Warmth from Waste: A Win-Win Synergy

Background Paper for project development
on District Energy from Waste: a common initiative

Contents

TERMS AND ABBREVIATIONS

CHP	Combined Heat & Power
District Energy	Term used to encompass both District Heating and District Cooling
DHC	District Heating and Cooling
EC	European Commission
EU	European Union
GHG	Greenhouse Gas
MSW	Municipal Solid Waste (household and similar waste)
RES	Renewable Energy Sources
WtE	Waste-to-Energy, thermal treatment (incineration with energy recovery) of household and similar waste that remains after waste prevention, re-use and recycling.

Executive summary

The Background Paper for project development on District Energy from Waste, created by three associations active in the energy field (CEWEP, ESWET and Euroheat & Power through the DHC+ Technology Platform), aims to serve as a basis for any future European or national project development, in particular under the Horizon 2020 Framework Programme.

The Paper identifies the potential for enhancing the collaboration between the District Heating and Cooling (DHC) sector and the Waste-to-Energy (WtE) sector across Europe. The results are presented in the form of a list of activities that could be developed at the European level along with their respective potential impact.

In 2009 the European Council set the objective for the EU to decarbonise its energy system by at least 80% below the 1990 level by 2050 without affecting general economic growth. The Directive on Energy from Renewable Sources (RES Directive) sets a 20% target for renewable energy by 2020. Current EU targets on waste will be revised during 2014 and are likely to become more ambitious: the amount of waste sent to landfill will be reduced and the demand for more sustainable waste treatment will increase.

A scenario which could help to fulfil all these targets is the increased exploitation of **synergy between WtE and DHC**.

Waste represents a local, cost effective, secure and sustainable[1] energy source which is already used in some DHC systems, allowing them to deliver affordable energy and reducing primary energy consumption.

[1] A major part of waste that remains after waste prevention, re-use and recycling is biodegradable and is considered to be biomass. Therefore energy produced from waste is partly renewable.

Contribution to the EU Energy & Climate objectives
- less primary energy use
- more renewable energy use
- reduced Greenhouse gas emissions

Contribution to the EU Waste Management objectives
- reduced landfilling
- energy recovery from residual, non-recyclable waste
- more sustainable waste management in a circular economy

Contribution to better environment
- reduced landfilling
- more efficient heating (and cooling) generation
- improved air quality

Improvement of Europe's competitiveness
- job creation
- use of locally-produced energy source, increasing energy independence
- leading European technologies & know-how with significant export value

The overall situation can be described as a "missed opportunity" on both sides:

Potential for Waste-to-Energy

Many EU countries still landfill a significant part of their waste despite the fact that DHC systems are already widely developed. Rather than landfilling the waste, they could generate energy from it in WtE plants and feed DHC networks with the thermal energy produced.

Potential for District Heating and Cooling

There are also countries with more sustainable waste management in place in which DHC is not extensively used. In such cases, it is crucial to develop DHC infrastructure in close vicinity to existing WtE plants.

The main objective of this initiative is to foster cooperation between the two sectors. Optimisation and improved management of the existing systems are needed. Further development of the synergy between WtE plants and DHC networks faces a number of challenges. Nonetheless, available heat and local resources can and should be better used!

To ensure the efficient exploitation of District Energy from Waste in Europe, projects need to be implemented in the following areas:

Transfer of know-how to the regions / cities where this efficient solution is underused or poorly used in order to:

- formulate policy recommendations that favour the interaction between the two sectors
- determine best practices and
- assess their transferability potential of the solutions, the pre-conditions for this and replicate it in different European regions

Raising awareness and tackling the barrier of public acceptance through:

- liaising with the citizens
- informing decision-makers and professionals about the advantages this solution can bring, providing them with tools to promote it locally
- helping urban planers to meet each other, discuss and develop integrated waste management and energy plans

Research and data collection in order to provide a comprehensive picture of the benefits that the combination of the two technologies brings, with the emphasis on:

- assessing available local resources (thermal energy from waste) and matching them with the existing and forecasted thermal demand
- conducting pilot studies and analysing environmental and economic benefits for different European regions
- fostering technological developments

Introduction

Who are we?

We are 3 associations that work closely together to promote District Energy from Waste (treated in Waste-to-Energy plants), i.e. CEWEP, ESWET and Euroheat & Power through the DHC+ Technology Platform.

CEWEP – Confederation of European Waste-to-Energy Plants
Represents the owners and operators of some 380 plants, which account for about 85% of the total Municipal Solid Waste (MSW) treated in WtE plants (waste incineration with energy recovery) in Europe.

ESWET – European Suppliers of Waste-to-Energy Technology
Represents the suppliers of Waste-to-Energy Technology. Its Members have built over 95% of WtE plants in Europe and their technology is used in virtually all plants in the world.

Euroheat & Power – the international association representing the District Heating and Cooling and Combined Heat & Power sector in over 30 countries
The DHC+ Technology Platform, set up under the umbrella of Euroheat & Power, serves to promote European research and innovation for District Heating, District Cooling and kindred technologies. Members include utilities, components manufacturers, national & European associations, universities, research establishments and consultancies.

What is Waste-to-Energy?

- Waste-to-Energy plants process household and similar waste that remains after waste prevention, re-use and recycling: they treat waste hygienically and they reduce its volume by about 90%.
- The plants are designed to efficiently recover the energy contained in the waste. The energy produced can be in the form of electricity and /or thermal energy (steam or hot water). The electricity is fed into the grid and distributed to the end-users; the hot water, depending on local infrastructure, can be sent to a nearby District Heating (or Cooling) network to heat (or cool) homes, hospitals, offices etc.; and the steam can be used if the nearby industries need it in their production processes.
- Their flue gas cleaning systems are designed to meet the strictest emission limit values placed on any industry set out in the Industrial Emissions Directive (2010/75/EU).

What is District Heating and Cooling?

