



sustainable energy for everyone



Status and prospects of co-processing of waste in EU cement plants

CASE STUDIES

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Case study

> **Belgium**

- > Bulgaria
- > Czech Republic
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Belgium Summary

Cement industry with long co-processing experience, technically ready to further increase alternative fuel use



Belgium has been one of the early adaptors in co-processing. As a result average substitution levels are high at 52.6% and there are a few barriers to co-processing due to political and societal acceptance. Main concerns are competition with WtE plants, future biomass availability and fiscal barriers between regions.

BARRIERS *Taxation and competition from WtE and Biomass plants can put a brake on increasing co-processing volume*

Waste market organization	Low	• Regionally different waste legislations lead to fiscal differences in waste pricing.
Waste market situation	Medium	• Market distortions due to support for power and heat production.
Political environment	Low	• Due to federal structure: improvement possible on alignment of taxation and other incentives
Societal perspective	Low	• No barriers identified
Cement industry	Low	• No barriers identified

ACTIONS FOR STAKEHOLDERS

The cement industry

- Need to continue to provide a suitable outlet for a wide variety of recovered fuels from waste.

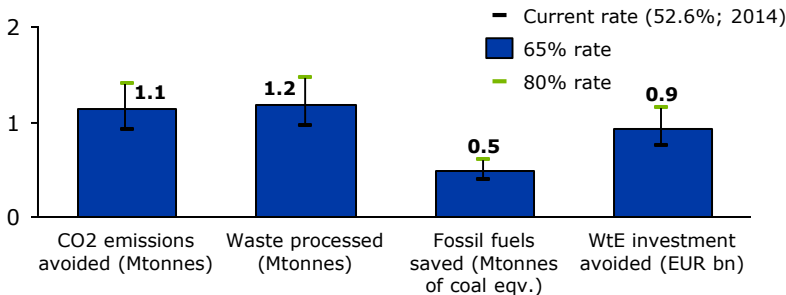
Policy makers

- Are asked to improve level playing field between industries and regions.
- Be aware of higher costs for Biomass and Hazardous Waste AF use at cement plants vs WtE installations or dedicated Biomass plants.
- Should recognize the material recovery aspect of co-processing.

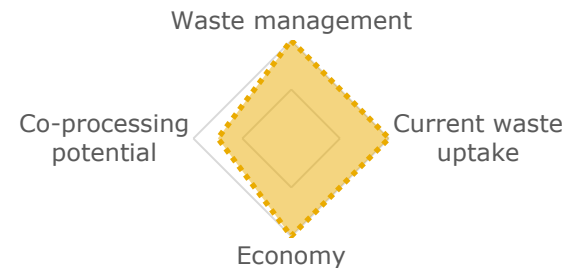
The waste management industry

- Should look for long term regional commitments with the cement industry for waste off take and avoid export of waste for only short term profits.

POTENTIAL *At 65% co-processing rate, the sector could mitigate some 1.1 Mtonnes of CO2 annually, while avoiding WtE investment of 0.9 EUR bn.*



BELGIUM AT A GLANCE



Belgium Cement Sector

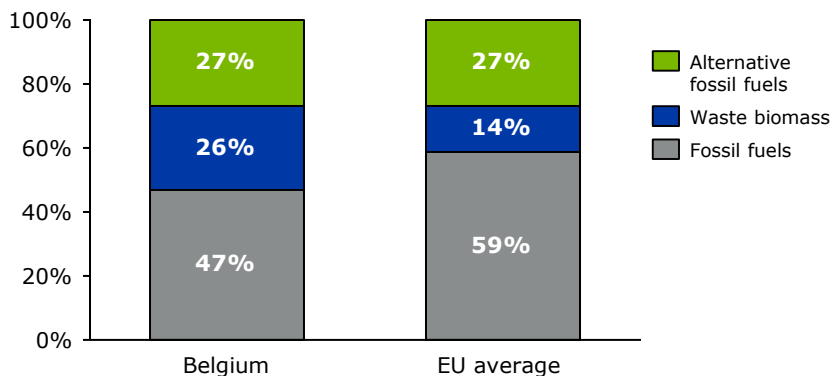
The Belgian cement sector shows high levels of co-processing in a stable construction industry environment.



Cement demand has been relatively constant during the past decade, averaging roughly 550 kg/capita. In 2014, 4.8 Mtonnes of clinker were produced of which 0.87 Mtonnes were exported. Co-processing rate was above the 2014 EU average at 52.6%.

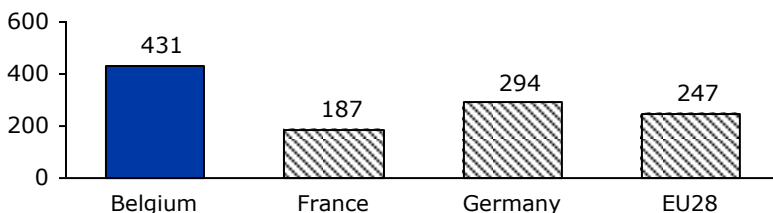
CO-PROCESSING *Fuel substitution rate in Belgium is above EU average with 52.6% of thermal energy coming from alternative fuels.*

Average thermal energy consumption in cement kilns (2014)



PRODUCTION *Belgium cement industry produces clinker on levels above the EU average, 0.87 Mtonnes or around 18 % of its production was exported in 2014.*

Grey clinker production per capita (tonnes; 2014)



AT A GLANCE

- Belgium had 2 grinding, 1 clinker and 3 fully integrated plants in 2014; the companies involved are multinationals [1]
- In 2014 there was a balanced export of cement and clinker and import of cement, mainly with neighboring countries [1]
- In 2014, 4.8 Mtonnes of clinker was produced, of which 18% was exported [2]
- The 2014 co-processing rate (52.6%) has been above the EU average of 40.2% in 2014. [1]
- Technically and legally the industry is capable to further increase fuel substitution, if economics permit [2]
- Two of the three cement producers have their own alternative fuel production plants, cooperating closely with the waste sector. [3] [4]
- The four clinker kilns can all be found in the Walloon Region, Flanders only has cement grinding facilities. [2]
- The cement industry has to pay taxes for using alternative fuels, while incineration plants with energy recovery are exempted, when using imported waste. [2]
- By 2020 the cement industry could reach substitution levels of between 60 and 65% [2]

Belgium Waste Management

Showing good performance, the waste market is advanced, well established and internationally integrated.

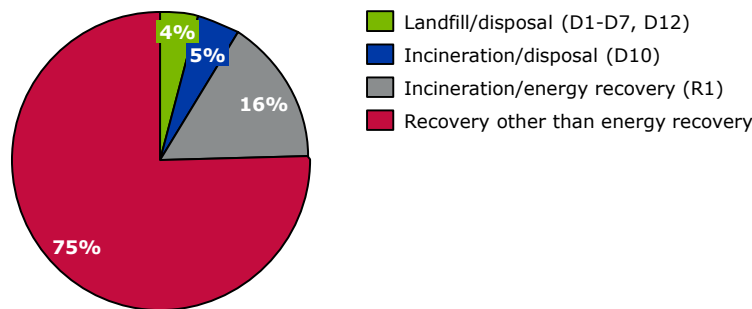


In 2014 the Belgium recycling rate reached a level of 57%. There are strong regional differences, with the Brussels region showing the lowest recycling rates. Economics of waste are determined by logistics, trans-border shipment and differences in regional taxation and fiscal treatment.

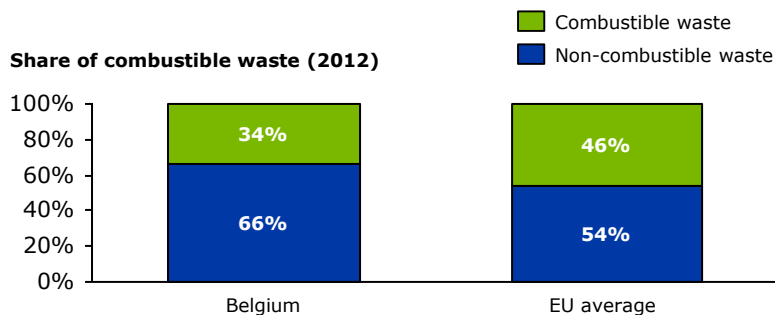
WASTE TREATMENT EU MSW Recycling Target 2020 has already been met, around 20% of waste recovered in plants with R1 status, landfilling is banned for untreated waste.

Waste treatment composition (2014)

Excluding major mineral wastes



WASTE AVAILABILITY In Belgium, but also the neighboring countries ample waste is available. Economics and fiscal regional differences have a strong influence on its destination.



AT A GLANCE

- Waste management in Belgium falls under the responsibility of the three regions: Brussels, Flanders and Wallonia, waste management policy and law are developed by these three separate entities.
- EU Directives on Landfilling and Waste have been adapted national and regional law.
- All three regions have separate MSW waste stream collection [5]
- The three regions have different tax rates for waste treatment, with Flanders having supportive tax rates for the WtE sector [2]
- A nationwide landfill ban of untreated waste, including biodegradable municipal waste, has been in place since 2007.
- Co-processing is allowed on national and regional levels, it is regarded as a viable solution for treatment of waste [2] and [6]
- Due to the long established practice of co-processing of waste and the good results, it is an accepted practice by society [2]
- There are plans to establish advanced Waste to Energy, Biomass to Energy and even waste to chemicals plants in Flanders [7]
- Pressure on combustible waste availability is expected due to increased recycling and re-use and the plans for new WtE and Waste to Chemicals in Flanders, as well as Biomass availability – across the whole of Belgium [2]

Belgium Barriers and Opportunities

Although barriers due to Federal structure exist, fiscal action in the Walloon Region can help increase co-processing.



The cement sector in Belgium has a long tradition of co-processing. Taxation, GHG reduction and waste availability at reasonable costs are the main economic drivers for co-processing. If political and fiscal incentives improve, then the use of waste in co-processing will further increase.

BARRIERS *To further increase co-processing a more level playing field between the regions on taxation is needed. Also tax exemption on Biomass and Dangerous Waste could help increase the use of alternative fuels.*

DRIVERS AND OPPORTUNITIES *Increasing costs for waste disposal and considering the use of waste biomass of municipal origin might provide additional incentives to use more alternative fuels.*

Waste market organization	Low	<ul style="list-style-type: none"> Regionally different waste legislations lead to fiscal differences in waste pricing.
Waste market situation	Medium	<ul style="list-style-type: none"> Market distortions due to support for power and heat production.
Political environment	Low	<ul style="list-style-type: none"> Due to federal structure: improvement possible on alignment of taxation and other incentives
Societal perspective	Low	<ul style="list-style-type: none"> No barriers identified
Cement industry	Low	<ul style="list-style-type: none"> No barriers identified

Drivers	<ul style="list-style-type: none"> Plants have the permits to operate with higher co-processing rates and are technically ready for increased waste uptake Increasing cost of fossil fuels and of waste disposal can lead to further AF uptake in the sector The need to reduce GHG emissions will lead to increased use of waste biomass
Actions for stakeholders	<ul style="list-style-type: none"> Balance the development of WtE and co-processing to avoid local overcapacities The Government should regard co-processing in cement as 'better than' R1, due to material recovery of ashes and energy efficiency aspects. Provide more fiscal incentives for waste use and tax exemption for the use of hazardous waste Look at the regional use of waste, avoid unnecessary export (Waste is a resource) Secure Biomass availability for the cement industry
What is the opportunity?	<ul style="list-style-type: none"> Reduce the GHG emissions in Wallonia Keep the Belgian cement sector competitive Increase number of jobs in waste to fuel processing



Data references:

- > Data for the cement sector were obtained from GNR (Getting the Numbers Right) at <http://www.wbcdcement.org/GNR-2014/index.html>
- > Data for the waste management were obtained from Eurostat at <http://ec.europa.eu/eurostat/data/database>

[1] 'Jaarverslag van de Belgische Cementnijverheid 2014', FEBELCEM

[2] Interview with Sébastien Loiseau, Responsable Environnement, FEBELCEM

[3] <http://www.geocycle.com/>

[4] <http://www.recyfuel.be/>

[5] EC "Assessment of separate collection schemes in the 28 capitals of the EU" - 070201/ENV/2014/691401/SFRA/A2, National factsheet on separate collection

[6] Three relevant decrees under Walloon law:

<http://environnement.wallonie.be/legis/dechets/degen019.html>

<http://environnement.wallonie.be/legis/pe/pesect065.html>

<http://environnement.wallonie.be/legis/dechets/degen024.html>

[7] 'Branche kompakt: Belgien will zum internationalen Recycling-Hub avancieren'; Germany Trade & Invest, Torsten Pauly , april 2016

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Bulgaria Summary

The cement sector is well prepared to increase its use of alternative fuels if country's waste management is improved



The cement industry has taken major steps to enable increased use of alternative fuels, even after the industry was hit by lower cement demand. Higher substitution levels can be achieved if infrastructural issues in the waste sector can be solved efficiently.

BARRIERS RDF quality and low landfill taxes remain amongst the other barriers preventing faster uptake of AF.

Waste market organization	High	• Waste processing industry is not well-developed
Waste market situation	Medium	• Landfill taxes too low
Political environment	Medium	• Poor law enforcement in waste management
Societal perspective	Low	• No significant barriers identified
Cement industry	Low	• No significant barriers identified

ACTIONS FOR STAKEHOLDERS

Policy makers

- Ensure prudent enforcement of the national waste management law
- Limit illegal discharge of waste and apply stricter control over volume and type of landfilled wastes

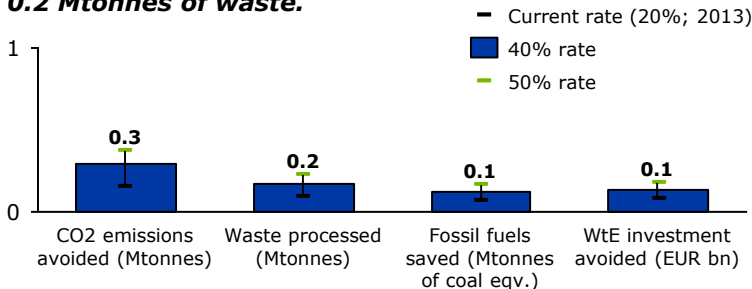
The cement industry

- Support the domestic waste management industry in the development of expertise required to produce pre-processed waste of sufficient quality

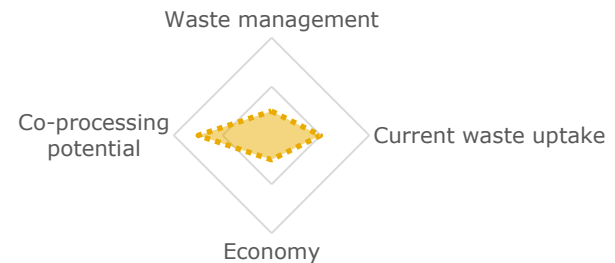
The waste management industry

- Provide training to enable operational excellence at sorting facilities
- Ensure that pre-processed waste is of sufficient quality

POTENTIAL At 40% co-processing rate, the sector could annually mitigate some 0.3 Mtonnes of CO₂ while utilizing 0.2 Mtonnes of waste.



BULGARIA AT A GLANCE



Bulgaria Cement Sector

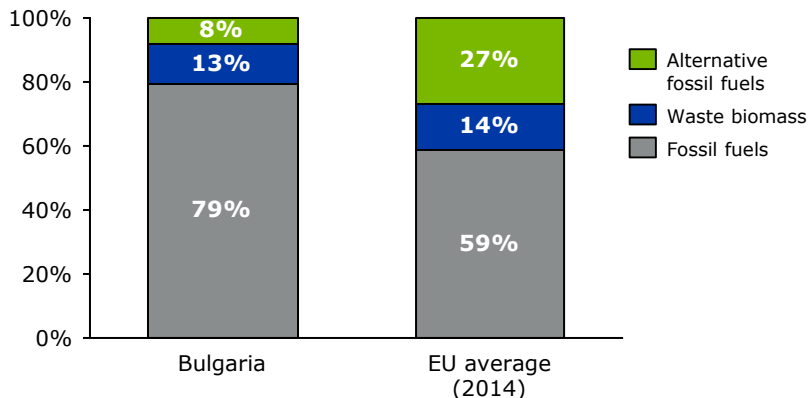
Domestic production of cement is expected to rise in the near future and so is the co-processing of waste



The domestic production has slowed down since 2008 due to recession in the construction sector and the country still imports about 20% of its cement consumption. Current waste uptake is low, but technology investments open up the opportunity to quickly increase co-processing rate in the industry.

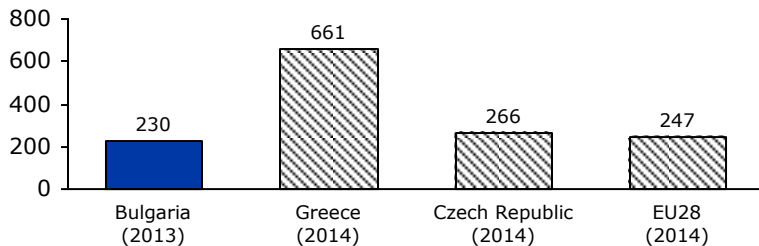
CO-PROCESSING *Bulgaria co-processing rate is well below EU average; 20.1% of thermal energy is from alternative fuels.*

Average thermal energy consumption in cement kilns (2013)



PRODUCTION *Bulgaria is at clinker production level close to EU average, ~14% of its production was exported in 2013.*

Grey clinker production per capita (tonnes/Nr)



AT A GLANCE

- Bulgaria had 3 operational cement plants in 2013, all of them owned by large international players.
- The production of grey clinker has been decreasing since 2008 due to low demand in the construction industry, however it is expected to pick up again in the near future. [1]
- In 2013, 1.68 Mtonnes of clinker was produced, of which 14% was exported. About 20% of the domestically consumed cement is currently being imported, mainly from Turkey. [2] The current co-processing rate (20.1%) was well below the EU average of 38.2% in 2013.
- However, a new, state-of-the-art cement kiln was recently opened ready to potentially co-processes large volumes of waste. Similarly, technical improvements have been made in the other plants to allow for increased waste uptake [3]
- The amount of waste available to the cement sector is limited as industrial waste is scarce and number of pre-processing facilities is inadequate. [4]
- Some of the cement plants have pre-processing facilities to ensure quality of waste they use. However, the industry is still partially dependent on imports of processed wastes. [1]

Bulgaria Waste Management

Disposal has been the default option of waste management for years, yet the country is determined to turn that around

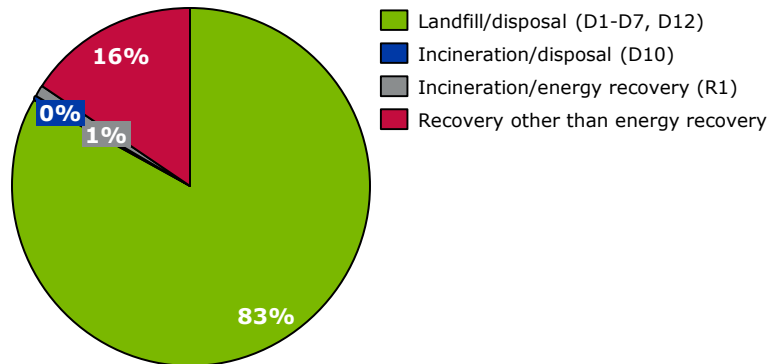


Bulgaria is set to reduce its very high landfilling rate in the coming years due to combination of regulatory measures and EU support. However, lack of expertise in the waste management industry is still a major barrier for fast increase of recycling and development of a quality waste stream for the cement sector.

WASTE TREATMENT *High share landfilling and very low incineration rates are characteristic for Bulgaria.*

Waste treatment composition (2013)

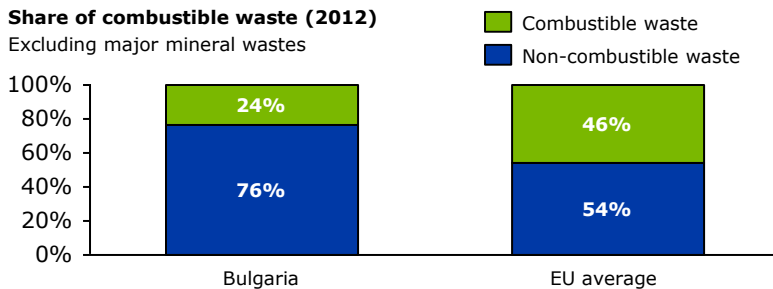
Excluding major mineral wastes



WASTE AVAILABILITY *Bulgaria is far below EU average in regards to combustible waste generation.*

Share of combustible waste (2012)

Excluding major mineral wastes



AT A GLANCE

- Bulgaria has one of the highest landfilling rates in the EU (83%) and the incineration capacity is virtually non-existent. Cases of substantial volume of illegal landfilling occur.
- The current tax for landfilling is relatively low in Bulgaria (around 18 EUR/tonnes). This hampered the use of more advanced waste treatment methods and led to more landfilling.
- The country's waste management legislation has been aligned with the EU Waste Framework Directive, which resulted into financial support of the EU for development of new sorting facilities and modernizing the existing ones, with the aim to decrease the share of landfilled waste. However, the process to obtain these funds has been very slow and it is not clear whether all projects can be finished before the set funding deadline (2020).
- Subsequently, the government has imposed annual tax increase on landfilling, with the goal to reach 50 EUR/tonnes in 2020. [4]
- Additionally, there is a lack of sufficient expertise in the waste management industry limiting the possibility of effective sorting and production of processed wastes of high quality.
- Bulgaria generates comparably much lower share of combustible wastes. Given the large volume of combustible waste being landfilled however, this is not an issue for potentially increasing co-processing. [4]

Bulgaria Barriers and Opportunities

Addressing of infrastructural issues is key in order to allow for advanced waste treatment in the country



Lack of sorting and pre-processing facilities and absence of expertise in the waste management industry coupled with poor enforcement from the policymakers is preventing the country from better organization of its waste market and increased use of domestic waste in cement kilns.

