



# Incineration overcapacity and waste shipping in Europe: the end of the proximity principle?

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# 1 Introduction

The approval of the Waste Framework Directive<sup>1</sup> -WFD- introduced some important changes in the European waste market.

One of the most relevant issues regarding environmental impacts of the WFD is that it opened the incineration market at a European level. This means that the evaluation of the needs of incineration capacity can be assessed at a European level, and that transport of waste between countries is allowed without notification provided that they are treated in waste incineration facilities that can be considered as energy recovery installations according to the efficiency formula set in the Directive.

This opens the door to the construction of new incineration plants in countries that already have a high share of waste incineration, and can have a negative effect on the achievement of high recycling rates. This also opens the door to the increase of waste shipping within the EU, which contradicts the principle of proximity set out in the WFD. On the other hand, the fact that waste shipping for incineration with energy recovery does not need authorisation creates a lack of information and threatens the recycling goals set by the Waste Framework Directive.

This document addresses the legislation in force in the EU regarding waste management and waste shipping; the current situation of waste incineration and waste shipping within the EU, focusing on the question of overcapacity; and the prospects for the next years, focussing on the impacts of waste incineration overcapacity on the achievement of an environmentally sound waste policy.

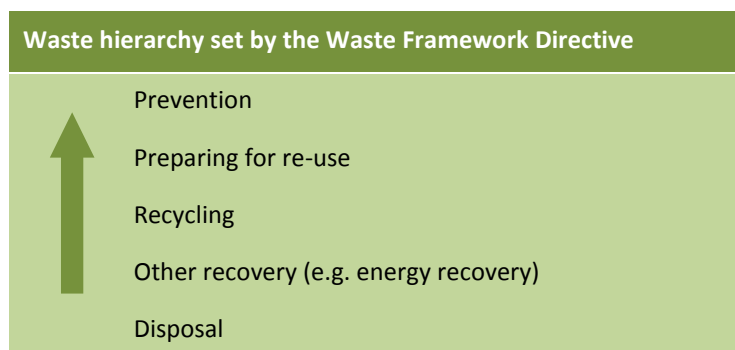
## 1.1 Legislative framework

The main Directive regulating the management of waste within the European Union is the Waste Framework Directive.

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<sup>1</sup> Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives.

- **Waste Framework Directive** (2008/98/EC): it establishes the following hierarchy that shall be applied as a priority order in waste management activities:



It also establishes the following targets:

Targets set by the Waste Framework Directive	
Year	Target
2015	Separate collection: at least paper/metal/plastic/glass
2020	50% recycling

According to the Directive, incineration must be considered a disposal operation and will only be considered as recovery where the energy efficiency of the process is higher than the one detailed in Annex II of the Directive.<sup>2</sup>

The WFD establishes the principle of self-sufficiency and proximity (art. 16), according to which Member States shall take appropriate measures to establish a network of installations for the disposal and recovery of waste that allows waste to be disposed of or to be recovered "in one of the nearest appropriate installations". However, the Directive opens the door to a European waste market since it states that this network "shall be designed to enable the Community as a whole to become self-sufficient in waste disposal as well as in the recovery of waste" (art. 16),

<sup>2</sup> 0,60 for installations in operation and permitted before 1 January 2009 and 0,65 for installations permitted after 31 December 2008, according to the following formula:

$$\text{Energy efficiency} = (E_p - (E_f + E_i)) / (0,97 \times (E_w + E_f))$$

In which:

$E_p$  means annual energy produced as heat or electricity. It is calculated with energy in the form of electricity being multiplied by 2,6 and heat produced for commercial use multiplied by 1,1 (GJ/year).

$E_f$  means annual energy input to the system from fuels contributing to the production of steam (GJ/year).

$E_w$  means annual energy contained in the treated waste calculated using the net calorific value of the waste (GJ/year).

$E_i$  means annual energy imported excluding  $E_w$  and  $E_f$  (GJ/year).

0,97 is a factor accounting for energy losses due to bottom ash and radiation.

This formula shall be applied in accordance with the reference document on Best Available Techniques for waste incineration.

and to "enable Member States to move towards that aim individually, taking into account geographical circumstances or the need for specialised installations for certain types of waste".

The Directive also establishes that "Member states should be allowed to limit incoming shipments to incinerators classified as recovery, when it has been established that national waste would have to be disposed of or that waste would have to be treated in a way that is not consistent with their management plans" (art. 16). This means that if imports of waste avoid national waste to be incinerated in energy-recovery installations and this national waste need to be landfilled or burned in incinerators without energy recovery, the "receptor" State can limit the shipments.

There are other Directives that regulate certain aspects of waste management or certain waste streams, and that also set out targets in this field:

Targets set in other European Directives		
Directive	Year of the target	Target
Directive on the Landfill of Waste (1999/31/EC)	2016	Reduction of the biodegradable waste sent to landfill to 35% of the 1995 generation level
Directive on Packaging and Packaging Waste (94/62/EC)	2008	Minimum 55% recycling of packaging waste
Directive on Waste Electrical and Electronic Equipment (2002/96/EC)	2006	Minimum 50% recycling of WEEE

Another document that must be taken into account for waste management planning is the **Roadmap to a Resource Efficient Europe** (SEC (2011) 1068 final), which aims at designing a vision for EU in the horizon of 2050. This Roadmap highlights the need of turning waste into a resource and advocates for giving a higher priority to re-use and recycling and to limit energy recovery to non recyclable materials by 2020.

On the other hand, the shipping of waste is regulated at both EU and international levels. At the international level, exports and imports of waste are regulated by the Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their Disposal.<sup>3</sup> The Convention is implemented in the EU via the Waste Shipment Regulation:

- **The Regulation on Shipments of Waste** (EC/1013/2006): it streamlines the existing control procedures. It applies, among others, to shipments of waste between Member States, imported to EU from third countries and exported from EU to third countries. Shipments of waste for disposal within the EU are subject to the procedure of prior written notification and consent. According to the Regulation, "disposal" includes incineration on land, which means that waste

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<sup>3</sup> It was signed in 1989 and entered into force in 1992.

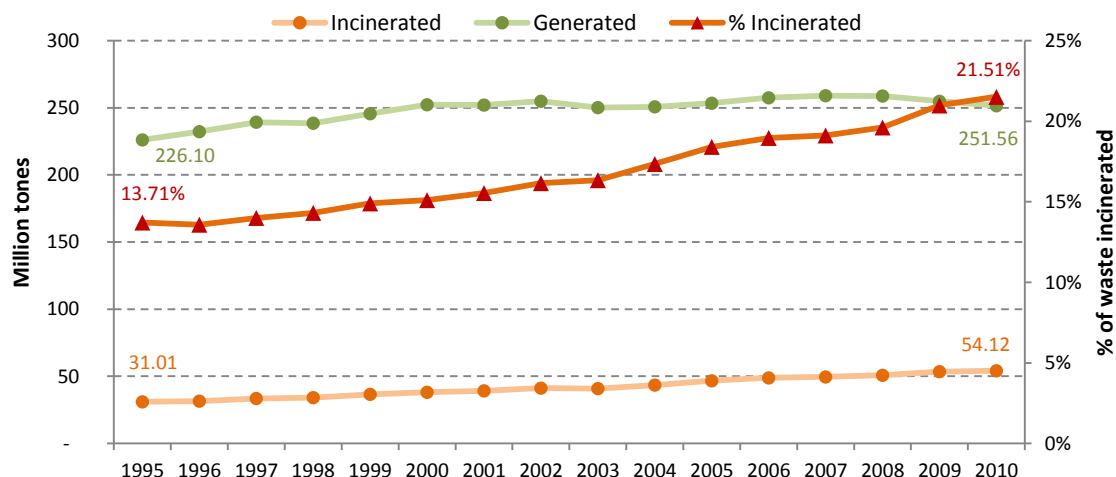
shipped for incineration must be notified.<sup>4</sup> The Regulation also states that Member States can implement bans on imports or exports regarding waste disposal, whereas for recovery Member States have more limited possibilities for objecting to imports and exports. According to the Regulation, "shipments of mixed municipal waste collected from private households (...) to recovery or disposal facilities" shall be subject to the notification procedure (art. 3).

