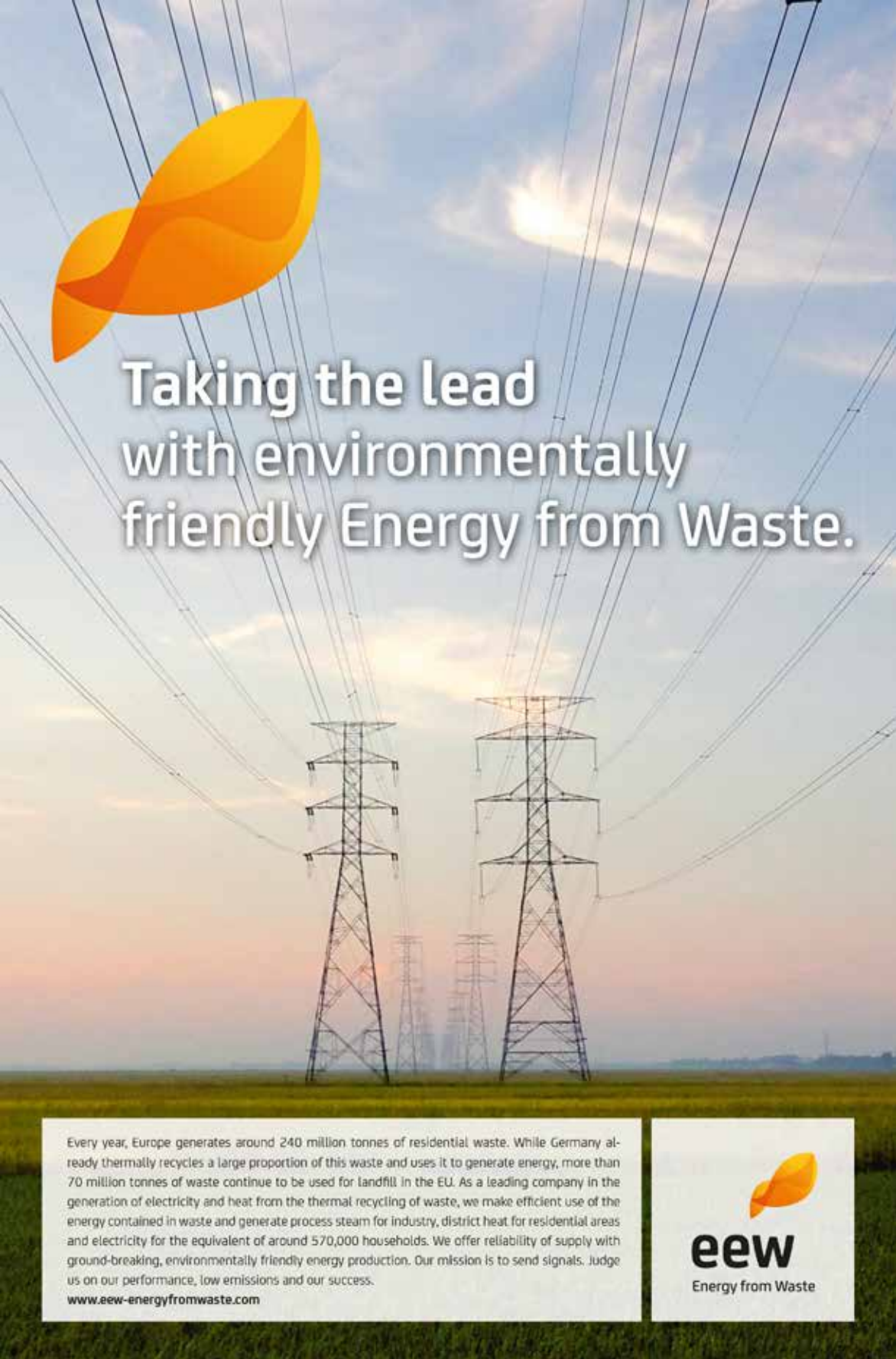

Every year, Europe generates around 240 million tonnes of residential waste. While Germany already thermally recycles a large proportion of this waste and uses it to generate energy, more than 70 million tonnes of waste continue to be used for landfill in the EU. As a leading company in the generation of electricity and heat from the thermal recycling of waste, we make efficient use of the energy contained in waste and generate process steam for industry, district heat for residential areas and electricity for the equivalent of around 570,000 households. We offer reliability of supply with ground-breaking, environmentally friendly energy production. Our mission is to send signals. Judge us on our performance, low emissions and our success.

