Dutch waste management in a nutshell

Waste = Resource

Fabienne Goosens
Introducing myself...
Which topics are covered today?

Introduction

Part I and II: Energy from waste
- Municipal waste
- Organic waste

Part III: Recycling

Part IV: The future

Part V: Propositions
Why does waste exist?
What is waste?
Working definition of waste

Why does something become waste?
- Lost Utility?

→ but this is subjective, we live in a consumer society!
Working definition of waste

What is waste?

• Entropy?

→ Heterogeneous nature. But what about separate collection?
Working definition of waste

What is waste?

• Negative price?

  ➔ **Trend**: price towards zero due to overcapacity. The tariff for processing waste in the 90s was 80-120 €/ton, recent contracts have been signed at 45-80 €/ton, some are below cost price.

  ➔ **Trend**: recycling. The more you can earn from the products you make from waste, the more competitive your price in a tender
Working definition of waste

Conclusion:

• When the (perceived) utility of something is lost, it becomes waste.

   **Paradox #1**: in a consumer society, perceived utility becomes more important than the physical reality.

• The entropy of waste is in general higher than the product it came from. You need energy to separate or recycle it.

   **Paradox #2**: in E-waste the concentration of metals is higher than in any mine.

• In general waste has a negative price, although the current trend is towards zero. Profits from processing waste, market forces, and policy influence the price.

   **Paradox #3**: the waste industry works with ‘up-side-down’ factories.
Municipal waste: what is the composition?

Composition by mass

1%: stone rubble (Puin)
1%: electronic equipment
1%: wood
2%: metals
4%: textiles
4%: glass
12%: paper
20%: plastic
36%: organic material
19%: other material
Municipal waste: elementary composition?
What other types of waste are there?

**Organic waste**
- biowaste (GFT)
- wood (clippings)
- sludge
- grass
- manure
- food waste (VGI)

**Integral waste**
- municipal waste
- office waste
- imported waste
- bulky waste streams
- furniture, mattresses
- landfill waste

**Separated streams**
- Refuse Derived Fuel (RDF)
- Torch & Tunka
- Organic wet fraction (ONF separated from integral waste)
- Others like paper, plastics, E-waste, diapers

Most will be (briefly) covered in this lecture!
How is waste collected in NL?
What policies in the Netherlands?

Policies

European tenders

1. VANG (van afval naar grondstof): from waste to resource
2. Standard based on efficiency: R1-status of incineration facilities
3. Standards based on Ladder of Lansink (LAP2)

Energy Efficiency = \frac{(E_p - (E_i + E_f))}{(0.97 \times (E_w + E_i))} > 0.7

In which:
- \(E_p\): The annual energy produced as heat or electricity. It is calculated with energy in the form of electricity being multiplied by 2.6 and heat produced for commercial use multiplied by 1.1 (GJ/year)
- \(E_i\): The annual energy input to the system from fuel contributing to the production of steam (GJ/year)
- \(E_f\): The annual energy imported excluding \(E_w\) and \(E_1\) (GJ/year)
- \(E_w\): The annual energy contained in the treated waste calculated using the net calorific value of the waste (GJ/year)
- 0.97: The factor accounting for energy losses due to bottom ash and radiation
What collection systems in NL?

Collection system:
• Chosen by municipalities

Trends
• Recycling, circular economy, “grondstoffenrotonde”
  • Diftar: differentiated tariffs
  • Separate collection of plastics booming
  • Green deals with government

From 2015: municipalities also responsible for sorting plastics
Why so much diversity in collection systems?

Left: Urbanisation
Right: Percentage of waste separated (2011)
Part I: Energy from municipal waste
Waste to energy plants in the Netherlands

- Amsterdam/AEB
- Moerdijk/Attero
- Alkmaar/HVC
- Rotterdam/vGG
- Dordrecht/HVC
- Weurt/ARN
- Duiven/vGG
- Harlingen/Omri
- Delfzijl/Eon
- Hengelo/Twence
- Roosendaal/Sita
Location Moerdijk: waste to energy plant and composting plant
Waste to energy plant Moerdijk

1. waste reception
2. waste bunker
3. incineration
4. electro filter
5. acid flue gas scrubber
6. bag filter
7. measurement flue gas
8. steam drum
9/10. turbine / generator
11. elektricity network
Waste to energy plant Moerdijk

• Movie
Location Wijster: separation plant, waste to energy plant, compost plant, digestion plants, landfill, gas treatment plant, bio-LNG plant.
Waste to energy plant Wijster

1 waste reception
2 waste bunker
3 drum screen
4 film grabber
5 infrared detector
6 plastic foil
7 plastic packaging
8 organic wet fraction (ONF)
9 drum screen
10 bunker
11 incineration
12 removal NOx
13 electro filter
14 turbine-generator
15 spray drier
16 dosage activated carbon
17 bag filter
18 acid and neutral scrubber
19 measurement flue gas
20 air cooled condensor
21 digester
22 biogas treatment plant
23 energy transition park Midden Drenthe
Summary: Energy from municipal waste

- Municipal waste is converted to energy at waste-to-energy plants.
- The plants produce 1132 GWh of electricity and 30 ton/h of heat.