- The fundamental idea behind modern District Heating and Cooling is to make use of local heat, cold and fuel sources that otherwise would be lost or remain underused.
- Processes like electricity generation, Waste-to-Energy, high-temperature industrial manufacture, and fuel- and biofuel refining liberate heat at temperatures that can no longer be used for the process itself, but which can satisfy other heat demands. District Heating, figuratively and literally speaking, provides the pipeline connecting these heat losses with the heat demands.
- Furthermore, District Heating and Cooling makes use of many kinds of local resources**:** renewables, such as biomass – including the biodegradable part of waste, geothermal, solar and wind resources, free cooling (like ground-, river-, lake- and sea water) and surplus heat from industry. Fuels can be switched depending on availability, price or environmental factors.

Background

Current situation of WtE and DHC (facts & figures)

Efficient Waste-to-Energy falls within the fourth step (recovery) of the waste management hierarchy after reducing, re-use, and recycling in the Waste Framework Directive (2008/98/EC). Its primary purpose is to safely treat the residual waste that cannot be recycled in a sustainable way while producing sustainable energy from it. WtE also helps to divert waste from landfills, thus reducing impacts on land, air and groundwater quality. However, the use of landfills for Municipal Solid Waste is still very extensive. According to Eurostat, more than 80 million tonnes of MSW (34% of MSW treated in EU28) reached landfills during 2012[2], instead of being re-used, recycled or recovered.

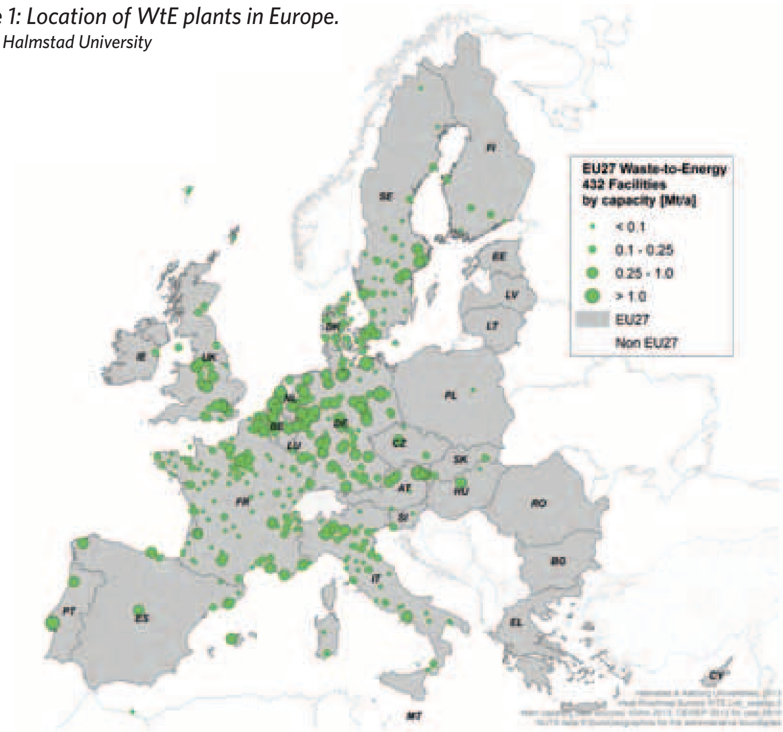
[2] EUROSTAT 2012

Along with Municipal Solid Waste, some similar streams such as commercial and industrial waste are available for thermal treatment in WtE plants.

More than 400 WtE plants are currently operating within EU (see Figure 1). These plants receive about 78 million tonnes of waste per year, representing a calorific heat value of between 470 and 1,240 PJ – enough to heat London for 5 years[3]. Currently, **less than half** of this potentially usable energy is recovered as electricity and heat, which means that there is still significant potential for development.

[3] London's total heat demand is 66 TWh/yr which equals to 237.6 PJ/yr. Source: https://www.london.gov.uk/sites/default/files/031250%20GLA%20Secondary%20Heat%20-%20Summary%20Report.pdf

Figure 1: Location of WtE plants in Europe.
Source: Halmstad University



For instance, more heat could be recovered from the existing WtE plants by linking them to District Heating and Cooling networks.

Currently, there are more than 6,000 DHC systems in Europe (see Figure 2)[4]. There are many examples proving that District Heating and Cooling is a viable, readily available solution for a quick transition from individual heating based on fossil fuels to a combination of more efficient, renewable and competitive energy supplies. Yet, there is room for further improvement and, in particular, for expansion.

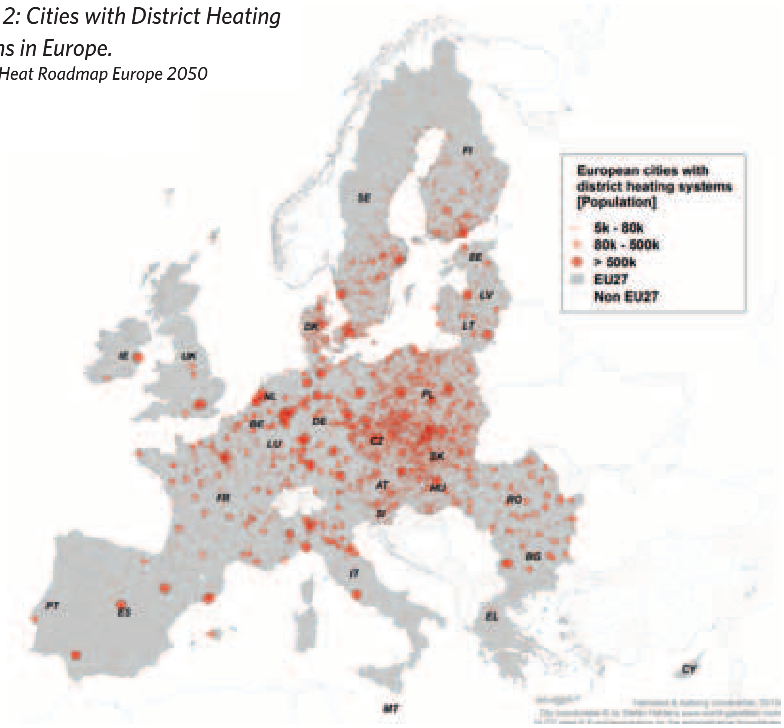
In Europe, recovered energy from waste for District Heating systems represents 50 TWh per year, i.e. around 10% of the total heat delivered through District Heating systems. Studies suggest that the potential for using heat from waste equals to 200 TWh per year by 2050, which means there are still opportunities for further development[5].

