"Alternative ways for managing urban organic waste: Current practices and future trends"

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CYPRUS 2016
4th International Conference on Sustainable Solid Waste Management, Limassol, 23-25 June 2016
Outline

- Introduction
- Bio-economy as Part of Europe’s Growth Strategy
- Future Trends on Urban Organic Waste Valorization and Bio-based Products Perspective
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❖ Introduction


❖ Bio-economy as Part of Europe’s Growth Strategy

❖ Future Trends on Urban Organic Waste Valorization and Bio-based Products Perspective
Each year in the European Union:

- 7.3 billion tonnes of resources are consumed
- 2.7 billion tonnes of waste are generated,
- 40% is being re-used or recycled, the rest ends up at landfill or is partly incinerated.
If this quantity of waste was recycled then:

- the equivalent of **148 million** tonnes of CO\textsubscript{2} emissions could be avoided annually;

- Around **5.25 billion** euro would be saved from the recovery of recyclables such as paper, glass, plastics, aluminum and steel per year.

- **500,000 new jobs** at least would be created.
EU-27 physical trade balance with the rest of the world, 2011

Total trade from EU-27 to ROW
- in 1999: 397 million tonnes
- in 2008: 536 million tonnes
- in 2011: 568 million tonnes

Total trade from ROW to EU-27
- in 1999: 1,340 million tonnes
- in 2008: 1,798 million tonnes
- in 2011: 1,629 million tonnes

EU-27 exports (2011)
- Biomass (141 million tonnes)
- Manufactures (212 million tonnes)
- Fuels/mining products (215 million tonnes)

EU-27 imports (2011)
- Biomass (172 million tonnes)
- Manufactures (183 million tonnes)

Map of the European Union (EU-27) and Rest of the World (ROW).
Circular Economy

- Extraction of natural resources
- Eco-design of products
- Reuse, recycling, recovery
- Manufacturing
- Distribution
- Product use
- Waste collection
- Disposal
Why do we need to manage urban organic waste in a sustainable way?
Definition of Bio-waste

**Bio-waste** is defined as biodegradable garden and park waste, food and kitchen waste from households, restaurants, caterers and retail premises, and comparable waste from food processing plants. It does not include forestry or agricultural residues, manure, sewage sludge, or other biodegradable waste such as natural textiles, paper or processed wood. It also excludes those by-products of food production that never become waste.

**NOTE!** Bio-waste are a subset of biodegradable MSW which also include paper/paperboard and wood

<table>
<thead>
<tr>
<th>Description</th>
<th>EWC Code</th>
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</thead>
<tbody>
<tr>
<td>Biodegradable kitchen and canteen waste</td>
<td>20 01 08</td>
</tr>
<tr>
<td>Waste from markets</td>
<td>20 03 02</td>
</tr>
<tr>
<td>Biodegradable garden and park wastes</td>
<td>20 02 01</td>
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</tbody>
</table>
Legislation related to Bio-waste

Framework directive **2008/98/EC** on waste
- Reduction of the production of waste & management of waste (collection, transportation, treatment and disposal)
- Promoting separate collection of **biowaste**
- By **2020**: Recovery **MSW 50% w/w**

Directive **1999/31/EC** on the landfill of waste

Directive **2009/28/EC** on the promotion of RES from waste

Directive **2000/76/EC** regarding the incineration of waste


Directive **2008/1/EC** concerning integrated pollution prevention and control (IPPC)
Bio-waste Quantity in Europe

- **118 to 138 Mt** of bio-waste are generated in the EU every year;
- About **88 Mt** are municipal bio-waste;
- There is still **40% of bio-waste being landfilled** in the EU.
MSW composition by region

MSW composition by region, 2012*

<table>
<thead>
<tr>
<th>Region</th>
<th>Organic</th>
<th>Paper</th>
<th>Plastic</th>
<th>Glass and Metal</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>57%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>East Asia and Pacific</td>
<td>62%</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Latin America and Caribbean</td>
<td>54%</td>
<td></td>
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</tr>
<tr>
<td>Middle East and North Africa</td>
<td>61%</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Europe and Central Asia</td>
<td>47%</td>
<td></td>
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</tr>
</tbody>
</table>

Source: The World Bank, 2012
EU 27 MSW composition

Municipal Solid Waste composition EU 27

Source: Eurostat
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Main MSW Treatment Techniques

MSW Production

Source Separation
- Recyclables
- Bio-waste
  - Aerobic process (composting)
  - Anaerobic process (AD)
  - Bio-drying