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Energy from Waste

Growth Potential for Energy-from-Waste Plant Operators in the European Union and Beyond

Karl-Heinz Müller and Peter Werz

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Across Europe, there is growing recognition that energy, raw materials, environmental and security policy can all be components of an interdependent policy strategy, and that waste management also plays a role at the intersection of these policies. The European Commission is currently preparing a Communication which will explore the contribution that energy from waste (EfW) can make to the European Energy Union [6]. The Energy Union is designed to reduce the EU's reliance on energy from Russia, following the dramatic events in Ukraine [3: p. 4f]. The EU's strategic energy and security goals create an opportunity to implement the longstanding EU waste management targets, particularly with regard to landfilling.

1. Waste management: guidelines, targets and reality

From a waste management perspective, it is neither sensible nor advisable to subject all waste streams to thermal recovery. The European Waste Framework Directive's waste hierarchy therefore sets out clear limitations by establishing recycling targets that member states have to reach. Currently, at least fifty per cent of paper, metals, plastics and glass should be recycled. The proposed Circular Economy Package foresees a material recycling target of 65 per cent for municipal waste. Furthermore, the Commission wants to limit the volume of waste consigned to landfills to fifty per cent in all EU member states. There is already heated debate over whether the recycling rate measures what we actually want to measure and whether what is included in the recycling rate actually ends up being recycled [10]. But the fact is that policy makers like to set environmental targets because these serve as clear benchmarks and thus make it easier for authorities to implement their objectives.

This means that the regulatory recycling targets reduce the volume of feedstock available to operators of EfW plants. Depending on the member state, in future 25 to 35 per cent of municipal waste streams – plus secondary waste streams such as sorting residues – will be available for EfW. Nonetheless, in light of the significant volumes of waste still being sent to landfill in the EU, EfW plant operators can make a significant contribution to the Energy Union and thus enjoy considerable growth potential. Strengthening recycling and expanding thermal recovery are therefore not contradictory aims.

A comparison of waste management targets with current actual practices reveals an extremely large divide between the various regions of Europe.