Also, it is expected that DHC will function as the backbone of Smart Cities. DHC will be used as infrastructure to provide efficient exchange and redistribution of energy, including better use of local resources like waste.

[4] Heat Roadmap Europe 2050 (Second pre-study for the EU27), May 2013

[5] Ibid

Figure 2: Cities with District Heating systems in Europe.
Source: Heat Roadmap Europe 2050



Current EU energy and waste policy context

- Article 14 of the Energy Efficiency Directive (2012/27/EU) calls on Member States to carry out assessments of their national heating and cooling potentials.
- The EU Directive on Energy from Renewable Sources (2009/28/EC) sets the target for all Member States to reach a 20% share of energy from renewable sources by 2020.
- The Waste Framework Directive (2008/98/EC) sets out the structure of the waste hierarchy and promotes energy efficiency in WtE plants.
- The EU Landfill Directive (1999/31/EC) sets targets for the diversion of biodegradable waste from landfills in order to reduce the impact of waste management on the environment.
- The Industrial Emissions Directive (2010/75/EU), requiring WtE plants to meet very strict air emission levels, together with the Waste Framework Directive and the Landfill Directive, constitute the foundation for improving European waste management. These Directives enable the development of necessary WtE infrastructure to convert waste, which is otherwise not suitable for recycling, into a source of sustainable, local, cost-effective and secure energy.
- According to the "Roadmap to a Resource Efficient Europe" (COM/2011/571), recovering energy from non-recyclable waste should be one of the Resource Efficiency initiatives.
- The Horizon 2020 Framework Programme (COM/2011/0808) will provide funding for EU projects aimed at improving Europe's competitiveness and focusing on secure, clean and efficient energy.

Illustration © European Commission

EU waste and energy targets

In 2009 the European Council committed the European Union to decarbonise its energy system by at least 80% below 1990 levels by 2050 without affecting economic growth. As thermal energy represents around 45% of final energy consumption[6], decarbonising the European energy system requires special attention to this sector. Renewable heating and cooling are vital to decarbonisation. This is outlined in various reports and studies, e.g. in the Energy Roadmap 2050 (COM/2011/885) published by the European Commission in 2011: "A shift in energy consumption towards low carbon and locally produced energy sources and renewable energy, including through District Heating systems, is needed".

The challenge for the heat market is to contribute to the decarbonisation goal while keeping the cost of energy affordable and maintaining a high level of comfort. A wide range of alternative and energy-efficient technologies, especially Waste-to-Energy, are readily available today to replace the two-thirds of the heat market, which currently are met through the use of fossil fuels.

District Energy from Waste contributes to reaching the EU renewable energy target established by the RES Directive given that part of the waste is biomass[7].

Current EU targets on waste will be revised during 2014 and are likely to become more ambitious: the amount of waste sent to landfill will be minimised and the demand for alternative treatment, such as recycling and Waste-to-Energy, will increase.

[6] Source: International Energy Agency, 2011

[7] About 50% of the energy produced by WtE plants comes from biomass.

Advantages

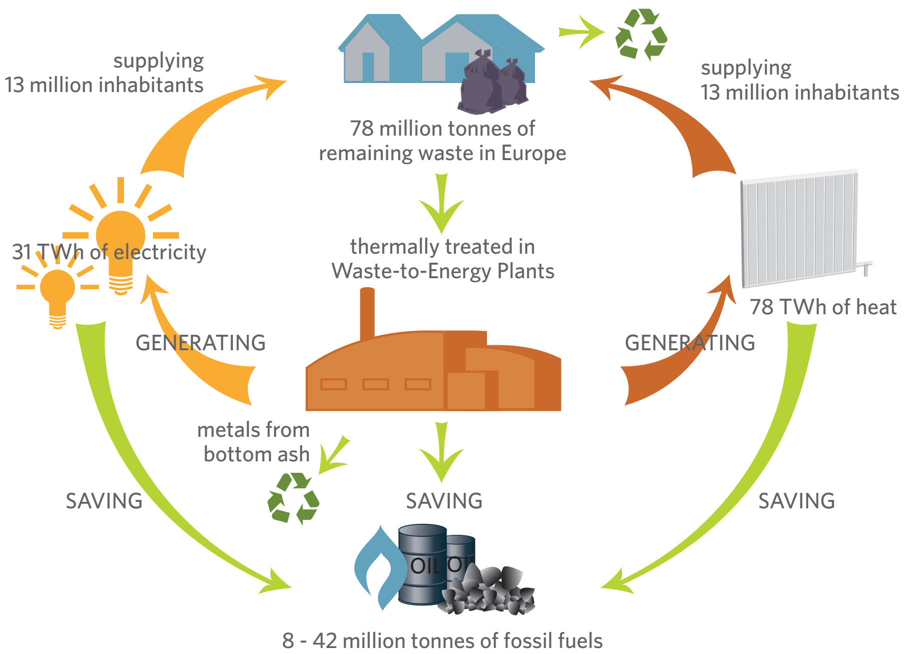
Environmental advantages of District Energy from Waste

From an energy and environment point of view, the synergy maximises the benefits of both WtE and DHC. This represents a concrete, readilyavailable and reliable solution towards fighting climate change through better waste management and cleaner energy systems.

About 78 million tonnes of household and similar waste that remains after waste prevention, re-use and recycling, was treated in Waste-to-Energy plants across Europe in 2011. From this waste, 31 TWh of electricity and 78 TWh of heat were generated (see Figure 3).

