local governments achieve justice, security, resilience, viable economies, and healthy environments. (www.iclei.org) The **Lead Market Initiative** in recycling aims to boost markets for technologies, products and processes relating to the recycling and re-use of

	products and materials.
Specificity for the green economy	While waste management is not an extremely complex system nevertheless the general public needs a certain amount of basic knowledge about environmental impact of waste as well as good waste management practices.
Probable impact on the green economy spheres	**Economic: positive impact (+)** Better knowledge will increase the separately collected waste and therefore increase different market development opportunities. **Environmental: positive impact (+)** Better knowledge and awareness will has a significant impact on the environment as individual consumption is the main cause for waste generation. More responsible consumption and better knowledge of less environmentally harmful treatment methods is key to any successfully run waste management system. **Social: positive (+)** Employment is created through improved recycling but also people get additional satisfaction from leading less environmentally harmful lives. **Territorial: neutral**
Externalities: impact on other sectors / case studies	Better knowledge of waste management will benefit agriculture, construction and industry dramatically. There is a potential for complete change of paradigms in these sectors due to better and innovative waste management techniques and interactions.
Interactions with other factors	Strong administration and NGOs sector are mainly responsible for improving the awareness of citizens and business operators. Policy and economic drivers may urge citizens to become better educated in waste management in order to save costs and avoid fines.
Spatial level of operation	Knowledge drivers can operate on different spatial level: EU, national, regional, local. There is a place for all of them as they approach the knowledge gap issue from a different perspective.
Policy recommendations	Policy implementation is closely dependent on business and citizen awareness therefore it should not be underestimated. New policies should be accompanies by capacity building.
Possible indicators	• Membership in EU networks for waste management;

3.4 Economic drivers and barriers

Table 30 Economic drivers and barriers

Description	**Economic instruments** direct individual and company behaviour to **certain waste treatment options.** Their efficiency depends on their levels but also on price elasticity. Ecocnomic instruments include: landfill gate fees, landfill taxes, penalties to municipalities not meeting the targets, tax incentives for packaging recovery schemes. **Landfill tax**

Landfill tax on BMW has been one of the most significant drivers for preventing waste from the landfills and managing it in alternative ways. The landfill tax, together with **closing of old landfills**, unregulated landfills have been identified by Estonian policy makers and other stakeholders as the most effective drivers and enablers for the decrease of landfilled MSW and the uptake of alternative waste management methods, i.e. greening the waste sector.

Table 31 Evolution of landfill tax in Estonia, EUR/t

	Pollution Charges Act 2002				Environmental Charges Act 2005			
	2002	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Non-hazardous waste basic	0.2	0.2	0.3	1.9	7.8	7.8	8.5	10
Factor for non-compliant landfills	6	6	6	4	2	2	2	3
Old non-compliance landfills	1.1	1.3	1.5	7.7	15.6	15.6	17	30.1
Oil-shale gangue and enrichment resid	0.1	0.1	0.1	0.2	0.4	0.5	0.6	0.8
Oil-shale ash	0.3	0.3	0.3	0.3	0.4	0.5	0.6	1
Oil-shale semi-coke	0.3	0.3	0.4	0.4	0.4	0.4	1	1
Factor for non-compliant landfills	3	4	2.5	2.5	2.5	2.5	5	8

Source: Presentation. Peeter Eek, Estonian Ministry of Environment

According to a recent study, a minimum rate of EUR 40 should be set progressively in place to start moving waste management up the waste hierarchy. This could contribute to move to a minimum access cost to landfill of EUR 100/tonne (ideally EUR 120) (taxes + gate fees). The revenues of such taxes should be invested in new infrastructures aiming at increasing recycling and reuse rates.[1]

Full cost collection tariffs
Designing a tariff for waste collection from households and businesses which reflects the full cost of waste landfilling is a driver for waste separation at source.

Incineration gate fees
The level of gate fees is in direct correlation with incineration being chosen as a treatment option.