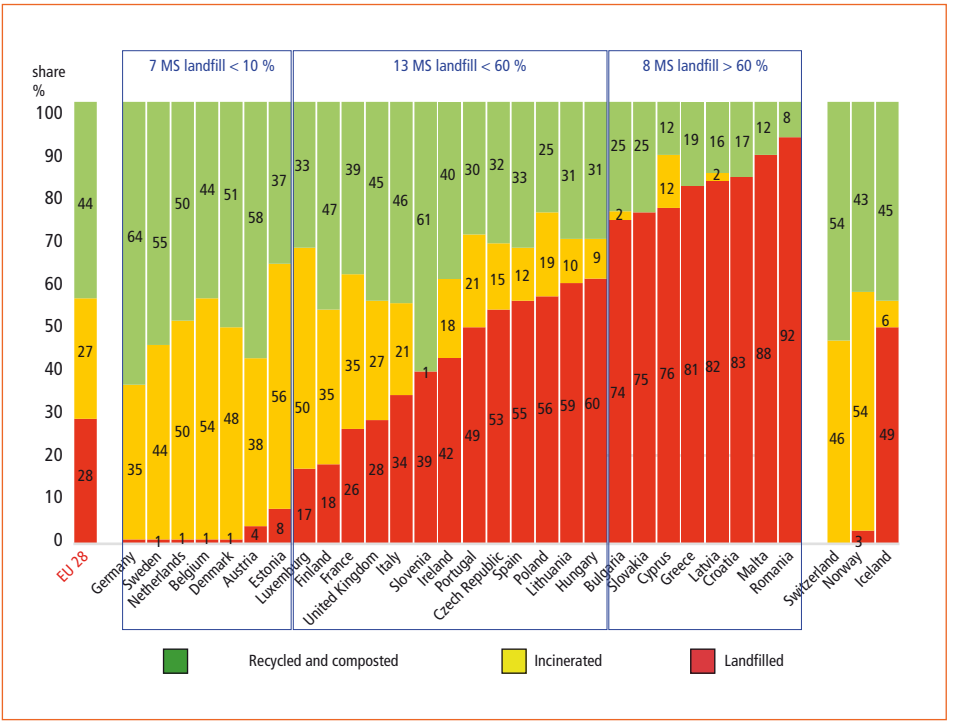

Figure 1: Waste management in the EU

Source: CEWEP

As you can see, several member states do not come close to reaching the targets established by Brussels. Of the 28 EU member states, nearly half (13) are still sending more than 50 per cent of their municipal waste to landfill. In spite of all the lip service paid to the circular economy, resource conservation and climate protection, landfilling remains one of the most popular waste management methods for mixed municipal waste in the EU. Moreover, there is a marked divide between the member states. All of the member states with a high rate of landfilling are located in the eastern or southern parts of the EU. While the infrastructure is good to very good in the markets of the North and the West, there is a lack of waste management capacity in the South and the East.

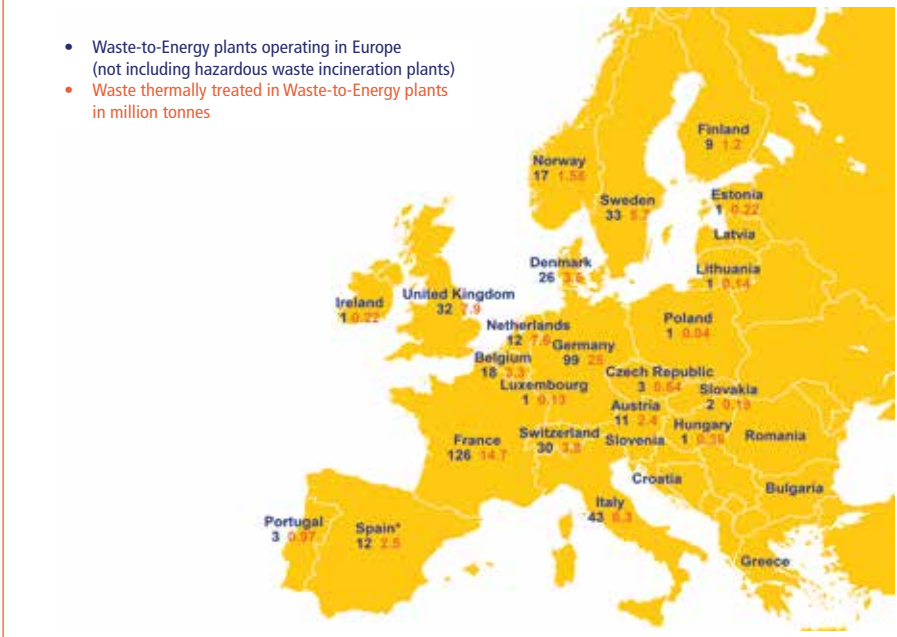

Figure 2: Thermal waste treatment in the EU

Source: CEWEP

The lack of infrastructure is clearly illustrated in Figure 2. At the southeast edge of the EU – Romania, Bulgaria, Greece, Croatia and Slovenia – there is not a single EfW plant that can thermally recover mixed municipal waste or refused derived fuels (RDF). In the other countries in the southern and eastern EU, the thermal treatment capacities are far too low in relation to waste arisings.

If the EU wants to achieve the goals set out in the Circular Economy Package, a massive expansion of thermal waste treatment capacity will be necessary, as the following table demonstrates:

Table 1: Energy from waste (EfW) capacities in the EU (based on targets in Circular Economy Package)

Arisings 2014	Less recycling (65 %)	Plus residues from recycling (10 %)	Less permitted landfilling (10 %)	Required EfW capacities	Operational capacities	Capacity demand
1,000 t						
240,862	-156,560	15,656	-24,086.2	75,872	64,381	11,491

Source: Eurostat/Presentation: EEW

According to Eurostat, around 241 million tonnes of municipal waste were generated in the EU in 2014 [8]. Assuming the recycling rate of 65 per cent targeted by the Commission in the Circular Economy Package is achieved, this leaves approximately

84 million tonnes of waste. In our simplified calculation, we conservatively assume that the recycling processes result in 10 per cent residues which are sent for thermal treatment. Depending on where along the value chain the recycling rate is measured in future, this figure could be significantly higher or lower. Furthermore, we make the simplified assumption that all EU members fully exploit the allowable maximum rate of 10 per cent landfilling, although we know that EU countries with more advanced waste management systems, such as Germany, do not send any untreated waste to landfill. According to this calculation, the EU needs additional thermal treatment capacity for at least 11.5 million tonnes of municipal waste in order to reach the targets of the Circular Economy Package. This represents the capacity of about 35 to 40 medium-sized EfW plants.