Depending on the avoided fossil fuel, between 8 and 42 million tonnes of fossil fuels (gas, oil, hard coal and lignite) can be substituted annually, which would emit 21 – 42 million tonnes of CO_2.

Figure 3: Waste-to-Energy Cycle.
Source: CEWEP

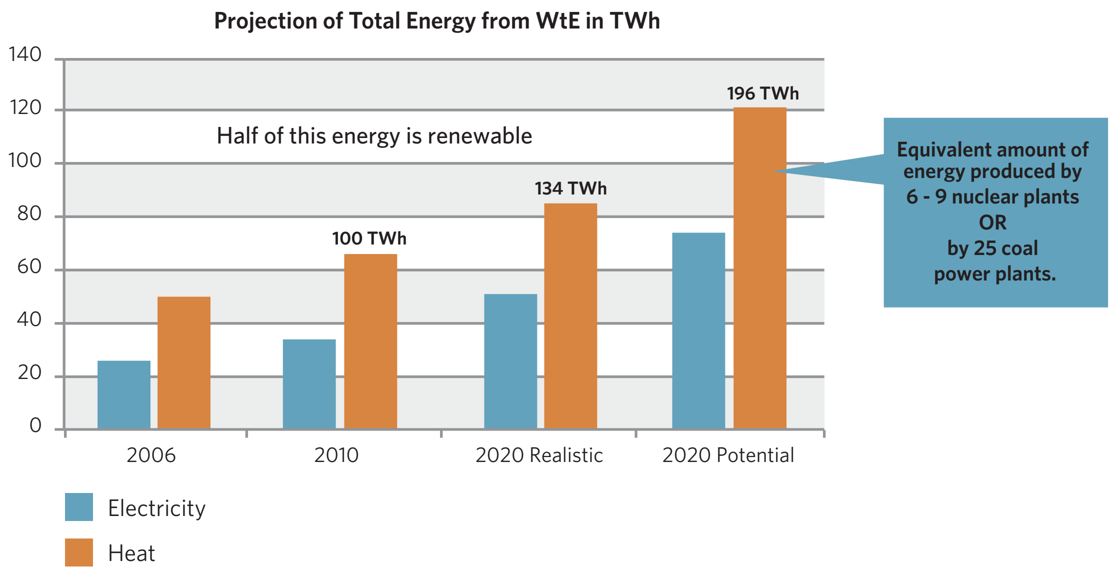


Energy recovery from waste helps achieving low-carbon policy objectives and ensuring security of energy supply.

WtE also helps to achieve the EU's policy for renewable energy sources to cover 20% of the whole energy consumption by 2020. About 50% of the energy produced by WtE plants comes from carbon-neutral biomass (see Figure 4). In 2011 WtE plants supplied about 50 TWh of renewable energy in Europe. This will grow by 2020 to a level of at least 67 TWh, and potentially to 98 TWh. The total amount of energy (renewable and non-renewable) produced by WtE plants would realistically double and could, with common efforts, reach 196 TWh by 2020 - enough to supply 70 million inhabitants. This would be equivalent to the amount of energy that is generated by 6-9 nuclear power plants or 25 coal power plants.[8]

[8] Energising waste – a win-win situation, CEWEP, http://www.cewep.eu/m_1177

Figure 4: Sustainable Energy from Waste.
Source: CEWEP



Includes both renewable and fossil components.

Economic advantages of District Energy from Waste

From an economic point of view, the long-term benefits outweigh the initial costs. Fossil fuels are saved, landfilling is minimised and the costs of both waste management and energy supply are lower for the citizens. This fact explains the broad support WtE and DHC have in some countries (such as Denmark, Germany and the Netherlands[9]), where not only environmental arguments but also financial implications are positively perceived by the population.

Rising energy prices and fuel poverty are major concerns for all European governments. No one would argue with the fact that it is better to invest in infrastructure than in fuel. Financial savings by using District Energy from Waste could benefit all European citizens from the most vulnerable customer to businesses and ultimately Europe's competitiveness on the world market.

Energy independence ranks equally high on the EU's energy agenda as competitiveness and decarbonisation. The proposed combination of WtE and DHC creates a diversified and more secure energy supply. **Using local waste instead of imported fossil fuels not only protects the environment, but also creates wellbeing and jobs within smart communities in Europe.**

[9] http://www.nytimes.com/2010/04/13/science/earth/13trash.html?pagewanted=all&_r=0

Europe-wide replicable solution

From a technical perspective, the synergy between WtE and DHC works and is replicable in many European regions where heat demand can be supplied by District Heating, and where waste treatment currently is not prioritised in accordance to the Waste Hierarchy. For many locations in Europe (and in particular in Southern Europe) where District Cooling could be envisaged, linking the networks to Waste-to-Energy plants could also help save primary energy.

There are already some very good examples of functioning synergies that could be replicated in other countries:

Keeping warm in Paris

50% of DH network in the city of Paris is supplied by 3 Waste-to-Energy plants

These WtE plants are: Saint-Ouen, Issy-les-Moulineaux and Ivry-sur-Seine. The plants treat non-recyclable waste from some 3.6 million Parisian households. By making use of this waste, they prevent the consumption of 300,000 tonnes of oil equivalent and the release of some 900,000 tonnes of CO_2 that would have been emitted into the atmosphere each year to keep the city warm. The steam from the combustion process is used to generate:

- Electricity, the majority of which is sold to EDF to supply the electricity grid.
- Heat, which is sold to the Parisian company for District Heating to supply heating and hot water to some 300,000 households, offices, hospitals and other buildings (including the famous Louvre museum).