Funding through Cohesion policy
Thanks to the availability of Cohesion policy funding has improved significantly during the last ten years. However, as mentioned above, it may create lock-in effects by keeping waste to better, sanitary landfills. In order to avoid this, prevention, reuse and recycling policies have to be developed at the same time with the construction of landills.
The availability of funding is an extremely important driver or barrier as

[1] EC Annual Growth Survey

	waste management is expensive and often municipalities lack the necessary funding for the establishment of integrated waste management systems. The efficiency of funding is another issue. **Profitability** Many changes at the level of the industry, the company or the individual production facility aimed at reducing waste generation can be profitable or at least break even financially. Producers can be encouraged or educated to examine and adopt changes in product and process design, and improvements can result from a variety of motives: • some actions will be justified for purely financial reasons; • others will enable the producer to gain a marketing advantage, for example by building brand reputation; • others may be undertaken to avoid encouraging regulatory action; and • others – probably most - may result from a combination of reasons and motives. (UNEP, 2012) **Changes in the prices of materials** may alternatively encourage and threaten recycling (for example current moderately high metals prices may collapse, leaving recovery operations financially uneconomic even if still environmentally beneficial). (UNEP, 2012) **Private sector involvement** The need to harness the efforts of the private sector in various different roles – producers, suppliers, service deliverers, recyclers, traders as well as first line generators of waste streams; (UNEP, 2012) Improve understanding of market conditions in recycling (*Lead Market Initiative for Europe, Mid-term progress report, 2009*) Possibility that environmentally damaging or hard-to recycle products will be taxed. (*ZeroWin*)
Specificity for the green economy	Economic instruments are major drivers of greening the waste sector.
Probable impact on the green economy spheres	**Economic: impact depends on levels (+/-)** They might have positive as well as negative impact and this is closely dependent on their levels. A high landfill tax will divert waste from landfill and favour economically other waste management sectors (i.e. incineration) while a low tax will attract it. **Environmental: impact (+)** The environmental impact depends on the waste management option which is stimulated by the level of economic instruments. **Social: depends on level** The choice of waste treatment methods (and associated employment) depends on the level of taxes and fees. **Territorial: neutral**
Trade-offs: mixed +/-	The level of taxes triggers a change in attitude of economic actors. Therefore the levels of taxes (landfill, incineration, etc.) should be set in such a way that

impacts on green economic spheres?	the biggest incentive is to treat waste in the best possible way from a waste hierarchy point of view.
Interactions with other factors	Economic drivers are closely linked with the available administration to implement them.
Spatial level of operation	National
Type of market force involved	Economic instruments determine behaviour of market players in the framework of waste management systems. They determine the treatment methods but also the prices of recycled materials versus vergin materials.
Policy recommend ations: making the link between policy and non-policy factors	Adoption of new policies should be accompanied with carefully designed economic instruments which should send the right signals to the economic operators and stimulate waste treatment methods high on the waste hierarchy.
Possibile indicators	• Level of landfill tax and landfill gate fee • Level of incineration gate fee • Level of cost recovery

VI. Size of the recycling economy

1. Employment in the waste sector

1.1. Types of jobs

Recycling practices vary from automated to manual. Recycling can also be carried out within different economic entities: municipal governments, private companies, neighborhood associations, and others. These differences lead to a great variety of waste-related jobs in terms of required skills, health and occupational conditions, and wage levels. As a note of caution it has to be kept in mind that in some countries (including countries in the EU) recycling work is performed by an informal network of scrap collectors who collect the recycled materials for revenue. Therefore, efforts for increased recycling should be accompanied with increased work environment requirements.

1.2. Jobs by way of waste treatment

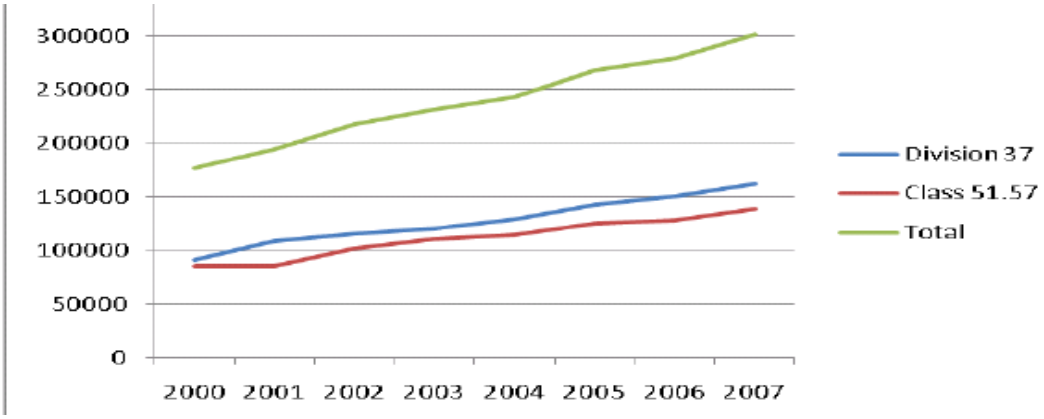
Studies show that recycling is not only preferable to landfills and incineration from an environmental perspective, but also creates more jobs. A study of the three U.S. cities of

