The renewable energy contribution from waste across Europe.

Jan Manders
Deputy President CEWEP

3rd December 2009
ISWA Dakofa Conference
CEWEP represents 380 of the 420 Waste-to-Energy plants across Europe.

They thermally treat household and comparable waste, which is not otherwise reused or recycled, and generate energy from it.

In 2007 across Europe they supply: electricity for 5 million households and heat for 4 million households.
Objectives of the Study

Demonstrate amount of Renewable Energy generated by various Waste Processing Routes across Europe (present and future potential)

Indicate contribution of Energy from Waste routes to the achievement of the EU Binding Renewable Energy Targets 2020 in the Renewable Energy Directive
A large part of the EU27 waste is still wasted by putting it on landfills!

But waste is a precious resource which should be utilised for raw materials and ENERGY!

Treatment of Municipal Solid Waste in the EU 27 in 2006
Source: EUROSTAT
Why Renewable Energy from Waste deserves the attention?

- RE from waste is a much **cheaper source** of RE than from most other RE sources (solar, wind, biomass)
- It is **readily available** from professional waste processing, although in volume it has its limitations
- It already makes a significant contribution to the Renewable Energy performance of various countries
- RE from waste contributes to achieving the 2020 RE binding targets across Europe
- It is a major **factor in avoided CO₂ emissions** due to professional waste processing
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)
Approach of study

- Consider years 2006, 2010 and 2020
- Estimate volumes of waste processed for these years
- Assume appropriate Renewable levels
- Calculate production levels of both electricity and heat for supply
- Construct data for 3 scenarios 2020: realistic, optimistic and potential

- For AD of separate biowaste and MSW sorted Biowaste
- For SRF and RDF (SRF) as fuel in cement kilns and power plants
- For Landfill Gas (LFG)
- For dedicated Biomass Energy Plants (BEP) (waste wood)
- For WtE thermally treating MSW and comparable waste incl dedicated RDF incineration plants.

- Agricultural waste, industrial food waste, sewage sludge and grown biomass NOT included in this study
## Recognition of energy from MSW and comparable waste as Renewable Energy

<table>
<thead>
<tr>
<th>Route</th>
<th>Source of waste</th>
<th>Abbr.</th>
<th>Form of energy</th>
<th>% of Energy as Renewable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incineration with Energy Recovery</td>
<td>Mixed residual waste</td>
<td>WtE</td>
<td>Steam -&gt; Electr. &amp; Heat</td>
<td>Av 50 Range 47-80</td>
</tr>
<tr>
<td>Landfill Gas</td>
<td>MSW or Mixed residual waste</td>
<td>LFG</td>
<td>Biogas -&gt; Electr. (and Heat)</td>
<td>100</td>
</tr>
<tr>
<td>Solid Recovered Fuel</td>
<td>Sorted fraction from MSW and CDW</td>
<td>SRF</td>
<td>Substituted Fuel in cement kilns, Power pl</td>
<td>Av 45 Range 30 -55</td>
</tr>
<tr>
<td>Anaerobic Digestion</td>
<td>Source separated biomass fraction or Sorted bio-fraction of MSW</td>
<td>AD</td>
<td>Biogas -&gt; Electr. &amp; Heat</td>
<td>100</td>
</tr>
<tr>
<td>Biomass Energy Plants incineration,gasification</td>
<td>Collected &amp; sorted waste wood</td>
<td>BEP</td>
<td>Steam -&gt; Electr. &amp; Heat</td>
<td>95 - 100</td>
</tr>
</tbody>
</table>
Renewable Energy 2006 from all sources for Europe in total

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

- AD: 4 TWh
- SRF: 1 TWh
- BEP: 1 TWh
- LFG: 8 TWh
- WtE: 25 TWh (13 TWh Electricity, 12 TWh Heat)

Legend:
- Heat
- Electricity
Growth in Renewable **Electricity** from all sources for Europe in total
Growth of Renewable Heat from all sources for Europe in total

![Graph showing growth of renewable heat sources in TWh for AD, SRF, BEP, LFG, and WtE categories with data for 2006, 2010, 2020 R, 2020 Opt, and 2020 Pot.]
## Anaerobic Digestion underlying assumptions

<table>
<thead>
<tr>
<th></th>
<th>units</th>
<th>2006</th>
<th>2010</th>
<th>2020 Real</th>
<th>2020 Pot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume of biowaste</td>
<td>kt</td>
<td>3900</td>
<td>5200</td>
<td>8000</td>
<td>10000</td>
</tr>
<tr>
<td>Renewable Electr Prod</td>
<td>TWh</td>
<td>0,78</td>
<td>1,04</td>
<td>1,6</td>
<td>2</td>
</tr>
<tr>
<td>Renewable Heat applied</td>
<td>TWh</td>
<td>0,5</td>
<td>0,6</td>
<td>0,8</td>
<td>1,2</td>
</tr>
</tbody>
</table>

Assumptions:
- Split in biowaste of 50 % source separated and 50 % from sorted MSW
- Generated Electricity is 200 kWh/ tonne biowaste
- Additionally heat can be applied as low T heat e.g. in greenhouses; potentially up to 150 kWh/t waste, but outlet is often not available.