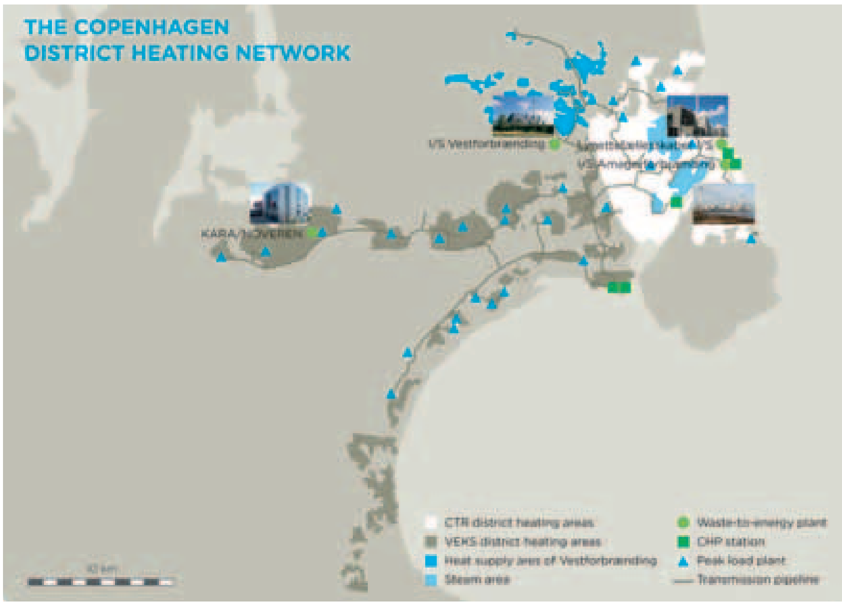
Learning from Denmark

Danish success factors

- Landfill ban on waste that can be incinerated
- Most of the Waste-to-Energy plants are Combined heat and power plants
- Wide-spread District Heating systems - tradition of creating collective heating systems

Since the oil crisis in the 1970s, great efforts have been made in Denmark to establish large District Heating distribution networks in order to reduce dependence on oil. WtE is a part of this policy as waste is a local fuel that, in addition to reducing the use of fossil fuels, contributes to increasing energy independence.

One of the world's largest District Heating networks is the Copenhagen network, stretching more than 50 km from east to west. Three WtE plants supply heat to the same network and **more than 30% of the total District Heating in the Greater Copenhagen area is generated from waste.**



Rambøll

The WtE plant in Malmö (Sweden)

supplies 60% of the heat distributed by the network

District Heating is supplied to 95% of Malmö's homes and the heat is distributed via 1,090 km of pipes – the distance from Malmö to Paris.

The Sysav plant is the most energy-efficient WtE plant in Sweden. It is one of the world's most advanced facilities for the incineration of waste. The hot-water boilers and the flue gas cleaning system have been reconditioned and developed in line with heightened demands on waste incineration.

In total, Sysav is licensed to incinerate 600,000 tonnes of waste per year. The plant produces approximately 1,400 GWh of thermal energy a year, which roughly equates the heating of 70,000 small houses. Additionally 250,000 MWh of electricity is produced at the same time.

Safe, clean and beautiful –
the Brescia (Italy) WtE plant

The architectural planning of this plant was developed in order to achieve a harmonious integration within its surroundings.

As in all WtE plants, attention to the environment has been confirmed by the fact that a large share of the cost for the realisation of the plant was devoted to the systems for flue gas cleaning and to the protection of the environment (in this case, 50% of the cost). The WtE plant was conceived within the framework of an integrated waste and territorial management strategy and represents an important source of energy for the city of Brescia. In 2011 the Brescia WtE plant processed 796,000 tonnes of waste and other biomass, producing 602 GWh of electricity and 747 GWh of heat (that is, almost 55% of the thermal energy supplied to the grid in Brescia during the year).

This means that in 2011 the WtE plant produced electricity equal to the needs of 200,000 households and heat equal to the needs of more than 60,000 apartments. At the same time it has allowed the saving of 150,000 toe (tonnes of oil equivalent) and has prevented the emission into the atmosphere of over 400,000 tonnes of CO_2.

Twence (Netherlands) WtE plant:
A Top Supplier of Sustainable Energy

Twence WtE plant received the Global District Energy Climate Award 2013 for its supply of heat to the local District Heating network of Essent in Enschede and its supply of steam to AkzoNobel.

This was made possible by the construction of a pipeline of over 5 km for the supply of heat and a 1.5 km pipeline for the supply of steam. Thanks to these pipelines, Essent and AkzoNobel managed to reduce their consumption of natural gas by a total of 125 million m^3 in 2011 and 2012.

In order to achieve this result in 2009 and 2010 Twence invested over 15 million € for connection to Enschede's municipal District Heating system. This involved technical in-plant modifications to enable the sourcing of steam and heat, as well as long-distance transport pipelines connecting the plant to the main system in Enschede. At the same time Twence and AkzoNobel invested over 10 million € in technical plants and pipeline for transporting steam to AkzoNobel's salt production plant.

The combined supply of both heat and steam makes this a unique initiative. It also makes Twence a front runner in the application of this technology.

And Waste-to-Energy is COOL...

District Cooling using surplus heat from District Heating networks only needs a tenth of the energy to fulfil the same cooling function that would be done with electricity [10], meaning substantial reductions in CO_2 emissions and primary energy use. District Cooling can use heat from waste incineration, making it an environmentally-friendly alternative to electrical air-conditioning systems that also spares resources.

A popular photographic motif in Vienna is the Spittelau WtE plant, whose façade was redesigned by eco-architect Friedensreich Hundertwasser following a major fire in 1989. The previously mundane structure was transformed into an impressive work of art, highlighting how a harmonious balance could be struck between technology, ecology and art. The Spittelau WtE Plant provides cooling and heating to the Vienna General hospital. This is in addition to providing heating for over 60,000 households in the city each year. The plant processes around 200,000 t / year of household waste from Vienna.[11]

[10] A Vision Towards 2020-2030-2050, DHC+ Technology Platform, March 2012
[11] Energising waste – a win-win situation, CEWEP, http://www.cewep.eu/m_1177

Challenges

In spite of all advantages the synergy between WtE and DHC represents, each of these modern technologies faces significant challenges.