Baltimore, Washington, D.C., and Richmond found that 79 jobs were required for every 100,000 tons of materials collected and sorted, and another 162 jobs for processing, for a total of 241. This is 10 times the job potential of waste disposal. (*Waste watch*)

1.3. Employment trend

A recent study revealed that the annual growth in employment in this sector was about 7 % per year between 2000 and 2007 (ETC/SCP, 2011). The overall employment at the EU level has been steadily increasing, from 176 826 in 2000 to 301 492 in 2007 for two types of activities – processing of recyclable materials and transportation of recyclables. This represents the increase of 70% between 2000 and 2007. This figure also represents an increase of 45% per one million inhabitants from 422 to 611. When including the other activities, such as collection of recyclables from households, transport of materials processing of materials at the manufacturing stage, the number will most likely increase substantially. (*ETC/SCP, 2011, Green economy and recycling in Europe*)

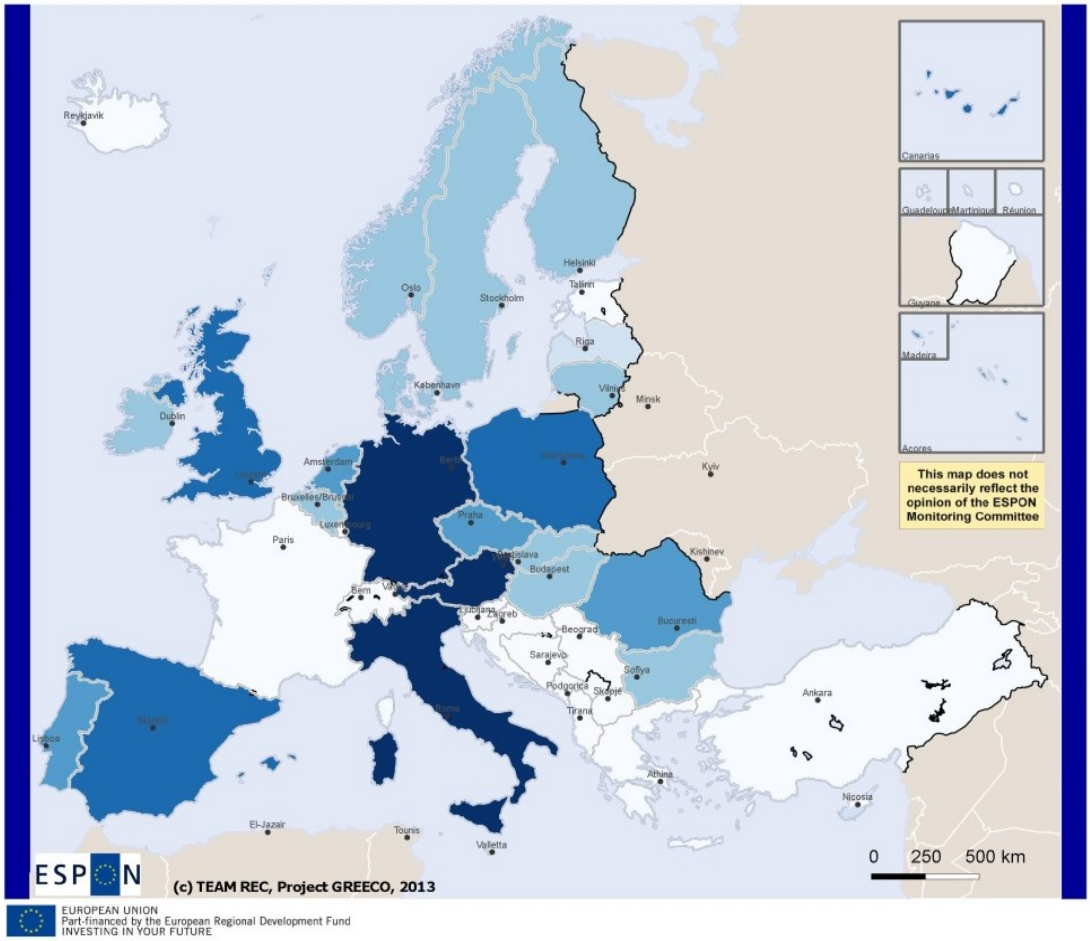
Figure 27 Total number of persons employed in recycling activities classified as NACE Rev 1.1 Division 37 and Class 51.57 in the EU, Norway and Switzerland, 2000-2007



Source: ETC/SCP, 2011, Green economy and recycling in Europe

It is further estimated that more than 560 000 new jobs could be created if the EU achieved a recycling target of 70 % for key materials (*Friends of the Earth, 2010*).