Most of the principles applied for shipments within the EU also apply in the European Free Trade Association (EFTA) countries: Iceland, Liechtenstein, Norway and Switzerland.

## 1.2 Evolution of waste generation and waste treatment in Europe

Even though waste prevention and waste recycling are at the top of the waste hierarchy, the generation of waste in the EU has grown steadily during the last years, and so has the percentage of waste incinerated.

Graph 1. Household waste generated and incinerated in Europe from 1995 to 2010, and percentage of waste incinerated.

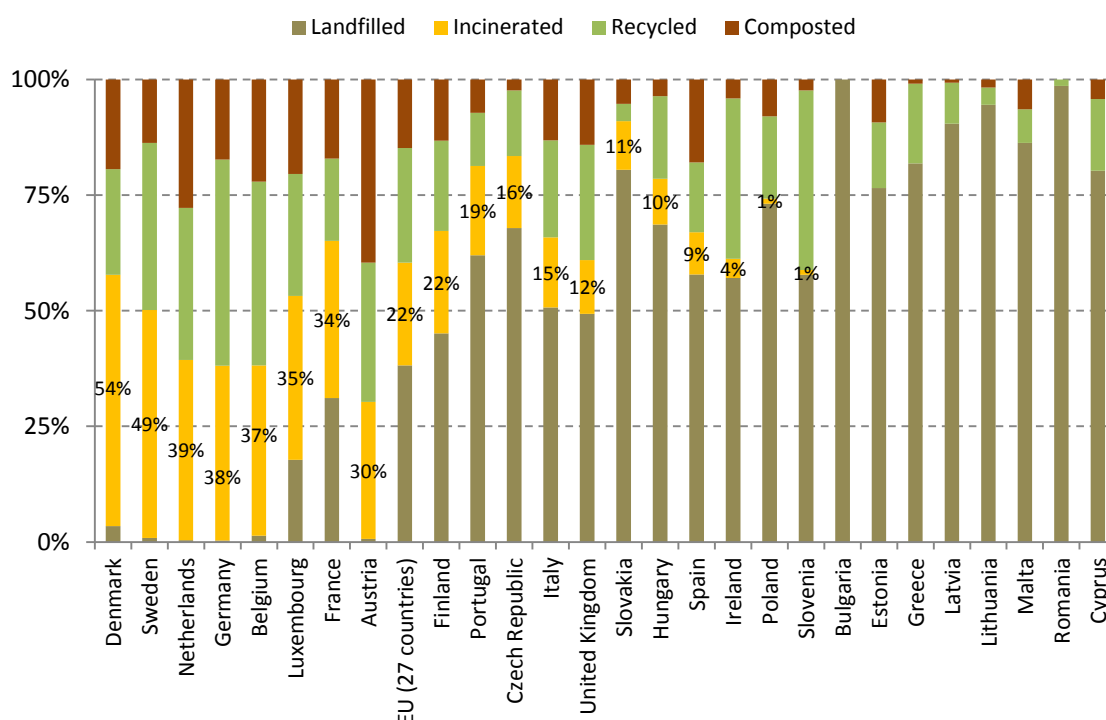


Source: Own elaboration from Eurostat data.

The situation of waste management varies very much among countries: some countries have a 0% landfilling, whereas others landfill most of its waste.

<sup>4</sup> However, operations that "use waste principally as a fuel or other means to generate energy" are classified as "recovery operations". This aspect was later clarified by the Waste Framework Directive, which included a requirement of minimum efficiency for considering incineration as recovery.

Graph 2. Waste treatment in the European Union in 2010, by countries.



Note: Countries have been sorted by their share of waste incinerated.

Source: Own elaboration from Eurostat data.

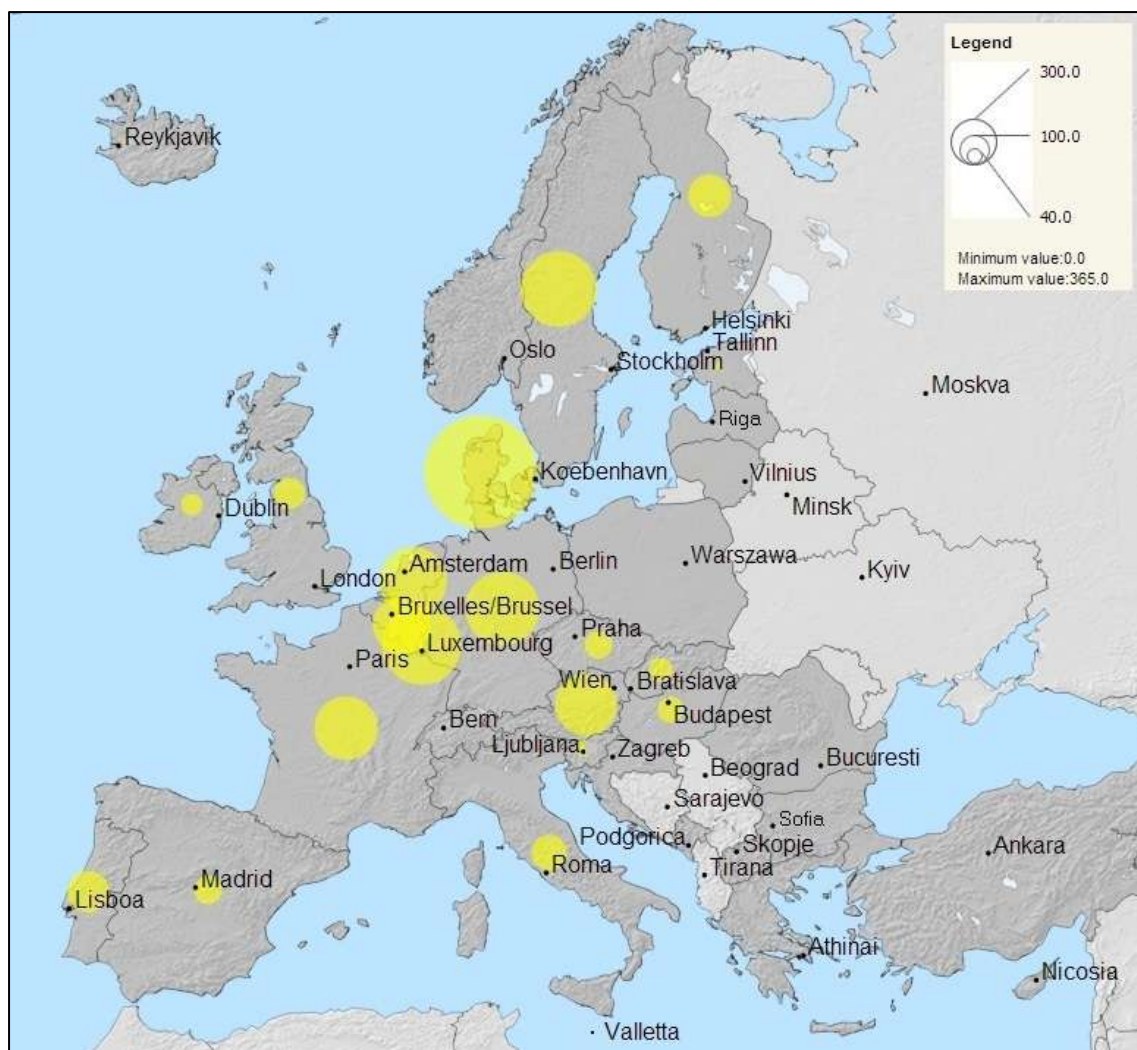
## 2 Current incineration capacity in Europe

Currently, there are 406 incinerators operating in the European Union.<sup>5</sup> There is no comprehensive data about the current incineration capacity installed in each country, so the total amount of waste incinerated can be taken as an approximation, although the capacity may be in some cases slightly higher, since not all incinerators operate at their full capacity. This was around 54 million tons per year in 2010.