BARRIERS *Lack of solid waste infrastructure and planning remain major issues slowing the diversion of waste from landfills and its use of alternative waste treatment methods.*

DRIVERS AND OPPORTUNITY *If the national waste management law is well coordinated and implemented, the country could obtain a sizeable option for waste utilization not dependent on taxpayers' money.*

Waste market organization	High	• Waste processing industry is not well-developed , there is a lack of expertise in the waste management industry and a lack of alternatives to landfilling
Waste market situation	Medium	• Landfill taxes too low
Political environment	Medium	• Poor law enforcement in waste management
Societal perspective	Low	• No significant barriers identified
Cement industry	Low	• No significant barriers identified

Drivers	<ul style="list-style-type: none"> • National targets for waste management, increasing landfill taxes and financial support to develop pre-processing facilities • Enforcement of the national waste management law; authorities recognize co-processing as a viable waste treatment option • Increased pressure to use more AF in the industry as the individual plants have made enabling investments in technology
Actions for stakeholders	<ul style="list-style-type: none"> • Ensure prudent enforcement of the national waste management law • Limit illegal discharge of waste and apply stricter control over volume and type of landfilled wastes • Support the domestic waste management industry in the development of the expertise required to produce pre-processed waste of sufficient quality • Provide training to enable operational excellence at sorting facilities • Ensure that pre-processed waste is of sufficient quality
What is the opportunity?	<ul style="list-style-type: none"> • General improvement of the waste management industry in the country • Development of a potentially sizeable uptake for combustible waste streams which cannot be recycled • Limited import of foreign waste and utilize domestic waste instead



Data references:

- > Data for the cement sector were obtained from NSI (National Statistical Institute) at <http://www.nsi.bg/en>
- > Data for fuels consumptions were from ExEA (Executive Environment Agency) at <https://eea.government.bg/en/>
- > Data for the waste management were obtained from Eurostat at <http://ec.europa.eu/eurostat/data/database>

[1] Interview with Desislava Kirova, SEP Manager at LafargeHolcim, 25 Nov. 2016

[2] Bulgaria National Statistical Institute, available: <http://www.nsi.bg/en>

[3] Devnya Cement, available: <http://www.devnyacement.bg/ENG>

[4] National analyses: National Waste Analysis (2012) and National Waste Management Infrastructure Analysis (2014). Both documents available only in Bulgarian and published on the webpages of the Bulgarian Ministry of Environment and Water, available: http://www5.moew.government.bg/?page_id=44826). The National Strategic Plan for Waste Management (2014, also in Bulgarian) is available at: http://www5.moew.government.bg/wp-content/uploads/filebase/Waste/NACIONALEN_PLAN/_NPUO_2014-2020.pdf

Disclaimer:

- > We use 2013 data for Bulgaria as 2014 data from all operators were incomplete at the time this study was finished.

Case study

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Czech Republic Summary

Despite the country's below EU average GDP, its waste management and cement industries are amongst the most developed

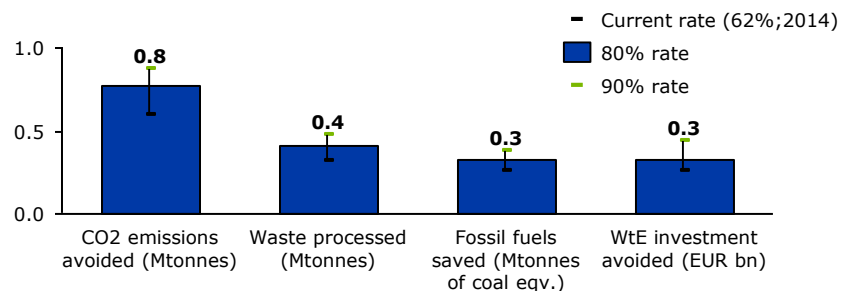


Both the waste management and the cement industry are highly developed, despite country's below EU average GDP. The high co-processing rates could even further be increased, however unavailability of high volumes of quality waste domestically and political barriers to import are slowing the progress.

BARRIERS *Strong bureaucratic barriers and lack of suitable waste are the main limiting factors.*

Waste market organization	Medium	<ul style="list-style-type: none"> High quality waste not available to the cement sector in sufficient quantity
Waste market situation	Medium	<ul style="list-style-type: none"> Competition for available waste
Political environment	High	<ul style="list-style-type: none"> Strong bureaucracy in regards to permitting for waste imports Support to incineration on national level
Societal perspective	Low	<ul style="list-style-type: none"> No significant barriers identified
Cement industry	Low	<ul style="list-style-type: none"> No significant barriers identified

POTENTIAL *At 80% co-processing rate, the sector could mitigate approximately 0.8 Mtonnes of CO₂ annually, while avoiding WtE investment of 0.3 EUR bn.*



ACTIONS FOR STAKEHOLDERS

Policy makers

- Incentivize further development of production of high quality wastes or simplify the procedures for waste imports

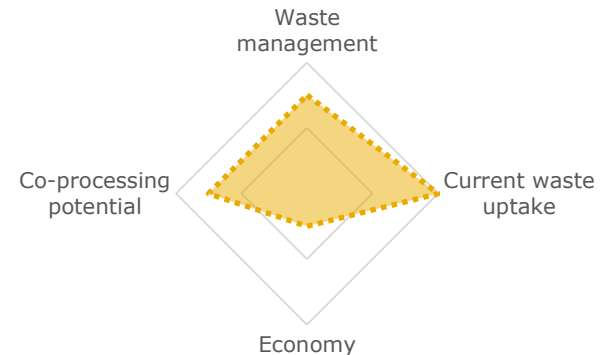
The cement industry

- Explore the possibilities for waste utilization from other industries
- Provide premiums to domestic waste industry to produce larger amounts of high quality wastes

The waste management industry

- Explore the economic feasibility of increasing the production of high quality wastes suitable for the cement industry

CZECH REPUBLIC AT A GLANCE



Czech Republic Cement Sector

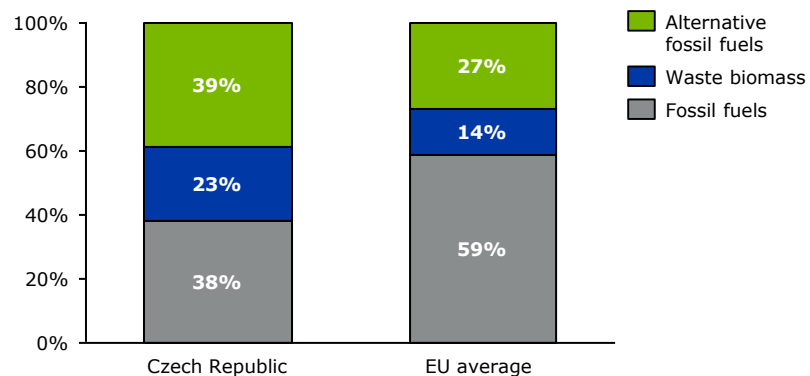
Technologically advanced industry owned by large international players orientated on domestic market



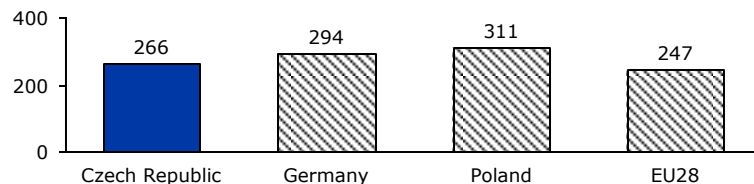
The Czech cement industry is technologically advanced and has one of the highest fuel substitution rates in the EU, with one of the plants already operating at 90% co-processing rate. Lately, however, the domestic supply of high quality wastes seems to be drying out.

CO-PROCESSING *Czech Republic has one of the highest co-processing rates in the EU with 62% of thermal energy coming from alternative fuels.*

Average thermal energy consumption in cement kilns (2014)



Grey clinker production per capita (tonnes/Nr; 2014)



AT A GLANCE

- All 5 Czech cement plants are owned by large international players - HeidelbergCement, LafargeHolcim, Buzzi Unicem and Cemex.
- In 2014, about 2.8 Mtonnes of clinker was produced; imports and exports were relatively insignificant.
- The domestic demand peaked before 2008, but declined significantly after many infrastructural development projects were stopped by the government. Since 2010 the country has again been experiencing increase in demand.
- Czech republic has one of the highest co-processing rates in the EU, 62% in 2014. One of the cement plants has already achieved fuel substitution of 90%.
- In order to achieve even more intensive fuel switching, fuels of very high quality are needed (i.e. with high calorific value, but minimal presence of chlorine or 'clinker poisons').
- The cement industry has been benefiting from well developed pre-processing industry, however, lately the supply of high quality domestic waste has been depleted.
- So far, the only substantial industrial waste stream that has been tapped by the cement sector is automotive.

Czech Republic Waste Management

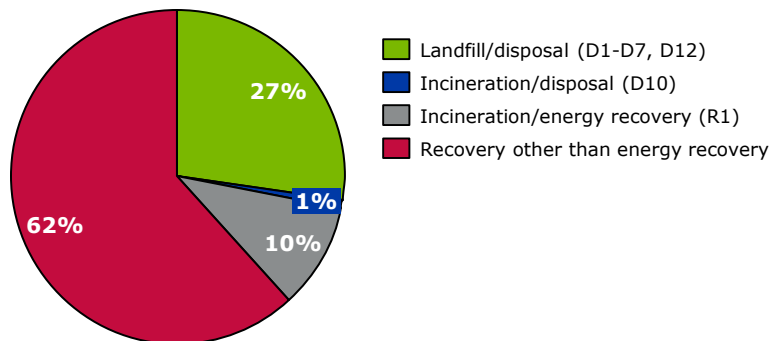
The country has a mature waste industry, but unable to produce sufficient volumes for the cement plants



The waste industry is highly developed, yet about a quarter of the waste is still landfilled. There are economic incentives to continue development of incinerators, but have to confront strong public opposition. The cement industry is trying to import more high quality wastes as their domestic availability is limited.

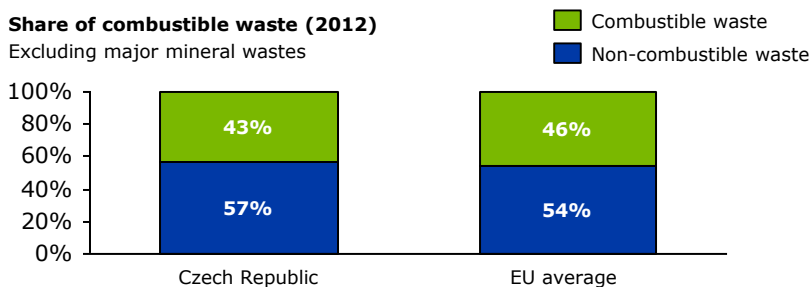
WASTE TREATMENT *Czech republic has a very high recycling rate, yet still substantial part of waste is being landfilled.*

Waste treatment composition (2014)
Excluding major mineral wastes



WASTE AVAILABILITY *Czech Republic is just slightly below the EU average in regards to combustible waste generation.*

Share of combustible waste (2012)
Excluding major mineral wastes



AT A GLANCE

- Despite a very high recycling rate (62%) and developing incineration (10%), still a substantial part of generated waste gets landfilled (27%). This might be partly caused by a low landfill tax (minimum at 20 EUR/tonnes in 2015), however a landfill ban is planned for 2023 for all MSW that can be re-used or recycled. [1]
- The government has a relatively neutral position towards co-processing, but incinerators are generally supported. The private sector is employing strong lobbying to continue development of incinerators as subsidies continue to be available both from the national government and the EU. [2]
- However, the public and NGO's opposition against incinerators is widespread and blocking or slowing down building of incinerating capacity. This presents a viable advantage for the cement sector, which is being perceived as the "cleaner" alternative to incinerators and generally enjoys public support for co-processing. [3]
- The cement industry is trying to import high quality waste from Austria and Germany as the domestic availability is insufficient, however, this is slowed down by a lengthy bureaucratic process; it can take more than 6 months between the initial request and the actual import taking place. [4] The availability of RDF was further reduced by the strong development of co-processing in Poland, which now imports wastes from Czech Republic and Germany.

Czech Republic Barriers and Opportunities

The industry is technically and economically ready for even greater fuel switching; but currently looking for sufficient volume of waste fuels



The cement industry is highly mature and ready to continue pursuing very high co-processing rates. As domestic availability of high quality wastes is insufficient, bureaucratic barriers for waste imports need to be lifted. In addition, support for waste pre-processing as opposed to waste utilization is desirable.

BARRIERS As the availability of domestic high quality wastes has peaked, the industry has to look for imports. Lengthy bureaucratic processes slow down the possibility of over-border waste trade.

DRIVERS AND OPPORTUNITY Continuous fuel switching in one of the most developed cement sectors in the EU can be incentivized if lessons learned from abroad are actionized. Waste management can be optimized from taxpayers' views.

<i>Waste market organization</i>	Medium	<ul style="list-style-type: none"> • High quality waste not available to the cement sector in sufficient quantity
<i>Waste market situation</i>	Medium	<ul style="list-style-type: none"> • Competition for available waste, in particular with incinerators
<i>Political environment</i>	High	<ul style="list-style-type: none"> • Strong bureaucracy in regards to permitting for waste imports • Support to incineration on national level
<i>Societal perspective</i>	Low	<ul style="list-style-type: none"> • No significant barriers identified
<i>Cement industry</i>	Low	<ul style="list-style-type: none"> • No significant barriers identified

Drivers	<ul style="list-style-type: none"> • Cement industry able to pay further premiums for high quality wastes driven by volatile fossil fuel prices • Substantial technical expertise allowing for very high substitution rates (up to 90%) • Planned landfill ban (2023) further incentivizing advanced waste treatment methods • Lessons learned from waste management industry in neighboring countries (e.g. Poland)
Actions for stakeholders	<ul style="list-style-type: none"> • Incentivize further development of production of high quality wastes or simplify the procedures for waste imports • Balance the development of WtE to prevent overcapacities and market distortions • Explore the possibilities for waste utilization from other industries outside of automotive • Provide premiums to domestic waste industry to produce larger amounts of high quality wastes • Explore the economic feasibility of increasing the production of high quality wastes suitable for the cement industry
What is the opportunity?	<ul style="list-style-type: none"> • Prevention of incineration overcapacity in the market, when ready-to-go alternative in the cement industry exists • Further support to one of the most modern and experienced cement sectors in the EU • Economically beneficial optimization of waste utilization from the taxpayers' perspective



Data references:

Data for the cement sector were obtained from GNR (Getting the Numbers Right) at <http://www.wbcdcement.org/GNR-2014/index.html>

Data for the waste management were obtained from Eurostat at <http://ec.europa.eu/eurostat/data/database>

[1] CEWEP (2015), Landfill taxes and bans, available: http://www.cewep.eu/media/www.cewep.eu/org/med_557/1406_2015-02-03_cewep_-_landfill_inctaxesbans.pdf

[2] STEO, available: www.steo.cz

[3] ARNIKA, available: www.arnika.org

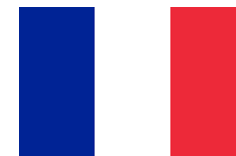
[4] Interview with Ing. Jan Gemrich, Director and Secretary at Research Institute of Binding Materials Prague, 08/Dec/2016

Case study

- > Belgium
- > Bulgaria
- > Czech Republic
- > **France**
- > Germany
- > Greece
- > Hungary
- > Ireland
- > Italy
- > Poland
- > Portugal
- > Spain
- > Sweden
- > United Kingdom

France Summary

The cement industry needs to undergo a technology upgrade to allow for higher co-processing rates



The outdatedness of the technologies in the French cement sector sets rather a hard cap on the maximum fuel switching potential. The industry has to find a way to get rid of overcapacity on the market and its inefficiencies to tap into the fast developing market with pre-processed wastes.

BARRIERS *Lack of investment to upgrade processes hampers higher use of alternative fuels*

Waste market organization	Medium	• High quality waste not available to the cement sector in sufficient quantity
Waste market situation	Medium	• Demand for high quality Solid Shredded Wastes (SSW) too low to incentivize production of it
Political environment	Low	• No significant barriers identified
Societal perspective	Low	• No significant barriers identified
Cement industry	High	• Technical readiness to increase co-processing rate is low • Lack of economic incentives to modernize the cement industry

ACTIONS FOR STAKEHOLDERS

The cement industry

- Address the overcapacity and inefficiencies in the sector
- Develop a long-term vision on how to successfully incentivize technological modernization of the sector

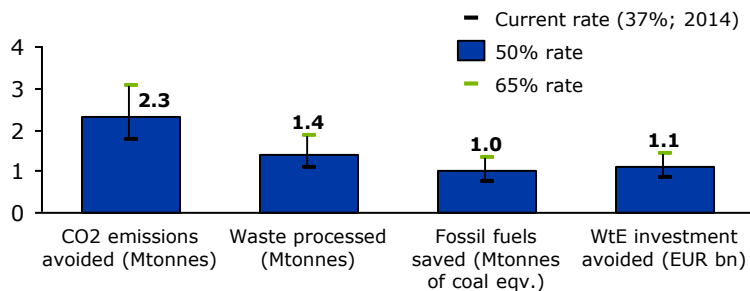
Policy makers

- Limit the impact of potential market distortions (e.g. subsidies for power generation in WtE)

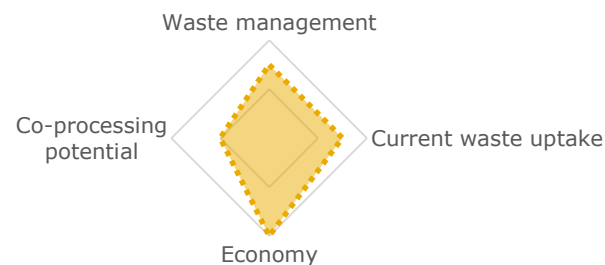
The waste management industry

- Improve the quality of domestically produced Solid Shredded Wastes (SSW) in order to allow for its uptake in the cement industry

POTENTIAL *At 50% co-processing rate, the sector could mitigate some 2.3 Mtonnes of CO2 annually, while avoiding WtE investment of 1.1 EUR bn*

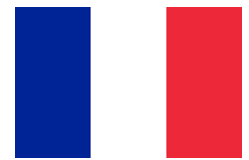


FRANCE AT A GLANCE



France Cement Sector

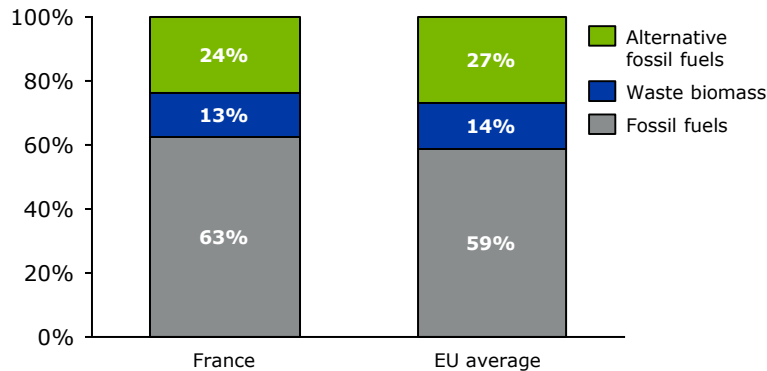
The cement industry needs a technological upgrade, however decreased demand is limiting the investment possibilities



As the domestic demand for cement has been decreasing following the economic downturn in 2008, the cement sector has not invested into technological upgrades allowing higher fuel substitution rates. A plan has to be made for closure of the oldest plants and modernization of the remaining ones.

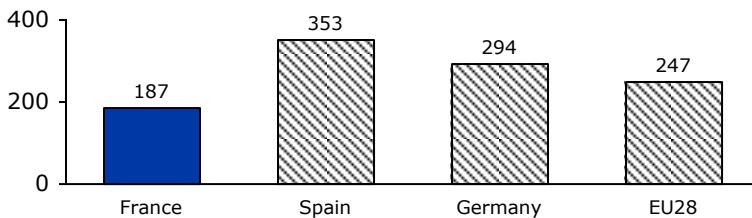
CO-PROCESSING *France co-processing rate is slightly below EU average with 37.3% of thermal energy coming from alternative fuels.*

Average thermal energy consumption in cement kilns (2014)



PRODUCTION *France has comparably low clinker production per capita. Both exports and imports of clinker are very low.*

Grey clinker production per capita (tonnes; 2014)

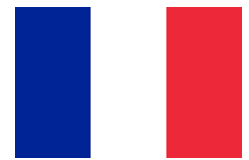


AT A GLANCE

- There are 4 main operators on the market, including HeidelbergCement, LafargeHolcim, CRH and Vicat. These groups had, in total, 28 clinker and cement plants in 2016 [1].
- France is one of the largest producers of white clinker in the EU; mainly used for domestic consumption [2].
- Between 2008 and 2014 the production of grey clinker decreased by 20% due to lower demand by the construction sector. As a result, two cement plants closed down in 2016 [3].
- In 2014, 12.4 Mt of grey clinker was produced. Both imports and exports of clinker were insignificant.
- The current co-processing rate (37.3%) is slightly below the EU average of 40.2% in 2014.
- Further fuel switching is largely limited due to the outdatedness of the technology in the cement sector. Average co-processing rate of around 50% across the industry is seen an upper limit without necessary technological upgrades. [4].
- There is an ongoing issue with the quality of solid shredded wastes (SSW) as low demand for this type of fuel has not stimulated adequate quality focus in the pre-processing facilities [5].

France Waste Management

Advanced waste management industry, yet without significant economic incentives to provide sufficient volumes of high quality pre-processed wastes

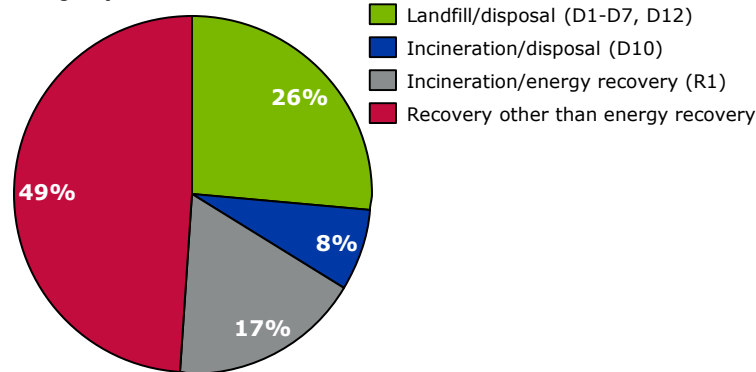


Coordination between the developing incineration industry and the cement sector could lead to Solid Shredded Wastes (SSW) production sufficient in volumes, but also in adequate quality, dependent on the type of end-use. As further landfill cuts will be enforced, the advanced treatment methods will have to step in.