Figure 28 Employment in waste collection, treatment and disposal activities, NUTS 0, 2009



Source: Eurostat

We can observe that the highest number of employment has been achieved in Germany, Austria and Italy followed by the UK, Spain and Poland.

Table 32 Employment in the three sub-sectors of waste management per one million inhabitants in the EU. Collection rate index.

Country*	Employment per population of one million			Index of collection rate for recyclables
	Collection**	Treatment & disposal***	Material recovery****	
Czech Republic	2162	347	618	72
Latvia	1654	133	315	44
Bulgaria	1483	123	306	49
Italy	1476	295	318	62
Slovenia	1289	174	739	43
Romania	1289	42	666	39
Spain	1241	215	131	62
Luxembourg	1182	203	670	94
Netherlands	1148	328	205	91
Norway	1040	-	-	98
Austria	1031	260	223	89
Slovakia	993	291	340	71
Sweden	946	115	524	98
Lithuania	940	364	489	55
Estonia	913	275	465	56
Poland	786	197	298	44
Hungary	740	784	253	54
United Kingdom	640	410	398	59
France	606	397	488	65
Portugal	570	389	300	57
Finland	360	340	268	81
Belgium	315	611	421	100
Cyprus	239	-	272	36
Average	**1070**	**301**	**421**	**66**

Source: ETC/SCP, 2011, Green economy and recycling in Europe

As it is noted in the Green economy and recycling in Europe report, it is difficult to see correlation between the level of recycling and the people employed in the industry. At the same time differences in employment vary significantly and while more than 2,000 people are in charge in the collection of the waste of one million people in the Czech Republic, around seven times fewer people are needed in Belgium. The differences in treatment and disposal employment are slightly smaller and most countries fall into the 200-400 employed category.

Box

In the United Kingdom, the British Metals Recycling Association reports an annual turnover of $12 billion (£6 billion), 15 million tons of materials recovered, and some 8,000 direct employees.

(*UNEP, Green Jobs, Towards decent work in a sustainable, low-carbon world, 2008*)

According to a study by the London South Bank University, the principal business opportunities in waste management are in collection, brokering, processing, end-use, remanufacture and recycling technologies. The most significant job opportunities are in the recycling of waste electrical and electronic equipment and plastics2 with an estimated 40 jobs per tonne of material processed from the former and 15.6 from the latter.

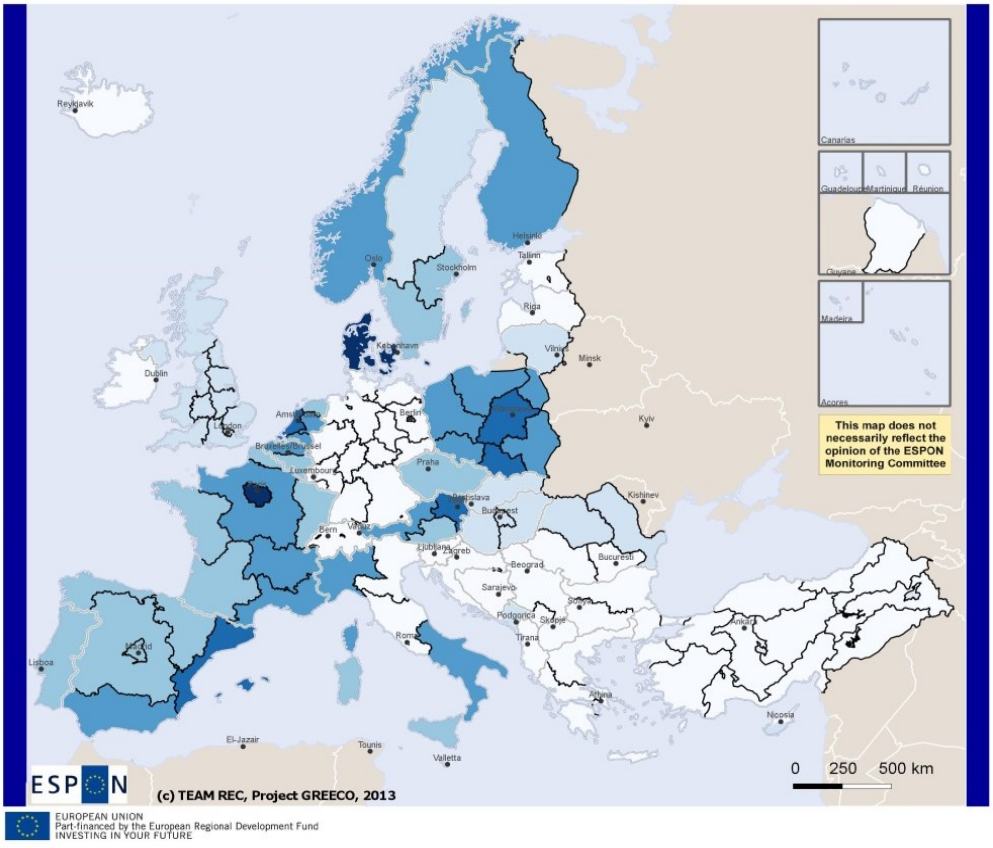
[2] "Jobs from Recycling", Local Economy Policy Unit, London South Bank University, 2004.