Germany, France and Italy accounted for 63% of all incinerators and 64% of all waste incinerated (Graph 4). However, the countries with higher incineration rates measured in per capita terms are Denmark (365 kg/inhabitant), Luxembourg (240) and Sweden (226) (Graph 3).

<sup>5</sup> [www.cewep.eu](http://www.cewep.eu)

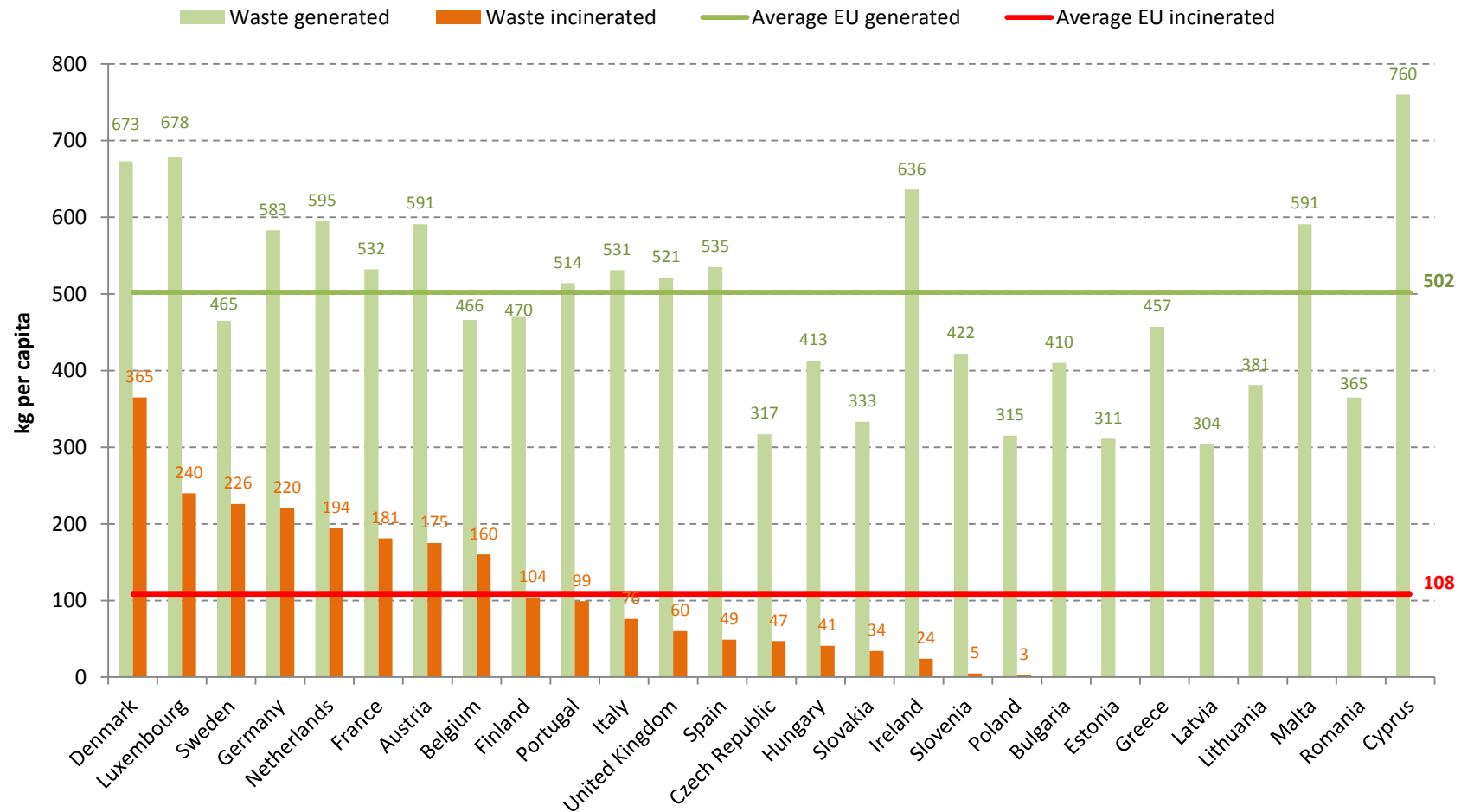
Figure 1. Waste incinerated in Europe in 2010 (kg per capita), per country.



Source: Eurostat (<http://epp.eurostat.ec.europa.eu>).

Eight Member States (Bulgaria, Cyprus, Estonia, Greece, Latvia, Lithuania, Malta and Romania) do not have incineration facilities. Most of them are located in Central and Eastern Europe and in the Baltic region.

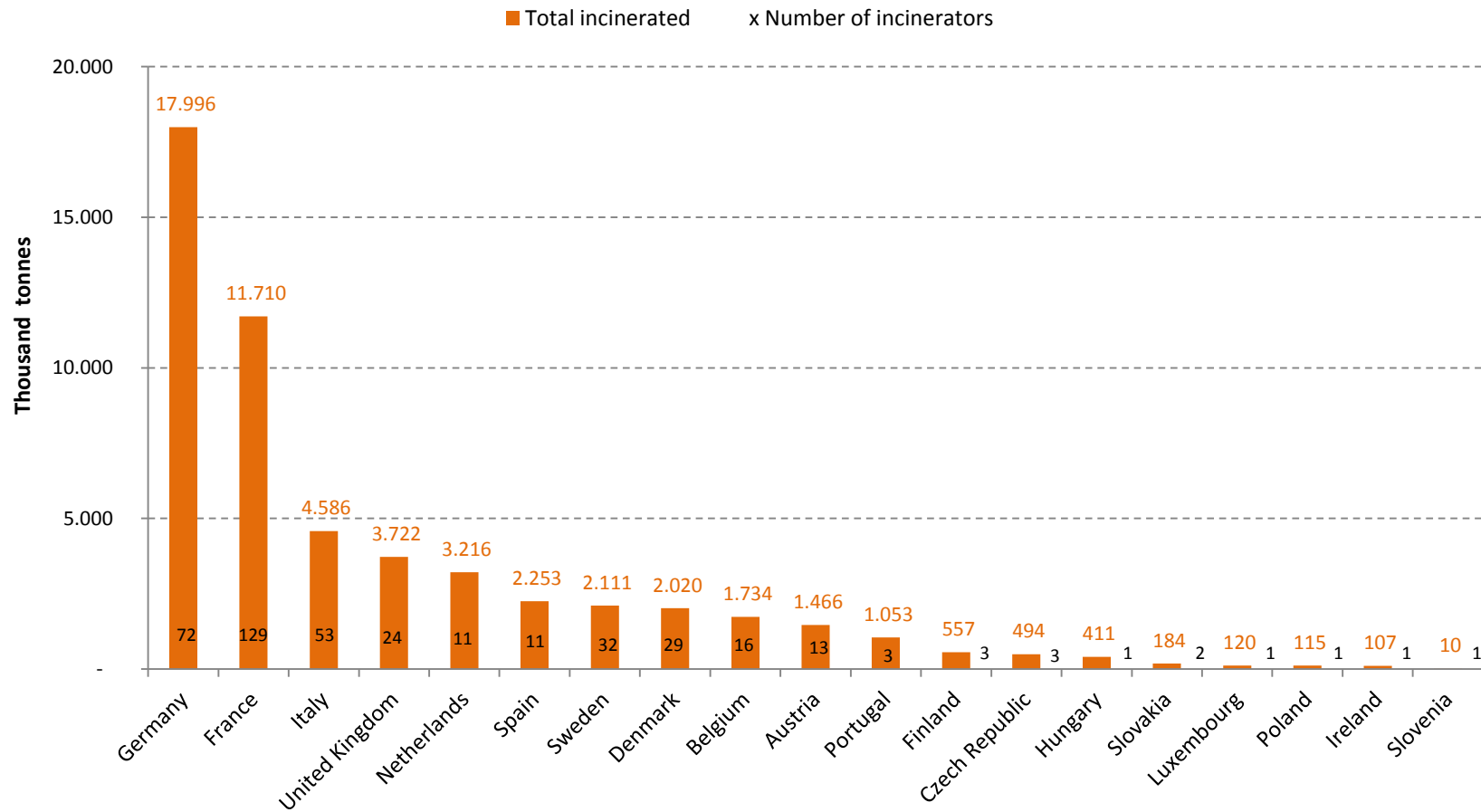
Graph 3. Waste generation and waste incineration per capita in Europe in 2010, per countries.