WASTE TREATMENT *Large share of waste is being incinerated, yet landfilling still remains an issue to be tackled.*

Waste treatment composition (2014)

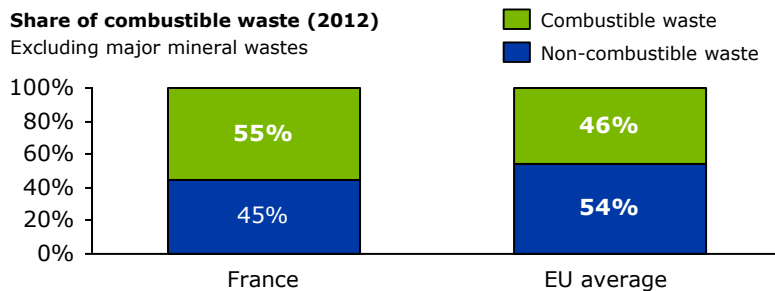
Excluding major mineral wastes



WASTE AVAILABILITY *France is way above EU average in regards to combustible waste generation.*

Share of combustible waste (2012)

Excluding major mineral wastes

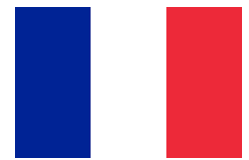


AT A GLANCE

- In 2014, about 49% of the treated wastes were recycled in France, 17% incinerated with energy recovery and 26% landfilled.
- The landfill taxes range from very low (20 EUR/tonne) to very high (120 EUR/tonne) depending on type of waste. A new waste management law aims at 50% reduction of waste landfilled by 2025. [6] [7]
- Currently, there is an oversupply of pre-processed waste in the domestic market which led to low cost of SSW, but also to a low quality, making it often unsuitable for the cement industry.
- The production of SSW is supposed to increase even further as the waste management industry has a goal of producing 2.2 Mtonnes of SSW by 2025. [8]
- Construction of new D10 installations is largely impossible due to strong public opposition, however further development of combined heat and power incinerators is expected.
- This could motivate the pre-processing industry to develop both high quality waste for the cement industry and lower quality waste for incinerators. As the competition for waste streams increases however, the price of SSW could raise.
- About half of the AF used in the cement sector comes from other industries; the availability of the wastes will therefore also depend on the market development in these other sectors.

France Barriers and Opportunities

The cement industry has to provide a long-term vision to solve its capacity and inefficiency issues



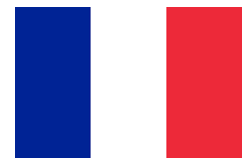
The cement industry was unable to modernize itself as of yet and is facing serious overcapacity and inefficiency issues. If this can be overcome and the waste industry ensures that quality of pre-processed wastes improves, a stable and well-received alternative to incinerators can be developed further.

BARRIERS *A general inability in the cement industry to pursue technology upgrades is the main barrier to increased fuel substitution.*

DRIVERS AND OPPORTUNITY *The cement sector has to first rejuvenate itself and get rid of overcapacity and inefficiencies. When modernized, it can tap into the fast developing market with pre-processed wastes even further.*

Waste market organization	Medium	<ul style="list-style-type: none"> • High quality waste not available to the cement sector in sufficient quantity, produced Solid Shredded Wastes (SSW) mostly unsuitable to be used in the cement sector
Waste market situation	Medium	<ul style="list-style-type: none"> • Demand for high quality SSW too low to incentivize production of it
Political environment	Low	<ul style="list-style-type: none"> • No significant barriers identified
Societal perspective	Low	<ul style="list-style-type: none"> • No significant barriers identified
Cement industry	High	<ul style="list-style-type: none"> • Technical readiness to increase co-processing rate is low • Lack of economic incentives to modernize the cement industry

Drivers	<ul style="list-style-type: none"> • Waste management industry target to produce to 2.2 Mtonnes of SSW by 2025 • New waste management law encourage further cuts in landfilling • Prohibition of installing new incineration facilities in dense populated areas • Public awareness and support to co-processing as the result of sector's transparency • Improvement of construction market can lead to more investment in the sector
Actions for stakeholders	<ul style="list-style-type: none"> • Limit the impact of potential market distortions (e.g. subsidies for power generation in WtE) • Address the overcapacity and inefficiencies in the sector • Develop a long-term vision on how to successfully incentivize technological modernization of the sector • Improve the quality of domestically produced SSW in order to allow for its uptake in the cement industry
What is the opportunity?	<ul style="list-style-type: none"> • Modernization of the cement sector and higher use of alternative fuels • Guaranteed uptake for the expanding pre-processing industry • Development of an alternative to incinerators without a burden on taxpayers



Data references:

- > Data for the cement sector were obtained from GNR (Getting the Numbers Right) at <http://www.wbcdcement.org/GNR-2014/index.html>
- > Data for the waste management were obtained from Eurostat at <http://ec.europa.eu/eurostat/data/database>

[1] ATILH – Association Technique de l’Industrie des Liants Hydaruliques

[2] Global Cement, White Cement Review, available:
<http://www.globalcement.com/magazine/articles/890-white-cement-review>

[3] SFIC: Syndicat Français de l’Industrie Cimentière

[4] Interview with Fabrice Copin, Directeur Délégué at ATILH, 28th November 2016.

[5] ATILH – Association Technique de l’Industrie des Liants Hydaruliques

[6] CEWEP (2015), Landfill taxes and bans, available:
http://www.cewep.eu/media/www.cewep.eu/org/med_557/1406_2015-02-03_cewep_-_landfill_inctaxesbans.pdf

[7] Loi pour la Transition Energétique et la Croissance Verte (August 2015)

[8] Plan National de Gestion des Déchets

Case study

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- > Bulgaria
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- > **Germany**
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Germany Summary

Germany has a very mature waste management system and cement industry

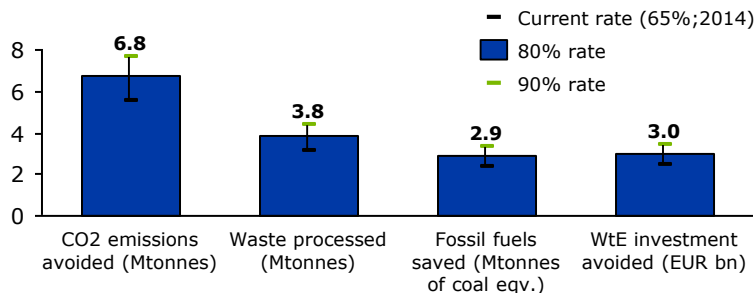


A well matured market with high substitution rates which still has the potential do develop even further. Balancing between co-processing and incineration can reduce overall costs and investment burden on society.

BARRIERS *The cement industry is ready to further increase the co-processing rates as barriers are being lifted.*

Waste market organization	Low	• No significant barriers identified
Waste market situation	Medium	• Competition for available waste • Market distortions , on biomass and GHG
Political environment	Medium	• NOx regulations beyond EU legislation
Societal perspective	Low	• No significant barriers identified
Cement industry	Low	• No significant barriers identified

POTENTIAL *At 80% co-processing rate, the sector could mitigate some 6.8 Mtonnes of CO2 annually, while avoiding WtE investment of 3 EUR bn.*



ACTIONS FOR STAKEHOLDERS

The cement industry

- Innovate and improve on the use of Alternative Fuels.
- Remain a reliable customer for Alternative Fuels.

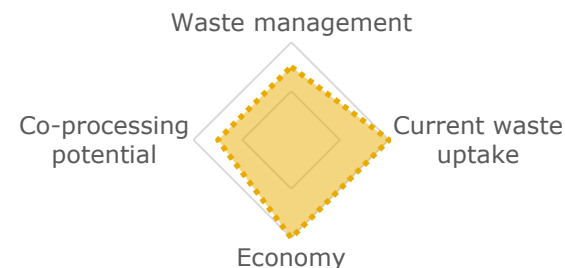
Policy makers

- Balance capacities of WtE and the cement industry.
- Level playing field regarding GHG emissions between cement and WtE.

The waste management industry

- Improvement of waste processing technology to make better fuels from lower quality waste streams.

GERMANY AT A GLANCE



Germany Cement Sector

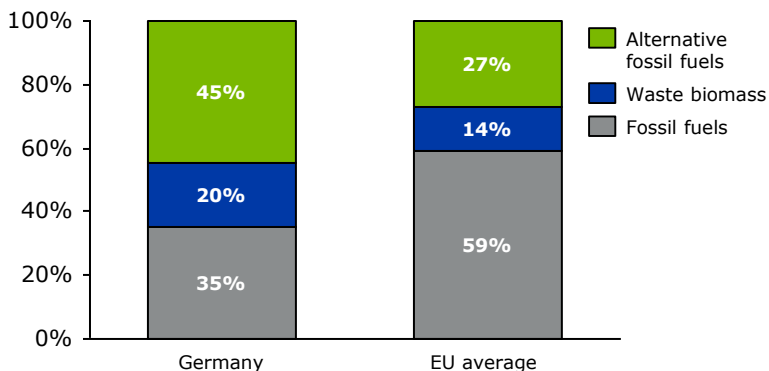
Germany's cement sector is highly developed



Majority of the cement production goes to the domestic market, the cement plants are highly energy-efficient, deriving most of their energy from co-processing waste fuels.

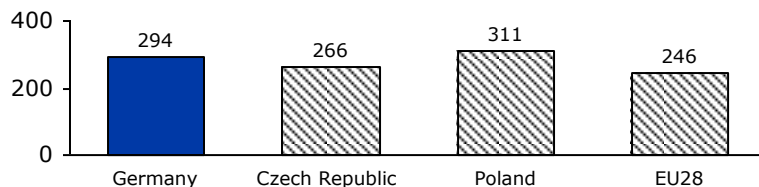
CO-PROCESSING *Germany has one of the highest co-processing rates in the EU with 65% of thermal energy coming from alternative fuels.*

Average thermal energy consumption in cement kilns (2014)



PRODUCTION *Germany has clinker capita production similar to its neighboring countries and slightly above the EU28 average.*

Grey clinker production per capita (tonnes; 2014)



AT A GLANCE

- 22 companies producing cement in 2014. The market consists of a mix of global players (HeidelbergCement, LafargeHolcim, Buzzi Unicem, CRH, CEMEX) and a larger number of SMEs (like Seibel und Söhne, Miebach, Märker, Spenner, Rohrdorfer, etc.).
- In 2014, a total volume of 32.1 Mtonnes cement and 23.9 Mtonnes clinker were produced; roughly 20% of which was exported.
- 53 cement kilns had operating permit in 2014, but not all were running, as 8 shaft kilns did not contribute to the annual production.
- Current substitution rate in Germany by waste-derived alternative fuels is very high; reaching 65% substitution in 2014 and the potential to grow to a level of 80% by 2020:
- Heavy investments have been made over the years: in permits, installations and abatement technology (emissions reduction and monitoring).
- The cement industry is facing substantial investments to be in conformity with new restrictions on NOx emissions that go beyond EU regulations.

Germany Waste Management

Germany has a highly modern waste management system

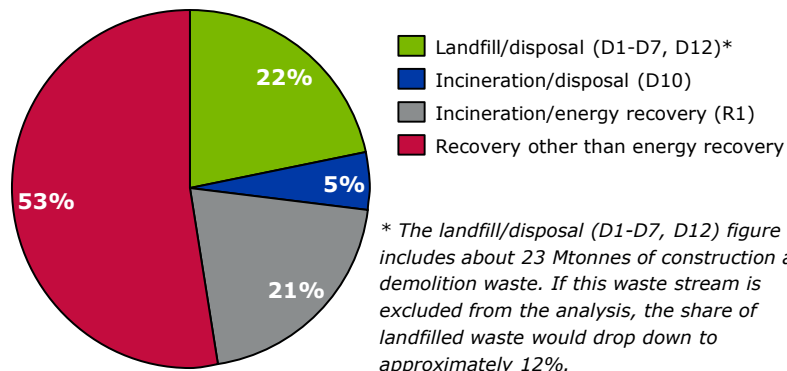


Germany was amongst the first EU countries to enforce the landfilling directive; it has a well-functioning waste legislation and abides to most EU waste directives.

WASTE TREATMENT Germany has a well developed WtE capacity and about 26% of the waste gets incinerated. However, despite a landfill ban, 22%* of waste is still being disposed of.

Waste treatment composition (2014)

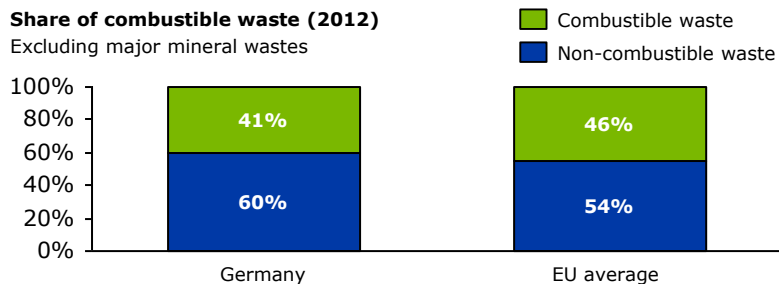
Excluding major mineral wastes



WASTE AVAILABILITY The volume of combustible waste available in Germany is slightly below the EU28 average.

Share of combustible waste (2012)

Excluding major mineral wastes



AT A GLANCE

- Landfilling of untreated biodegradable matter and of municipal solid waste containing organics ceased on 1 June 2005. Yet still, about 22% of waste is being disposed of.
- MSW is mainly treated in MBTs or sorting plants; with the primary aim to produce materials for recycled for reuse and secondary for providing feedstock for further energy recovery in WtE plants or other plants undertaking energy recovery (like the cement industry)
- Untreated or poorly treated MSW is brought to incinerators.
- German policy execution has led to a waste sector with a high level of recycling (53%) no landfilling (of MSW), and many options for energy recovery or incineration (collectively 26% of total waste generated in 2014).
- However, incinerators and WtE plants are excluded from the EU-ETS, unlike cement plants, this is seen as a disadvantage for the cement industry, due to expected shortages of emission rights.
- There already seems to be an excess capacity in WtE and incineration, which led to waste being imported for both incinerators and WtE plants.
- Biomass to Power and Biomass to Heat is privileged under the Renewable Energy Act (EEG) and Renewable Heating Act (EEWärmeG), which puts the cement industry at a disadvantage for using waste biomass based alternative fuels.

Germany Barriers and Opportunities

Germany can avoid part of additional WtE investments



Political focus on waste, massive investments and reliable collection, and treatment systems brought Germany to its present waste leadership position. However, if co-processing barriers are lifted, huge investment costs to WtE can be avoided.

BARRIERS Political and environmental barriers are still to be better addressed in order to fully develop the co-processing potential in Germany.

DRIVERS AND OPPORTUNITY If the capacities of WtE and the cement industry are well balanced and a level playing field in carbon costs is established, the cement industry could significantly contribute to national GHG reduction targets.

Waste market organization	Low	• No significant barriers identified
Waste market situation	Medium	<ul style="list-style-type: none"> • Competition for available waste, in particular with incinerators • Market distortions, especially on biomass, the heat and power sector are privileged. • Market distortions, due to differences in GHG accounting between cement plants and incinerators.
Political environment	Medium	• NOx regulations beyond EU legislation
Societal perspective	Low	• No significant barriers identified
Cement industry	Low	• No significant barriers identified

Drivers	<ul style="list-style-type: none"> • Well developed and reliable waste processing industry • Long term AF use experience • Economic incentives to use AF • Need to reduce GHG emissions under EU ETS
Actions for stakeholders	<ul style="list-style-type: none"> • Improvement of waste processing technology to make better fuels from lower quality waste streams • Balancing the capacities of WtE and the cement industry to avoid overcapacity • Achieve a level playing field between cement industry and WtE / Incinerators regarding GHG emissions from waste derived fuel • Achieve a level playing field between cement industry and privileged projects with regard to waste biomass
What is the opportunity?	<ul style="list-style-type: none"> • More jobs in the waste industry • Co-processing and WtE capacity balancing leads to overall reduction in costs and investment burden on society • Increased use of waste biomass in co-processing • Further reduction of GHG emissions at industry level • Lowering overall costs to achieve national GHG reduction targets



Data references:

- > Data for the cement sector were obtained from GNR (Getting the Numbers Right) at <http://www.wbcdcement.org/GNR-2014/index.html>
- > Data for the waste management were obtained from VDZ and Destatis and Eurostat at <http://ec.europa.eu/eurostat/data/database> and from

[1] VDZ, "Zementindustrie im Überblick, 2015", available on: <https://www.vdz-online.de/publikationen/>

[2] Interview with Dr. Martin Oerter, VDZ, March 2016

[3] VDZ, "Umweltdaten der deutschen Zementindustrie 2014", September 2015, available on: <https://www.vdz-online.de/en/publications/>

[4] Strategie Planung Umweltrecht. S. 139-162. „Perspektiven der Verwertung von Ersatzbrennstoffen in Zementwerken“, Renato Sarc, Roland Pomberger and Karl E. Lorber, 2013.

[5] Energie aus Abfall, Band 10, S. 837-852 "Ersatzbrennstoff-Kraftwerke in Deutschland und Österreich", Stephanie Thiel, 2013

Case study

- > Belgium
- > Bulgaria
- > Czech Republic
- > France
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- > **Greece**
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Greece Summary

The Greek waste management is in turmoil which causes problems to the export oriented cement industry

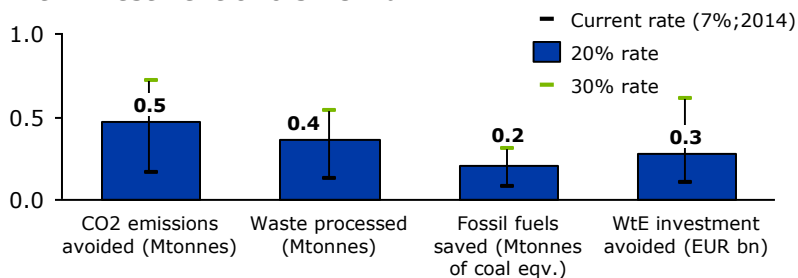


The export oriented cement industry has to stay internationally competitive, yet has a very low uptake of alternative fuels mainly caused by a lengthy administrative process to obtain permits and depleted market for pre-processed fuels due to a very poor waste management in the country.

BARRIERS *Strong bureaucratic barriers and lack of suitable waste are the main limiting factors.*

Waste market organization	High	<ul style="list-style-type: none"> • High quality waste not available to the cement sector in sufficient quantity • Waste processing industry is not well-developed
Waste market situation	Medium	<ul style="list-style-type: none"> • National economic situation doesn't allow investments in waste industry
Political environment	High	<ul style="list-style-type: none"> • Energy recovery not supported on national level • Excessive bureaucracy in regards to permitting
Societal perspective	Medium	<ul style="list-style-type: none"> • Public acceptance of incineration in general is low
Cement industry	Low	<ul style="list-style-type: none"> • No significant barriers identified

POTENTIAL *At 20% co-processing rate, the sector could mitigate some 0.5 Mtonnes of CO2 annually, while avoiding WtE investment of 0.3 EUR bn.*



ACTIONS FOR STAKEHOLDERS

The cement industry

- Explore the possibility of importing alternative fuels
- Co-operate with the local waste management industry to ensure suitable quality of processed waste

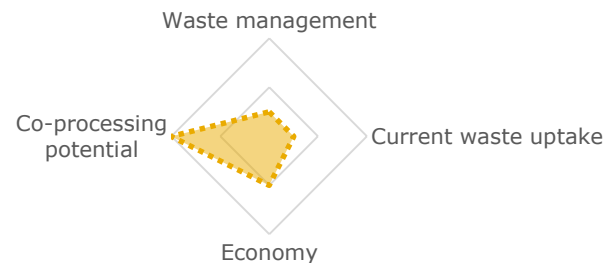
Policy makers

- Alleviate the bureaucratic barriers for permitting
- Include co-processing into national waste management planning

The waste management industry

- Ensure reliable waste collection and treatment system and ensure stable stream of pre-treated waste to the cement industry

GREECE AT A GLANCE



Greece Cement Sector

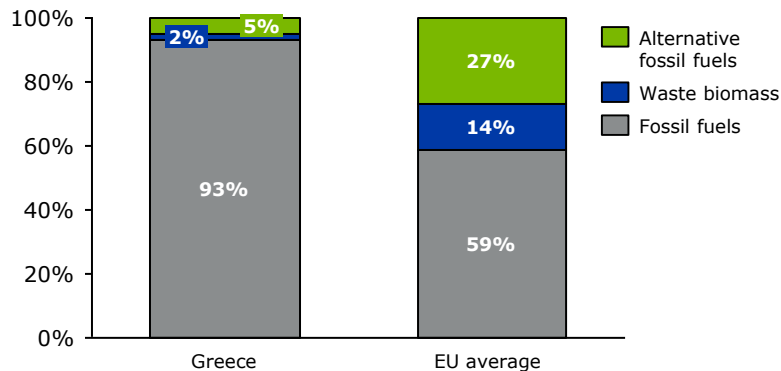
Export oriented sector with extremely low waste uptake induced by administrative and management barriers



The Greek cement sector is heavily export oriented, yet it's competitiveness on the international markets might be hampered by the lowest fuel substitution rate in Europe. Already, Titan Cement plans to undertake major investments in Egypt rather than Greece to allow for more waste uptake in its plants.