2. GVA in the waste sector

2.1. GVA in the waste sector by country

The turnover of seven of the recyclables (glass, paper & cardboard, plastics and the above mentioned metal groups) has increased by almost 100% from about 32.5 billion Euros in 2004 to 60.3 billion Euros in 2008. The amount of and the importance of exported recyclables out of the EU has increased since 2000 until the financial crisis started in 2008. However, the turnover of recyclables has already recovered quite a lot in the second half of 2009. The export value of recyclables out of the EU is now larger for precious metals, plastic waste, paper and cardboard waste than the internal trade within the EU. (ETC/SCP, 2011, Green economy and recycling in Europe)

Figure 29 GVA for Waste collection, treatment and disposal activities, material recovery (E38), NUTS 1, 2009



GVA for Waste collection, treatment and disposal activities, material recovery (E38), NUTS 1, 2009

- No data
- 0.0013 - 24.0000
- 24.0000 - 72.0000
- 72.0000 - 124.0000
- 124.0000 - 201.0000
- 201.0000 - 298.0000

Source: Eurostat

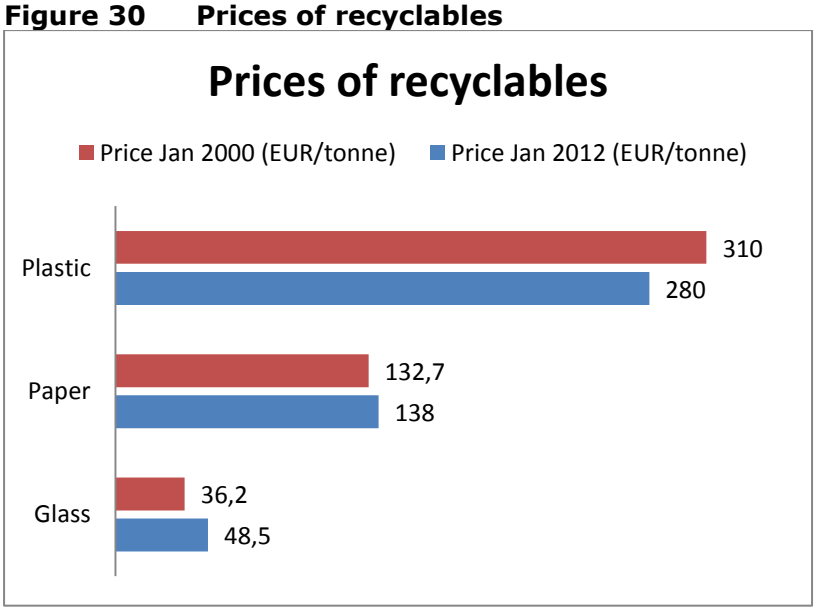
2.2. Additional economic benefits from greening the waste sector