Source: Own elaboration from Eurostat (<http://epp.eurostat.ec.europa.eu>).



Graph 4. Total waste incinerated (in thousands of tons) and number of incinerators in Europe in 2010, per country.



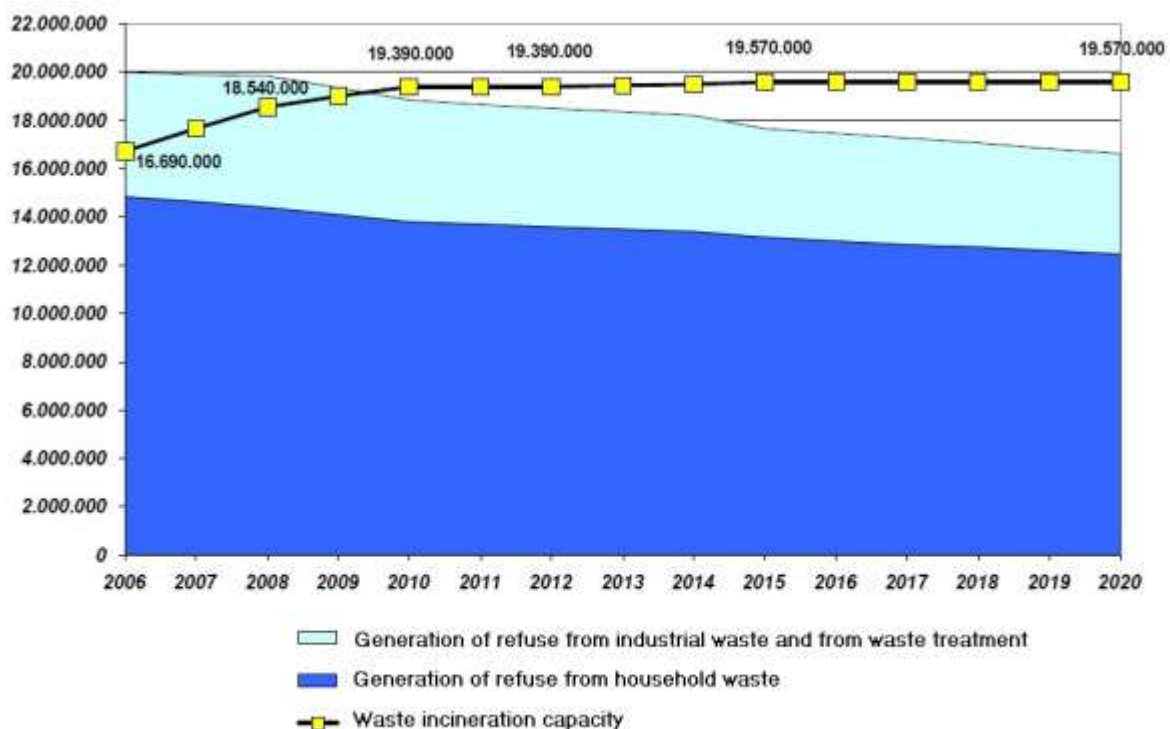
Source: Own elaboration from Eurostat (<http://epp.eurostat.ec.europa.eu>) and CEWEP ([www.cewep.eu](http://www.cewep.eu)).

## 2.1 Installed overcapacity and plans to enlarge it

Some Member States already have waste incineration overcapacity.

In **Germany**, for example, the current incineration capacity is already bigger than the national generation of refuse waste, according to a report commissioned by the German Union for Nature Protection (NABU, 2009). However, this capacity is expected to grow by 2020.

Graph 5. Installed and foreseen incineration capacity in Germany and current and foreseen potential waste flows for incineration (in tons), 2006-2020.

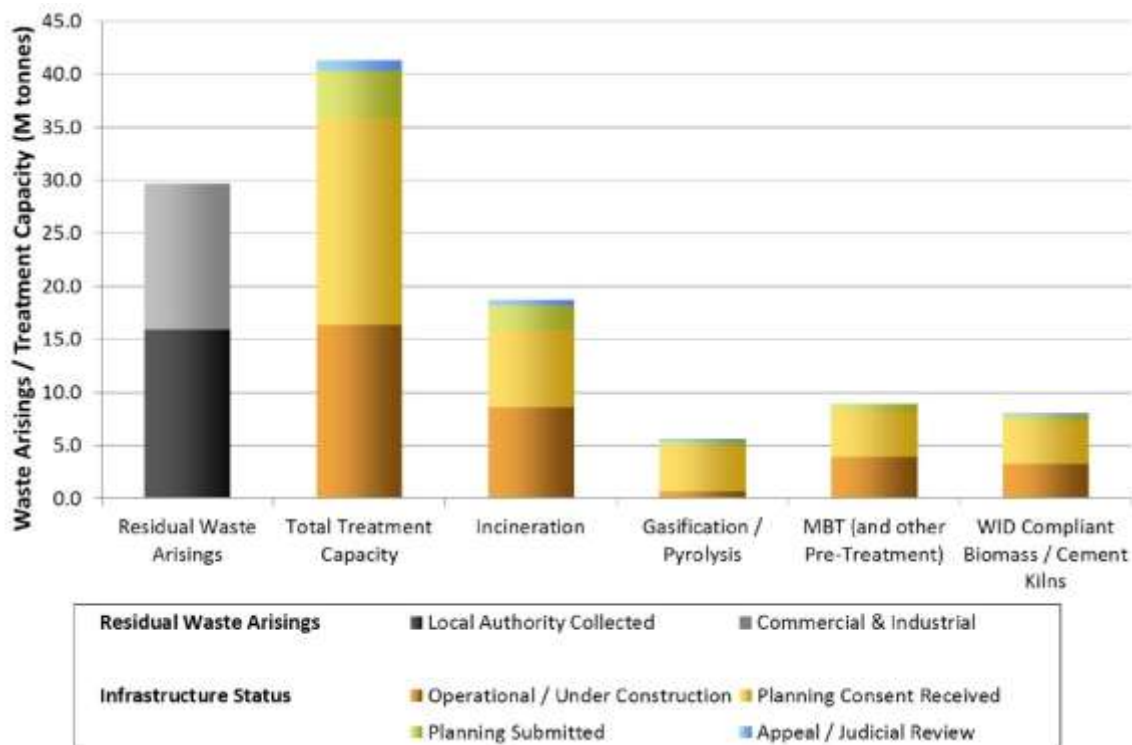


Source: Adaptation from NABU 2009.

