CEWEP represents 390 of 440 Waste-to-Energy plants across Europe. (60 mt of EU capacity of 73 mt in 2010) They thermally treat household and comparable waste, which is not otherwise reused or recycled, and generate energy from it.

In 2009 across Europe they supply: 30 TWh electricity and 55 TWh of heat.
Topics for today

- Major drivers in EU policy on Waste & Energy
- Recovery status for WtE / Energy Efficiency
- Life Cycle Thinking and LCA for WtE
- WtE capacity development in EU
- Renewable Energy from Waste and its potential contribution to the EU binding targets on RE
Waste Hierarchy adopted by EU within the Waste Framework Directive

The 5 step waste hierarchy in the Waste Framework Directive helps to achieve sustainable waste management, placing prevention at the top and disposal (such as landfilling) as the least favoured option.
A large part of the EU27 waste is still wasted by putting it on landfills with negative effects on the environment.

But waste is a precious resource which should be utilised!
Treatment of MSW in the EU 27 in 2008

Source: EUROSTAT

“Bio-Recycling“ refers to biological treatment including composting, MBT and anaerobic digestion.
Diversion of biodegradable waste from landfills - the EU targets and country status in 2006

Landfilling of biodegradable municipal waste in 2006, in % of 1995 levels

- **Germany**
- **Austria**
- **Denmark**
- **Estonia**
- **Sweden**
- **Belgium**
- **Luxembourg**
- **Slovakia**
- **Netherlands**
- **France**
- **Finland**
- **Italy**
- **Spain**
- **Hungary**
- **Slovenia**
- **Portugal**
- **Lithuania**
- **United Kingdom**
- **Latvia**
- **Romania**
- **Czech Republic**
- **Ireland**
- **Greece**
- **Poland**

- **Target 2006**
- **Target 2009**
- **Target 2016**

* country with derogation periods of up to 4 years to achieve the target
Waste to Energy in Europe
(Incineration with Energy Recovery of MSW and comparable waste)

- dominant route for the treatment of residual waste
- Fully proven and environmentally safe

- About 71 million tonnes of capacity in operation in 2009 supplying about 30 TWh of electricity (8 million households) and about 55 TWh of heat.

- about 50 % of this energy is classified as renewable

- represents a net CO₂ saving and avoids the use of fossil fuels elsewhere for energy production
Waste to Energy Cycle

- 65 million tonnes of remaining waste
- Thermally treated in Waste-to-Energy plants
- 26 billion kWh electricity
- SAVINGS
- 6 - 35 million tonnes of fossil fuels
- 65 billion kWh heat
- Supplying 12 million inhabitants
- Supplying 11 million inhabitants

Reference year 2007
Treatment of waste in a WtE plant is recovery if:

An existing plant meets efficiency factor $> 0.6$
New plant (from 2009) meets efficiency factor $> 0.65$

Energy efficiency formulae:

\[
\frac{\text{Energy produced} - (\text{Energy in added fuel} + \text{Energy import})}{0.97 \times (\text{Energy in the waste} + \text{Energy in added fuel})}
\]

Equivalency factor electricity production $\times 2.6$
Equivalency factor heat exported $\times 1.1$

* factor accounting for energy losses due to bottom ash and radiation
R1 formula and scope

\[
R1\text{-factor} = \frac{Ep - (Ef + Ei)}{0.97 \times (Ew + Ef)}
\]

**Scope:**

- ... incineration facilities dedicated to the processing of municipal solid waste

→ Formula does not apply to hazardous waste incinerators, nor to co-incinerators; probably also not to RDF plants

**Introduction:**
By end of 2010 in all member states
Heat vs Power production by WtE plants across EU relative to EU R1 Criterion

Based on data from majority of CEWEP WtE plants
Full 10 parameter LCA for avg WtE plant
Summary of Impact analysis
carried out for CEWEP 2009

Biogenic CO₂ →

Burden
Credits

Waste treatment
- biogenic CO₂

Waste treatment

heat export

electricity export

metal recovery
Net CO$_2$ emissions from modern WtE

A state-of-the art WtE plant saves CO$_2$ in the range of 100 to 350 kg CO$_2$ eq per tonne of waste processed *, depending on:

- Waste composition (% biogenic)
- Amount of heat and electricity supplied
- Country Energy substitution mix

If WtE replaces (poor) landfilling, then there would be additional savings of 200 to 800 kg CO$_2$ /tonne waste

* The more energy can be supplied as heat the higher the CO$_2$ savings
WtE Capacity Europe by end of 2008 is 71 m tonnes.
Average size of WtE plants varies from country to country.
WtE capacity growth in steps
(includes MSW & comparable & dedicated RDF/SRF incin plants)

European WtE Capacity development (mill. tonnes)
71 by end 2008 --> 80 by end 2011 --> 97 by end 2016
### Waste to Energy Capacity Development within Europe