In this context, it is important to note that the Eurostat data only includes household waste and the commercial waste that is collected by the municipal waste management service provider in the member state. This means the figures do not include commercial waste that is freely traded on the market and treated. Consequently, there is also a relatively unquantified volume of commercial waste available whose recycling potential can vary depending on its type and origins, and which may also require thermal treatment. The actual demand for EfW capacity is therefore very likely to be significantly higher.

Looking at the southern and eastern member states which have the EU's highest landfilling rates – Bulgaria, Romania, Croatia, Slovakia, Greece and Latvia[1] –, the divide within the EU with respect to waste management capabilities becomes even more apparent.

Table 2: Energy from waste (EfW) capacities in selected countries in southern and eastern Europe*

Arisings 2014	Less recycling (65 %)	Plus residues from recycling (10 %)	Less permitted landfilling (10 %)	Required EfW capacities	Operational capacities	Capacity demand
1,000 t						
17,872	-11,617	1,162	-1,787.2	5,630	341	5,289

(targets from Circular Economy Package)
* Bulgaria, Romania, Croatia, Slovakia, Greece and Latvia
Figures for Greece and Romania are for 2013 because no figures are available for 2014
Source: Eurostat/Presentation: EEW

As the table shows, these countries generate 17.8 million tonnes of municipal waste collected by local authorities, representing just 7 per cent of the EU total. At the same time, there is demand here for 5.3 million tonnes of thermal treatment capacity, equivalent to around half of the additional capacity needed by 2030 in order to come anywhere close to reaching the targets set out in the Circular Economy Package. Here as well – as described above – there is an unknown quantity of commercial and industrial waste that is not taken into account by the Eurostat system.

[1] As island nations, Cyprus and Malta are not taken into consideration here.

2. Import-dependent energy supplies

While the EU as a whole still sends significant volumes of waste to landfill, it is also even more strikingly dependent on fuels from non-EU states. The EU is the world's largest energy importer, with imports accounting for 53 per cent of energy in 2014 [3: p. 3]. Importing strategically vital raw materials is not a problem if the raw materials are sourced from several suppliers to minimise or even eliminate the danger of a one-sided dependency. But this is not the case for the EU's energy imports: For natural gas, imports accounted for 66 per cent, of which 39 per cent came from Russia ([5], p. 2). The situation is only somewhat better for solid fuels such as coal: With imports making up 42 per cent of supplies, here one-third (33 per cent) of the imported fuel was from Russia.

This dependence creates a strategic policy problem because it could negatively influence the European Union's ability to act in foreign policy matters. Between 2007 and 2009 there were repeated disputes between Ukraine and Russia regarding Russian gas shipments. The issue was ultimately about debt repayments, but the EU was also affected because Russian natural gas transits through Ukraine, where several pipeline routes from northern Siberia and Central Asia converge, before being transported via the Transgas route through Slovakia and the Czech Republic to Western Europe. Since then, there has been a dramatic deterioration in the security situation: The Ukraine crisis remains unresolved and the EU's relations to Russia have cooled considerably in the wake of the annexation of Crimea and the sanctions subsequently imposed by European countries.

In 2014, the states belonging to the Energy Community – which includes the EU as well as other countries in south-eastern Europe and the Black Sea region – carried out a stress test to find out what would happen if there was a complete stoppage of primary energy imports from Russia [5]. One of the findings was that a total halt to imports would have a particularly substantial impact on some of the Eastern European states.