Diagram showing the flow of energy from waste to electricity and heat.
Developments in Wijster

To improve R1 status from 0.7 to >0.87: several projects

- 7 bar steam: provide to energy transition park
- Exhaust steam: provide energy to waste water plant
- Several projects in development

Supply of hot water to own water treatment

Supplying 30 tonnes of steam per hour to Noblesse
Part II: Energy from organic waste
...but first: a leap back in time

- Why collect organic waste?
How do you make compost?

Pre-treatment:
- size reduction
- separation
- removal iron

Digestion:
- selection of material
- anaerobic process
- biogas and digestate

Composting process:
- fill with organic material
- introduce air and humidity
- remove and clean air

Post-treatment:
- size screening
- mixing
- storage
- ripening

Supply organic waste

Tunnel composting

Hall composting
Why produce and use green gas?

• Movie plankgas, episode 4
http://www.youtube.com/watch?v=rnd6oho9R_M&noredirect=1
Attero is one of the largest producers of green gas in the Netherlands
How can you make energy from organic waste?

- Biological route: anaerobic digestion
- Thermal route
- What dictates which route to choose?
How can you clean biogas to form green gas?

- Removal of $\text{CO}_2$, $\text{SO}_2$, $\text{HCl}$ to bring on specifications of natural gas
- Scrubber with water or amines, or cryogenic separation
Summary: Energy from waste at Attero

- **municipal waste**
  - **Waste to energy plants**: 1132 GWh electricity, 30 ton/h heat

- **organic waste**
  - **Digesters**: 11.7 milj m³ Green gas, 23 GWh electricity
  - **Compost plants**: 14 GWh electricity
  - **(former) landfills**: 23 GWh electricity
Research & business development: gasmotor Schinnen

- Why innovative? The gas motor is able to run on 1.5% methane
Research & business development: Bio-LNG plant Wijster

Bio-LNG plant in Wijster which also produces liquid CO₂
Research & business development: Biomass to energy plant (BEC) Odiliapeel

- Peka Kroef: potato factory
- BEC: biomass combustion provides steam
Part III: recycling of waste
Attero is market leader of separating plastic packaging from municipal waste in the Netherlands.
Why and how to separate plastic packaging?

- National obligation for municipalities since January 1, 2010
- Effectuation by separating at source or mechanical separation (Attero)
- Financial compensation only in case of material recycling (plastics -> plastics)

Near infrared technology scans waste on conveyor belt

• reflection of light gives information → plastics
• computer processes info and ejects plastics with air valves

Mix of films

PET PE PP PS
Why and how to separate plastic packaging?

- Movie: [http://www.youtube.com/watch?v=T7bNdjQsukw](http://www.youtube.com/watch?v=T7bNdjQsukw)

Near infrared technology scans waste on conveyor belt

- reflection of light gives information \(\rightarrow\) plastics
- computer processes info and ejects plastics with air valves

Mix of films
Research & business development: separation

Recently realised projects
• Refurbishment of line 11 in Wijster to recover more plastics
• Plastic sorting in Wijster

Projects in development
• Plastic separation plant in Moerdijk
• Separating beverage cartons from waste
• Separating glass from waste
• Washing and granulating sorted plastics
• Chemical recycling of sorted laminated PET
Research & business development: Washing and regranulation of plastics
## Products from recycling

<table>
<thead>
<tr>
<th>Products</th>
<th>Examples</th>
</tr>
</thead>
</table>
| **Plastics**                  | • foils
     • rigid plastics
     • synthetic grass fibers
     • fibers |
| **Textile**                   |                                                                        |
| **Biofuels**                  | • wood from gft
     • wood from prunings
     • paper/plastic mix
     • fluff |
| **Fuels**                     |                                                                        |
| **Granulate**                 | • construction material
     • chipboard
     • construction material
     • soil conditioner |
| **Wood**                      |                                                                        |
| **Sand**                      |                                                                        |
| **Compost**                   |                                                                        |
| **Metals**                    | • ferro and non ferro
     • road construction
     • industrial application
     • construction material |
| **Bottom ash**                |                                                                        |
| **Plaster**                   |                                                                        |
| **Inert material**            |                                                                        |

*Images of various products are shown for visual representation.*

**Notes:**
- Tunka ®
- Torch ®

*Images of Tunka ® and Torch ® are shown for visual representation.*
Products from recycling: amounts (2012)

- 287,000+ tonne compost
- 47,000 tonne biofuels
- 28,000 tonne wood
- 11,000 tonne plastics
- 50,000 tonne metals
- 195,000 tonne fuel
- 416,000 tonne bottom ash
- 191,000 tonne granulates
- 64,000 tonne sand
- 14,000 tonne plaster
- 1,000 tonne textile fibers

- 1,165 GWh electricity (consumption 711,000 people)
- 10.2 million m³ biogas (consumption 15,600 people)

Ambition: increase the amount of products recycled with 20% by 2015 (compared to 2011)
To summarise, our core activities are:

<table>
<thead>
<tr>
<th>Energy production</th>
<th>Bioconversion</th>
<th>Digestion</th>
<th>separation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 waste to energy plants</td>
<td>6 plants</td>
<td>7 plants 1 in option</td>
<td>4 plants</td>
</tr>
<tr>
<td>1 biomass plant (2015)</td>
<td>1800 kton</td>
<td>530 kton</td>
<td></td>
</tr>
<tr>
<td></td>
<td>436 kton</td>
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Attero processes the waste of over 6 million people
The activities take place at these locations...