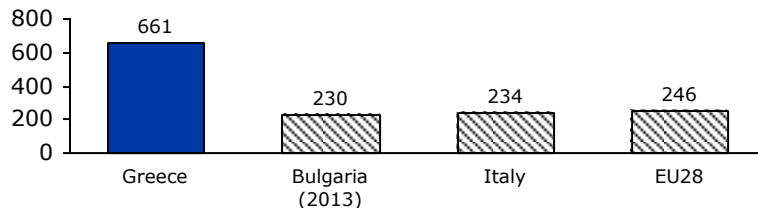
CO-PROCESSING *Greece has the lowest co-processing rate in the EU with 7% of thermal energy coming from alternative fuels.*

Average thermal energy consumption in cement kilns (2014)



PRODUCTION *Greece has one of the highest clinker per capita productions in the EU as majority of the cement and clinker is exported, mainly to North Africa.*

Grey clinker production per capita (tonnes; 2014)



AT A GLANCE

- Titan Cement is the largest player in the local cement industry, and of Greek origin. It has 3 plants in Greece and also operates plants in Egypt, North America, Eastern and Southeastern Europe. LafargeHolcim (2 plants) and Italcementi (1 plant) are the other cement producers in Greece.
- The major part of Greek cement and clinker is being exported (68% in 2014); it is sent mainly to North Africa [1]
- As a result, Greece has a very high clinker production per capita (661 kg/capita in 2014).
- After several years of decrease in production, the industry has been recovering well from a low in 2011, despite continuous shrinking of the country's GDP.
- The co-processing rate in Greece is the lowest in the EU, on average 7% (compared to EU average 41%), caused by limited availability of suitable waste-fuels and lengthy permitting process for their use in cement kilns.
- However, one of the plants already reaches over 20% substitution and the sector should be ready to increase its substitution rate up 30% in short period of time, if other barriers are mitigated. [2]

Greece Waste Management

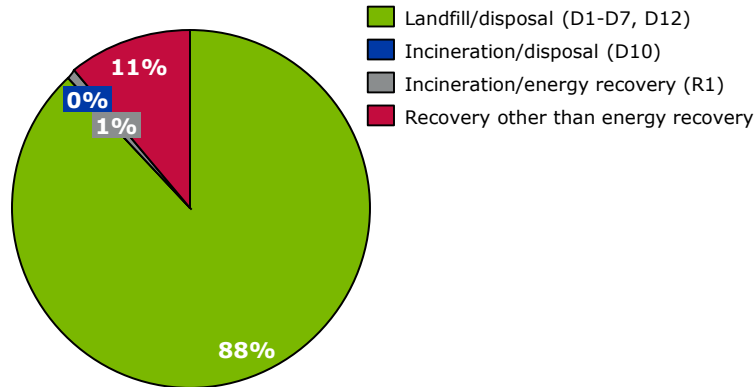
Waste management in Greece is facing a long list of problems combined with a lack of implementable political vision



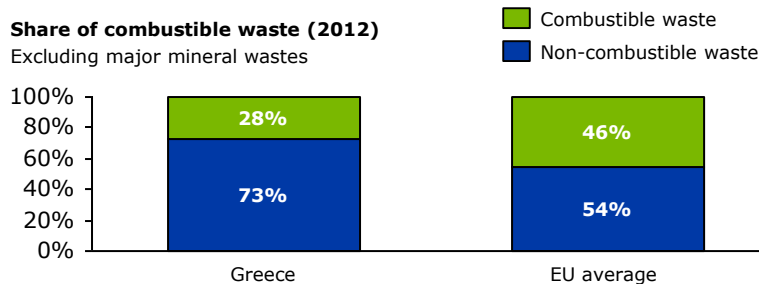
The waste industry is facing major management, economical and logistical issues combined with an unrealistic political vision for its development. As such, almost all waste goes to landfills, often illegal ones, including the poor quality RDF which cannot be used in cement kilns.

WASTE TREATMENT With 88% landfilling rate, Greece has one of the worst waste management systems in the EU.

Waste treatment composition (2014)
Excluding major mineral wastes



WASTE AVAILABILITY The volume of combustible waste available in Greece is extremely low compared to other countries.



AT A GLANCE

- Greece has a malfunctioning waste management system where 88% of total waste gets landfilled and only 11% recycled. There is no incineration capacity in the country outside of cement plants.
- The volume of potentially combustible wastes generated (28% of total) is well below EU average (46%).
- Further, the country faces an ongoing problem with a lack of sanitary landfills and illegal dumping has occurred frequently. As of December 2014, 39 illegal landfills were still in operation and 206 additional sites were awaiting restoration. The EC fined Greece 10 MEUR for infringement of the EU waste framework directive in the same year.
- The RDF produced by the waste industry has been of very poor quality, unsuitable for cement kilns, and is hence being landfilled as well. [2]
- In the new National Waste Management Plan from 2015, the amount of landfilled waste should be limited to 30% of total waste generated and more than 50% of MSW should be prepared for reuse.
- However, production of Refuse-Derived Fuel (RDF) and Solid Recovered Fuel (SRF) is not considered to be an appropriate waste treatment option and the utilization of waste-derived fossil fuels is considered as a process of high environmental impact.
- There is no distinguishing between co-processing in cement kilns and other ways of energy recovery. [3]

Greece Barriers and Opportunities

The government has to include co-processing in its planning and severely improve the current waste management situation



The cement industry is technically ready to increase its use of alternative fuels, yet either almost none are available domestically or lengthy administration process hampers their uptake. A number of positive opportunities exists if the barriers can be overcome.

BARRIERS Very limited availability of suitable waste, lengthy permitting process and lack of recognition in national waste management planning are limiting the co-processing potential in the country.

DRIVERS AND OPPORTUNITY In order to maintain a competitive cement industry, either the domestic waste management situation has to be bettered, or the sector has to start importing pre-processed wastes from abroad.

Waste market organization	High	<ul style="list-style-type: none"> • High quality waste not available to the cement sector in sufficient quantity, produced RDF unsuitable to be used in the cement sector, currently being landfilled • Waste processing industry is not well-developed, illegal landfilling occurs
Waste market situation	Medium	<ul style="list-style-type: none"> • National economic situation doesn't allow investments in waste industry
Political environment	High	<ul style="list-style-type: none"> • Energy recovery not supported on national level • Excessive bureaucracy in regards to permitting for co-processing
Societal perspective	Medium	<ul style="list-style-type: none"> • Public acceptance of incineration in general is low
Cement industry	Low	<ul style="list-style-type: none"> • No significant barriers identified

Drivers	<ul style="list-style-type: none"> • Most Greek cement plants are technically ready to increase their use of waste-derived alternative fuels • Investment has been made in plant level to allow for higher co-processing rates • Export oriented market has to stay competitive internationally and hence try to lower its operational costs • EU's push to adhere to waste framework directive
Actions for stakeholders	<ul style="list-style-type: none"> • Explore the possibility of importing alternative fuels • Co-operate with the local waste management industry to ensure suitable quality of processed waste • Alleviate the bureaucratic barriers for permitting • Include co-processing into national waste management planning as other EU countries • Plan the development of more advanced waste treatment methods • Ensure reliable waste collection and treatment system and ensure stable stream of pre-treated waste to the cement industry
What is the opportunity?	<ul style="list-style-type: none"> • Development of reliable waste management option to help the dire situation in the country • More competitive cement industry • Better compliance with EU directives • Lower environmental impact of cement production



Data references:

- > Data for the cement sector and on co-processing were obtained from our respondent Alexandros Katsiampoulas from Titan Cement and these are not publicly available due to confidentiality issues
- > Data for the waste management were obtained from Eurostat at <http://ec.europa.eu/eurostat/data/database>

[1] Hellenic Cement Industry Association, "Statistics," accessed May 2015, available: <http://www.hcia.gr/en/statistical-elements/exports/>.

[2] Interview with Alexandros Katsiampoulas, Titan Cement, March 2016.

[3] Watson Farley & Williams, The New Greek National Waste Management Plan, September 2015, available: <http://www.wfw.com/wp-content/uploads/2015/09/Greece-National-Waste-Management-Plan-September-2015.pdf>.

Case study

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Hungary Summary

Modernized cement industry with potential to become of EU leaders in the utilization of alternative fuels



The cement industry is well developed and aims to reach a higher rate of waste co-processing. Crucial to achieve this is increased production of high quality wastes from domestic sources.

BARRIERS *Low landfill taxes and lack of high quality waste on the domestic market are the main limiting factors.*

Waste market organization	High	<ul style="list-style-type: none"> High quality waste not available to the cement sector in sufficient quantity Waste processing industry is not well-developed
Waste market situation	Medium	<ul style="list-style-type: none"> Moderate landfill taxes for combustible wastes
Political environment	Low	<ul style="list-style-type: none"> Support to incineration on national level
Societal perspective	Medium	<ul style="list-style-type: none"> Public acceptance of incineration in general is low
Cement industry	Low	<ul style="list-style-type: none"> No significant barriers identified

ACTIONS FOR STAKEHOLDERS

The cement industry

- Explore other potentially suitable waste streams outside of Municipal Solid Wastes (MSW)
- Incentivize pre-processing facilities to upgrade the quality of produced Refuse-Derived Fuel (RDF)

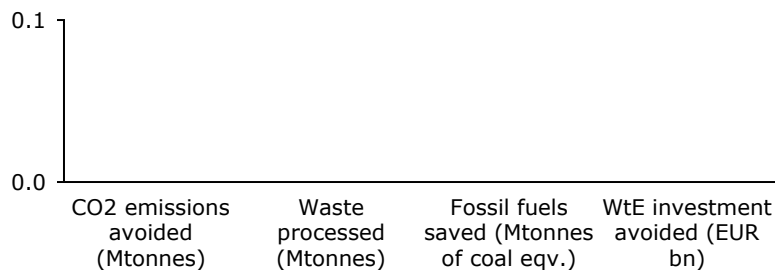
Policy makers

- Balance the development of WtE to prevent overcapacities and market distortions
- Incentivize further development of production of high quality wastes by introducing a legislative framework as standalone increase of landfill taxes is not sufficient to reduce the volumes of combustible wastes going to landfills

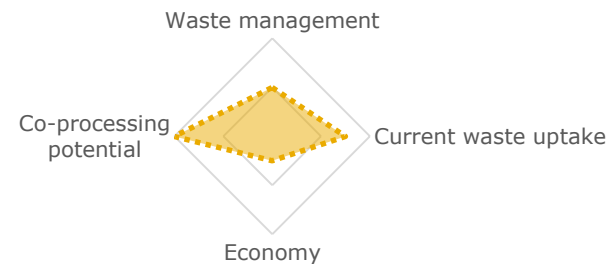
The waste management industry

- Improve the quality of domestically produced RDF to suit the needs of the cement industry

POTENTIAL – DATA NOT AVAILABLE



HUNGARY AT A GLANCE



Hungary Cement Sector

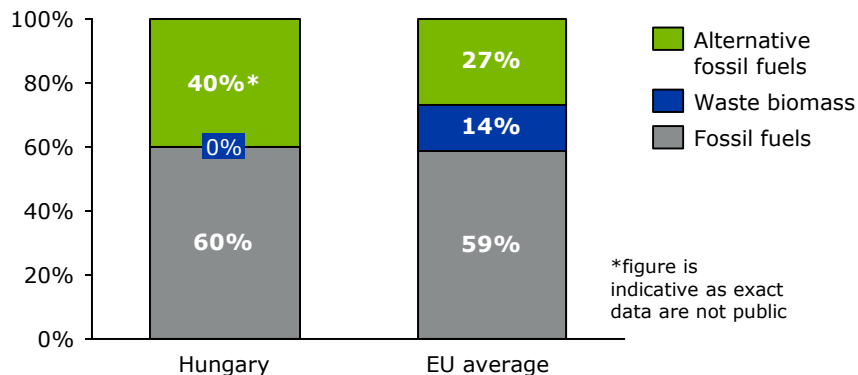
Highly technologically developed industry faced with low demand, but ready to utilize more alternative fossil fuels



The Hungarian cement industry uses the state-of-the-art technologies, but suffers from decreased domestic demand and plants operate at low load factors. Co-processing, already at EU average levels, is expected to increase fast, if sufficient streams of high quality wastes can be ensured.

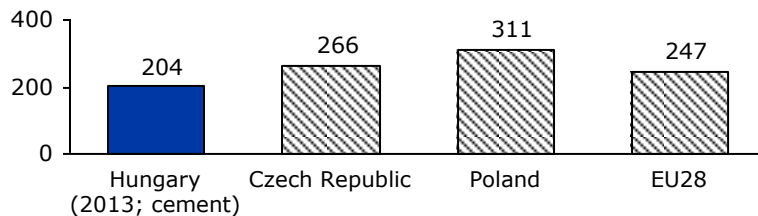
CO-PROCESSING *Hungary is at EU average rate in terms of co-processing with around 40% of thermal energy coming from alternative fuels.*

Average thermal energy consumption in cement kilns (2014)



PRODUCTION *Hungarian cement plants are operating at lower than optimal load factors (just above 60% on average) which explains the low cement per capita production in the country.*

Grey clinker production per capita (tonnes; 2014)



AT A GLANCE

- There are currently 3 cement kilns operating in Hungary, all operated by subsidiaries of HeidelbergCement or LafargeHolcim groups.
- The domestic demand of cement and clinker has been slowly increasing again over the past few years, however is still well below the pre-recession levels in 2008.
- As a consequence, the plants are operating at lower than optimal load factors – just above 60% of their average production capacity.
- However, as Hungary is landlocked between 7 neighboring countries, imports of both clinker and cement play an important role.
- The co-processing rate in Hungarian cement plants was at the level of EU average (40%) in 2014.
- Hungarian cement industry uses state-of-the-art technologies which can facilitate even higher co-processing rates. The industry is expecting to reach 60 – 70 % fuel substitution in 5 years time [1].
- However, to achieve this target the industry needs access to high quality wastes in sufficient volumes, which is currently problematic. The cement plants have to already often rely on import on pre-processed wastes.

Hungary Waste Management

Despite the developing pre-treatment capacities, the cement industry is still depending of imports of high quality wastes

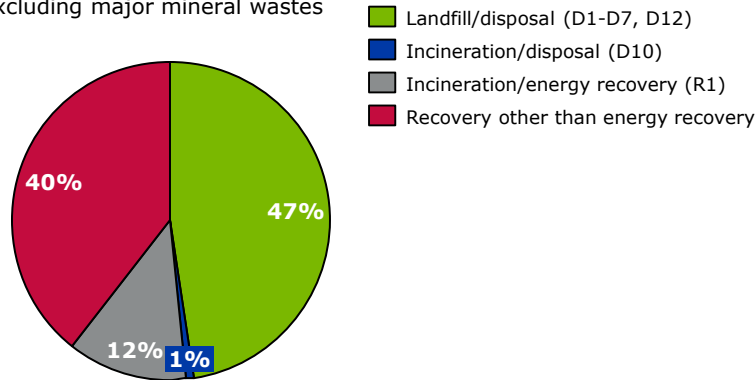


The rate of waste landfilling is high due to low taxes. Together with more state investments in waste incineration is limiting the domestic waste availability to the cement industry.

WASTE TREATMENT *Substantial volumes of waste is being landfilled (47%), but more advanced treatments methods have been steadily developing.*

Waste treatment composition (2014)

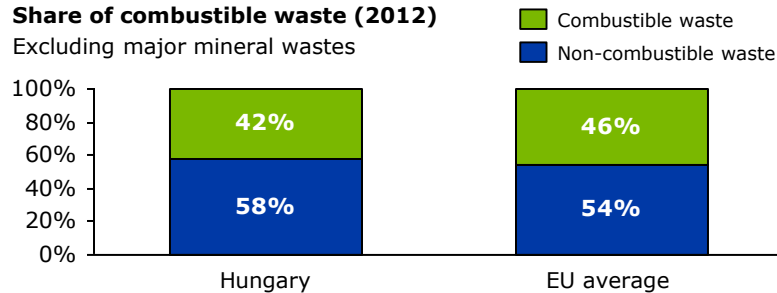
Excluding major mineral wastes



WASTE AVAILABILITY *Hungary is just slightly below the EU average in regards to combustible waste generation.*

Share of combustible waste (2012)

Excluding major mineral wastes



AT A GLANCE

- The majority of waste generated in Hungary in 2014 was landfilled (47%), about 40% recycled, while the incineration capacity (including co-processing) has been developing and currently accounts for (12%) of the total.
- The landfill taxes are below the EU average (80 EUR/tonne), however relatively moderate (between 25 – 35 EUR/tonne) in comparison with countries recording similar GDP.
- Municipal MBT plants are producing processed wastes with low calorific values (8 – 14 MJ/kg) and the availability of high quality domestic industrial wastes which could be used to produce RDF is limited.
- As a consequence, high quality wastes pre-processed domestically are lacking in sufficient volumes and the cement industry has to rely on imports of RDF.
- Although the public is generally against waste incineration in Hungary, more investments have been planned to build new incinerators utilizing in particular the domestic Solid Recovered Fuel (SRF) produced.

Hungary Barriers and Opportunities

The industry is technically ready for greater waste uptake; but currently challenged by insufficient volume of waste



The cement industry has been modernized and is now ready to further increase its use of alternative fuels. However, the industry is now forced to look into imports extensively, as domestic availability of high quality waste outside of industrial wastes is low.

BARRIERS *As low landfill taxes disincentive production of high quality pre-processed waste, the cement industry has to look for imports from abroad.*

DRIVERS AND OPPORTUNITY *The highly modern cement industry is striving to achieve one of the highest co-processing rates in the EU, but right incentives have to be in place.*

Waste market organization	High	<ul style="list-style-type: none"> High quality waste not available to the cement sector in sufficient quantity Waste processing industry is not well-developed (collection, pre-processing facilities, alternatives to landfilling, etc.)
Waste market situation	Medium	<ul style="list-style-type: none"> Moderate landfill taxes for combustible wastes
Political environment	Low	<ul style="list-style-type: none"> Support to incineration on national level
Societal perspective	Medium	<ul style="list-style-type: none"> Public acceptance of incineration in general is low
Cement industry	Low	<ul style="list-style-type: none"> No significant barriers identified

Drivers	<ul style="list-style-type: none"> Highly modern cement industry Use of alternative fuels have been growing rapidly, plans are to increase co-processing rate to 70% in the next 5 years
Actions for stakeholders	<ul style="list-style-type: none"> Balance the development of WtE to prevent overcapacities and market distortions Incentivize further development of production of high quality wastes, for example, by introducing a legislative framework standalone increase of landfill taxes is not sufficient to reduce the volumes of combustible wastes going to landfills Continue the efforts to gain the public acceptance for use of waste co-processing Explore other potentially suitable waste streams outside of MSW Incentivize pre-processing facilities to upgrade the quality of produced RDF Improve the quality of domestically produced RDF to suit the needs of the cement industry
What is the opportunity?	<ul style="list-style-type: none"> Utilizing the full potential of the highly modern cement industry to achieve one of the highest co-processing rates in the EU Further valorization of domestic waste Avoided WtE investment as the cement industry is ready to provide additional capacity

Data references:

- > Data for the cement sector were provided by our respondent from the Hungarian Cement Concrete and Lime Association István Asztalos.
- > Additional data were obtained from USGS Mineral Survey at <https://minerals.usgs.gov/minerals/pubs/commodity/cement/myb1-2013->
- > Data for the waste management were obtained from Eurostat at <http://ec.europa.eu/eurostat/data/database>

- > *The respondent provided the following references for their statements in the questionnaire:*
 - Cement plants data communication
 - Hungarian Central Statistical Office
 - The environmental status of Hungary 2015 – Issued by Otto Herman Institute, Hungary

Disclaimer

- > As data for the thermal energy consumption for the use of fossil and alternative fuels in the sector are not public, we could not estimate the potential for CO2 avoided, amount of waste processed, fossil fuels saved and WtE investment avoided.

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Summary of Ireland

Co-processing started in 2008 and substitution has grown considerably since then. The cement sector is ready to increase alternative fuel use.



Ireland cement consumption suffered from the 2007 economic crisis, experiencing a 75% drop by 2012. The industry has embraced the use of alternative fuels since 2008 and by now some plants are above 50% substitution, and with ambitions to go much further.

BARRIERS *Economic uncertainty, lengthy planning and licensing processes and the potential addition of incineration capacity form the main barriers for increasing co-processing.*

Waste market organization	Low	• With increased roll-out of multi-bin collection, even less waste is not separated in the future
Waste market situation	Low	• There is potential for future competition for available waste.
Political environment	Medium	• Co-processing is accepted as a solution at the national level, but local councils delay approvals.
Societal perspective	Medium	• In some counties public acceptance of co-processing of waste is low.
Cement industry	Low	• No barriers identified.

ACTIONS FOR STAKEHOLDERS

The cement industry

- Provide a guaranteed uptake of domestically produced alternative fuels like SRF, tyres, liquid wastes and meat and bone meal.
- Continue to educate stakeholders on the process and benefits of co-processing.

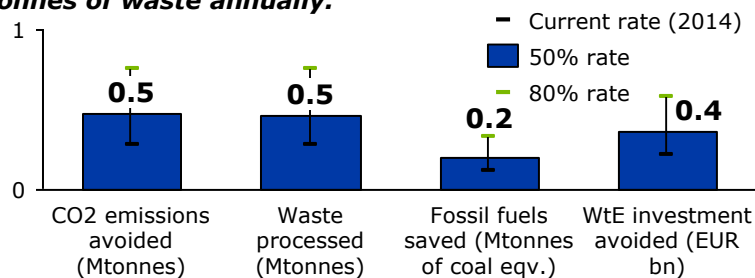
Policy makers

- Further support for co-processing as the better alternative to incineration with energy recovery by providing incentives and by avoiding future overcapacity.
- Local councils to accept co-processing as a valid solution in waste management and emissions reduction.

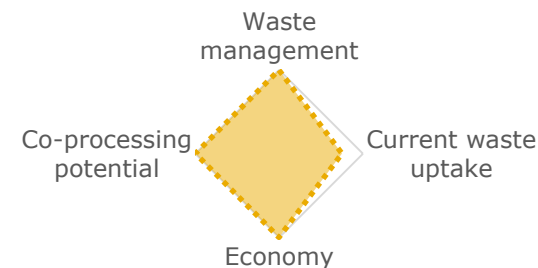
The waste management industry

- Should be ready to invest more into fuel processing capacity to meet cement industry demand.

POTENTIAL *At 50 % co-processing rate, the sector could mitigate 0.5 Mtonnes of CO2 annually, utilizing about 0.5 Mtonnes of waste annually.*



IRELAND AT A GLANCE



Irish Cement Sector

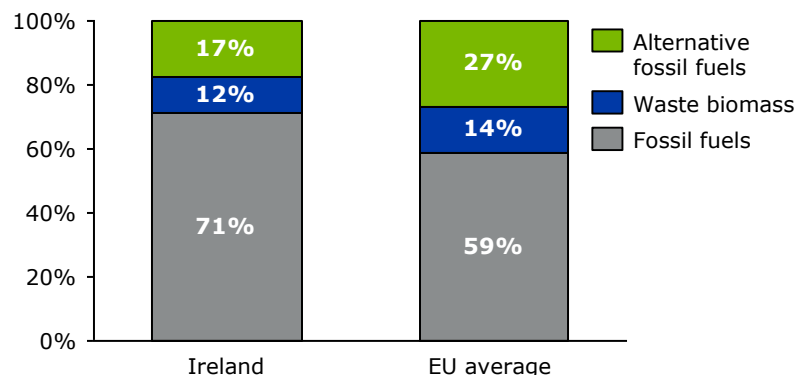
The sector is recovering from a decline in domestic cement demand. Co-processing was introduced in 2008.