Investing in greening the waste sector can generate multiple economic and environmental benefits. Recycling leads to substantial resource savings. For example, for every tonne of paper recycled, 17 trees and 50 per cent of water can be saved. By recycling each tonne of aluminium, the following resource savings could be accrued: 1.3 tonne of bauxite residues, 15 m3 of cooling water, 0.86 m3 of process water and 37 barrels of oil. These are in addition to the avoidance of 2 tonnes of CO2and 11 kg of SO2 released. In terms of new products, the Waste to Energy (WtE) market was already (UNEP Report, 2011)

2.3. Inherent value of waste

Some waste streams have a high economic value. For example, the platinum embedded in catalytic converters of scrapped cars exported from Germany to Africa amounts to about a third of annual platinum use in Germany. Although exports of waste are nowhere near the scale of global trade in raw materials, some waste streams and end-of-life products are receiving increased attention to minimise loss of resources. (SOER Report**)**

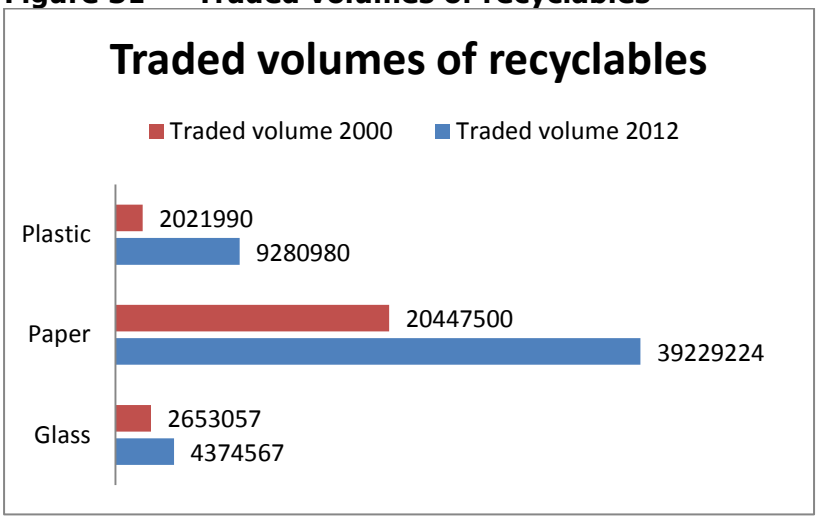
Figure 30 Prices of recyclables



Source: Eurostat

Prices of paper and glass have been growing slowly through the years while the price of plastic has been more volatile. In January 2004 it reached a low of around 240 EUR/tonne and in January 2007 it reached a high of around 370 EUR/tonne.

Figure 31 Traded volumes of recyclables



Source: Eurostat

The traded volumes have increased significantly between 2000 and 2012: 4.6 times for plastic, 1.9 times for paper and 1.64 times for glass.

2.4. Two scenarios: partial versus full implementation of waste legislation

Table 33 Turnover of waste management and recycling as well as in jobs for two types of scenarios

Parameter	Unit	Scenario A	Scenario B	Difference (B-A)	Difference (B-A) in %
Turnover in 'waste management' sector	MEUR	90,200	92,400	2,400	2.4%
Turnover in 'recycled materials' sector	MEUR	54,800	94,400	39,600	72.3%
Total turnover	MEUR	145,000	186,800	41,800	28.8%
Jobs in 'waste management' sector		1,434,900	1,469,900	35,000	2.4%
Jobs in 'recycled materials' sector		512,300	882,200	369,900	72.2%
Total jobs		1,947,200	2,359,100	404,900	20.8%

Source: EC, 2011, Implementation of EU waste legislation for green growth, Final Report

Scenario A: No further development of the waste management systems as compared to 2008
Scenario B: Full implementation of waste legislation

VII. New technologies

Existing new technologies are one of the main drivers for greening the waste sector. These are associated with collection; reprocessing and recycling waste; extracting energy from organic waste; and efficient gas capture from landfills. The production of these technologies is also considered as a part of the waste management related economy.

1. Collection and transportation of waste

The equipment associated with waste collection is an industry apart. Technology includes compactor trucks, fore-and-aft tippers, container hoists, open-or-closed top tailers, etc..

2. Recovering energy and other useful products from waste

Waste-to-Energy (WtE) technologies have replaced incineration without energy recovery in many countries. These installations have to comply with the norms of the Waste Incineration Directive. The waste burned in these installations includes residual MSW, commercial, industrial and RDF. There are a number of new technologies which do not involve incineration. These include thermal technologies (gasification, thermal depolymerisation, pyrolysis, plasma arc gasification) and non-thermal technologies (anaerobic digestion, fermentation, MBT, etc.).

