Implications of New Waste Management Legislation in Finland

Jukka Salmela
Helsinki Region Environmental Services Authority, Waste Management
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Framework

- Key driving mechanisms for Waste Management:

  - Had to be implemented no later than 12.12.2010
  - Emphasis on prevention and energy utilisation

- **RES directive for renewable energy (2009/28/EC)**
  - ”20, 20, 20 by 2020”
  - Requires ”National renewable energy action plans”
  - Set’s ”National overall targets”
  - RES target for Finland is 38 %
National Implementation 1/2

The Waste Directive:

- **Waste management based on landfilling and composting**
  - Land use has set's no limitations (enough space!)
  - WTE has not been subvented by the state
  - Waste incineration; slow market entry due to complaints

- **→ Requires both a political and technological shift**

- **The New Waste Act (646/2011)**
  - Promotion of waste hierarchy
  - Limitation for biowaste landfilling
  - Increased waste tax (landfilled waste)
  - Target for MSW:
    - 50 % recycling
    - 30 % energy
National Implementation 2/2

RES Directive:

- Finland to increase RES share up to 38% by 2020 (28.5% by 2005)
- Action Plan 2010 (with focus on waste management)
- Increase RES production from 7,500 ktoe up to 10,700 ktoe
- Increase biogas utilisation by 0.7 TWh
- Promote CHP production instead of power generation
- Introduce a feed-in tariff for biogas

Law on electricity from RES (1396/2010)
- Guarantee price of 83.5 €/MWh
- Heat premium of 50.0 €/MWh if CHP efficiency > 75%

Graph showing:
- Market Price: 58 €
- Feed-In tariff: 25.50 €
- CHP Premium: 50 €
Implications on Waste Management

- Operators expect zero allowance on landfilling of biowaste in the future
- Waste incineration has/will become dominant in the treatment of MSW
- Treatment of biowaste will shift from composting towards anaerobic digestion
- Local CHP capacity is expected to be build >19 MW (by 2020) due to introduced subventions (LFG, biogas, syngas…)
- Investments on new technology become viable (f.ex waste heat recovery)
Utilisation of product gas / LFG

Figure by Kuittinen et. al. 2009
Utilisation of product gas / MWWTP

Figure by Kuittinen et. al. 2009
Utilisation of product gas / IWWTP

Figure by Kuittinen et al. 2009

- Green bar: utilised
- Red bar: flared

- Units: milj. m³
Utilisation of product gas / co-digestion

Figure by Kuitinen et. al. 2009
New Bioreactor landfill 13-50 ha
- 65 extraction wells
- 3 manifold stations
- ~ 4 000 m³/h (2015)

Old bioreactor landfill 50 ha
- Landfilled waste ~11 Mm³
- 220 extraction wells
- 4 booster stations
- 7 manifold stations
- ~ 9 000 m³/h

Conversion of Composting into Anaerobic Digestion
- Gas utilisation
- 700 m³/h (2013 -)
Case study

- Studies on best utilisation method 2001 - 2005
  - Gas production at highest between 2010-2015
  - Utilisation method has to be readily available!

- DH production:
  - Limited to heating season (Sept. – April)
  - Areal overproduction of DH
  - Low price for the gas

- Feed into NG network:
  - Very high investment & operation cost
  - Building of network connection
  - Possible shortages in gas generation!

- Upgrading into vehicle fuel:
  - 1000 trucks / 7000 cars (contract based)

→ OWN ONSITE CHP PRODUCTION!
CHP Production (before HR)

Power production  | MW  | 15.0
Efficiency (el)   | %   | 42.0
Efficiency CHP    | %   | 86.1 (theoretical)
Production 2010   | GWh | >100

Suitable for recovery using ORC
ORC-process (1,35 MWe)
Expected start-up 11 / 2011
CHP Production (after HR)

- 1,35 MW<sub>e</sub>
- 9 MW<sub>th</sub>
- 15 MW<sub>e</sub>
- Local DH network 7 MW<sub>th</sub>
- Leachate treatment
- Process heat
- Space heating

ORC-process

Low Temperature Thermal Oil Loop
High Temperature Thermal Oil Loop
Energy conversion (CHP)

CHP efficiency: 62.4%

Thermal & mechanical losses:
7,032 kW (18.9%)

Fuel power:
37,304 kW (100%)

Electricity:
15,064 kW (40.4%)

Lube oil:
1,868 kW (5.0%)

Engine cooling:
4,960 kW (13.3%)

Exhaust gases:
8,360 kW (22.4%)
Case summary

− Waste heat utilisation can potentially produce annually > 10 000 MWh electricity, hence covering the total electricity consumption within the studied site.

− If this ~ 10 GWh power production would replace similar production in a traditional condensing coal fired power plant, this would result an annual CO₂ reduction of nearly 8 500 tons.

− A brief economical analysis also gives positive result for the investment.
  − Estimated total investment 2 130 000 € (vat. 0%)
  − Average O&M cost of 0,007 €/MWh
  − Estimated plant availability 90 %
  − IRR 10 %
  − Payback time with electricity market price is 5,8 years
  − Payback time with feed-in tariff scheme is only 3,3 years
THANK YOU FOR YOUR ATTENTION!