Currently applications in ES, DE, AT, BE, DK, IT, NL, CH; sometimes in co-digestion with other biomass from agriculture. Major interest developing in UK.
Renewable Energy projection from AD across Europe

Projection of Renewable Energy from AD across Europe in TWh

- 2006
- 2010
- 2020 (Realistic)
- 2020 (Optimistic)
- 2020 (Potential)

- Electricity
- Heat
**Renewable Energy from SRF/ RDF**

- Material originating from sorting of Commercial & MSW
- SRF/RDF supposed to be 45 % biogenic (ERFO)
- Major outlets for SRF/RDF are
  - Cement kilns (heat)
  - Power plants (electricity)
  - Dedicated incineration plants (CHP) = WtE plant (data included in WtE overview)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement kilns</td>
<td>1800</td>
<td>2500</td>
<td>3500</td>
<td>5000</td>
<td>7000</td>
</tr>
<tr>
<td>Power Plants</td>
<td>1150</td>
<td>1500</td>
<td>3000</td>
<td>6500</td>
<td>13000</td>
</tr>
<tr>
<td>Dedicated WtE Plants</td>
<td>1000</td>
<td>7000</td>
<td>10000</td>
<td>12000</td>
<td>15000</td>
</tr>
</tbody>
</table>

This volume is included in WtE section
Renewable Energy projection from SFR (in cement kilns and power plants)
Exploitation of LFG for Energy Recovery has grown fast but is now leveling off. 85% is coming from the UK, IT, FR and DE.
Utilisation of LFG in the UK has been dominated by electricity and has been driven by support schemes.
Electricity from LFG in UK is now levelling off at 4.8 TWh
Assumptions on Energy from Landfill Gas Recovery across Europe

- In 2006 Electricity production from LFG was about 7 TWh
- Projections 2020 potential based on country by country analysis
- Energy from LFG in UK, IT, DE, FR, NL and similar countries will decline (reduction of waste being landfilled and exhaustion of existing landfill recovery operations)
- New Member States will focus on meeting Landfill Directive but reluctant to make investment for LFG conversion to electricity.
- Various obstacles will contribute to modest growth of LFG conversion in current “Landfill countries”:
  - lack of funding for additional conversion investment
  - Lacking grid capacity to transport generated power
  - Remote location does hamper exploitation of heat potential
Electricity from LFG in Europe not likely to grow.
Dedicated Biomass Energy plants (BEP) (incineration of waste wood)

- Now mainly restricted to DE, NL, SE, CH, BE
- Only viable when heavily subsidised
- Data difficult to verify.
- Limited growth potential

<table>
<thead>
<tr>
<th>2008 estimate</th>
<th>k tonnes</th>
<th>Electricity TWh</th>
<th>Heat TWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>1,2</td>
<td>1,2</td>
<td>-</td>
</tr>
<tr>
<td>NL</td>
<td>0,5</td>
<td>0,56</td>
<td>-</td>
</tr>
<tr>
<td>Sweden</td>
<td></td>
<td>0,38</td>
<td>1,48</td>
</tr>
<tr>
<td>Others</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
WtE: Waste Incineration with Energy Recovery
## Future assumptions WtE:
Waste-to-Energy volumes for scenarios

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>EU 27</td>
<td>60,0</td>
<td>72,2</td>
<td>97,2</td>
<td>119</td>
<td>130</td>
</tr>
<tr>
<td>CH, NO, CR</td>
<td>4,4</td>
<td>4,6</td>
<td>4,6</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>TOTAL</td>
<td>64,4</td>
<td>76,9</td>
<td>102</td>
<td>124</td>
<td>135</td>
</tr>
</tbody>
</table>

Volumes do include MSW, commercial waste & dedicated RDF incineration plants
Source: Estimates by CEWEP
WtE Energy output assumptions

Average energy output data per tonne of waste treated (for portfolio of existing and new plants)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Electricity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>production kWh/t waste</td>
<td>400</td>
<td>450</td>
<td>500</td>
<td>520</td>
<td>550</td>
</tr>
<tr>
<td><strong>Heat</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>supply kWh/t waste</td>
<td>760</td>
<td>850</td>
<td>820</td>
<td>740</td>
<td>900</td>
</tr>
</tbody>
</table>

Exploitation of heat potential

Total energy output (renewable & fossil)
The **Total** Energy Output projection for WtE

**Projection of Total Energy from WtE in TWh**

- **2006**: 20 TWh (Realistic), 20 TWh (Optimistic), 20 TWh (Potential)
- **2010**: 30 TWh (Realistic), 30 TWh (Optimistic), 30 TWh (Potential)
- **2020**: 60 TWh (Realistic), 60 TWh (Optimistic), 120 TWh (Potential)

Includes both renewable and fossil components.
Growth of Renewable Energy from WtE for the total of Europe

Projection of Renewable Electricity and Heat from WtE Europe (TWh)