3. Processing organic wet waste

Mechanical and biological treatment (MBT) technologies are pre-treatment technologies which contribute to the diversion of MSW from landfill. MBT is a term for an integration of several mechanical processes commonly found in other waste management facilities such as Materials Recovery Facilities (MRFs), composting or Anaerobic Digestion plant. MBT plant can incorporate a number of different processes in a variety of combinations. Additionally, MBT plant can be built for a range of purposes. [3]

4. Converting energy-rich components of waste into useful products

Refuse Derived Fuel (RDF) is a popular product derived from high-calorific-value waste using a waste converter technology. RDF consists of plastic and biodegradable waste. RDF can be used for electricity production and in cement kilns.

5. Recycling plastic

A greater variety of technologies are needed than other waste types. The reasons are differences in the purity of post-producer and post-consumer waste (European Commission, 2008c) and varying treatment needs for different types of plastic (ACRR,

[3] DEFRA, 2013, Mechanical Biological Treatment of Municipal Solid Waste

2004). For example, plastic bottles made of PET (polyethylene terephthalate) cannot be recycled together with transport packaging made of LDPE (low.density olyethylene).

6. Sorting of paper and cardboard

Paper and cardboard wastes are sorted and traded in more than 50 different qualities. Sorting of paper and cardboard wastes is still dominated by manual sorting. This is connected with an increased need to check the quality of collected paper. Before non-contact quality sensors (particularly near infrared spectrometry) emerged a few years ago, quality control methods had particularly consisted of pulping-screening devices (Cost Action E48, 2010). Innovations for recycling paper, such as multiple loop flotation deinking systems dispersers (3) and fractionation (4) have been developed and introduced to the market in the last couple of decades (Cost Action E48, 2010). Previously, fibres from recovered materials were mainly used to produce brown grades of paper and cardboard but the introduction of new technologies means that white grade paper can be produced, suitable for newsprint and magazines (Cost Action E48, 2010). (EEA, 2011, Earnings, jobs and innovation: the role of recycling in a green economy)

VIII. Way ahead. Recommendations for policy makers

1. Greening of the waste sector

- ✓ Greening of the waste sector should be associated first and foremost with waste prevention and only when this is not possible - with moving waste management from methods low on the waste hierarchy (landfilling) to methods high in the waste hierarchy (recycling). This is despite the fact that more generated waste will generate more value according to the NACE and EGSS classifications.

- ✓ Product design plays a crucial role in the amount and type of waste generated. Products can be designed so that they can be repaired, re-filled or re-used. The type and combination of materials and hazardous substances used is crucial for the recyclability of a product. Currently, the incentives for product designers and manufacturers to design products that are long lasting, repairable, refillable, and easily recyclable are weak. These need to be enhanced and new business models developed that make these types of products, services and product-service-systems attractive and economically viable.

- ✓ The EU Eco-design (2009/125/EC) sets a framework for specifying eco-design principles and requirements for energy-related products, including design principles related to resource use and waste. Yet the focus in implementation so far is clearly on energy aspects. The EU Ecolabel is another instrument to guide design towards more resource-efficiency but it has had only limited influence on the overall market.

- ✓ There are many concepts for better design, including the cradle-to-cradle concept which requires the use either of non-toxic, non-harmful synthetic materials that have no negative effects on the natural environment and can be used in continuous cycles as the same product without losing their integrity or quality, or of organic materials that, once used, can be disposed of without negative environmental impacts (Braungart and McDonough, 2002).

- ✓ Greening of the waste sector should also be closely associated with industrial ecology where waste of one industry becomes raw material for another one. Closely related terms include 'closed-loop' system, circular economy and zero-waste system. Treating the waste close to the place of origin is also an important aspect of greening the waste sector. Therefore, regions and cities have a key role to play in setting up industrial ecology systems.

- ✓ Waste treatment should be considered a part of the green economy as it addresses all three dimensions of the green economy – environmental, social and economic. However, it should be considered genuinely green under two conditions: that all possible efforts are done to prevent as much waste as possible and under the condition that there is a constant move from landfilling to materials recovery. The higher in the waste hierarchy the waste management method is the 'greener' the job and the GVA.

- ✓ NACE classification does not capture the two most desirable approaches to waste – waste prevention and waste recycling. Within the framework of the NACE classification the goal should be increase 38.3 (materials recovery) for the sake of part of 38.2 (landfilling).