Challenges for WtE

- Improving reduction, re-use, re-cycling and energy recovery while minimising landfilling is needed to guarantee a sound waste management throughout the EU.
- WtE plants can reach very high efficiencies if the infrastructure to supply heating / cooling is in place.
- Public perception is very variable; it can improve with pro-active communication, transparency and good examples.
- Lack of efficient local waste management plans linked to the EU / national objectives in some EU countries / cities.

Challenges for DHC

- Raising awareness about the possibilities that District Heating and Cooling infrastructure offers with a view to creating eco-districts.
- Providing urban planners with reliable information on available local resources.
- Lack of sustainable urban energy planning in some EU countries / cities.
- Integration of all available surplus and renewable thermal energy in DHC systems

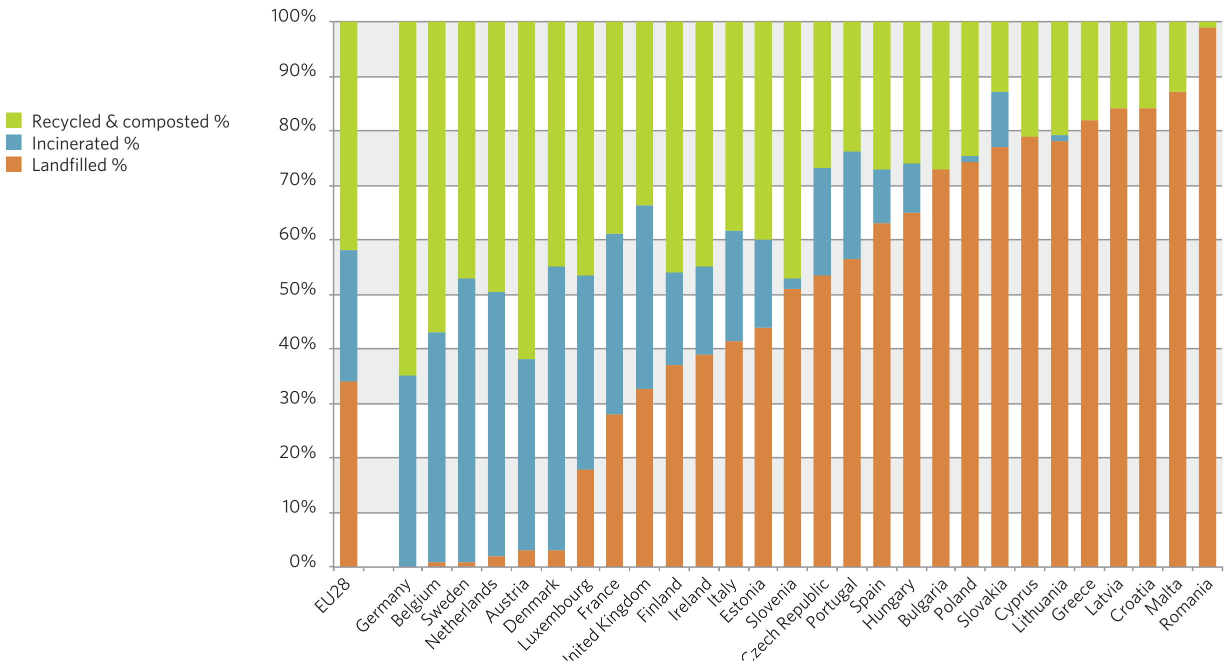
Main goals and objectives of the initiative

By overcoming the barriers cited above, European citizens could benefit from the cooperation between WtE and DHC. With suitable support, the opportunities for WtE and DHC can be used and common objectives achieved.

Opportunities for WtE

- With better waste management comes WtE. Many countries are going to treat their residual waste in line with the Waste Hierarchy.
- When linked to heat consumers, the plants can reach high energy efficiencies, enabling them to contribute even more towards the EU 2020 targets and beyond (2030 / 2050).
- Half of the energy produced is recovered from renewable, carbon-neutral biomass that would otherwise have been landfilled. This enables the introduction of otherwise squandered energy into these grids.
- GHGs, potential contamination of soil and ground water, as well as other pollution including odour from landfills are avoided.
- The development of Waste-to-Energy is very unbalanced throughout Europe (see Figure 5), some countries being well advanced (like Germany, Belgium, Sweden, etc.) while others landfill almost 100% of their waste (like Romania, Croatia, Latvia, etc.). Therefore, an important transfer of knowledge and best practices can be achieved.
- The virtuous synergy between WtE and DHC, through its energy and environmental advantages, could help improve public acceptance and help highlight best practices throughout Europe.

Figure 5: Municipal waste treatment in 2012, EUROSTAT data



Opportunities for DHC

- Implementation of the relevant EU legal framework (RES Directive, Energy Efficiency Directive).
- DHC as the backbone of Smart Cities (use of local resources, integrated network, etc.).
- DHC networks provide a flexible infrastructure to rapidly-changing energy supply (from fossil fuels to RES including waste) and support consumption-efficient behaviour.
- Thermal distribution networks are also a key element in order to improve energy efficiency, reduce CO_2 emissions and ensure security of energy supply. There is a major opportunity to use even more thermal energy from waste if the connection between thermal consumer (using hot water or steam for industrial process) to WtE plants is encouraged. Therefore we need drivers for developing new and expanding existing infrastructure for District Heating and Cooling where they are suitable.
- DHC networks improve urban air quality because centralised energy production facilities are equipped with efficient flue gas cleaning resulting in very low emissions, avoiding the use of individual combustion systems with uncontrolled emissions.

Choice in favour of the synergy

The District Heating and Cooling sector and the Waste-to-Energy sector can fruitfully work together as:

- waste represents a local, cost-effective, secure and sustainable energy source to be used in DHC systems;
- while many EU countries still landfill a significant part of their waste, a number of them, in particular in Central and Eastern Europe, already have widely developed DHC systems, which could be supplied by the waste that should be diverted from landfills;
- there are also countries with sustainable waste management where new DHC systems could be developed and linked with existing WtE plants.