According to a study commissioned by the German Ministry of Environment (Dehoust *et al.* 2010), a reduction of 5 Mt of refuse is expected for Germany by 2020, compared with the figures of 2006. Out of this 5 Mt, 3 Mt would have been sent for incineration, and 2 to mechanical-biological treatment. This means that the overcapacity of incineration would be at least of 3 million tons by 2020.

The **United Kingdom** is foreseen to have an overcapacity of 6.9 million tonnes of waste treatment capacity in the near future if the facilities that already have planning consent reach operation (Graph 6). However, a further 4.4 million tonnes of treatment capacity are seeking planning consent. Most of this overcapacity corresponds to incineration facilities (Eunomia 2012).

Graph 6. Residual waste arisings and treatment capacity in the United Kingdom.



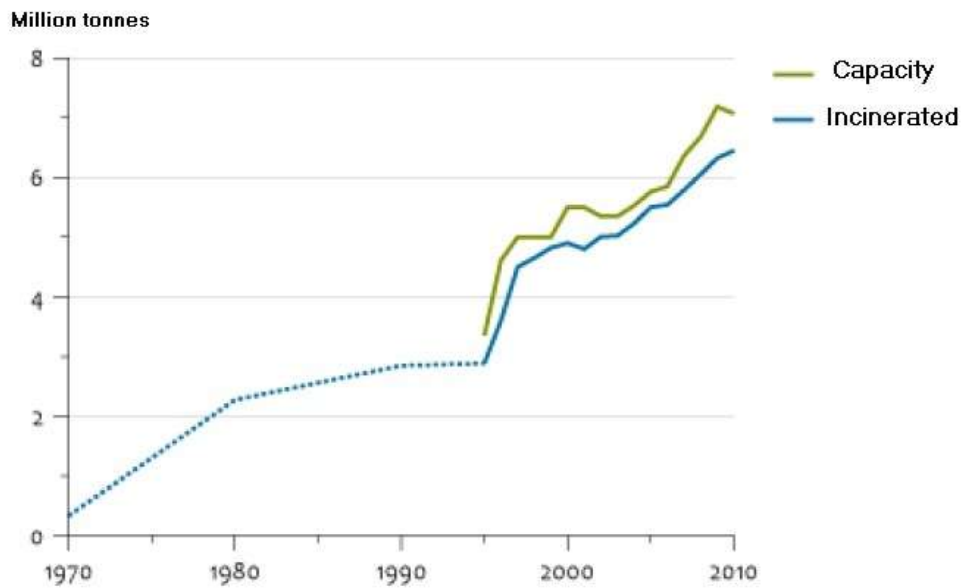
Source: Eunomia 2012.

Currently, the UK is exporting half of the solid recovered fuels (SRF) produced in the country - around one million tonnes- to other EU Member States that have overcapacity, like Germany or the Netherlands (Eunomia 2012).

In fact, in **The Netherlands** there is a current incineration overcapacity of around 10%,<sup>6</sup> caused by a declining availability of waste and overinvestment. That creates an important reliance of Dutch incineration facilities from waste imports, mostly from the UK. This demand is likely to increase, according to the Dutch Waste Management Association (Van Eijik 2012).

<sup>6</sup> Agentschap NL 2012.

Graph 7. Incineration capacity and waste incinerated in the Netherlands, 1970-2010.



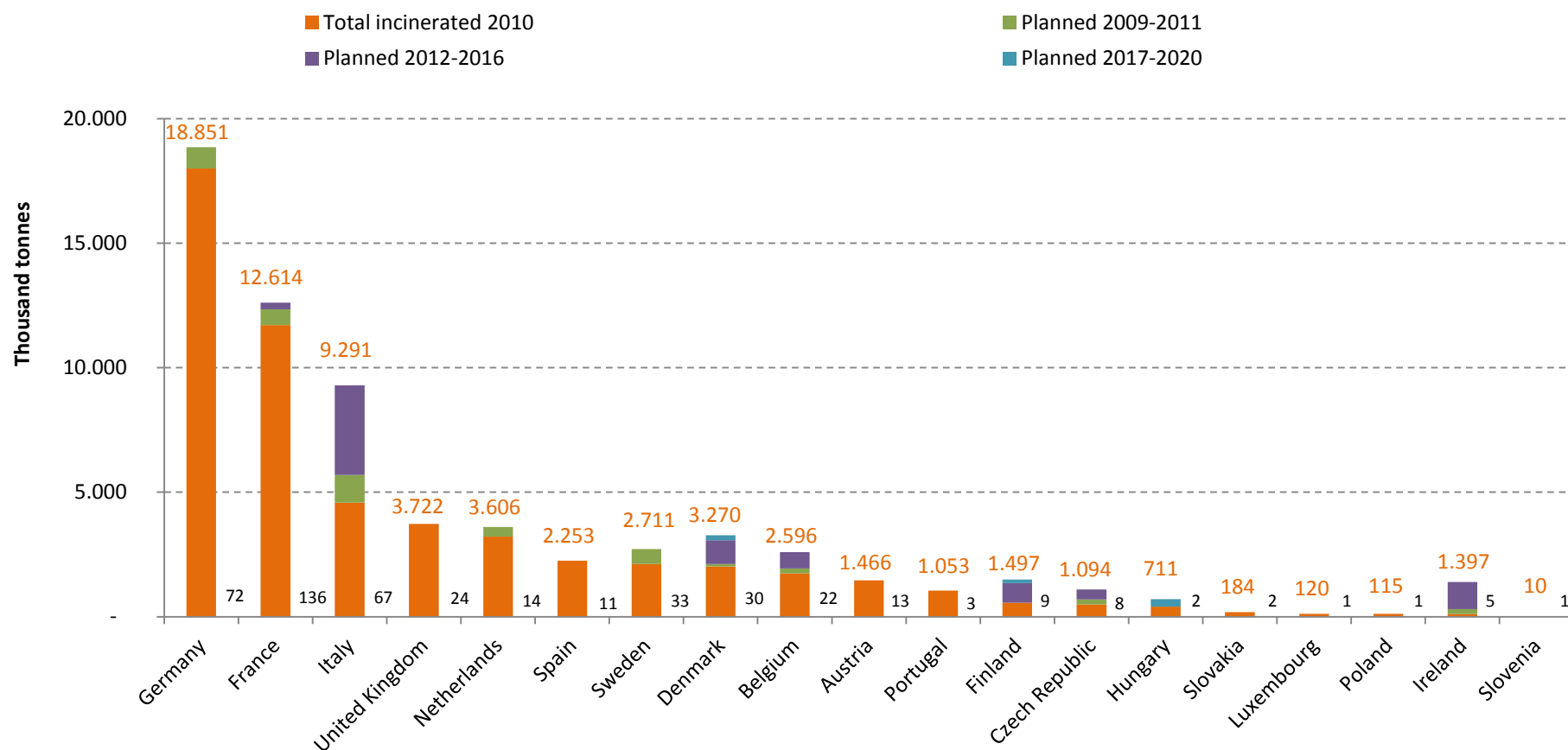
Source: Adaptation of CBS et al. 2012.