2. Territorial dimensions of waste management

- ✓ Waste management has a very strong territorial dimension as it is closely linked to the characteristics of the territories. Cities are big generators of Municipal Solid Waste (MSW) and urban industrial areas are responsible for manufacturing waste generation. City waste governance is extremely important for introducing innovative management solutions and therefore cities should be enabled to provide this.

- ✓ Waste management approaches are closely correlated to land use and land management. Landfilling – the least desirable waste treatment option – leads to highest land consumption which might be highly problematic in densely populated areas.

3. Multi-level governance

- ✓ Waste is a perfect example of the importance of multi-level governance. Cities are instrumental to awareness raising, industrial ecology, separate collection

and recycling. Regions are better placed to organize functioning regional waste management systems. National level is in charge of overall policy making.

- ✓ Good multi-level governance is key to a successful waste management system. This means good policy making on national level, strong regional coordination and innovative local solutions. Strong vertical links are indispensable in this system. Additionally, cities generate huge quantities of waste and hold a key to better waste management through awareness-raising and separate collection of waste.

- ✓ Green city strategies should contain waste management as their integral part. The density of population and sheer quantity of waste offers the possibility for innovative solutions.

- ✓ Being home to a big number of industrial processed cities should explore the options of establishing zero-waste systems where outputs of one sector that become the input of another create a circular economy.

- ✓ Regions are extremely important players in greening the waste management sector as they are well-placed to coordinate the efforts of individual municipalities and to establish integrated waste management systems.

- ✓ Cooperation between municipalities is also of utmost importance as very often the integrated waste management systems are regional. This requires an advanced level of cooperation culture which should not be taken for granted. The development of waste management has shown that the optimal territory for modern waste management is the region and not the municipality (with the exception of big cities).

- ✓ Although waste management responsibilities are mainly in the public domain private operators have a great deal of expertise and know-how to contribute first as contractors of a big number of waste management related services and secondly as waste generators who can influence their own waste management practices.

- ✓ Personal behavior is of utmost importance for waste management. Therefore, regional and municipal authorities should foster awareness continuously.

4. Waste management as an economic bottom line

- ✓ Policy-makers and businesses should be aware that there is a close correlation between better waste management, better resource efficiency and higher profits. This economic bottom line should be incorporated as an important driver for change.

- ✓ The main goal of policy makers should be breaking the linkages between economic growth and waste generation or an absolute decoupling. All policy efforts should be aimed at that direction.

- ✓ Waste has strong market dimensions despite being classified as a non-market activity in EGSS. These market dimensions should not be underestimated: market of recycled goods and materials in competition with virgin ones; market dimensions of industrial eco-systems; and competition between different methods of waste management.

- ✓ Despite data limitations, studies have indicated that the waste management market is growing. UNEP has identified four factors are driving this growth: the overall increase in the volume and variety of the waste generated; rising political awareness of the need to better manage waste; urbanization and strife for a better living environment; development of formal and informal trade in secondary raw materials recovered from waste.

5. Waste as a horizontal sector

- ✓ Bioeconomy and waste are linked through agricultural production but also through the waste generated by the food manufacturing sector and households through food consumption. Regions and municipalities are in the position to address some aspects of this specific sector of waste. Bio waste can also be used for the production of bio gas. Food and vegetable waste prevention could be achieved by better planning and logistics in the food industry.

- ✓ Excessive waste generation is one of the pressures exerted by the tourist industry. Tourist municipalities should explore approaches to better waste management in peak season but also involving the tourists and in this way greening both the waste and the tourist sectors. Relevant tourist operators should also incorporate better waste management in their operation.

- ✓ The building sector is a major waste generator of C&D waste. Regional authorities should look at ways of using recycled C&D waste through material substitution including through the process of urban mining. C&D waste prevention could be achieved by better planning of construction activities, extended use of off-site construction methods and an extension of the lifetime of buildings;

- ✓ Energy and waste sectors are closely linked. Efforts of national and regional authorities should be in two directions: minimization of waste generation during energy production but also finding innovative ways of producing energy from waste.

- ✓ The manufacturing sector is the cause of a big part of waste generation in Europe. However, it could also be the solution. There is a need for national and regional governments to work together with the manufacturing sector in order to tackle waste prevention and waste recycling whenever prevention is not

possible. Regional and municipal authorities are well-placed to establish industrial ecology networks.

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