The domestic demand for cement significantly reduced after 2007 and the industry had to look for new ways to sustain production by securing cement export markets. In 2014, 2.7 Mtonnes of clinker were produced. The co-processing rate of 29% was below EU average in 2014.

CO-PROCESSING *Irish co-processing rate is below EU average with 29% of thermal energy coming from alternative fuels.*

Average thermal energy consumption in cement kilns (2014)



PRODUCTION *Ireland has 582 kg per capita clinker production, a high number in comparison to the EU average.*

Grey clinker production per capita (tonnes; 2014)



AT A GLANCE

- In 2014 there were 4 operational cement plants in the Republic of Ireland, all of which are of local origin: Irish Cement (CRH) (2 plants), Lagan Cement and Quinn Cement. [1]
- The domestic demand for cement decreased significantly since the start off the Irish financial crisis, (- 75% change in production between 2007 and 2012), the sector had to adapt by exporting cement and by mothballing capacity. [1]
- In 2014, 2.7 Mtonnes of clinker were produced. [1]
- The co-processing rate of 29% was below the EU average in 2014. [1]
- The EPA recognises R4/R5 in National waste statistics for the component of material recovery in co-processing. [3]
- Cement Manufacturers Ireland (CMI) set a target of achieving 50% substitution of fossil fuel by alternative fuels by the end of 2017, subject to planning approvals. [3]
- With full availability of materials and the development of appropriate national infrastructure, it is expected that the overall substitution rate in Ireland can grow to 80% over the next 10 to 20 years. [2]

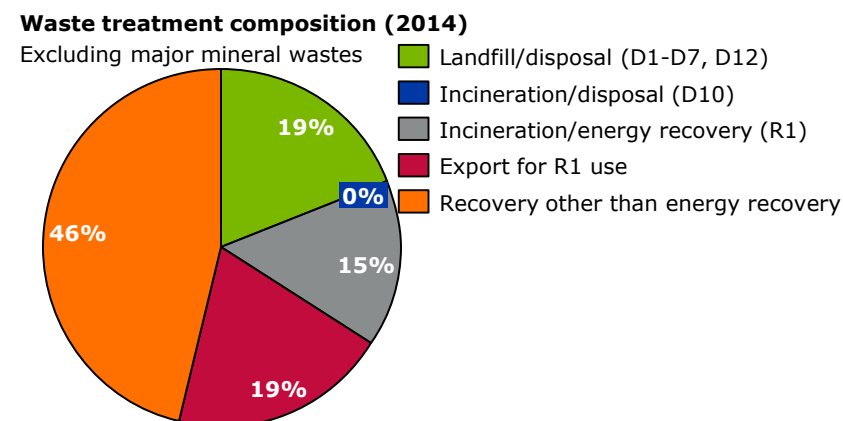
Irish Waste Management

The waste sector has moved away from landfilling to advanced processing of waste, also by making fuels for co-processing

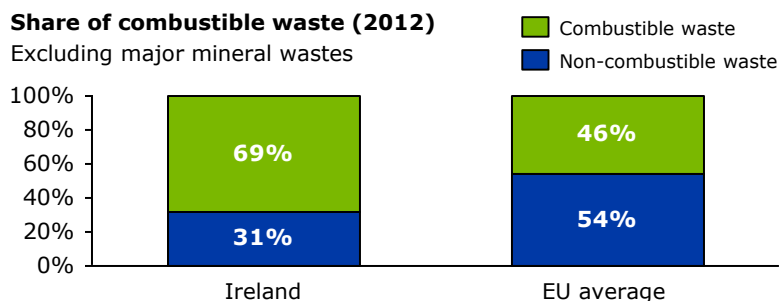


Ireland has a high landfill tax and a strong policy on processing waste streams for further use. In the last decade large investments were made in processing plants. It is expected that enough alternative fuels will be available in the near to medium future.

WASTE TREATMENT *Recycling, landfilling and export of recovered waste provide the top 3 end uses of waste. Incineration/energy recovery is gaining in importance.*



WASTE AVAILABILITY *Ireland has a large enough volume of available combustible waste.*



AT A GLANCE

- Co-processing is supported by the waste sector, it is seen as a viable solution for treatment of industrial and Municipal Solid Waste (MSW). [3]
- Solid Recovered Fuels (SRF), Liquid Recovered Fuels (LRF), waste tyres and meat and bone meal are used, or planned to be used, in all Irish kilns. [3]
- Landfill taxes in Ireland are high at 75€/t and landfilling of unprocessed waste is not allowed. [4] and [7]
- In some instances rural waste collection is difficult to organize. [1]
- Today there is limited WtE incineration capacity, of around 220 kt/a, processing mainly low calorific waste. [1] and [5]
- Substantial amounts of SRF are being exported to other countries.
- New incineration capacity for low calorific waste is being built (Poolbeg, Dublin with 600 kt/a capacity) and plans for additional plants are being considered. [6] This additional WtE capacity introduces the possibility of competition for feedstock for recovered fuels. [1]
- The waste sector in Ireland has undergone a major transformation over the past 15 years, moving away from landfilling to increased waste processing and addition of WtE capacity. Ireland is a showcase on implementation of EU Waste Directives. [7] and [8].
- With increasing co-processing rates, the higher demand for alternative fuels will require new investments in the waste sector.

Barriers and Opportunities in Ireland

If planning delays are addressed and the economy improves, then co-processing in the cement sector is set for strong growth.



The Irish cement sector has shown impressive growth in co-processing over the last decade, at present only one plant does not have permission to use alternative fuels. If all plants are fully enabled to use co-processing at high rates, then substitution of fuels is expected to grow strongly over the coming years.

BARRIERS *The economic recovery needs to continue to enable investments in co-processing. At two plants the planning process has caused delays to further co-processing.*

DRIVERS AND OPPORTUNITY *Better control of waste management in general and development of pre-processing facilities could lead to increased co-processing, as the industry is ready and the business case is strong.*

Waste market organization	Low	<ul style="list-style-type: none"> Further roll-out of household multi-bin systems may play a role in changing waste management practices due to increased source separation of waste in the future.
Waste market situation	Low	<ul style="list-style-type: none"> There is potential for future competition for available waste.
Political environment	Medium	<ul style="list-style-type: none"> Co-processing is accepted as a solution at the national level, but local councils delay approvals.
Societal perspective	Medium	<ul style="list-style-type: none"> In some counties public acceptance of co-processing of waste is low
Cement industry	Low	<ul style="list-style-type: none"> No barriers identified.

Drivers	<ul style="list-style-type: none"> Permits to use alternative fuels and operate with higher co-processing rates are in place or expected to be in place soon, despite delays. Companies are experienced and plants are technically ready for increased AF uptake. Economic advantages of replacing fossil fuels and lowering of carbon emissions. Receiving the credits for R4/R5 material recovery of alternative fuel ashes in clinker.
Actions for stakeholders	<ul style="list-style-type: none"> Further investments in waste collection and waste processing will be needed to increase alternative fuels volume and quality. Industry should continue to promote co-processing Government should actively support co-processing, like they are doing with WtE. Local councils should accept co-processing as a proper solution in waste management. The Government and especially regional planning bodies, should avoid future overcapacity in WtE plants, by carefully balancing the various recovery and re-use options.
What is the opportunity?	<ul style="list-style-type: none"> Reduced dependency of the cement industry on imported fossil fuels, and increased profitability. Increased Recovery and Re-use of residual waste materials. Reduced investments required for WtE plants Reduce national CO2 emissions.



Data references:

- > Waste management data for Ireland are yet unavailable for 2014. Thus, we use Ireland's preliminary data from EPA.
- > For figures on the cement sector in Ireland we use national data provided by our respondent.

[1] Interview with Brian Gilmore, CMI, December 1st, 2016

[2] Building a Sustainable Future for Ireland, CMI, 2014

[3] Ireland's cement industry and alternative fuels, CMI, 2015

[4] <http://www.housing.gov.ie/environment/waste/levies/landfill-levy>

[5] Indaver website on Meath WtE plant, Indaver, 2016 (<http://www.indaver.ie/en/services-for-municipal-waste/municipal-services-in-ireland/export-of-msw-waste-for-recovery/> & <http://www.indaver.ie/en/installations-and-processes/infrastructure-in-ireland/meath/meath-facility-details/>)

[6] Covanta Dublin: <http://dublinwastetoenergy.ie/>

[7] National Waste Report 2012. EPA, August 2014

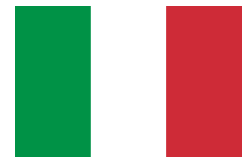
[8] EPA's National Statistics - Progress towards EU waste recycling, recovery and diversion targets. EPA, September 2016.

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Italy Summary

A cement industry in transition with sufficient waste available, but with low co-processing rates due to permitting issues

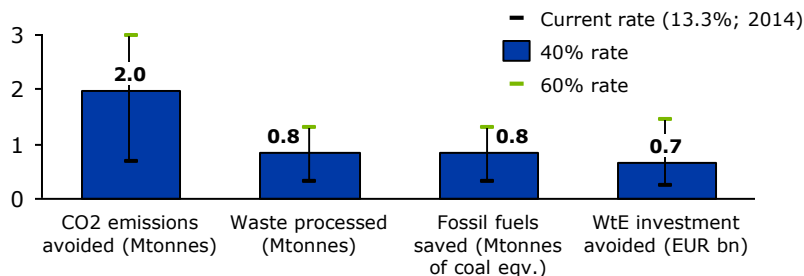


Despite sufficient volumes of waste-derived fuels, the co-processing rate in Italy is relatively low. This is for large part due to the fact that municipalities are reluctant to issue necessary permits. If this can be improved, the competitiveness of the Italian cement industry can increase.

BARRIERS *Mainly political issues are blocking the further uptake of waste in the cement industry.*

Waste market organization	Low	• No significant barriers identified
Waste market situation	Medium	• Extended wait time for permit issuance
Political environment	Medium	• Poor law enforcement in waste management
Societal perspective	High	• Public acceptance of co-processing of waste is low
Cement industry	Low	• No significant barriers identified

POTENTIAL *At 40% co-processing rate, the sector could mitigate some 2 Mtonnes of CO₂ annually, while avoiding WtE investment of 0.7 EUR bn.*



ACTIONS FOR STAKEHOLDERS

Policy makers

- Improve waste management law enforcement
- Decrease the wait-time for permit issuance
- Explore synergies between the cement industry and WtE

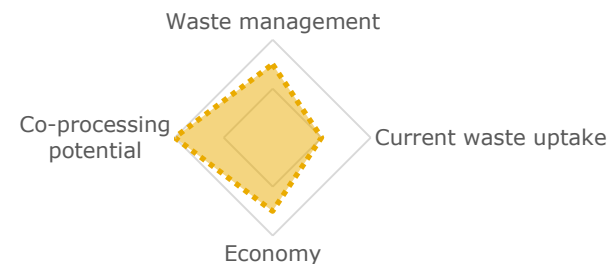
The cement industry

- Stimulate an open debate and transparency between the opposition groups, public and the cement industry

The waste management industry

- Improve landfilling situation in the southern parts of the country and ensure that more waste is suitable for recycling and recovery operations

ITALY AT A GLANCE



Italy Cement Sector

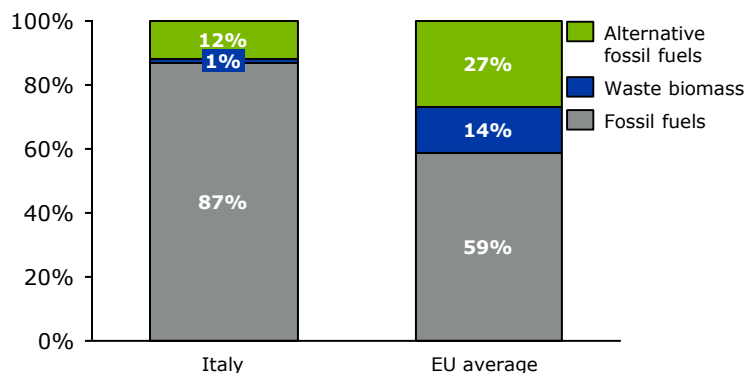
Italian cement sector experiences a sharp decline in demand



Italian cement sector has been sluggish in the last decade, with a sharp decline in production since 2008. Waste co-processing rate is very low (13.3 % in 2014) and plant operators are looking to utilize more waste to remain competitive.

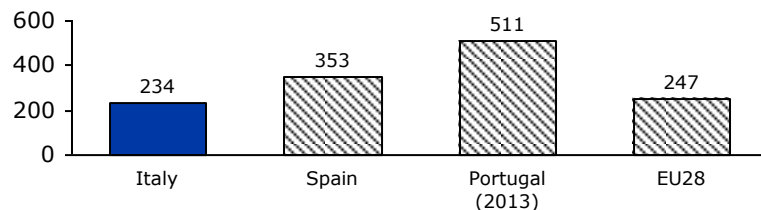
CO-PROCESSING *One of the lowest co-processing rates in the EU; 13.3% of thermal energy is from alternative fuels.*

Average thermal energy consumption in cement kilns (2014)



PRODUCTION *Italy is at clinker production levels close to EU average and below regional averages. Only about 1.4% of its production was exported in 2014.*

Grey clinker production per capita (tonnes/Nr; 2014)



AT A GLANCE

- Italy had 37 plants producing clinker and cement in 2014. The market consists of a mix of global players (HeidelbergCement, Buzzi Unicem) and relatively large national operators. [1]
- In 2014, about 14.3 Mtonnes of clinker was produced, a sharp decline from almost 30 Mtonnes in 2007. The export share was low in 2014, about 1.4% of clinker production.
- There is still a significant production overcapacity present on the Italian market and many operators see higher use of alternative fuels as a way to increase their competitiveness.
- The current co-processing rate is one of the lowest in the EU at 13.3% in 2014.
- It is estimated that commercially viable plants will have to operate at approximately 40% substitution rates by 2025 remain competitive. [2]
- Almost all cement kilns already switched to dry-process clinker making (35 out of 37) and additional investments have been made to lower various polluting emissions of the plants (e.g. low NO_x burner according to best available technology standards).

Italy Waste Management

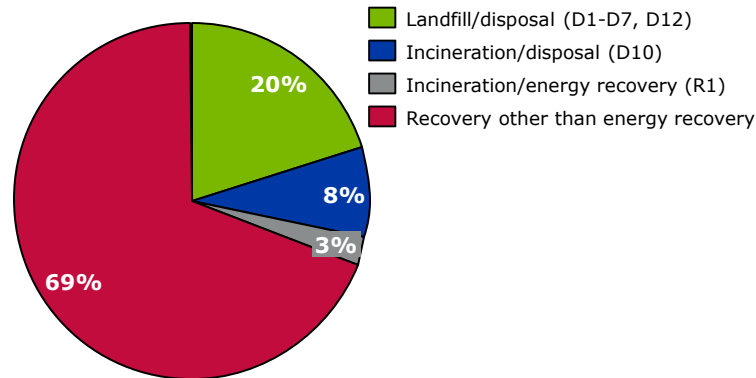
A large exporter of pre-processed fuels, yet their domestic utilization remains low



Italy is a large exporter of Solid Recovered Fuel (SRF), however its domestic uptake is hampered by limited issuance of processing permits from the municipalities. Landfilling problems persist in southern parts of the country.

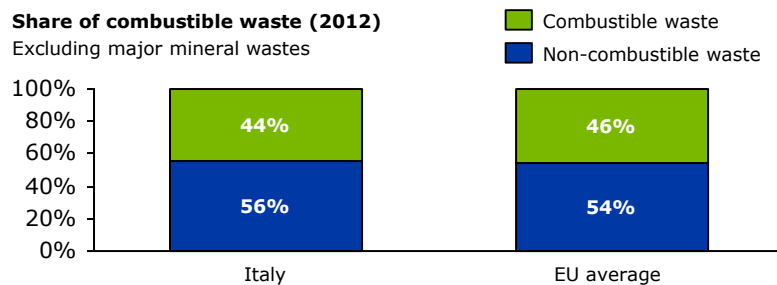
WASTE TREATMENT *High recycling rate and low share of incineration are characteristic for Italian waste management.*

Waste treatment composition (2014)
Excluding major mineral wastes



WASTE AVAILABILITY *Italy is slightly below EU average in regards to combustible waste generation.*

Share of combustible waste (2012)
Excluding major mineral wastes



AT A GLANCE

- Despite a very high recycling share in waste treatment (69%) a substantial part of generated waste gets landfilled and both co-processing and incineration options remain underdeveloped.
- Italy suffers from poor landfill management and inadequate landfill capacity. Landfill taxes range vastly depending on type of waste (1-103 EUR/tonnes). [3]
- Italy is one of the major European exporters of SRF. If a strong market for SRF is created domestically (e.g. due to higher uptake in cement kilns), the export rate could be lowered substantially. [4]
- Some high quality SRF in Italy has end-of-life status, which could potentially ease the uptake of waste in cement kilns, but also potentially increase the cost of SRF.
- There are significant differences in waste infrastructure between regions in Italy, where in northern part both pre-treatment facilities and final users (WtE, cement plants) are present, but in southern parts the majority of waste is landfilled due to poor infrastructure (despite the presence of cement plants). [4,5]
- Co-processing has a strong position in national waste management plans. However, permits for waste incineration are issued at municipal level, very often allowing only small volumes of waste to be co-processed. [5]

Italy Barriers and Opportunities

Italy has an opportunity to support its cement sector and utilize domestically produced SRF if political barriers are lifted



If the political barriers for co-processing are lifted, the cement industry can increase its competitiveness, more of produced SRF can be used domestically and public cost savings for waste management achieved.

BARRIERS *Opposition from regional political authorities supported by public and environmental groups has to be addressed to allow for increased waste uptake in the cement industry.*

DRIVERS AND OPPORTUNITY *The Italian cement industry can be stabilized and SRF export reduced if the debate with opposition groups is initiated and successful. Given the size of the cement industry, sizable easing of dissatisfying waste management situation can be achieved.*

Waste market organization	Low	• No significant barriers identified
Waste market situation	Medium	• Extended wait time for permit issuance
Political environment	Medium	• Poor law enforcement in waste management
Societal perspective	High	• Public acceptance of co-processing of waste is low
Cement industry	Low	• No significant barriers identified

Drivers	<ul style="list-style-type: none"> • Economical pressure to increase co-processing rates across the industry • Well established pre-processing industry for SRF • Classification of SRF as end-of-life product can lift limits on SRF use in the industry • Economic studies estimated potential reduction of 15% in public waste management costs if co-processing potential is exploited [6]
Actions for stakeholders	<ul style="list-style-type: none"> • Improve waste management law enforcement Decrease the wait-time for permit issuance • Stimulate an open debate between the opposition groups, public and the cement industry • Establish communication channels between the cement industry and local municipalities to coordinate waste management on strategic level • Explore synergies between the cement industry and WtE and ensure coordinated development of the WtE sector to prevent overcapacity • Improve landfilling situation in the southern parts of the country and ensure that more waste is suitable for recycling and recovery operations
What is the opportunity?	<ul style="list-style-type: none"> • Stabilization of the cement industry and better competitiveness • Reduction of the volume of SRF being exported to serve rather the domestic market • Public cost savings in waste management • Easing of dissatisfying waste management situation in southern parts of Italy



Data references:

- > Data for the cement sector were obtained from AITEC (Associazione Italiana Tecnico Economica Cemento) at <http://www.aitecweb.com/default.aspx>
- > Data for the waste management were obtained from ISPRA (Istituto Superiore per la Protezione e la Ricerca Ambientale) at <http://www.isprambiente.gov.it/en/ISPRA/the-institute> and Eurostat at <http://www.wbcdcement.org/GNR-2014/index.html>

[1] AITEC (2105), Relazione annuale, available:

http://www.aitecweb.com/Portals/0/pub/Repository/Area%20Economica/Pubblicazioni%20AITEC/Relazione_Annuale_2015.pdf

[2] Interview with Daniele Gizzi, Environmental Manager at AITEC, 15/11/2016

[3] CEWEP (2015), Landfill taxes and bans, available:

http://www.cewep.eu/media/www.cewep.eu/org/med_557/1406_2015-02-03_cewep_-_landfill_inctaxesbans.pdf

[4] FISE UNIRE (2015), L'Italia del Riciclo, available: http://www.garc.it/wp/wp-content/uploads/reports/Rapporto_Italia_del_Riciclo_2015.pdf

[5] ISPRA (2015), Rapporti rifiuti urbani 2015, available:

<http://www.isprambiente.gov.it/it/pubblicazioni/rapporti/rapporto-rifiuti-urbani-edizione-2015>

[6] Nomisma Energia (2012), Potenzialità e benefici dall'impiego dei Combustibili Solidi Secondari (CSS) nell'industria, avallabile:

http://www.aitecweb.com/Portals/0/pubnoaut/NomismaEnergia_Potenzialita_e_benefici_impiego_combustibili_solidi_secondari.pdf

Case study

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- > **Poland**
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Poland Summary

Co-processing in Poland developed rapidly in the last decade, coincidentally with advances in country's waste management

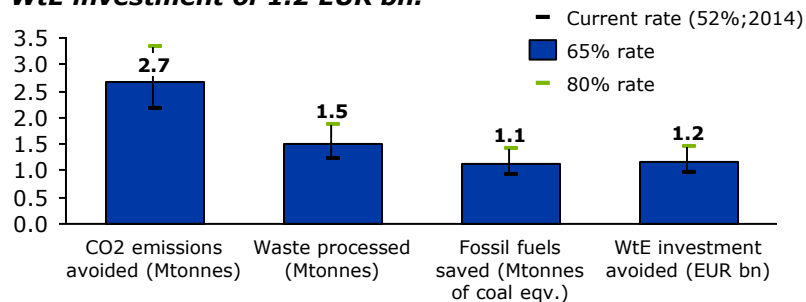


The cement sector is well-prepared to further increase its fuel substitution and recent developments in the political environment and the waste management industry suggest that this can happen relatively rapidly if the quality of produced of RFD can be bettered.