Furthermore, other countries like **Sweden** or **Denmark** also have incineration overcapacity, as well as plans to expand it.

Despite this existing overcapacity, according to a survey made by CEWEP (Confederation of European Waste-to-Energy Plants) in 2010, the incineration capacity in Europe is foreseen to grow in around 13 million tonnes up to 2020 through the construction of 48 new incinerators and the increase of the capacity of some of the existing facilities (Graph 8).

The increase in the incineration capacity in countries that have already an overcapacity may be mainly driven by the opening of the European market for incineration created by the Waste Framework Directive.

Graph 8. Amount of waste incinerated in 2010 and additional capacity of incineration planned for the periods 2009-2011, 2012-2016 and 2017-2020, by countries.



Note: Data in orange corresponds to the total capacity foreseen for 2020. Data in black corresponds to the total number of facilities foreseen for 2020. No data for Spain, Austria, Portugal, Slovakia, Luxembourg and Poland has been provided.

Source: Own elaboration based on CEWEP ([www.cewep.eu](http://www.cewep.eu)).

This overcapacity of incineration facilities is expected to grow in the EU in the near future if waste legislation is implemented. As mentioned in section 1.1, the Resource Efficiency Roadmap establishes that no waste that can be recycled or composted should be incinerated by 2020. This may create a much bigger gap between the incineration capacity and the waste effectively incinerated.

#### **The case of Mallorca**

The incinerator of Son Reus, in Mallorca, is classified as an incinerator with energy recovery. It was built in 1997 and had an initial capacity of 300,000 tons/year. This capacity was later extended to 730,000 tons/year, but there is not enough waste in the island to make it work at full capacity. In November 2012 the government of the region has been approved by the European Commission to import 200,000 tons/year of refuse-derived fuel from Italy. The shipment will be done by sea and will allow the incinerator an increase of 8 million euro of revenues.

Source: [www.tirme.com](http://www.tirme.com)

**Overcapacity has very high potential impacts on recycling markets and on waste treatment prices.** On one hand, investments in incineration facilities must be paid off and this creates a need of waste being sent to incineration, rather than prevented or recycled. On the other hand, if not enough waste is sent to incineration to pay off the investments, incineration fees must increase, which has an effect on waste charges paid by households and commercial activities.

Last, overcapacity represents a financial risk for investing companies and public bodies: in 2010 the Dutch Van Gansewinkel Groep closed one of its incinerators in Rotterdam due to overcapacity in the Dutch waste market (Berthoud 2011).

Therefore, planning overcapacity when the magnitude of the current and future waste flows

is not certain represents both an environmental and an economical threat.

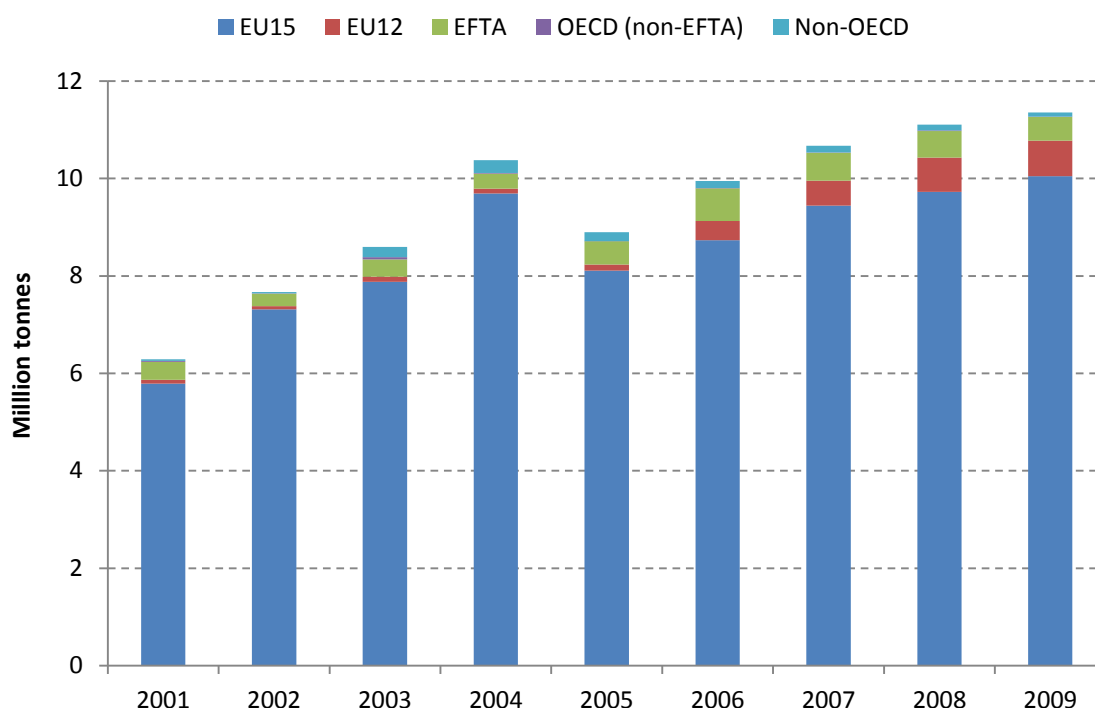
## **3 Waste shipments**

Since only shipments to incinerators below the energy recovery threshold (according to the Waste Framework Directive)<sup>7</sup> and shipments of mixed household waste must be notified there is a lack of information of shipments sent to incineration with energy recovery.

According to the information available, the quantity of notified waste exported from the EU Member States has increased significantly during the last decade. The destination of notified waste shipments is, in most of the cases, another country within the EU, but also other OECD and non-OECD countries (Graph 9).

<sup>7</sup> See energy efficiency formula detailed in chapter 1.1.

Graph 9. Shipments of notified waste from EU Member States to other EU and non-EU countries, 2001-2009.



Notes: EU-15: Old EU Member States, EU-12: New Member States.

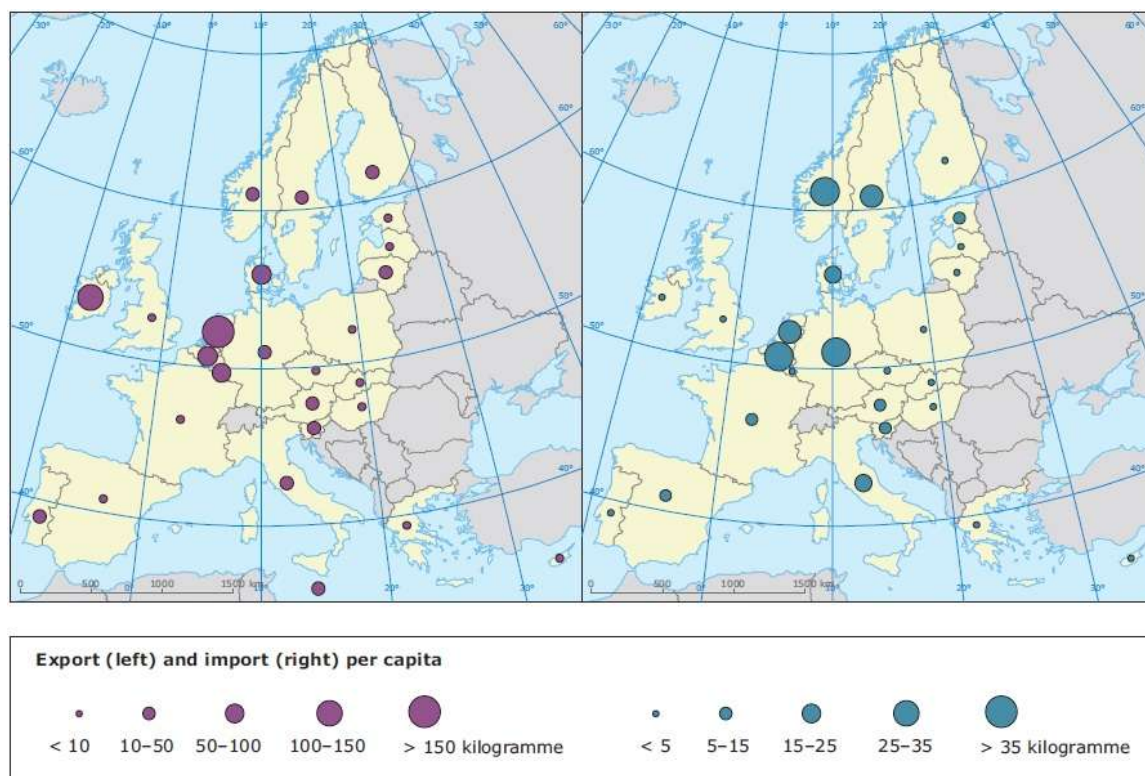
Source: European Commission 2012.