<table>
<thead>
<tr>
<th>Country Groups</th>
<th>Likely developments Potential for expansion</th>
</tr>
</thead>
<tbody>
<tr>
<td>DE, NL, DK, SE, CH, A, BE</td>
<td>Recent extensions Demand and Capacity in balance or slight overcapacity emerging</td>
</tr>
<tr>
<td>FR, IT, ES, PT, IE</td>
<td>Market opportunities, but complications due to local policies &amp; preferences</td>
</tr>
<tr>
<td>UK, CZ, PL,</td>
<td>Major extension potential</td>
</tr>
<tr>
<td>GR, new entrants</td>
<td>Major potential, provided they can manage internally and with support from EU</td>
</tr>
</tbody>
</table>
EU 27 have ambitious targets for Renewable Energy overall 20% of consumption by 2020

The gap to close is about 1500 TWh of Renewable Energy (at a flat – zero growth - EU energy consumption level of 13700 TWh)
<table>
<thead>
<tr>
<th>Route</th>
<th>Current significance</th>
<th>Where in Europe?</th>
<th>Form of energy</th>
<th>Status of technology</th>
<th>Growth potent.</th>
</tr>
</thead>
<tbody>
<tr>
<td>WtE from residual MSW (incineration with energy recov)</td>
<td>OOOOOO</td>
<td>Throughout</td>
<td>Power, Heat</td>
<td>Mature</td>
<td>Yes, regional</td>
</tr>
<tr>
<td>Incineration of RDF, SRF derived from MSW and CDM in Cement kilns, power plants etc</td>
<td>OOO</td>
<td>DE, IT, AT, SE, ES, FI, UK</td>
<td>Power, Fuel replacer</td>
<td>mature / Being proven</td>
<td>regional</td>
</tr>
<tr>
<td>Anaerobic Digestion from source-separated organic MSW</td>
<td>O</td>
<td>IT, ES, BE, D, FR, UK</td>
<td>Biogas, Power</td>
<td>Proven / developing</td>
<td>yes</td>
</tr>
<tr>
<td>Anaerobic Digestion from Sorted organic fraction of MSW</td>
<td>O</td>
<td>IT, ES, FR</td>
<td>Biogas, Power</td>
<td>Proven / developing</td>
<td>regional</td>
</tr>
<tr>
<td>Incineration of Waste derived Biomass (e.g. wood)</td>
<td>OO</td>
<td>DE, NL, BE</td>
<td>Power subsidised</td>
<td>Proven</td>
<td>Yes, regional</td>
</tr>
<tr>
<td>Landfill Gas Extraction</td>
<td>OO</td>
<td>Throughout Western Eur</td>
<td>Power, biogas</td>
<td>Mature</td>
<td>Yes, regional</td>
</tr>
<tr>
<td>Gasification &amp; Pyrolysis</td>
<td>o</td>
<td>few</td>
<td>Power, Syngas</td>
<td>Developing</td>
<td>?</td>
</tr>
</tbody>
</table>
Renewable Energy 2006 from Waste (all routes) for Europe in total

Renewable Energy in 2006 in TWh
25 TWh Electricity & 31 TWh Heat

- AD
- SRF
- BEP
- LFG
- WtE

Heat
Electricity
Growth in Renewable *Electricity* from all routes for Europe in total
Growth of Renewable Heat from all routes for Europe in total
How much does Energy from Waste contribute to the EU 27 binding targets?

<table>
<thead>
<tr>
<th></th>
<th>2006</th>
<th>2020</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total EU 27 Energy consumption</td>
<td>13700 TWh</td>
<td>13700 TWh</td>
<td>If no growth in consumption !</td>
</tr>
<tr>
<td>Total EU 27 Renewable Energy</td>
<td>1258 TWh  (8,5 %)</td>
<td>2735 TWh Target 20 %:</td>
<td>The gap is about 1500 TWh</td>
</tr>
<tr>
<td>Renewable contribution from Waste EU 27</td>
<td>55 TWh</td>
<td>Between 90 – 151 TWh</td>
<td>Waste can potentially fill 95 from the gap of 1500 TWh</td>
</tr>
<tr>
<td>Share Energy from Waste of Total RE</td>
<td>4,4 %</td>
<td>Between 3,3 and 5,5 %</td>
<td>assuming Binding EU Targets are achieved !</td>
</tr>
</tbody>
</table>
RE from waste is by far the cheapest form of Renewable Electricity!

Price level of various sources of Renewable Electricity, average EU in €/MWh (incl Subsidies) 2007

Source: EREF report 2009;

* * Price level for WtE € 45 -65 €/ MWh. Only few % of WtE Electricity gets some Renew Subsidy

* For LFG avg Feed in Tariff in EU: 71 € (incl minor subsidy)
Thank you for your attention!

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