BARRIERS *The cement industry is ready to further increase the co-processing rates as barriers are being lifted.*

Waste market organization	Medium	<ul style="list-style-type: none"> High quality waste not available to the cement sector in sufficient quantity Waste processing industry is not well-developed
Waste market situation	Medium	<ul style="list-style-type: none"> Explicit cap on waste related public expenditures Landfill taxes too low Risk for future competition for available waste.
Political environment	Low	<ul style="list-style-type: none"> No significant barriers identified
Societal perspective	Low	<ul style="list-style-type: none"> No significant barriers identified
Cement industry	Low	<ul style="list-style-type: none"> No significant barriers identified

POTENTIAL *At 65% co-processing rate, the sector could mitigate some 2.7 Mtonnes of CO2 annually, while avoiding WtE investment of 1.2 EUR bn.*



ACTIONS FOR STAKEHOLDERS

The cement industry

- Provide a solid offtake guarantee for waste derived fuels

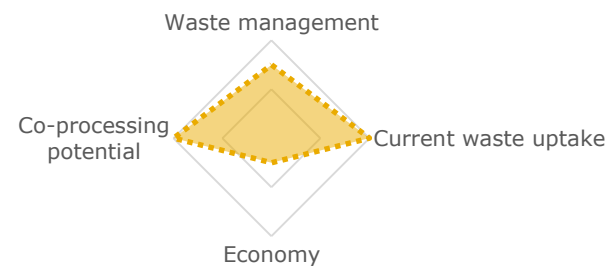
Policy makers

- Properly align WtE and cement AF capacities, in order to reduce the risk of unnecessary investments.
- Support source selected waste collection.

The waste management industry

- Improve collection (source separation) and waste processing practices
- Investments in collection and additional mechanical and mechanical biological waste processing capacities

POLAND AT A GLANCE



Poland Cement Sector

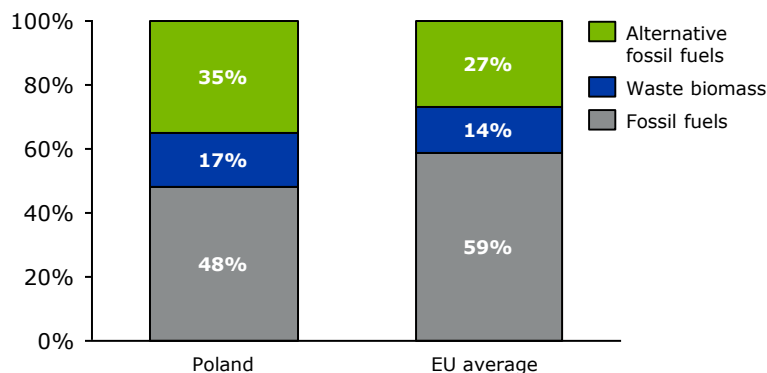
The domestic demand has already peaked, however the co-processing rate has increased rapidly in the last decade



Polish cement industry the highest clinker per capita production in the region. Cement is used mainly internally; the past decade has seen a boom in construction and infrastructure development. Fuel substitution rate developed quickly; 10 years ago this was around 15% and in 2014 reached 52%.

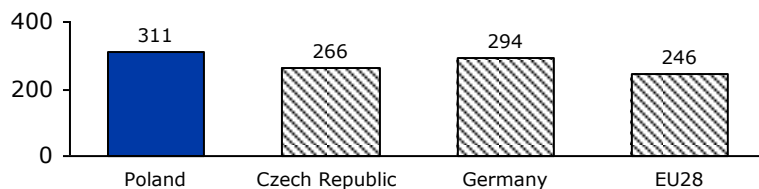
CO-PROCESSING *Poland has above EU average co-processing rate with 52% of thermal energy coming from alternative fuels.*

Average thermal energy consumption in cement kilns (2014)



PRODUCTION *Poland has the highest clinker capita production in the region and above the EU28 average. Only less than 2% of clinker production was exported in 2014.*

Grey clinker production per capita (tonnes; 2014)



AT A GLANCE

- Most players in the Polish cement sector are multinationals, these include: HeidelbergCement, LafargeHolcim, CEMEX, CRH, Buzzi Unicem and Miebach Group.
- Poland has 11 Portland cement plants and majority of the cement produced is consumed domestically
- Clinker production peaked in 2011 at over 13.6 Mtonnes (Cement production was close to 19 Mtonnes) and in was at 11.8 Mtonnes in 2014.
- The fuel substitution rate in Poland was well above EU average in 2014: 52% (compare to EU average 41%). Two cement plants already have substitution rates of over 80%.
- Co-processing is encouraged by Polish government and viewed positively by the society
- The cement industry is the largest consumer of processed waste as a fuel (1.2 Mtonnes/a)
- Between 70% and 80% of AF used is of MSW origin, the other AF are used car tyres and sewage sludge
- Consumption of RFD can grow to between 1.7 and up to 2 Mtonnes/a the coming years.

Poland Waste Management

The country is rapidly developing its incineration and pre-processing capacities, including co-processing in its plans

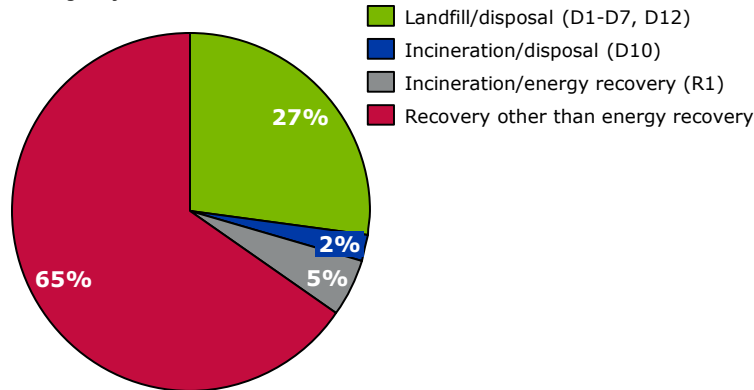


Poland plans to significantly increase waste processing capacity and recycling rates. Energy recovery plays a primary role in the country's waste plan, while the government is trying to balance waste related costs and targets in order to minimize negative impacts on its citizens.

WASTE TREATMENT *Poland has a high recycling rate at 65%, yet 27% of its waste still gets landfilled as a result of the limited incineration and energy recovery options.*

Waste treatment composition (2014)

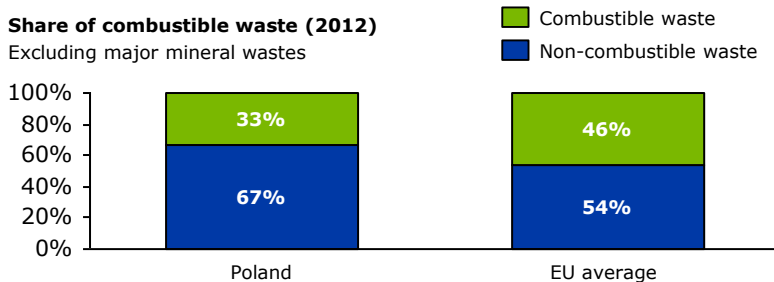
Excluding major mineral wastes



WASTE AVAILABILITY *The volume of combustible waste available in Poland is well below the EU28 average.*

Share of combustible waste (2012)

Excluding major mineral wastes



AT A GLANCE

- As of 2014, 27% of total waste generated was landfilled (EU average 28%) and about 65% recycled (EU average 55%).
- Poland uses the National Waste Management Plan (KPGO 2014) to formulate its Policy, the plan is to reach thermal conversion of > 25% of mixed municipal waste in WtE facilities by 2020; reduce landfilling of MSW to less than 10% by 2025.
- There are plans to undertake major investments in the coming years with construction and modernization of 1.2 Mtonnes waste processing, 1.8 Mtonnes waste sorting capacity and 6 WtE plants.
- The Government is seeking to balance increased recycling and advanced waste treatment costs, the average amount of waste tax per capita should not exceed PLN 18 / month or 4EUR/month.
- Production of RDF/SRF in MBTs is earmarked for specific use in cement production, WtE or district heating plants.
- For use in the cement industry, the quality of RDF needs to improve. The need for high quality fuels are only partially being met at present;
- The cement industry is today's main RDF customer, even with WtE plants coming online in the coming years, it is expected that close to 2 Mtonnes of RDF will be used by the cement industry in the future;

Poland Barriers and Opportunities

Poland has to further improve its waste management system, but has already developed rapidly in the last decade



Limited source separation, gaps in pretreatment infrastructure and high investments are among the main barriers to more co-processing in cement production in Poland; if improvements are made, it will help achieving compliance with EU policies and increase AF use in cement.

BARRIERS The cement sector is facing minimum barriers in Poland to further increase its co-processing rate. The waste management industry has to make sure that RDF produced is of high quality as the cement industry is the main customer.

DRIVERS AND OPPORTUNITY As the cement industry is ready to further increase its fuel substitution and the waste sector is developing fast, the opportunity to cut landfilling further and lower public costs of waste treatment are at hand.

Waste market organization	Medium	<ul style="list-style-type: none"> • High quality waste not available to the cement sector in sufficient quantity, produced RDF unsuitable to be used in the cement sector • Waste processing industry is not well-developed
Waste market situation	Medium	<ul style="list-style-type: none"> • Explicit cap on waste related public expenditures • Risk for future competition for available waste. • Landfill taxes too low
Political environment	Low	<ul style="list-style-type: none"> • No significant barriers identified
Societal perspective	Low	<ul style="list-style-type: none"> • No significant barriers identified
Cement industry	Low	<ul style="list-style-type: none"> • No significant barriers identified

Drivers	<ul style="list-style-type: none"> • Waste treatment capacity is growing, both in mechanical/mechanical biological and WtE terms • Most Polish cement plants are technically ready to increase their use of waste-derived alternative fuels • The cement industry offers a readily available, cost effective alternative to processing of waste in WtE plants
Actions for stakeholders	<ul style="list-style-type: none"> • Properly align WtE and cement AF capacities, in order to reduce the risk of unnecessary investments • Improve collection (source separation) and waste processing practices • Investments in collection and additional mechanical and mechanical biological waste processing capacities
What is the opportunity?	<ul style="list-style-type: none"> • Less landfilling of waste, as envisioned in the Polish Waste Policy • Less fines for infringement of EU waste framework policy • Lower operating and carbon cost for the domestic cement industry • Less burden on the society as less WtE investment is needed



Data references:

- > Data for the cement sector were obtained from GNR (Getting the Numbers Right) at <http://www.wbcdcement.org/GNR-2014/index.html>
- > Data for the waste management were obtained from Eurostat at <http://ec.europa.eu/eurostat/data/database>

[1] SPC, production data, <http://www.polskicement.pl/Wyniki-59>

[2] SPC, Interview with Bożena Środa, March 2016.

[3] SPC, "20 lat co-processingu paliw alternatywnych w cementowniach w Polsce", Tadeusz Radzięciak, Krakow, October 2015.

[4] Switzerland Global Enterprise, "Market Report Waste Management in Poland", <http://www.s-ge.com/schweiz/export/de/blog/marktstudie-s-ge-waste-management-poland>, Swiss Business Hub, APAX Consulting Group, 2013.

[5] Polish Government, "Aktualizacja Krajowego planu gospodarki odpadami 2014", https://www.mos.gov.pl/kategoria/3340_krajowy_plan_gospodarki_odpadami_2014/, 2015.

[6] Clifford Chance Poland, Briefing: "Municipal waste incineration plants ", http://www.cliffordchance.com/briefings/2013/03/municipal_waste_incinerationplants.html, 2013.

[7] Arcadis, The functioning of waste markets in the EU, second workshop, case 6: "Comingled waste collection in Poland", Mike van Acoleyen, 16 November 2015.

[8] CEWEP, "Landfill taxes and bans," February 2015, available: http://cewep.eu/media/cewep.eu/org/med_557/1406_2015-02-03_cewep_-_landfill_inctaxesbans.pdf.

Case study

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Portugal Summary

An active cement sector slowed down by inefficient waste management industry



Portugal has experienced high decrease in domestic demand for cement during the last 15 years. The industry has been actively lifting barriers to co-processing and gained public acceptance as a viable option of advanced waste management, but low quality of RDF and low landfill taxes remain major obstacles.

BARRIERS RDF quality and low landfill taxes remain amongst the last barriers preventing faster uptake of AF.

Waste market organization	High	<ul style="list-style-type: none"> • High quality waste not available to the cement sector in sufficient quantity • Lack of control over waste management
Waste market situation	High	<ul style="list-style-type: none"> • Landfill taxes too low • Demand for high quality RDF too low to incentivize production of it • Competition for available waste
Political environment	Low	<ul style="list-style-type: none"> • No significant barriers identified
Societal perspective	Low	<ul style="list-style-type: none"> • No significant barriers identified
Cement industry	Low	<ul style="list-style-type: none"> • No significant barriers identified

ACTIONS FOR STAKEHOLDERS

Policy makers

- Improve control over waste management
- Increase landfill taxes closer to EU average level

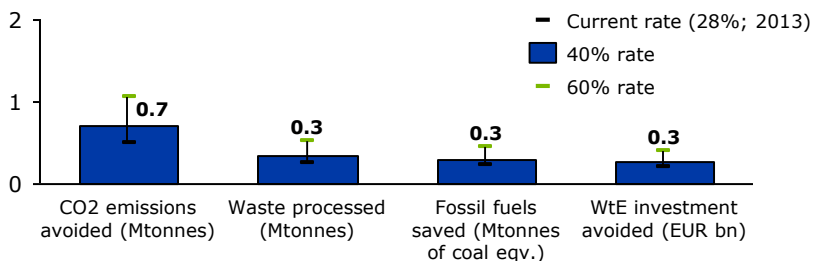
The cement industry

- Provide a guaranteed uptake for domestically produced high quality RDF

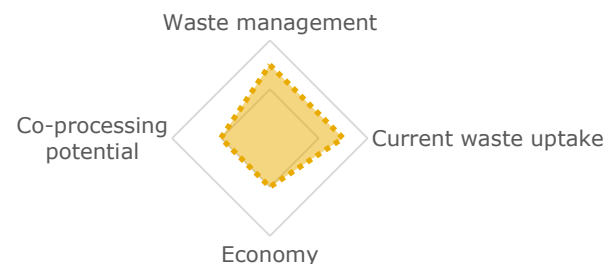
The waste management industry

- Improve the quality of domestically produced RDF to suit the needs of the cement industry

POTENTIAL At 40% co-processing rate, the sector could mitigate some 0.7 Mtonnes of CO₂ annually, utilizing about 0.3 Mtonnes of waste annually.



PORTUGAL AT A GLANCE



Portugal Cement Sector

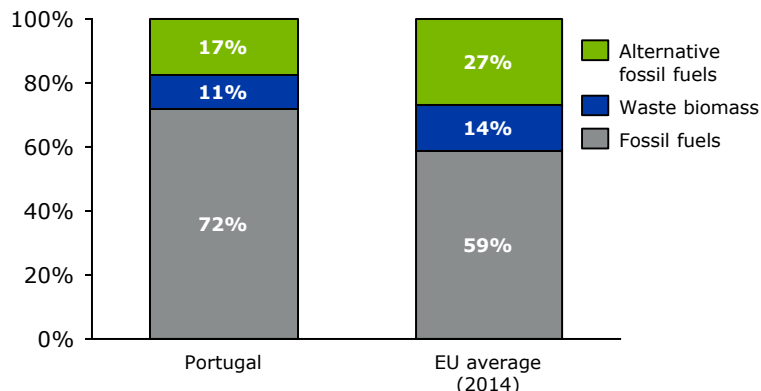
Portugal cement sector had to partially refocus on export as domestic demand has been decreasing



The domestic demand has been decreasing for extended period of time and the industry had to bring more focus on exports. In 2013, 5.4 Mtonnes of clinker were produced out of which 1.4 Mtonnes were exported. Co-processing rate was below EU average at 28.4% in 2013.

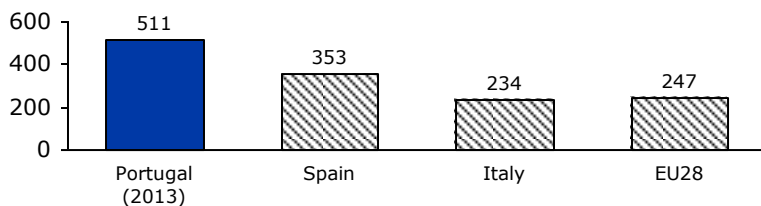
CO-PROCESSING Portuguese co-processing rate is below EU average; 28.4% of thermal energy from is alternative fuels.

Average thermal energy consumption in cement kilns (2013)



PRODUCTION Portugal has a very high per capita clinker production of which around 26% was exported in 2013.

Grey clinker production per capita (tonnes/Nr; 2014)



AT A GLANCE

- Portugal had 6 operational cement plants in 2013; the market is mainly consisting of domestic companies [1]
- As the domestic demand for cement decreased significantly in the last 15 years (65% change between 2002 – 2013), the sector had to partially re-orientate on export, most of which goes to North African countries. [2] In 2013, 5.4 Mtonnes of clinker was produced, of which 26% was exported.
- The current co-processing rate (28.4%) was below the EU average of 38.2% in 2013.
- However, as the price of petcoke in Portugal is rather high, there is a significant interest in the industry to further increase its fuel substitution levels (i.e. when Alternative Fuels are more economical to use). [3]
- More than 100 ktonnes of alternative fuels has been imported from EU members states to be used in Portuguese cement kilns, as domestic waste sources are often lacking in quality (e.g. RDF produced from MSW has too high moisture content). [4]
- The industry made important investments to allow for higher substitution rates (e.g. bypass systems & waste driers). The sector is eager to rapidly increase its fuel switching, reaching to > 50% use of AF in the next 3 years. [4]

Portugal Waste Management

Despite national support and public acceptance, the waste uptake in cement sector is slowed by low quality RDF

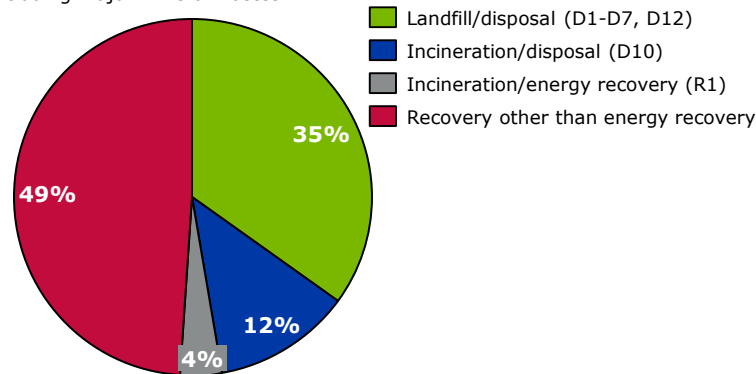


Portugal tried to stimulate advanced waste management by tiered tax approach for waste treatment, however, its effectiveness is limited due to low landfill taxes. The country produces adequate quantities of RDF, however, its low quality limits the use in cement kilns.

WASTE TREATMENT *Landfilling and low energy recovery, dominate the Portuguese waste management landscape*

Waste treatment composition (2014)

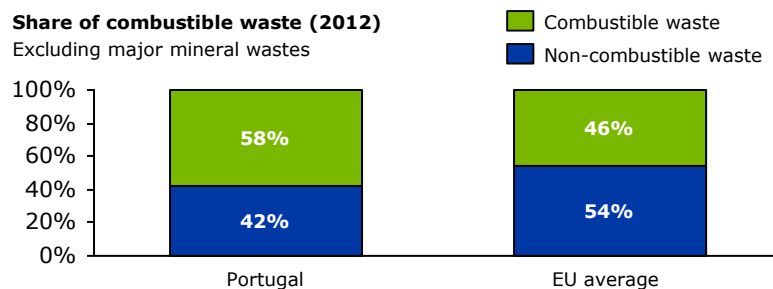
Excluding major mineral wastes



WASTE AVAILABILITY *Portugal has a large volume of available combustible waste.*

Share of combustible waste (2012)

Excluding major mineral wastes



AT A GLANCE

- Co-processing is supported at the national level as a viable solution for treatment of industrial and municipal solid waste (MSW). [5]
- Both incineration and co-processing of waste generally face little opposition from the public or local authorities. Similarly, the permitting procedure for co-processing has been streamlined.
- However, advanced waste treatment methods are not incentivized by a low landfill tax (6 EUR/tonnes in 2015) and landfill oversight is a problem resulting into cases of illegal waste dumping.
- Portugal has a tiered approach to taxes for different waste treatment options; recycling being free of taxes, incineration with energy recovery burdened with 50% of the landfill tax and co-processing with 25%. Nevertheless, the effect of this approach is rather marginal as long as the landfill tax remains one of the lowest in the EU. [6]
- Portugal is planning to further develop its incineration capacity, which could become a stronger competitor for waste to the cement industry. [7]
- Currently, the majority of RDF utilized in the cement sector comes from industrial applications, as a persisting problem (high moisture content) with the quality of RDF produced from MSW hampers use in cement kilns.

Portugal Barriers and Opportunities

If remaining barriers in waste management are addressed, the cement industry is set for a fast increase of waste uptake



The cement sector in Portugal has actively acted to lift most of the barriers to further waste uptake in the industry. If the quality of domestic pre-processed waste can be improved and landfill taxes increased, the road to fast increase in co-processing is open.