The reduction observed in the graph above between 2004 and 2005 is largely due to reduced waste exports from the Netherlands.<sup>8</sup>

Levels of exports and imports of notified waste differs among EU Member States. The most significant exporters are the Netherlands, Ireland, Luxembourg and Belgium, followed by Denmark and Lithuania. With regard to imports, the most significant importers (on a per capita basis) are Germany and Sweden, followed by Belgium and the Netherlands. This leaves an open question as to why some countries such as Belgium and The Netherlands have such prominent role as exporters and importers at the same time.

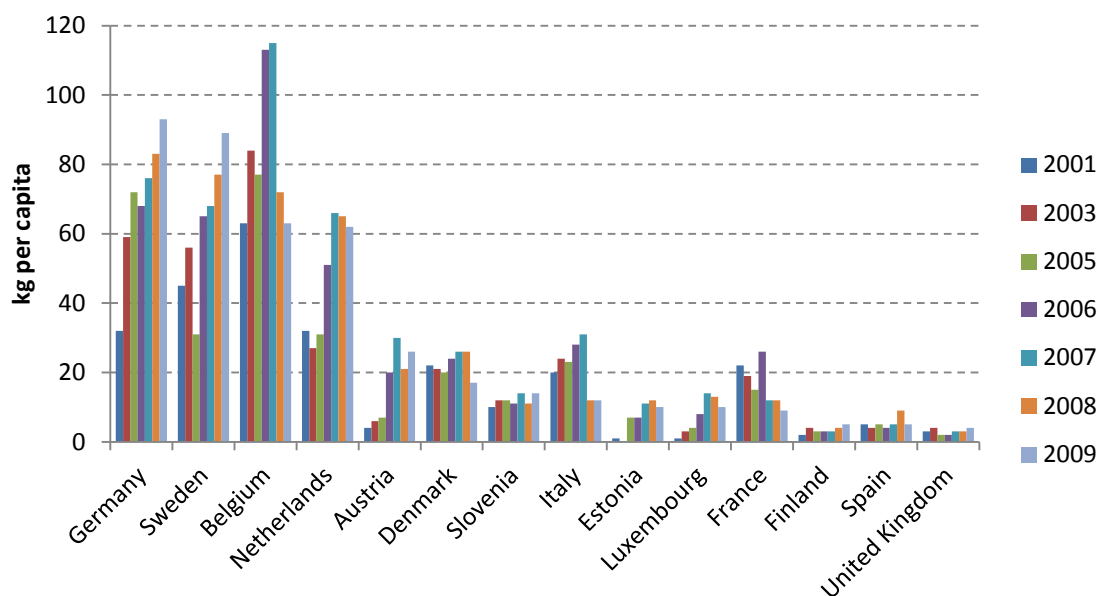
<sup>8</sup> One important factor for this change might be the enforcement of the landfill ban in Germany, since Germany received considerable amounts of household waste and waste incineration residues from the Netherlands in 2004 and before, but not in 2005 anymore (EEA 2009).

Figure 2. Exports and imports of notified waste in 2005 (kg per capita).



Source: EEA 2009.

Graph 10. Imports of notified waste, 2001-2009 (kg per capita).



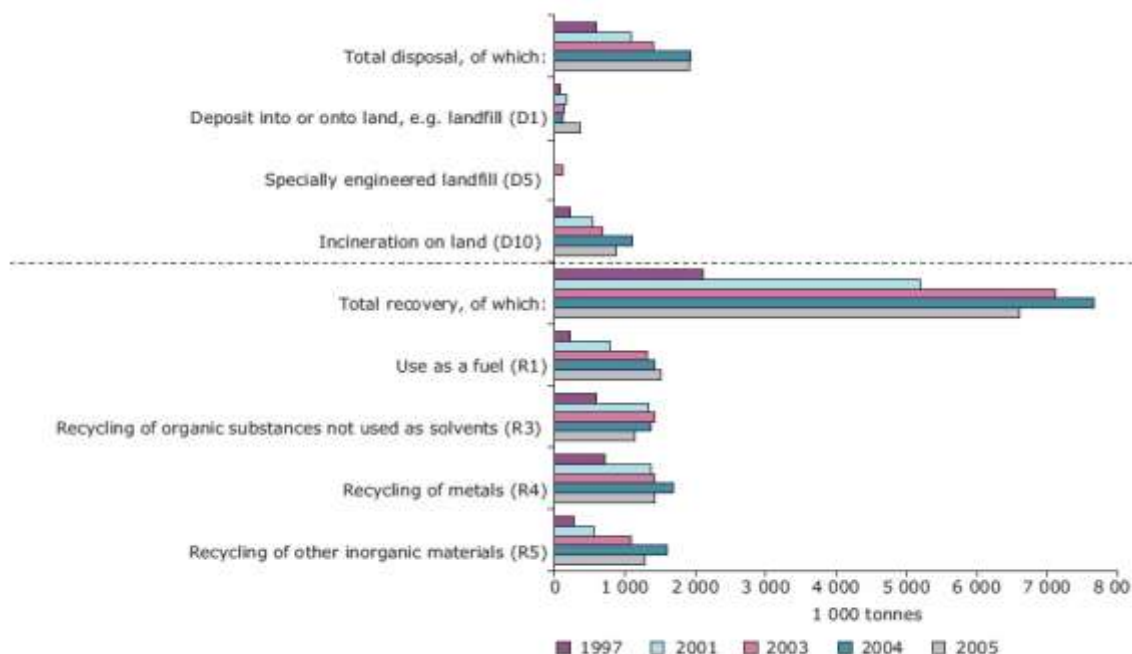
Source: European Commission 2012.

Most shipped waste is destined to recovery operations (mainly recycling and incineration with energy recovery, see Graph 11). It has to be taken into account that, after the approval of the



Waste Framework Directive, shipments of waste destined for recovery must not be notified. Therefore, there is a lack of information on these shipments after 2009.

Graph 11. Treatment of notified waste shipped from EU Member States to other EU and non-EU countries, 1997-2005.



Source: EEA 2009.

There are some factors that may favour a growth in waste shipping in the upcoming years:

- The construction of new incineration facilities.
- The upgrading of incinerators in operation above the energy recovery threshold set by the Waste Framework Directive.

On the other hand, the increase of the shipping costs that can be derived from an overall expected increase in energy costs could restrain this tendency.