Energy from waste facilities could reduce this dependence on imports. EfW plants provide a reliable source of energy and thus can serve as a local, decentralised solution to supply metropolitan regions and critical infrastructure, such as strategically important industrial plants. This has also been recognised by the European Commission, which recently announced plans for a Communication that will explore the connection between the strategy to promote the circular economy and the Energy Union [6]. In particular, the Commission will be looking at EfW facilities with combined heat and power (CHP) processes, which can achieve efficiency levels of up to ninety per cent. The Roadmap for the Energy Union indicates that the European Commission's interest goes beyond climate and resource protection, as the Communication planned for later this year on *Exploiting the Potential of Waste to Energy* is associated with both the areas of climate protection as well as energy security [3: p. 5].

In this context, if we now look at these EU member states in the southern and eastern reaches of the EU, it becomes apparent that they not only have a high rate of landfilling but a major dependence on imports of primary fuels (Figure 3). With the exception of Romania, the EU member states with the highest rates of landfilling are also especially dependent on imports of primary fossil fuels such as coal and natural gas.

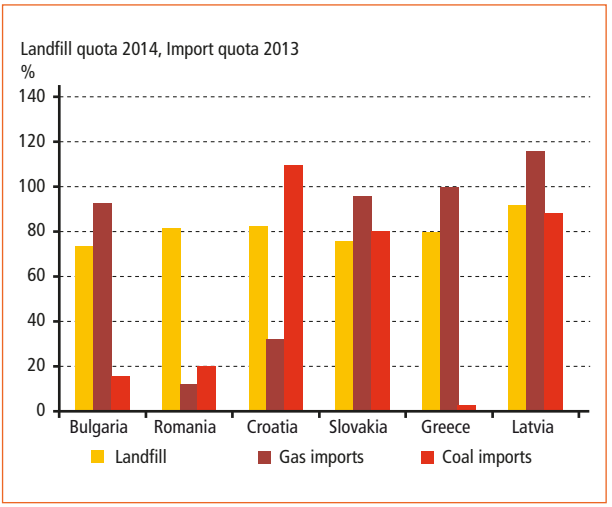

Figure 3:

Landfilling and import quotas in selected member states in the south-eastern EU

Source: Eurostat

3. How can the potential of Energy-from-Waste be utilised?

As we have seen, there are many advantages to thermal waste treatment. So why did the EU member states cited in this paper not start exploiting this potential long ago? One possible answer was provided by the European Commission itself: Thermal waste treatment with today's state-of-the-art energy recovery and flue gas cleaning technology is relatively expensive. Investments in improving waste management are explicitly identified as being eligible for support from the European Regional Development Fund (ERDF) [11]. However, ERDF only finances investment costs, i.e., the design and erection of EfW plants. Once a plant has been built, the member states assume all responsibility for the ongoing operating costs. Owing to the high share of fixed costs for an EfW plant, the operating costs can only be marginally reduced by lower personnel costs, especially since a lack of skilled personnel in these countries means staff first have to be trained.

Figure 4 shows a comparison between the gross domestic product (GDP) of the countries cited in this paper and Germany.

Compared to the countries considered here, Germany is not only far more advanced in its waste management capabilities, it is also much richer. In terms of thermal waste treatment, this means that sending a tonne of mixed municipal waste to an EfW plant is significantly less expensive in relation to GDP for a German than for a person from Southern or Eastern Europe.

In relation to per capita GDP, thermal waste treatment in Bulgaria is approximately six times as expensive as in Germany. In Greece as well, state-of-the-art EfW treatment costs roughly twice as much in comparison.