BARRIERS *Poor quality of domestically produced RDF along with extremely low landfill taxes are the main barriers. However, the industry managed to gain public acceptance and faces no permitting issues.*

DRIVERS AND OPPORTUNITY *Better control of waste management in general and development of pre-processing facilities could lead to fast increase in uptake of AF as the industry is ready and the business case is strong.*

Waste market organization	High	<ul style="list-style-type: none"> • High quality waste not available to the cement sector in sufficient quantity, produced RDF mostly unsuitable to be used in the cement sector • Lack of control over waste management, illegal deposition of hazardous waste may occur
Waste market situation	High	<ul style="list-style-type: none"> • Landfill taxes too low • Demand for high quality RDF too low to incentivize production of it, low quality RDF used for export • Competition for available waste, in particular locally with incinerators
Political environment	Low	<ul style="list-style-type: none"> • No significant barriers identified
Societal perspective	Low	<ul style="list-style-type: none"> • No significant barriers identified
Cement industry	Low	<ul style="list-style-type: none"> • No significant barriers identified

Drivers	<ul style="list-style-type: none"> • Most plants have permits to operate with higher co-processing rates (up to 70%) [8] • High exposure to international fossil fuels prices further incentivizes AF uptake in the sector • Plants are technically ready for increased waste uptake (already over 50% average substitution is plausible) • Openness and transparency of the cement sector secured public acceptance of energetic waste valorization in cement kilns
Actions for stakeholders	<ul style="list-style-type: none"> • Improve the control over waste management, enforce prohibition of illegal deposits of hazardous wastes in landfill sites • Balance the development of WtE and co-processing to avoid local overcapacities • Increase landfill taxes closer to EU average level to incentivize advanced waste treatment • Provide a guaranteed uptake of high quality RDF produced domestically, including premiums • Improve the quality of domestically produced RDF to suit the needs of the cement industry
What is the opportunity?	<ul style="list-style-type: none"> • Decreased share of landfilling as energy recovery options are further exploited • Reduced dependency of the cement industry on expensive fossil fuels, and increased competitiveness • Limited import of foreign waste and domestic waste valorization instead



Data references:

- > Data for the cement sector were obtained from ATIC's members (Associação Técnica da Indústria de Cimento) at http://www.atic.pt/content/qf_cemb_grupos.asp
- > Data for the waste management were obtained from Eurostat at <http://ec.europa.eu/eurostat/data/database>

[1] Cimpor Portugal, available:

http://www.cimpor.pt/artigo.aspx?lang=pt&id_object=91&name=PORTUGAL.

[2] World Cement, available:

https://www.worldcement.com/europecis/05022013/cement_consumption_construction_portugal_2012_853/ and Ine, available: Exportações (€) de bens por Local de destino e Tipo de bens (Nomenclatura combinada - NC8); Anual - INE, Estatísticas do Comércio Internacional de bens; www.ine.pt.

[3] Interview with Joao Pereira, Secil Director, 18/Nov/2016

[4] Interview with Joao Pereira, Secil Director, 18/Nov/2016

[5] Ministério do ambiente, do ordenamento, do território e do desenvolvimento regional, available:

https://apambiente.pt/_zdata/Politicar/Residuos/Planeamento/PERSU_II/Despacho21295_2009_CDR.pdf.

[6] Assembleia da República, available: https://info.portaldasfinancas.gov.pt/NR/rdonlyres/06E2525B-1E76-454C-AB73-75539519258F/0/Lei_82D_2014.pdf.

[7] Água e Ambiente, July/August 2016 (printed version), contents available at

<http://www.ambienteonline.pt/canal/jornal/edicao/edicao-julhoagosto-2016>.

[8] Portuguese Environment Agency, Permits for co-processing, available:

<https://www.apambiente.pt/index.php?ref=16&subref=84&sub2ref=943&sub3ref=944>.



Disclaimer:

- > We use 2013 as baseline for figures in Portugal as data for 2014 have not yet been officially published (will be available in 2017).
- > Our interviewee for this case study Joao Paulo Pereira from SECIL emphasized that there is a wide consensus in the Portuguese waste sector that the waste statistics (published by the national statistics office and reported to the Eurostat) do not reflect the reality. First, the total amount of waste generated, particularly non urban waste, is lower than is expected. If this value is compared to other countries (normalized by economic output or population), Portugal has one of the lowest generation rates. Also, the current time series has typical annual values ranging from 10 to 12 million tons per year. The previous time series, built from 2007 to 2010 and replaced by the current one in 2014, had value ranging from 20 to 30 million tons. There are significant methodological changes between the two series, but it is hard to argue that the current is better than the former.
- > Since the total amounts are under estimated, it is expected that the recycling share of non urban waste is overestimated. There is an obvious bias in these numbers: waste producers that send to recycling or recovery operations will more easily report the correct amount of waste. If the producer sends to a landfill or even to illegal dumps, then there is no reason to report these values since he will be paying more or even be risking heavy fines for illegal discharges.
- > It is also important to note that the Portuguese waste statistics is built on the digital platform that requires waste operators (licensed companies) to report received waste. However, many companies, particularly those in mineral extraction, do not send their waste to other companies, instead treating it 'indoors'. In these cases, the waste generated is left outside the scope of the digital platform and therefore does not appear in the Portuguese waste statistics. This is the reason why in Portugal the mineral waste and agricultural waste is so low when compared with other comparable countries.

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Spain Summary

A large cement sector faced with immature waste management industry



Uncoordinated waste management, poor enforcement of national legislation on municipal level and strong public opposition towards both incineration and co-processing significantly limit the opportunities for the Spanish cement industry, which shrunk significantly in the last decade.

BARRIERS Before further increasing co-processing shares, a number of barriers have to be addressed.

Waste market organization	Medium	• Waste processing industry is not well-developed
Waste market situation	High	• National economic situation doesn't allow investments in waste industry, • Landfill taxes too low • Market distortions
Political environment	Medium	• Poor law enforcement in waste management • Lack of cooperation between regions in the country
Societal perspective	High	• Public acceptance of co-processing of waste is low
Cement industry	Low	• No significant barriers identified

ACTIONS FOR STAKEHOLDERS

Policy makers

- Improve waste management law enforcement on regional level
- Coordinate the permit issuance between regions, ensure compatibility between regions

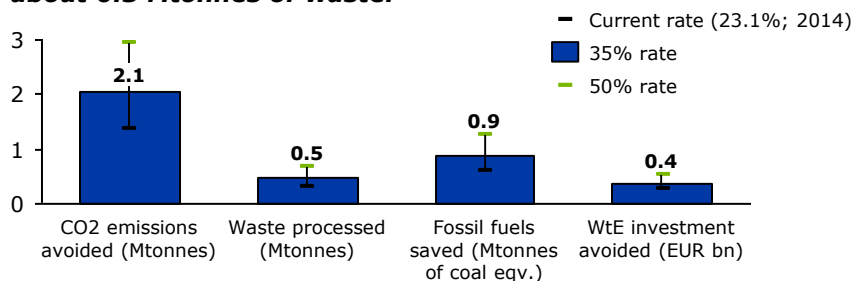
The cement industry

- Stimulate an open debate and transparency between the opposition groups, public and the cement industry

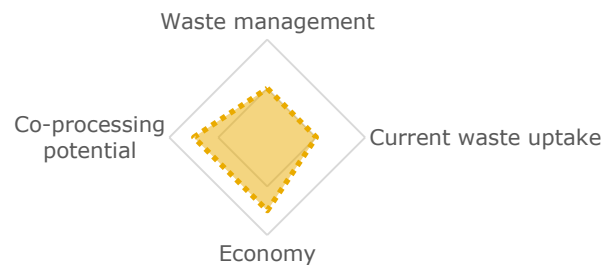
The waste management industry

- Increase cooperation between regions on waste management issues
- Ensure development of pre-processing facilities

POTENTIAL At 35% co-processing rate, the sector could mitigate some 2.1 Mtonnes of CO₂ annually, while processing about 0.5 Mtonnes of waste.



SPAIN AT A GLANCE



Spain Cement Sector

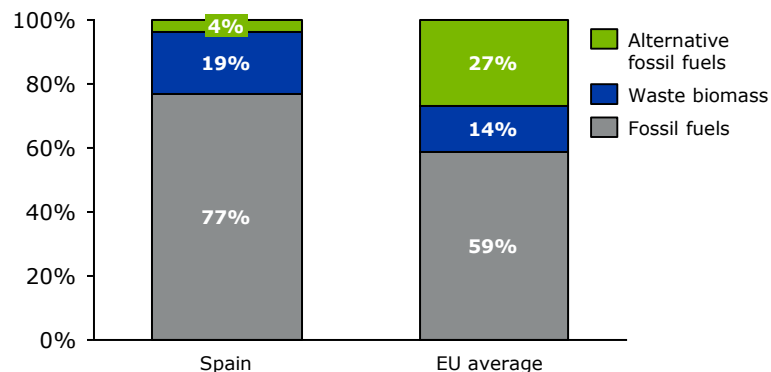
The Spanish cement sector is fighting a crisis



The domestic production is expected to pick up again from a period of downturn. In 2014, 16.4 Mtonnes of clinker were produced out of which 5.6 Mtonnes were exported. Co-processing rate was well below EU average at 23.1% in 2014.

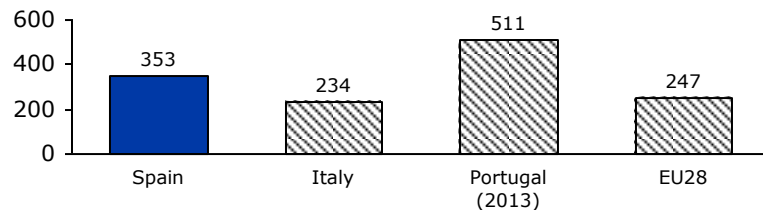
CO-PROCESSING Spanish co-processing rate is well below EU average; 23.1% of thermal energy is from alternative fuels.

Average thermal energy consumption in cement kilns (2014)



PRODUCTION Despite a significant dropdown in domestic demand, Spanish production per capita was still well above the EU average in 2014 as 34% of the clinker was exported.

Grey clinker production per capita (tonnes/Nr; 2014)



AT A GLANCE

- Spain had 33 plants producing clinker and cement in 2014. The market consists of a mix of large international players, medium sized operators and smaller domestic ones.
- The Spanish cement industry is currently in midst of a crisis, the clinker production has been declining since 2007 from 31 Mtonnes to 16.4 Mtonnes in 2014. [1]
- In 2014, about 34% of the grey clinker produced has been exported. [1]
- The current co-processing rate of 23.1% was well below the EU average of 40.2% in 2014.
- Subsidies for power and heat generation for biomass make biomass co-processing costly.
- In order to obtain permits for waste co-processing, cement plants have to deliver an urban compatibility report; pressure from the local political and activist groups in order not to renew these permits is quite common.
- It is expected that despite the barriers to fuel switching, co-processing rate could be in the 35-50% range in 5-10 years, bringing the Spanish industry close to EU averages. [2]

Spain Waste Management

Bad economic situation and inadequate capacity of advanced waste treatment options remain an issue

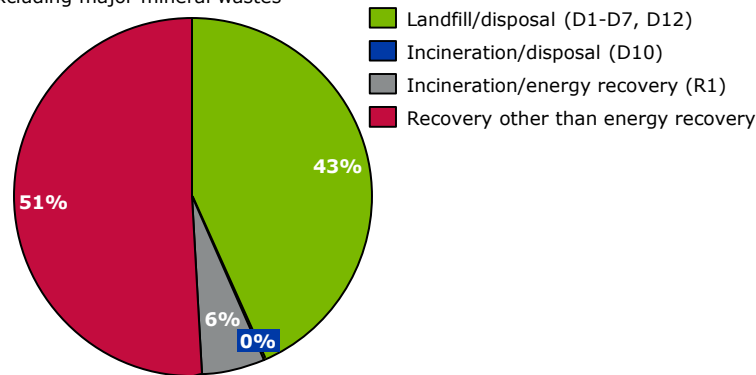


Spanish waste management is suffering from bad economic situation, low enforcement of national directions on municipal level and strong public opposition to co-processing. Due to low disposal taxes, the landfilling share remains high and recycling and pre-processing capacities are underdeveloped.

WASTE TREATMENT *high landfilling rate and almost no incineration are characteristic of Spanish waste management.*

Waste treatment composition (2014)

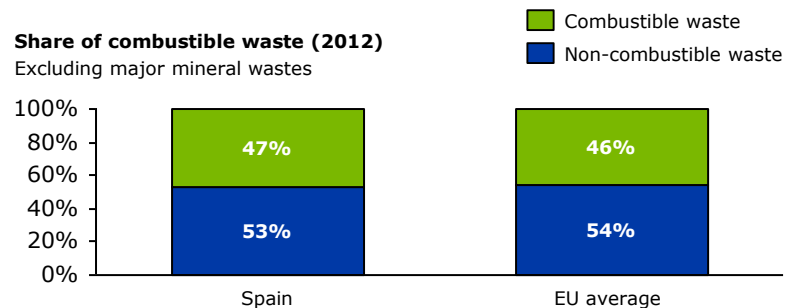
Excluding major mineral wastes



WASTE AVAILABILITY *Spain at EU average levels in regards to combustible waste generation.*

Share of combustible waste (2012)

Excluding major mineral wastes



AT A GLANCE

- There is a strong opposition towards both incineration with energy recovery and co-processing of waste in Spain, especially from local activist and environmental groups. Despite success in waste reduction and recycling, a large share of waste generated is still being landfilled (43% in 2014).
- Spanish waste management is generally facing a number of issues including low landfill taxes (12 EUR/tonnes minimum), bad financial situation of regional authorities preventing pursuing of more advance treatment methods, and recent actions by the EU, which initiated sanctions against the country for illegal landfilling.[3]
- Co-processing and WtE are viewed as homogeneous operations and despite their clear position in the national waste management planning (PEMAR plan), the enforcement of the plan on municipal level is not adequate. [4]
- There is a general lack of both recycling and pre-processing facilities in the country.
- Regional differences for taxes and fees of waste treatment, lead to an internal or cross-border "shopping behavior," i.e. waste is transported to location with lower rates, despite the fact that sound local treatment options might exist. This can lead to regional over-or under-capacities for different types of waste treatment.

Spain Barriers and Opportunities

Spain has a number of issues to address; if successful, co-processing could become a significant waste treatment option



The waste uptake in Spanish cement sector is hampered by a number of infrastructural, political and economical barriers. However, if the main barriers are lifted, the cement sector is ready for higher co-processing rates which could contribute to lower levels of landfilling.

BARRIERS *Underdeveloped pre-processing industry, public opposition to incineration and co-processing along with low disposal fees and poor economic situation hamper increased waste uptake in the cement industry.*

DRIVERS AND OPPORTUNITY *Increased utilization of waste can assist the recovery of the Spanish cement sector if the mediation with the opposition is successful and waste directive enforcement is improved.*

Waste market organization	Medium	<ul style="list-style-type: none"> • Waste processing industry is not well-developed, illegal landfilling occurs
Waste market situation	High	<ul style="list-style-type: none"> • National economic situation doesn't allow investments in waste industry, regional imbalances in waste treatment options exist • Landfill taxes too low • Market distortions, in the use of biomass waste streams
Political environment	Medium	<ul style="list-style-type: none"> • Poor law enforcement in waste management, in particular at local and regional level • Lack of cooperation between regions in the country
Societal perspective	High	<ul style="list-style-type: none"> • Public acceptance of co-processing of waste is low
Cement industry	Low	<ul style="list-style-type: none"> • No significant barriers identified

Drivers	<ul style="list-style-type: none"> • Pressure to decrease the landfilling (including illegal landfilling) share • Increasing cost of fossil fuels can further incentivize AF uptake in the sector • Inclusion of co-processing in circular economy directive could further incentivize preferential waste treatment in cement plans (as partial material recovery)
Actions for stakeholders	<ul style="list-style-type: none"> • Improve waste management law enforcement on regional level • Provide leveled playing field for energetic biomass utilization • Coordinate the permit issuance between regions, ensure compatibility between regions • Stimulate an open debate and transparency between the opposition groups, public and the cement industry • Increase cooperation between regions on waste management issues • Ensure development of pre-processing facilities • Address regional imbalances in waste treatment over- and under-capacities
What is the opportunity?	<ul style="list-style-type: none"> • Support to the recovery of the cement sector • Reduction of the share of landfilled waste in the country • Diversification of locally available waste management opportunities



Data references:

- > Data for the cement sector were obtained from Spanish cement sector (Oficemen) at https://www.oficemen.com/reportajePag.asp?id_rep=248
- > Data for the waste management were obtained from Eurostat at <http://ec.europa.eu/eurostat/data/database>

[1] Oficemen, Anuario del sector cementero español, 2015

[2] Interview with Dimas Vallina, Managing Director at CEMA and Pedro Mora, Technical Director at OFICEMEN, 17/Nov/2016

[3] Judgment of the Court (Eighth Chamber) of 25 February 2016. European Commission v Kingdom of Spain. Case C-454/14.

[4] Plan estatal marco de gestión de residuos (PEMAR) 2016-2022

Disclaimer:

- > The reporting on alternative fuels in Spain differs from GNR. There is an additional category called “partially biomass fuels”. This group includes the most commonly used alternative fuels in the Spanish cement sector. We include the figures from “partially biomass fuels” in the category “Waste Biomass” in our calculations.
- > “Alternative fossil fuels”: Waste oils; Solvents and varnishes; Other non biomass; Plastics; Hydrocarbon residues
- > “Biomass fuels”: Dried sewage sludge; Wood and vegetable biomass; Paper, carton and cellulose; Animal meal and animal; other biomass
- > “Partially biomass fuels”: RDF, used tires, impregnated saw dust, wastes from paper industry, textile

Case study

- > Belgium
- > Bulgaria
- > Czech Republic
- > France
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- > Greece
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- > Ireland
- > Italy
- > Poland
- > Portugal
- > Spain
- > **Sweden**
- > United Kingdom

Sweden Summary

Well advanced waste industry providing strong competition for available waste-fuels to the developed cement sector

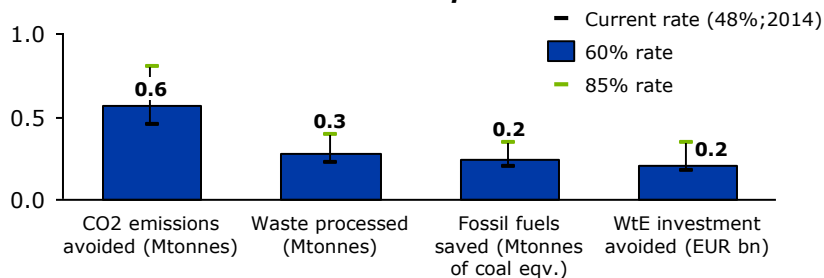


Now that major investments in technology have been made, the co-processing rate is steadily increasing in Sweden. However, strong competition for waste and limited potential for synergies across industries might slow down further reduction of fossil fuels in the cement sector.

BARRIERS *Strong competition for available waste is limiting further development of co-processing in the cement sector.*

Waste market organization	High	<ul style="list-style-type: none"> High quality waste not available to the cement sector in sufficient quantity
Waste market situation	Medium	<ul style="list-style-type: none"> Competition for available waste
Political environment	Medium	<ul style="list-style-type: none"> Support to incineration on national level
Societal perspective	Low	<ul style="list-style-type: none"> No significant barriers identified
Cement industry	Medium	<ul style="list-style-type: none"> Limited synergy potential with other industries Too high dependency on waste imports

POTENTIAL *At 60% co-processing rate, the sector could mitigate some 0.6 Mtonnes of CO2 annually, while avoiding the use of 0.2 Mtonnes of coal equivalent.*



ACTIONS FOR STAKEHOLDERS

The cement industry

- Pursue synergetic opportunities with the industrial sector and incinerators
- Incentivize pre-processing facilities to upgrade the quality of SRF/RDF

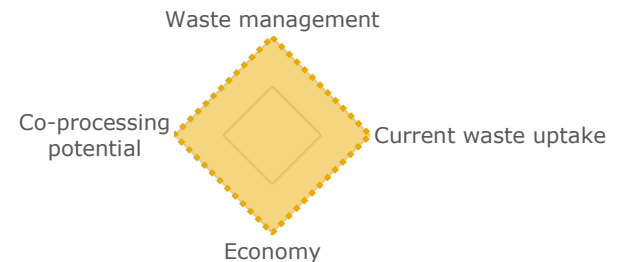
Policy makers

- Investigate the best utilization of waste streams from a societal perspective
- Explore the possibility of supporting heat generation in industries from forestry waste

The waste management industry

- Improve the quality of domestically produced SRF/RDF

SWEDEN AT A GLANCE



Sweden Cement Sector

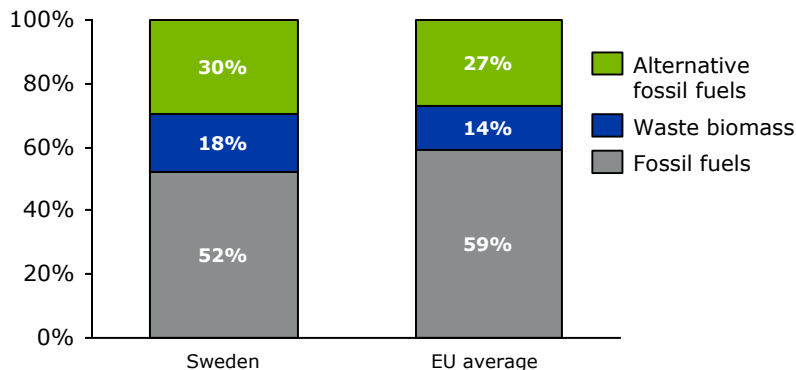
Sweden has a single operator on the market, with one plant covering most of the cement production



Swedish cement production is largely dependent on one large plant located in Gotland. The co-processing rate (48%) is above EU average and expected to increase further in the coming years. However, the most developed incineration market in the EU threatens the waste availability for the cement industry.

CO-PROCESSING *Sweden has above EU average co-processing rate with 48% of thermal energy coming from alternative fuels.*

Average thermal energy consumption in cement kilns (2014)

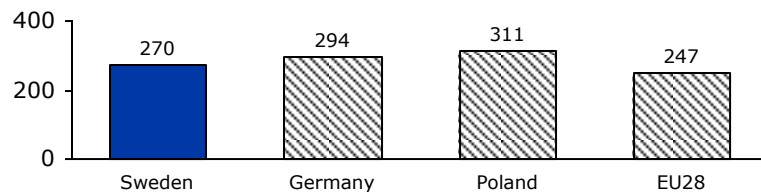


AT A GLANCE

- Sweden had 3 cement plants in 2014, all operated by Cementa AB which is a subsidiary of Heidelberg Cement.
- The majority of the cement manufactured in Sweden comes from the Slite plant in Gotland with annual production capacity of around 2 Mtonnes.
- In 2014, about 2.6 Mtonnes of clinker was produced of which 5% was exported.
- The co-processing rate at 48% was above EU in 2014.
- The demand for cement in Sweden is expected to increase in the coming years. [1]
- Cement plants do not utilize any industrial waste and focus solely on Refuse Derived Fuels (RDF) and Solid Recovered Fuels (SRF).