- Potential
- Optimistic
- Realistic

Renewable Heat
Renewable Electricity

- 2006
- 2010
- 2020
Cost of RE from waste: in general lower than all other sources of RE, except large Hydropower

<table>
<thead>
<tr>
<th>Route</th>
<th>Cost of Renewable Electricity &amp; Heat</th>
<th>Financial support required for the investment?</th>
</tr>
</thead>
<tbody>
<tr>
<td>WtE</td>
<td>Very competitive,</td>
<td>No, provided realistic gate fees for waste</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Some, for maximisation of electrical efficiency, examples NL, IT</td>
</tr>
<tr>
<td>LFG</td>
<td>ok</td>
<td>Yes, see example of UK</td>
</tr>
<tr>
<td>SRF</td>
<td>ok</td>
<td>No, provided realistic gate fees</td>
</tr>
<tr>
<td>AD</td>
<td>Moderately high</td>
<td>Yes, requires some help to make it feasible</td>
</tr>
<tr>
<td>BEP</td>
<td>Moderately high</td>
<td>Yes, not feasible without substantial support</td>
</tr>
</tbody>
</table>
RE from waste is by far the cheapest form of Renewable Electricity!

* 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)
The Avoided CO$_2$ Emissions due to Energy Production from Waste are huge

Please note that these data exclude fossil emissions and therefore do not represent a full carbon footprint analysis for the various routes!
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</td>
<td>2735 TWh</td>
<td>The gap is about 1500 TWh</td>
</tr>
<tr>
<td>Renewable contribution from</td>
<td>55 TWh</td>
<td>Between</td>
<td>Waste can potentially fill 95 from the gap of 1500 TWh</td>
</tr>
<tr>
<td>Waste EU 27</td>
<td></td>
<td>90 – 151 TWh</td>
<td></td>
</tr>
<tr>
<td>Share Energy from Waste of</td>
<td>4,4 %</td>
<td>Between</td>
<td>assuming Binding EU Targets are achieved!</td>
</tr>
<tr>
<td>Total RE</td>
<td></td>
<td>3,3 and 5,5 %</td>
<td></td>
</tr>
</tbody>
</table>
In 2006 Renewable Energy from Waste origin amounts to about 24 TWh of electricity and 31 TWh of heat. This represents 4.4% of all RE produced in Europe.

This is likely to grow to 38 TWh and 52 TWh respectively by 2020, but has the potential to grow to 66 and 85 TWh.

Energy from Waste has the potential to fill 95% from the EU 27 RE gap of 1500 TWh!

Energy from Waste also has a significant contribution to make in avoiding CO₂ emissions.

Of the various sources WtE is by far the largest and has the most substantial growth potential, followed by SRF.
In 2006 Waste to Energy supplies a considerable amount of Renewable Energy: 38 TWh for the whole of Europe.

This will grow towards 2020 to a level of at least 66 TWh, and potentially to 98 TWh, through an increase of the amount of waste processed via WtE and by steady efficiency improvements (heat & electrical efficiency).

Countries which continue to make a significant contribution through WtE to their total Renewable Energy production are: NL, BE, DK, DE, SE.

Note that the total Energy output of WtE and SRF is twice the amount regarded as renewable!
Why should generation of RE from MSW and comparable waste get priority across Europe?

- It is a sustainable biomass source of RE, e.g. not competing with the food chain, although of limited supply.
- With the implementation of smart professional Waste Management Policies it will become available as “low hanging fruit” at relatively low cost.
- If we want to even get near to achieving the EU 27 binding targets, we cannot afford “to waste” this readily available source!
- It is a substantial contributor to avoiding CO₂ emissions.
Recommendations for maximisation of Renewable Energy from Waste across Europe?

**EU Policy Level**
- Promote classification as Renewable by all MS
- Promote that MS set up support schemes
- Speed up R1 status of WtE plants across Europe

**National Level**
- Attitude to learn from successful examples elsewhere e.g. SE, DK, DE, NL, Flanders, UK (LFG)
- Make RE from Waste a key element in National Waste Mgt Plans, in particular for new Member States
- Set up (modest) support schemes for RE from waste to overcome the hurdles
Thank you for your attention!

CEWEP
Confederation of European Waste-to-Energy Plants
Office in Brussels:
Boulevard Clovis 12A
B-1000 Brussels
BELGIUM

Tel.: +32 (0)2 770 63 11
Fax: +32 (0)2 770 68 14
e-mail: info@cewep.eu

www.cewep.eu

Jan.manders@efwc.nl
<table>
<thead>
<tr>
<th><strong>Key assumptions for 2020 scenarios EU 27</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>**</td>
</tr>
<tr>
<td><strong>MSW market</strong></td>
</tr>
<tr>
<td><strong>Landfill diversion of MSW in EU 27</strong></td>
</tr>
<tr>
<td><strong>Commercial Waste Market</strong></td>
</tr>
<tr>
<td><strong>Waste &amp; Energy Management Policies</strong></td>
</tr>
<tr>
<td><strong>Support schemes for Renewable Energy</strong></td>
</tr>
</tbody>
</table>