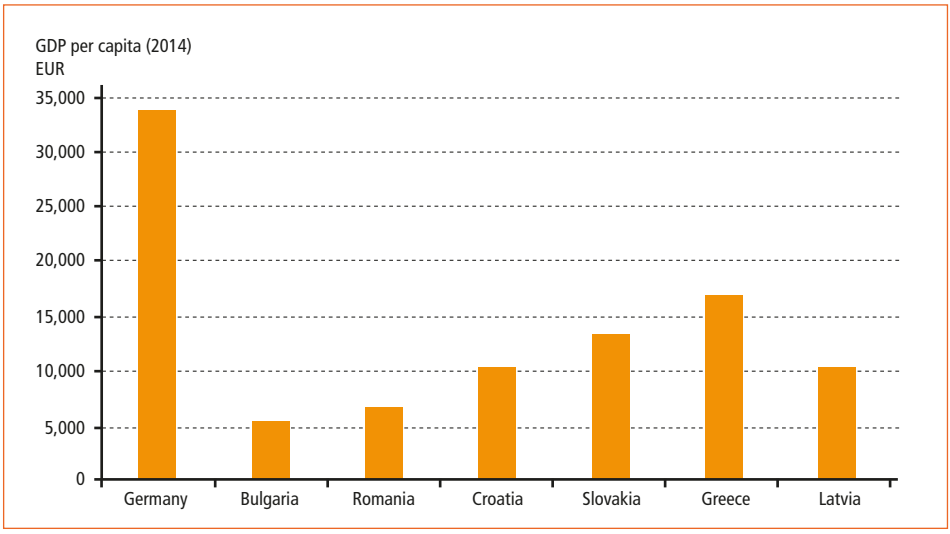

Figure 4: Per capita GDP (2014)

Source: Eurostat

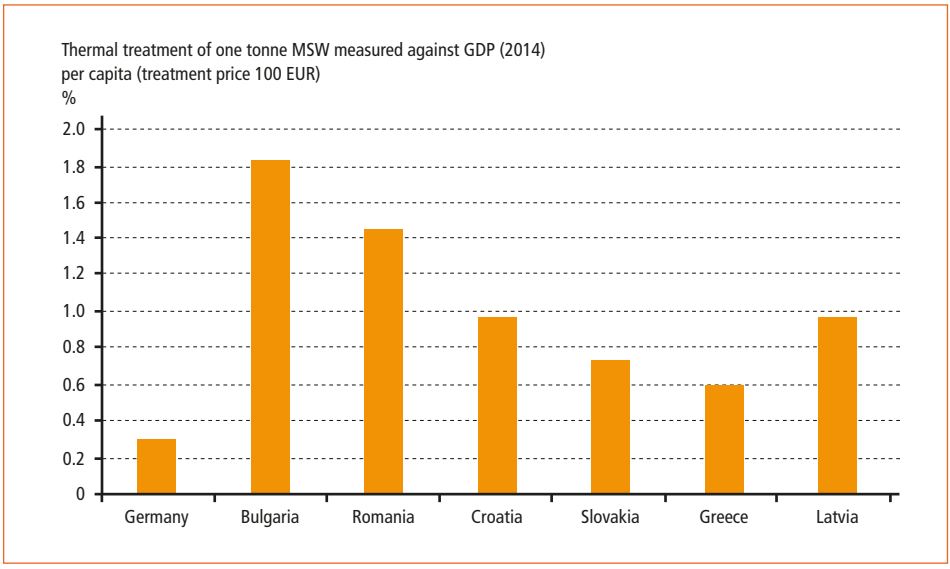

Figure 5: Costs of thermal treatment compared to per capita GDP (2014)

Source: Eurostat

Support for plant building through the European funding programmes can therefore only be the first step. In order to meet the regulatory waste and energy targets in Southern and Eastern Europe, ongoing operating costs must also be supported with EU funds. Otherwise, these technologies will be unaffordable for these countries.

4. Growth potential outside of the EU

While there are funding programmes and assistance available in the EU to help the economically less developed member states gradually approach the living standards in the more affluent countries, outside of the EU the only support comes in the form of traditional development cooperation. However, here too, it is necessary to keep in mind the operating costs of a plant in order not to overwhelm the local economies.

The future need for orderly waste management worldwide is one of the key international issues in public services, concluded the World Bank in 2012 [9]. It forecasts that arisings of municipal solid waste will nearly double by 2025 to more than 6 million tonnes per day.

Table 3: Waste generation projections for 2025 by income

Region	Current Available Data			Projections for 2025 (from Annex J)			
	Total Urban Population	Urban Waste Generation		Projekted Popilation		Projected Urban Waste	
		Per Capita	Total	Total Populations	Urban Population	Per Capita	Total
	millions	kg/capita/day	tons/day	millions	millions	kg/capita/day	tons/day
Lower Income	343	0.60	204,802	1,637	676	0.86	584,272
Lower Middle Income	1,293	0.78	1,012,321	4,010	2,080	1.3	2,618,804
Upper Middle Income	572	1.16	665,586	888	619	1.6	987,039
High Income	774	2.13	1,649,547	1,112	912	2.1	1,879,590
Total	**2,982**	**1.19**	**3,532,256**	**7,647**	**4,287**	**1.4**	**6,069,705**

Source: The World Bank, 2012

When looking at waste management methods, it becomes clear that the use of modern waste treatment technology worldwide is highly correlated with a country's income level.