Main objectives of the initiative

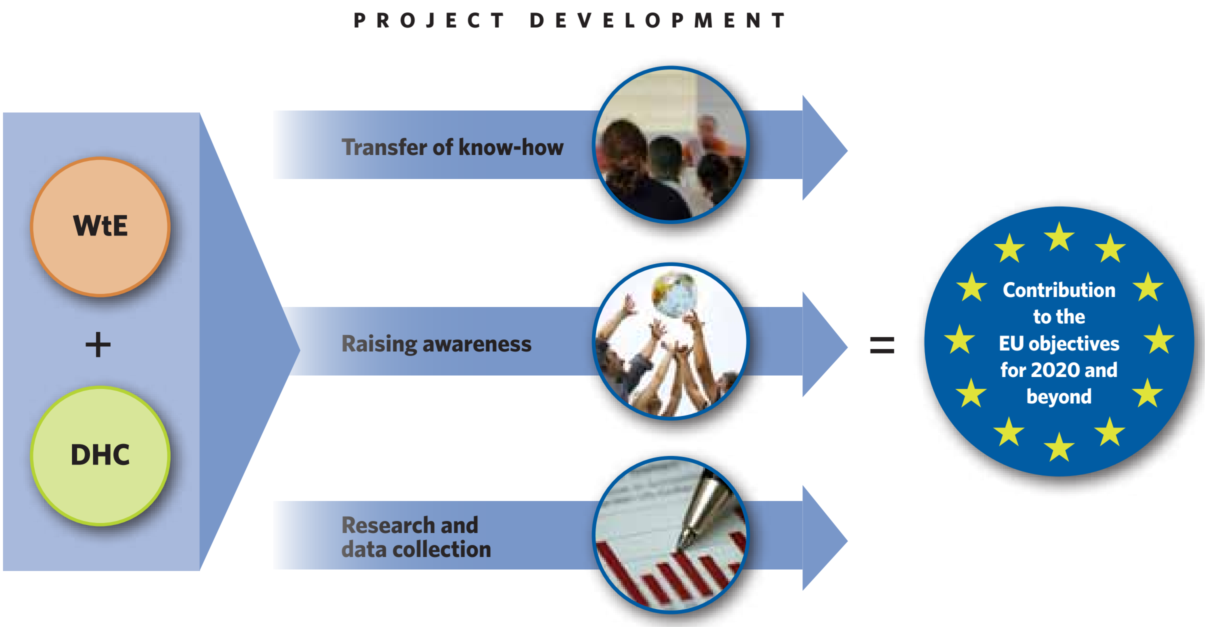
- Contribution to the EU Energy and Climate objectives of less primary energy use; more renewable energy use; and reduced greenhouse gas emissions.
- Contribution to the EU Waste Management objectives of reduced landfilling and more sustainable waste management in a circular economy.
- Contribution to improving air quality through reduced landfilling and more efficient heating (and cooling) generation.
- Improvement of Europe's competitiveness by creating jobs, using locally-produced energy source and exporting leading European technologies and know-how.

Activities and resources estimation

In order to achieve the objectives set above and to take advantage of all the benefits that the synergy between WtE and DHC could represent, the above-mentioned challenges need to be addressed.

As seen, while the use of heat from WtE through DHC systems has already been put in place in some regions / cities, this effective solution is underused / poorly used in others. Therefore, a major transfer of knowledge and best practices should quickly and efficiently be realised. Another aspect is the low level of awareness among decision-makers and professionals about the advantages this combination can bring. Actions must be taken to address this "overlooked" but key aspect. Finally, to fully reach the objective of the activities mentioned below, some information is still missing in order to gain a full picture of the benefits that WtE and DHC systems can bring. Data collection plays an important role in achieving the full development of WtE and DHC.

Figure 6: Reaching EU objectives thanks to the initiative District Energy from Waste



Theme I: Transfer of know-how

The transfer of know-how between advanced EU regions / cities to other EU regions / cities can be performed at different levels.

Activity I.1: Legislative framework

DESCRIPTION: An overview and comparison of the different legislative frameworks in the different European regions / cities is needed in order to formulate policy recommendations and support policy-makers when they will consider improving their local legislation in favour of greater interaction between WtE and DHC. It should result in the creation of well-balanced and effective legislative mechanisms to foster the development of District Energy from Waste throughout Europe.

TARGET GROUPS: EU, national and local policy-makers

EXPECTED IMPACT: To improve decision-makers' understanding of the existing legislative drivers and foster the use of thermal energy from waste in DHC. This will be done by preparing an **overview / study** on the current status of the local legislative provisions that favour the interaction between the two technologies. A **database** of local support schemes throughout Europe will be compiled, translated in English and synthesised. This will be made public, and serve as a stand-alone output, but the information within it will also be used to design a **toolbox** of "best legislations" and formulate **policy recommendations / guidelines.**

ESTIMATED RESOURCES: 1.5 million €

Activity I.2: Best practices

DESCRIPTION: A detailed description of best practices, with concrete facts and figures, is needed in order to better inform decision-makers about the benefits of using thermal energy from waste in DHC systems. For each example, the description should at least include the existing waste management plan, the business model in place, economic data and results achieved, especially the benefits for citizens.

TARGET GROUPS: policy- and decision-makers, utilities

EXPECTED IMPACT: At least 2 examples of best practices from different geographical regions[12] should be described in detail. These best practices will be showcased to the public in a comprehensive document (**report**), at specific events (**workshops**), as well as on a specific **website**.

ESTIMATED RESOURCES: 60,000 €

[12] Geographical regions could be selected by using the DHC state-of-development as described in the Ecoheat4eu project (further development, expansion, refurbishment, new development)

Activity I.3: Transferability

DESCRIPTION: One key aspect of the transfer of know-how is the transferability potential of the solutions and pre-conditions for their replication. Therefore, this aspect has to be assessed and local specificities highlighted. Direct transfer of knowledge should be fostered by organising physical meetings between experienced and learning cities.