MSW
- MBT (Mechanical Biological Treatment)
- Thermal treatment
Waste Treatment in the EU

EU-27, (kg per capita), 1995 - 2014 - Source: Eurostat
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Europe 2020:
Bio-economy as part of Europe’s growth strategy
Sustainable Bio-economy (1/2)

- A sustainable bio-economy may be built on the principle of resource efficiency, circular economy and minimum environmental impact;

This requires:

- The development of new value chains based on the development of sustainable biomass collection and supply systems with increased productivity, and improved utilisation of biomass feedstock, (while unlocking utilisation and valorisation of waste and lignocellulosic biomass;

- Bringing existing value chains to new levels, through optimised uses of feedstock and industrial sidestreams;

- Bringing technology to maturity through research and innovation, and through upgrading and building demonstration and flagship biorefineries.
The Strategic Innovation and Research Agenda, for Bio-based and Renewable Industries for the Development and Growth in Europe through (Bio-based-Industries joint undertaking (BBIJU) focuses on 5 value chains:

1. Production of advanced biofuels, bio-based chemicals and biomaterials from lignocellulosic feedstock;
2. Utilization of the full potential of forestry biomass;
3. The development of the next generation agro-based value chains through the improvement of agricultural production and the realization of new markets;
4. **The emergence of new value chains from (organic) waste;**
5. The production of integrated energy, pulp and chemicals biorefineries (sustainable bio-based materials and energy production).
BBI OVERALL STRATEGIC OBJECTIVES FOR 2020 AND 2030

➢ The BBI activities will guarantee a secure and sustainable supply of lignocellulosic biomass including organic waste (resources) for European bio-refineries;

➢ Resources to be increased to 15% of the total amount in 2020 (25% in 2030);

➢ 20% of the chemicals and materials production in Europe will be bio-based by 2020 and 30% by 2030.
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Waste to bio-based products perspective:
a dream or a realistic vision?

Ethanol Case Study
The Waste2bio project
The Waste2bio project

The project’s main objective is the development of an innovative method of producing bioethanol from Bio-waste via bioconversion through the following actions:

- The Design and operation of an innovative pilot plant for the production of bioethanol from dried bio-waste via bioconversion;

- The production of a final bio-based product (after the bioconversion process) which can be further used instead of fossil fuels as a biofuel or a bio-based chemical block for the production of alternative products.
200L Bioconversion facility

- Pre-Treatment Unit
- Main Bioreactor
- Boiler
- Control Panel
Existing waste to ethanol facilities

Perseo Project - Valenthia

**PERSEO Process**

- Organic Matter in MWS
  - Pretreatment
  - Thermochemical Treatment
  - Simultaneous Saccharification and Fermentation (SSF)
- Enzymes Yeasts
- Collaboration with: Novozymes Fermentis
- Distillation
- Dehydration
- Water
- S/L Separation Unit
- Lignin
- Cogeneration

99.5% Bioethanol
ETANOLIX Project
Using bioconversion process

**Type:** Demonstration plant.

**Status:** Pilot scale operation since 2015.

**Feedstock:** Organic food waste derived from food production companies.

**Products:** Ethanol.

**Capacity:** 15,000 - 21,000 tons.

**Productivity:** 5000 m³/year of ethanol based on the European standard EN 15376.
Existing waste to ethanol facilities
Enerkem Alberta Biofuels-Edmonton, Canada

Type: Commercial operation

Status: Operational

Technology: Thermochemical conversion

Feedstock: post-sorted municipal solid waste (after recycling).

Products: methanol, ethanol.

Capacity: 38 million liters.
Ethanol Value Chain
Ethanol Value Chain
Other Bio-based Materials that maybe produced from bio-waste
What are the main products that can be produced from petroleum and lignocellulosic biomass?
An Example of a Flow-Chart for Products from Petroleum-based Feedstocks
Analogous Model of a Bio-based Product Flowchart for Biomass Feedstocks
Conclusions

- There are large quantities of urban organic waste that need to be treated;
- Urban organic waste are difficult to handle due to the fact that they biodegrade rapidly thus, their value chain is negatively affected;
- At this stage, urban organic waste are mainly treated through aerobic processes to produce compost and through anaerobic process to produce biogas while landfilling is dominating;
- This resource can be used as a feedstock for the production of various bio-based chemical blocks, intermediates and final products substituting petroleum based feedstocks;
- Significant research and technology development is required in order to develop the appropriate value chains.
Thank you

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