Table 4: Correlation between the use of modern waste treatment technologies and a country's income level

	High Income		Upper Middle Income		Low Income		Lower Middle Income	
	mass	percentage	mass	percentage	mass	percentage	mass	percentage
	tonnes	%	tonnes	%	tonnes	%	tonnes	%
Dumps	0.05	0.01	44	32.41	0.47	12.50	27	48.81
Landfills	250	42.51	80	58.92	2.2	58.51	6.1	11.03
Compost	66	11.22	1.3	0.96	0.05	1.33	1.2	2.17
Recycled	129	21.94	1.9	1.40	0.02	0.53	2.9	5.24
Incineration	122	20.75	0.18	0.13	0.05	1.33	0.12	0.22
Other	21	3.57	8.4	6.19	0.97	25.80	18	32.54
Sum	**588.05**	**100.00**	**135.78**	**100.00**	**3.76**	**100.00**	**55.32**	**100.00**

Source: The World Bank, 2012

An EfW plant with CHP technology corresponding to the standard in Germany would therefore certainly have no chance of being realised in most developing and emerging economies without international support.

Therefore, completely different approaches may be necessary for now. Conceivable options include concepts where EfW facilities are largely financed by energy revenues [1]. Of course, plants of this type would not be comparable to the highly modern EfW plants in Western Europe, especially with regard to flue gas cleaning. Yet, compared to the existing waste management practices in these countries – mostly uncontrolled dumping in unsealed landfills – it would definitely represent progress and considerably improve quality of life for the local population. The same standards, on the other hand, might be possible with *feed-in guarantees* which would provide guaranteed revenues for energy fed into the grid and thus could increase willingness to invest. But here as well there is the question of who provides the guarantee.

After all, investments of this type can and will only be made if there is a certain level of state order and good governance. Companies will hardly be willing to make long-term investments in failed states and corruption-prone countries. In addition, a prerequisite for investment in most cases is the existence of a trade agreement because the Investor-State Dispute Settlements (ISDS) provide investors with more certainty, especially in states with dubious legal systems.

Nevertheless, the global demand for thermal waste treatment plants will continue to grow. Right now there are more than 2,200 thermal treatment plants with a total capacity of 280 million tonnes installed worldwide. It is estimated that by the year 2024 another 550 EfW plants with an annual capacity of 150 million tonnes will be constructed. This comes on top of the more than 250 plants with a capacity of nearly 60 million tonnes that started operations between 2010 and 2014 [2].

As an industry leader, EEW Energy from Waste, along with its new shareholder Beijing Enterprises Holdings Limited, aims to take an active role in this growth market in Europe and other regions.

5. Conclusion

Energy recovery of mixed municipal waste in state-of-the-art EfW facilities could help the EU to reach several of its goals simultaneously. Compared to landfilling, thermal waste treatment lowers greenhouse gas emissions. Furthermore, the energy generated in the recovery process can help provide electricity and heat to the population. Because of their reliable energy production and locally sourced feedstocks, EfW facilities are also suitable suppliers of energy for critical infrastructure such as strategically important industrial plants. Energy from waste plants can help reduce the EU's dependency on primary energy imports. In summary, state-of-the-art EfW plants with CHP technology could not only help the EU reach its waste-related targets, they also fit well within the EU's strategic energy and security concept set out in the Energy Union.

However, thermal waste recovery in accordance with Western European standards is relatively expensive – also and in particular with regard to the ongoing operating costs. It is highly unlikely that these standards will be lowered for the EU members with less developed waste management systems because the common market's rules need to create a level playing field for everyone. As well, due to the EU's mixed record of success in implementing its waste policy targets so far in parts of the community, there is a need to reconsider the current funding policies. It is not sufficient to merely support member states with one-time investment costs and then to leave them to shoulder the ongoing operating costs – which are often too high for these economies – on their own.

Such funding is practically non-existent outside of the EU, so it will be necessary here to adopt new approaches to lower the operating costs. A certain level of legal certainty, however, will be required.

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