**Incineration & separation**
- Moerdijk
- Wilp
- Spijk

**Composting & Digestion**
- Deurne
- Tilburg
- Venlo
- Maastricht

**Landfills**
- Wilp
- Twence (15%)

**Attero shareholder:** Twence (15%)
Which adds up to these figures (2013)…

- € 328 mln Net turnover
- € 108 mln EBITDA
- 11.7 mln m³ green gas
- 3.3 mln ton Waste processed
- 1,185 GWh Electricity production
- 793 fte
Part IV: the future of waste
Innovation: S-curves

• First mover advantage of innovation: 40% of the market share. Attero has 40% of waste incineration market
• Incineration matured from 1990s to 2013. Transition to next technology will come soon
### Attero: changing focus

<table>
<thead>
<tr>
<th>Period</th>
<th>Focus</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1931 - 1960</td>
<td>Organic waste</td>
<td>Compost production</td>
</tr>
<tr>
<td>1960 - 1980</td>
<td>Landfilling</td>
<td>Economic growth</td>
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<td>1981 - 1995</td>
<td>Separation</td>
<td>Re-use</td>
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<tr>
<td>1996 - 2009</td>
<td>Incineration</td>
<td>Waste to Energy</td>
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<td>2010 - now</td>
<td>Recovery</td>
<td>Resources</td>
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<td></td>
<td>Recycling</td>
<td>Sustainable energy</td>
</tr>
<tr>
<td></td>
<td>Upcycling</td>
<td>Secondary fuels</td>
</tr>
</tbody>
</table>
What is the future we can expect?

Increasing affluence in Africa, Asia, South America

Scarcity of energy and raw materials

From oil-based to biobased economy
Quest for alternatives

Value of materials in waste rises

Transition business model Attero

1. Turnover from products for the circular economy instead of gate fees
2. Producer of raw materials instead of waste processing (different paradigm!)
3. Focus on new partners that will be our new customers and participate in our new business model
Focus on growth in recycling and becoming chain manager: the facilitating party enabling complete recycling.

Attero 1.0  Attero 2.0  Attero 3.0

Hybrid Processing & Recycling  Complete Recycling  Complete Recycling & Chain manager
The development of Attero is based on...

- Green gas, electricity and heat, fibers, nutrients, etc.
- Ferro, Non ferro, green electricity, heat, plastic, glass etc.
Attero closes the loops

**Technical cycle**
- Product
- Consumption
- Raw material

**Biological cycle**
- Raw material
- Food
- Consumption

- Green gas, electricity and heat, fibers, nutrients, etc.
- Ferro, Non ferro, green electricity, heat, plastic, glass etc.
Research and business development: bottom ash

Co-operation with Inashco

Non-ferro

Co-operation with Elemetal

Copper

Ferro
Example research projects: Pure Copper Production

- Pure copper from bottom ash: pilot plant in Deurne
Bio-based economy and waste: value pyramid
Research & business development: bio-BTX

- Instead of syngas or methane: BTX production
- BTX = benzene, toluene, xylene
- Higher in value pyramid
- BTX formed preferentially over syngas
Research & business development: biobased plastics

- Bioplastics from organic waste in Venlo
- Bioplastics from toilet paper (zeefgoed)
Research & business development: Feed from organic waste

- Proteins from insects grown on organic waste
Is this future utopia or already developing?

- Blue Economy, biomimicry, permaculture, aquaponics, IE...
Questions?
Part V: Propositions
1. Taxing waste incineration would be...

A. ...a disaster to the waste management industry. Result: empty incinerators (waste will be exported), large losses for the waste incinerators in the Netherlands

B. ...the best opportunity to force the transition towards recycling of waste. Result: faster transition to sustainable waste system, more innovation
Propositions

2. Industrial Ecology...

A. Cannot thrive without waste, it needs it and derives its right of existence from it.

B. Needs to eliminate waste (or the concept of it). It is the only thing that stands in the way of true sustainable systems.
Propositions

3. The system of returnable deposits (statiegeld)

A. Should be stopped

B. Should continue or even be extended with small PET-bottles
Propositions

4. Waste management is...

A. Superfluous. We should work on restoring natural cycles. The current waste management system is the result of breaking crucial links with nature.

B. Crucial. We need manmade systems to take care of waste, and keep waste separate from nature to protect it.