#### Waste shipment to Denmark

Denmark has four times as many incineration plants according its waste generation. Incinerators are a key element in the district heating systems in Denmark. There are at least three incinerators that import waste:

- Two of them import household waste from London.
- The other one imports waste from Germany.

However, there are plans to increase the capacity of the existing incinerators and to build new plants.

Source: Danmarks Naturfredningsforening

Waste shipping for incineration in other Member States could also be attenuated by the creation of new incineration taxes or by the increase of the existing ones. Currently seven Member States apply taxes on waste incineration that range between 1.03 and 44.0 euros per tonne.

Table 1. Taxes on waste incineration applied in Europe

Country (Region)	Tax (€/tonne)
Austria	8.0
Spain (Catalonia)	5.7-16.5
Denmark	44.0
Belgium (Flanders)	7.93
France	2.4-11.2
Italy	1.03-5.16
Portugal	1.06-1.59

Note: All rates correspond to year 2011 except those of Catalonia (2012) and Italy (2009).

Source: OCDE (<http://www2.oecd.org/ecoinst/queries>), Hogg (2011), Fischer et al. (2012), Watkins et al. (2012).

## 4 Environmental impacts of waste shipping and waste incineration

The political ambition of the EU to be self-sufficient in handling its landfill and other waste disposal activities has almost been achieved, as only a limited amount of waste is disposed of outside the EU.

However, the ratio of waste shipped for disposal and waste shipped for recovery has not declined. Hence, the aim described in the Waste Framework Directive, in the sense that individual Member States should individually move towards self-sufficiency in waste disposal is far to be achieved.

The increase in waste shipment within EU member states has a high environmental impact in terms of CO<sub>2</sub> emissions, derived from transportation. A life cycle approach of the expansion of the incineration market at a European level should take into account not only the energy recovered through waste incineration but also the energy consumed for shipping waste, which in the case of long distances can account for a significant percentage of the energy content of waste shipped.

Regarding waste incineration, it has to be taken into account that:

- **Incineration is an inefficient way to produce energy:** energy recovery from waste incineration is lower than energy savings derived from waste recycling. For most of the materials that compose waste, recycling saves more energy than is generated by incinerating mixed solid waste in an incineration facility (Morris 1996 and 2008; EPA 2012).

Table 2. Comparison of energy recovery through recycling and incineration for several materials, in MJ/kg.

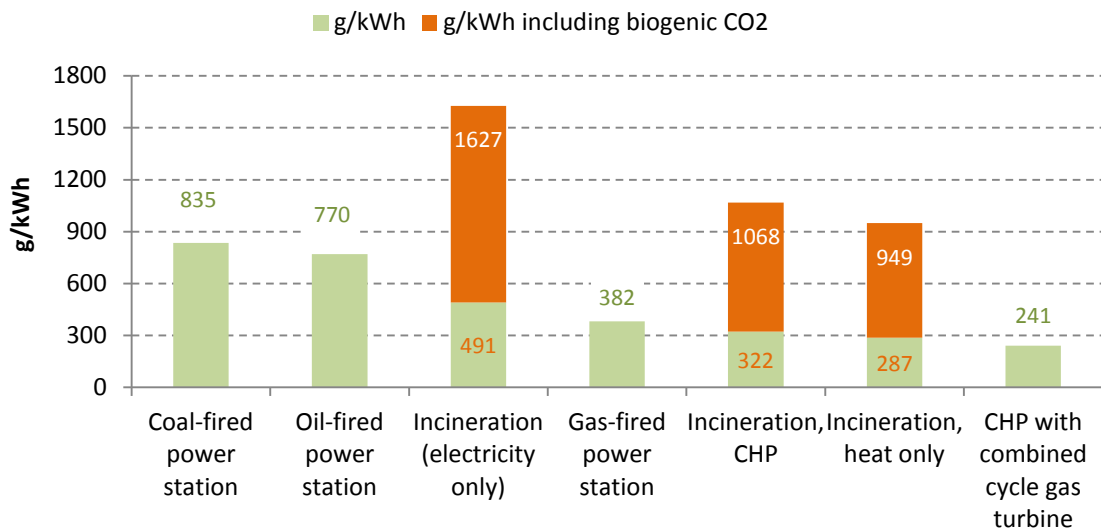
Material	Energy savings derived from recycling	Energy recovered through incineration (incineration without energy recovery)	Energy recovered through incineration (incineration with energy recovery)
Glass	2.85	*	*
Office paper	10.54	2.55	7.17
Newspaper	17.81	2.98	8.38
Steel cans	21.61	*	*
PET	34.36	3.98	11.17
Cooper wire	87.59	*	*
Aluminium cans	161.58	*	*

Notes: \* For these materials the energy balance is negative since energy is required to raise the temperature of the material to the temperature found in a combustor.

Source: Own elaboration based on EPA 2012.

- **Incineration is not the solution to climate change:** incineration is a very carbon-intensive source of energy if we compare it to other available technologies (Graph 12), and allows a low CO<sub>2</sub> reduction compared with recycling (Table 3).

Graph 12. CO<sub>2</sub> emissions of several energy conversion plants.



Source: Hogg (2006).

Table 3. Comparison of greenhouse gas emissions reduction through recycling and incineration for several materials, in MTCO<sub>2</sub>eq/tonne.

Material	GHG reduction from using recycled inputs instead of virgin inputs	Avoided GHG emissions per tonne incinerated
Glass	0.28	-0.02
Office paper	2.85	0.48
Newspaper	2.78	0.56
Steel cans	1.80	-0.02
PET	1.11	0.75
Cooper wire	4.89	-0.02
Aluminium cans	8.89	-0.02

Source: Own elaboration from EPA 2012.

- **Incineration is not the solution to the waste problem:** almost 30% of waste incinerated must be landfilled or sent to treatment plants for special waste.

Figure 3. Mass balance of an incineration plant.



Source: Kalogirou 2012.

- **Incineration is not the solution to the energy problem:** incineration is a very expensive source of energy.

Costs of electricity generation for several technologies			
Technology/fuel	Capital cost (\$/kW)	Fixed Operating & Maintenance costs (\$/kW-year)	Variable O&M costs (\$/MWh)
Coal	3,167	35.97	4.25
Nuclear	5,339	88.75	2.04
Waste incineration	8,232	373.76	8.33
Photovoltaic solar	4,755	16.70	0
Onshore wind	2,438	28.07	0

Source: US Energy Information Administration (2010).

## 5 Conclusions

The opening of the incineration market at a European level threatens the application of the principle of proximity set out in the Waste Framework Directive (WFD) as well as the recommendations set out in the Roadmap to a Resource Efficient Europe, which advocates for giving higher priority to prevention, re-use and recycling.

Currently there is an overcapacity of incineration in some European countries that generates an increasing volume of waste being shipped. However, information on the incineration capacity and on the generation of waste that can be incinerated is scarce.

There is also a lack of available data in relation to the amount of waste being shipped to waste incinerators across Europe, since the legislation in force states that only shipments to incinerators below the energy recovery threshold set in the Annex II of the Directive<sup>9</sup> and shipments of mixed household waste need to be notified. This means that an important amount of waste can continue to be shipped to waste incinerators without any sort of notification. However, the information available shows that the volumes of waste shipped for incineration have increased significantly during the last decade.

The perspectives of the incineration industry for the near future show an increase in the incineration capacity at a European level, which together with the existing overcapacity in

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<sup>9</sup> See chapter 1.1.

some countries may lead to an increase in waste shipping among Member States. This increase may also hamper the accomplishment of the recycling targets set out in the WFD, especially in those countries that are currently further away from achieving them.

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