PRODUCTION *Sweden is slightly above EU average at clinker production. About 5% of its production was exported in 2014.*

Grey clinker production per capita (tonnes; 2014)



Sweden Waste Management

Focus on advanced waste treatment created a strong competition between industries and incentivized waste import

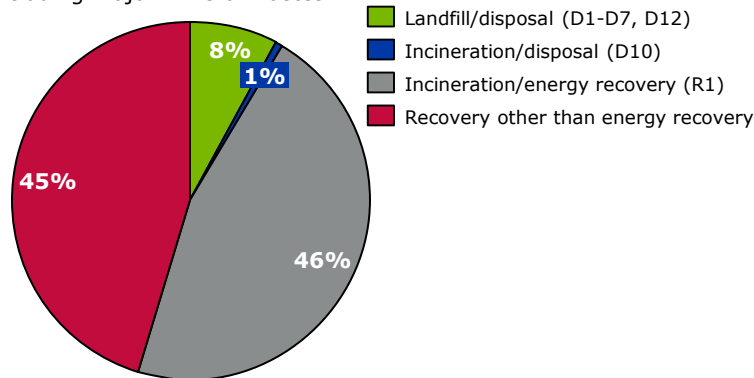


As landfilling of waste has been reduced to below 10%, there is a strong competition for waste between incinerators, biogas plants and the cement industry. Coordination between actors utilizing waste is low and additional waste already has to be imported as the incineration and biogas capacities increase.

WASTE TREATMENT *Sweden waste treatment is dominated by incineration and waste recycling.*

Waste treatment composition (2014)

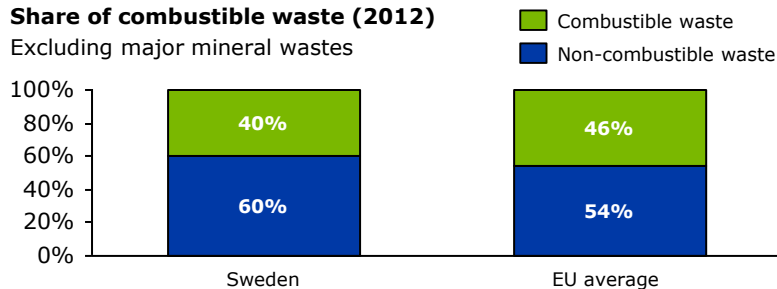
Excluding major mineral wastes



WASTE AVAILABILITY *Sweden is below the EU average with regards to combustible waste generation.*

Share of combustible waste (2012)

Excluding major mineral wastes



AT A GLANCE

- With above EU average recycling rate (45%) and one of the most developed incineration industry (46% incineration rate) in the EU, only a relatively small part of waste gets landfilled.
- In recent years, Sweden had to import waste, mainly from Norway and the United Kingdom as its domestic waste generation could not keep up with the increasing capacity of incinerators. [1]
- Despite the incineration overcapacity, more plants are currently planned or already under construction. As incinerators are connected to the district heating network, their public acceptance is relatively high.
- In comparison with EU average, Sweden generates a higher share of waste with low calorific values, which limits their usability for the cement industry.
- As a majority of the pre-processing facilities focuses on delivering waste to incinerators, there is a lack of high-quality SRF/RDF available to the cement industry, which is often left dependent on imports.
- More successfully, the cement industry is collaborating with recycling facilities, which provide sorted materials that cannot be recycled.
- Additional competition for certain waste streams (e.g. forestry and pulp industry) comes from the biogas industry.

Sweden Barriers and Opportunities

Co-processing steadily increases, however utilization of waste streams has to be optimized to achieve best results from the societal perspective



As the incineration industry in the country is both well-developed and supported by authorities, the cement industry has to find ways to co-exist and perhaps mobilize other waste streams.

BARRIERS A very strong competition for waste with one of the most developed incineration industries in the EU, which is the preferred option to co-processing, presents a major barrier to further fuel substitution. There is an opening however, if biomass resources can be mobilized.

DRIVERS AND OPPORTUNITY A coordinated effort between the incinerators, responsible authorities, the cement sector and other industries is needed to optimize waste utilization in the Swedish cement sector. Domestic availability of high quality wastes should be ensured.

Waste market organization	High	<ul style="list-style-type: none"> High quality waste not available to the cement sector in sufficient quantity
Waste market situation	Medium	<ul style="list-style-type: none"> Competition for available waste, in particular with incinerators
Political environment	Medium	<ul style="list-style-type: none"> Support to incineration on national level
Societal perspective	Low	<ul style="list-style-type: none"> No significant barriers identified
Cement industry	Medium	<ul style="list-style-type: none"> Limited synergy potential with other industries (in waste transfers) Too high dependency on waste imports

Drivers	<ul style="list-style-type: none"> All there cement plants have been modernized, allowing for further increase in waste uptake in the sector Certain potential for synergies with other industries (e.g. fly ash and industrial waste utilization) Potentially substantial availability of biomass wastes from the forestry industry
Actions for stakeholders	<ul style="list-style-type: none"> Investigate the best utilization of waste streams from a societal perspective and optimize their flows to recycling facilities, biogas plants, cement kilns and WtE installations Explore the possibility of supporting heat generation in industries from forestry waste Pursue synergetic opportunities with the industrial sector and incinerators Incentivize pre-processing facilities to upgrade the quality of produced SRF/RDF Improve the quality of domestically produced SRF/RDF to suit the needs of the cement industry
What is the opportunity?	<ul style="list-style-type: none"> Optimized use of waste in the country, while lowering the dependency of cement industry on fossil fuels through exploiting the large potential for biomass utilization in cement kilns Avoided WtE investment as the cement industry is ready to provide additional capacity Reduction of waste imports to the cement industry



Data references:

Data for the cement sector were obtained from GNR (Get the Numbers Right) at <http://www.wbcdcement.org/GNR-2014/index.html>

Data for the waste management were obtained from Eurostat at <http://ec.europa.eu/eurostat/data/database>

[1] Interview with Karin Comstedt Webb, Manager Climate and External Environment at HeidelbergCement Northern Europe and Anders Jansson, Marketing manager at HC Miljö AB, 01/Dec/2016.

Case study

- > Belgium
- > Bulgaria
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- > Sweden
- > **United Kingdom**

United Kingdom Summary

An active cement sector ready to increase co-processing rates, if suitable incentives for co-processing are introduced



The cement industry in the UK has taken major steps to enable increased use of alternative fuels, even after the industry was hit by a lower demand for cement. Higher substitution levels can be achieved with suitable incentives for investment, recognition of materials recovery through co-processing and a level playing field between cement and other sectors using waste or biomass as a fuel.

BARRIERS *Alternative Fuel availability, logistics and economics prevent faster growth of co-processing.*

Waste market organization	Medium	<ul style="list-style-type: none"> High quality waste not available to the cement sector in sufficient quantity.
Waste market situation	Medium	<ul style="list-style-type: none"> Market distortions due to WtE and Biomass related government support.
Political environment	Low	<ul style="list-style-type: none"> There are no significant regulatory barriers to co-processing.
Societal perspective	Low	<ul style="list-style-type: none"> No barriers identified.
Cement industry	Low	<ul style="list-style-type: none"> No barriers identified.

ACTIONS FOR STAKEHOLDERS

The cement industry

- Provides solid off take of waste based fuels and aim at reaching the technically feasible level of 80% alternative fuel use sooner than 2050

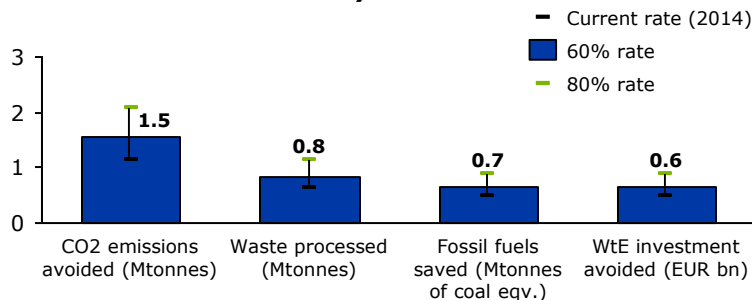
Policy makers

- Should positively recognize the recovery of materials by co-processing
- Are asked to introduce a level playing field on use of waste biomass
- Improve the industry's position vs WtE and vs incinerators, especially regarding carbon emissions

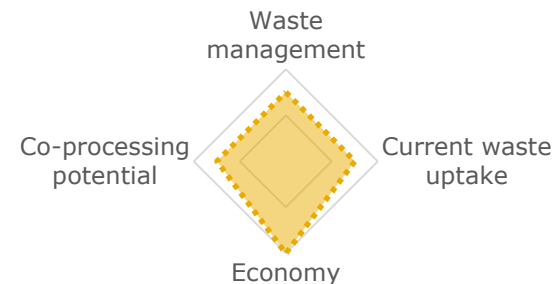
The waste management industry

- Should increase the volume of domestically produced quality fuels to fulfill the needs of the cement industry

POTENTIAL At 60% co-processing rate, the sector would avoid 1.5 Mtonnes of CO₂, utilizing about 0.8 Mtonnes of waste annually.



UNITED KINGDOM AT A GLANCE



United Kingdom Cement Sector

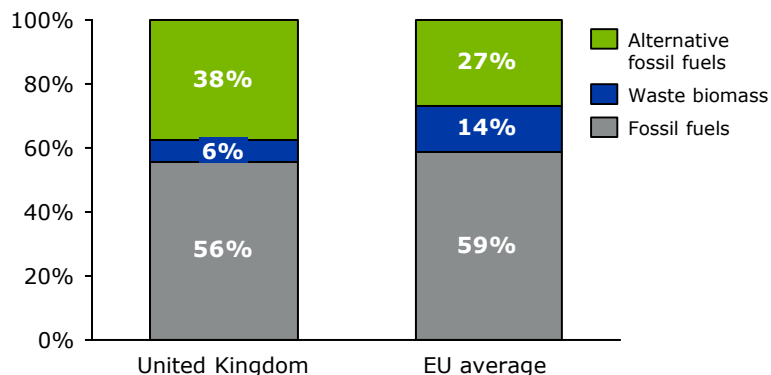
The cement market is slowly improving due to high housing demand and coming infrastructure investments



The domestic demand has been slowly increasing, after a drop of consumption in 2007/2008, still cement consumption in 2014 is still 25% below 2007 levels. Co-processing rate was slightly above EU average at 44 % in 2014.

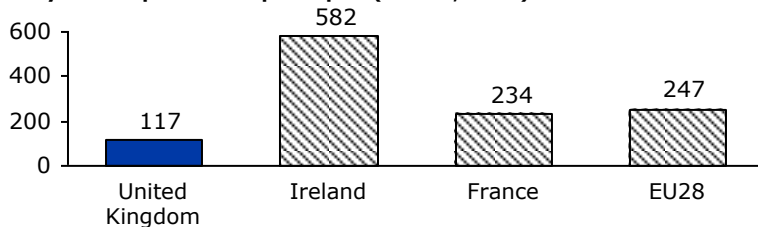
CO-PROCESSING *The UK substitution rate is above the EU average with 44 % of thermal energy coming from alternative fuels.*

Average thermal energy consumption in cement kilns (2014)



PRODUCTION *Per capita clinker production in the UK is well below the European average at 117 kg/capita.*

Grey clinker production per capita (tonnes; 2014)



AT A GLANCE

- At present there are 5 cement producers in the UK, 4 of these are global cement multinationals. [1] [3]
- Cement consumption in Great Britain peaked in 2007 at 13 Mtonnes followed by a low in 2009 at 8.7 Mtonnes, in 2014 cement sales were 10.6 Mtonnes. [2]
- Cement imports accounted for 17.2% of sales in 2014, export of cement and clinker was virtually nonexistent. [2]
- In 2014, clinker production in the UK was 7.2 Mtonnes. [2]
- The current co-processing rate (44%) is above the EU average, co-processing started in the 1990's. [1]
- It is expected that incremental growth could bring the cement industry to around 50% fuel substitution by 2020. [1]
- Further improvement in kiln process control and investment in waste to fuel processing is required to significantly increase co-processing. [1]
- Burning a large proportion of waste fuels has been accompanied by significant investments in the industry. [5]

United Kingdom Waste Management

Availability of quality alternative fuel, suitable incentives and recognition of benefits all play a role to increase co-processing.

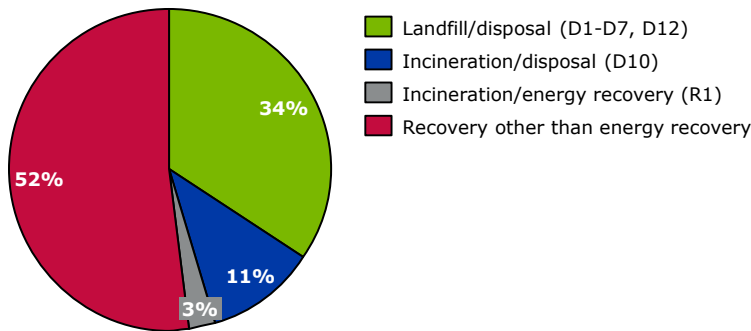


The quadrupling of the landfill tax standard rate between 2006 (£21 /t) and 2014 (£80/t) has led to increased recycling of waste and higher availability of RDF for WtE applications. Policy support for additional processing of such streams could provide the cement industry with more alternative fuel.

WASTE TREATMENT *Landfilling waste in the UK has dropped significantly over the past few years, export of recovered waste has grown while WtE capacity is slowly coming online.*

Waste treatment composition (2014)

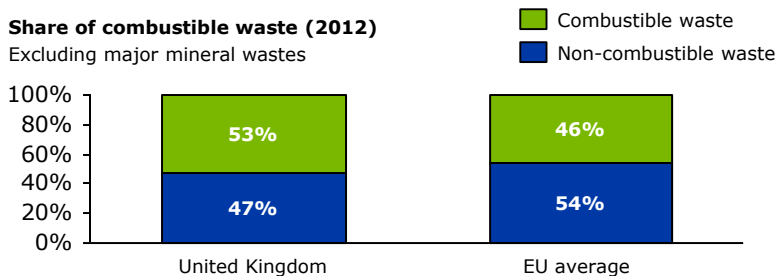
Excluding major mineral wastes



WASTE AVAILABILITY *Overall there is enough volume of available combustible wastes, but there are regional differences leading to export or limited local availability.*

Share of combustible waste (2012)

Excluding major mineral wastes



AT A GLANCE

- The Government (Defra and UK Regulators) is positive on co-processing, there are no specific legislative or regulatory hurdles for the use of alternative fuels in cement production. [1]
- The industry association (MPA) took the initiative to develop the "Code of Practice for the Use of Waste Materials", which has been adopted by all UK Regulators and helped provide a consistent approach at cement plants when using alternative fuels. [1] [4]
- Co-processing is seen as a viable solution for treatment of especially commercial & industrial wastes (solid / liquid), tyres and less for processed Municipal Solid Waste (MSW). [7]
- Co-processing is not fully recognized as a value-adding waste treatment solution and the industry receives no incentives for co-processing. [7] Similarly no credit for material recovery of the fuels ashes is given to the cement industry. [1]
- Recycling policy is devolved to the administrations of Scotland, Northern Ireland and Wales, who set their own targets. [6]
- The waste sector is slow in investing in more advanced waste processing of solid fuels, and AF are sometimes of poor quality [1]
- The position of clinker plants vs. incineration with or without energy recovery is disadvantaged, due to differences in GHG accounting. [1]
- Logistics are an important factor in co-processing economics, as some plants are far away from the main urban regions. [1]

United Kingdom Barriers and Opportunities

Availability of quality alternative fuels and recognition of co-processing in policies can lead to increased fuel substitution.



The UK cement sector is in a good position to further increase the use of alternative fuels. Permits and technology are in place and there are no regulatory barriers to co-processing. Recognition for material recovery and level playing field between WtE, biomass users and the cement sector can provide a boost.

BARRIERS *Economics dictate the increased use of AF; a lack of policy based incentives, logistics challenges and availability of the volume of quality alternative fuel are the main barriers.*

DRIVERS AND OPPORTUNITY *If properly supported AF use can increase; via incentives for UK investment, recognition of materials recovery status, a level playing field between cement and electricity/heat uses.*

Waste market organization	Medium	<ul style="list-style-type: none"> High quality waste not available to the cement sector in sufficient quantity.
Waste market situation	Medium	<ul style="list-style-type: none"> Market distortions due to WtE and Biomass related government support.
Political environment	Low	<ul style="list-style-type: none"> There are no significant regulatory barriers to co-processing.
Societal perspective	Low	<ul style="list-style-type: none"> No barriers identified.
Cement industry	Low	<ul style="list-style-type: none"> No barriers identified

Drivers	<ul style="list-style-type: none"> Use of alternative fuels is accepted by industry and plants can incrementally increase co-processing levels, as permits are in place. Plants are technically ready for incremental increase in AF use, up to about 50%. High landfill taxes promote AF use.
Actions for stakeholders	<ul style="list-style-type: none"> Government to incentivize the use of alternative fuels and recognize material recovery. Level the playing field on GHG accounting between the cement industry and incinerators. Balance the development between WtE/biomass using power plants and co-processing clinker plants to avoid local overcapacities The cement industry should continue providing a guaranteed uptake of waste based fuels by. The waste sector should increase the quantity and quality of domestically produced alternative fuels, to suit the needs of the cement industry.
What is the opportunity?	<ul style="list-style-type: none"> Decreased share of landfilling or waste export by energy and material recovery in cement. More circular economy, as low value waste transforms to high quality and durable product within the value chain. More competitive local cement industry and more local options for waste recovery. Lowering of greenhouse gases emissions of the cement industry.



Data references:

- > Waste data we use in this study come from Eurostat, however we do acknowledge that Eurostat and Defra figures differ.
- > For figures on the cement sector in the UK, we use national data provided by MPA as GNR data do not have a full coverage of the industry in the country (<10% of the total clinker production is not covered by the GNR, therefore our threshold to use rather national data was reached).

[1] Interview with Dr. Rebecca Hooper and Dr. Richard Leese (Mineral Products Association - MPA)

[2] MPA Cement Statistics ANNUAL 1 Apr – 15

http://cement.mineralproducts.org/downloads/industry_statistics.php

[3] The UK cement industry in 2015 – 2016, Edwin Trout, Global cement, Cement Industry Suppliers Forum, June 2016

[4] MPA Code of practice for the use of waste materials in cement and dolomitic lime manufacture, MPA, May 2013

[5] Industrial Decarbonisation & Energy Efficiency Roadmaps to 2050, Cement, WSP and Parsons Brinckerhoff and DNV GL, for DECC, March 2015

[6] Municipal Waste Management in the United Kingdom, Paul Watson (CRI), for EEA 2013

[7] MPA, MPA Cement Sustainable Development Report 2014, December 2015



Case study:

- This case study is based on a review of available literature and an interview with a regional expert.
- The figures used in the case study come from the sources specified in the reference page.
- The barriers, drivers and recommendations to stakeholders are based on the consultants' expertise and have been discussed with the regional expert as well. The scoring of the barriers (low, medium, high) is qualitative and based on the relative severity of the issue in regards to further uptake of Alternative Fuels in the country.

On charts used in the case study:

Potential (slide 1)

- The current rate shows the estimated impact in the four categories in the baseline year (2014).
- The bars in the chart display expected mid-term outlook in terms of co-processing rates in the country. The impact in the four categories is calculated by extrapolation of the baseline data to higher co-processing rate. The long-term outlook (higher end – green dash) is calculated in the same way.
- **CO2 emissions avoided** is calculated as a sum of thermal energy consumption (excluding drying of fuels) coming from Alternative Fossil Fuels and Biomass, using the average calorific value for fossil-based fuels used in cement kilns (93.5 kgCO₂/GJ) from the Cement Sustainability Initiative Protocol. We are using the term “avoided emissions,” please note this is a difference to the term “emission reductions” used in the EU ETS.
- **Waste processed** potential is calculated by extrapolation of current amount of waste processed by fixing both the average calorific value of Alternative Fuels and production levels while increasing the share of Alternative Fuels on the total thermal energy consumption.
- **Fossil fuels saved** is calculated as coal equivalent avoided due to use of Alternative Fuels using the average calorific value for coal as a primary fuel (25.1 MJ/kg) from IPCC. Potentials are based on extrapolation of the baseline data.
- **WtE investment avoided** is calculated using the current volume of waste co-processed (in tonnes) as baseline, utilizing the average WtE investment cost (0.78 MEUR/ktonne of waste incineration capacity- figure based on consultants' expertise). Potential are based on extrapolation of the baseline data. Please note we do not make a difference whether the WtE investment would come from public or private sources.



Country at a glance spider chart (slide 1)

- The scoring is done with a following set of criteria:

Score	1/4	2/4	3/4	4/4
Waste Management	Poor. High landfilling share (~80%), low incineration rate (~1%).	Medium. Above average landfilling share (~50%), medium-low incineration rate (~5%).	High. Average landfilling share (~30%), higher incineration rate (~15%).	Very high. Below average landfilling share (~10%), very high incineration rate (~25%).
Current waste uptake	Very low co-processing rate (<10%).	Medium co-processing rate (>10, <25%).	Average co-processing rate (>25%, <45%).	Very high co-processing rate (>45%).
Economy	Very low. GDP per capita <15,000 EUR.	Low. GDP per capita >15,000 EUR; <20,000 EUR.	High. GDP per capita >20,000 EUR; <28,000 EUR.	Very high. GDP per capita >28,000 EUR.
Co-processing potential	Very low. Annual growth expected 0 - 1%.	Low. Annual growth expected 1 - 2%.	Medium. Annual growth expected 2-3%.	High. Annual growth expected >3%.

Average thermal energy consumption in cement kilns (slide 2)

- Shown as a relative share between thermal energy consumption coming from Alternative Fossil Fuels, Biomass and Fossil Fuels.

Waste treatment composition (slide 3)

- Shows treatment of all waste streams in the country as a relative share. Please note that this is not limited to Municipal Solid Waste only. Major mineral wastes are excluded from the calculations because these waste streams are not relevant for Waste to Energy applications.

Waste availability (slide 3)

- Calculated by comparing total waste production in the country and waste generated in "combustible categories" as defined by the consultants. For the cement industry the combustible waste streams include: (a) spent solvents, (b) used oils, (c) rubber wastes, (d) plastic wastes, (e) wood wastes, (f) textile wastes, (g) animal and mixed food waste, (h) vegetal wastes, (i) household and similar wastes, (j) mixed and undifferentiated materials (k) common sludges – following the classification at EUROSTAT database.