TARGET GROUPS: Local authorities, utilities

EXPECTED IMPACT: To support the knowledge transfer from at least 10 mentor cities to learning cities from different geographical regions (e.g. in such countries as Romania, Croatia, Spain and Lithuania).

ESTIMATED RESOURCES: 600,000 €

Theme II: Raising awareness

The low awareness about the benefits of District Energy from Waste is one of the major challenges for this initiative. This low awareness concerns citizens as well as professionals.

Activity II.1: Public acceptance

DESCRIPTION: One of the main barriers to the development of WtE is the "not in my back yard" phenomenon. The direct consequence is that WtE plants are often situated far from the place where thermal energy could be used. To ensure that they are built near to heat consumers, it is important to well inform citizens about the benefits WtE could bring. Existing networks should be used, such as the Covenant of Mayors network, to foster dissemination and increase the impact.

TARGET GROUPS: Citizens, NGOs

EXPECTED IMPACT: Key players that can help reaching the target groups have to be identified. This can be politicians, representatives of local administration, important journalists, NGOs, etc. Information tools, specifically targeting citizens, should be developed: such as **interviews, short movie, info days, exhibitions, site visits, postcards,** etc. **Meetings** with civil society should also be held.

ESTIMATED RESOURCES: 100,000 €

Activity II.2: Informing and involving urban planners

DESCRIPTION: Urban planners are key stakeholders. It is therefore important to inform them about the benefits of WtE and DHC. In particular, this option is not always taken into account when developing eco-districts. However, identifying and informing them is only the first step, their engagement in concrete projects is important to keep their interest high.

TARGET GROUPS: Urban energy (DHC) planners, urban environmental (waste) planners

EXPECTED IMPACT: To engage in **dialogue with relevant urban planners**, in particular using the results of the UP-RES project, and to ensure that they are aware of the WtE and DHC solutions by inviting them to sign a "**Declaration of awareness**" and displaying signatory cities on the project's website. Special **training sessions** on this topic should also be organised. Around 10 "least performing" countries should be covered by this action.

ESTIMATED RESOURCES: 200,000 €

Activity II.3: Supporting the development of integrated waste management and energy plans at city level

DESCRIPTION: Integrated waste management is increasingly important because municipalities and regions can only access the EU Structural Funds after having submitted an elaborated Waste Management Plan. Integrating the section on energy recovery from unrecyclable waste with the heat planning using available calculation tools for justification of their choice would simplify their work. However, the most important is to help waste and energy planners meet each other, discuss and develop integrated plans.

TARGET GROUPS: Waste management authorities and local energy utility planners

EXPECTED IMPACT: Establish communication channels between these two entities where they do not exist. Interested stakeholders will receive training on the use of **GHG calculation tool** for waste management and an introduction to the **Ecoheat4Cities project results** which allow comparing the heat performance of District Heating and Cooling systems and individual heating options. Additionally, an **aggregated tool** with the implementation guidelines will be developed as part of a PhD study, and made available for the planners.

ESTIMATED RESOURCES: 350,000 €

Theme III: Research and data collection

Collecting data is crucial in order to provide a comprehensive picture of the benefits that the synergy can bring.

Activity III.1: Assessment and forecast of local resources

DESCRIPTION: In terms of waste management, indicators are easily available through Eurostat for current and past figures. Waste Management Plans, which are also to be developed for each country / region, also contain the foreseen growth in waste quantities. Knowing the amount of waste that the local authorities plan to allocate to projected Waste-to-Energy plants (while respecting the waste hierarchy), it is possible to derive the amount of **thermal energy** which will be available on the heating grid, thus helping the planning of other energy sources to fill the gap between the baseload energy from waste and the variable heat demand.

TARGET GROUPS: Waste management authorities, local energy authorities

EXPECTED IMPACT: The current and future **heat demand** in the chosen cities will be assessed in order to **match local potentials** and plan synergies between WtE and DHC that will help to fulfil European targets.

ESTIMATED RESOURCES: 550,000 €

Activity III.2: Analysis of the economic and environmental benefits of District Energy from Waste

DESCRIPTION: District Energy from Waste is a long term investment. It is necessary to conduct a thorough cost-benefit analysis while investing in a concrete energy source, including heat from Waste-to-Energy. However, not much information is available due to commercial / confidentiality reasons. Therefore, it is important to conduct pilot studies and analyse the data obtained for different European regions.

TARGET GROUPS: local policy- and decision-makers, utilities

EXPECTED IMPACT: 10 representative **case studies** for each geographical region will be conducted; economic and environmental results from these examples will be showcased. The data will be then used to prepare **scenario assessments** for target cities with comparable characteristics interested in replication of the synergy between DHC and WtE.

ESTIMATED RESOURCES: 600,000 €

Activity III.3: EU research on Waste Heat Recovery

DESCRIPTION: Advanced Waste Heat Recovery options for DHC networks. Development and evaluation of advanced Waste Heat Recovery options for DHC systems. The goal is to develop and evaluate systems to convert waste heat into useful heat and / or refrigeration power and / or electricity from WtE plants and industrial processes close to the DHC network. Novel power and refrigeration cycles (e.g. multiple-level Organic Rankine Cycles, heat pumps, gas cycles, etc.) will be designed optimised for the full load operation as well as for off-design conditions (those demanded by the DHC network during time) in order to predict their performance at partial loads and determine the optimal control strategy. Such optimal strategy will include constraints such as those posed by the need to treat the waste produced in the area.

TARGET GROUPS: municipalities and authorities interested in a more sustainable, "smart" operation of the city.

EXPECTED IMPACT: fuel savings, reduction of CO_2 emissions and costs, reduction of pollutant emissions.
5 pilot projects to be developed based on optimised novel cycles designs for WtE plants as well as other interesting power plants / industrial processes.

ESTIMATED RESOURCES: 350,000 € over three years

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