Waste Management and Energy : Denmark Case Study

Mairead Kennedy Ramboll BioCleanTech Forum November 2016





Ramboll in brief

- Independent engineering and design consultancy and provider of management consultancy
- Founded 1945 in Denmark
- Over 13,000 experts
- Over 300 offices in 35 countries
- Significant presence in the Nordics, North America, the UK, Continental Europe, Middle East, Asia, Australia, South America and Sub-Saharan Africa

- EUR 1.1 billion revenue
- Owned by Ramboll Foundation
- Ramboll Energy World leaders in low carbon, district energy infrastructure and waste to energy
- At the forefront of developments in Danish district heating sector for over 40 years



- 1. History of Waste Incineration in Denmark
- 2. Waste Strategy
- 3. Impact of Strategy on District Heating
- 4. Challenges for Energy Recovery Facilities and District Energy



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115 years of Waste Incineration in Denmark





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115 years of Waste Incineration in Denmark: The Fuel Crises

- Denmark had to adopt a new energy policy
- New wave of waste-to-energy plants
- New tough regulations in 1986
- New energy policy in 1990:
 - Heat primarily to be produced in Combined Heat and Power plants
 - Existing plants to be converted to CHP
- 1997: Ban on landfilling of combustible waste





115 years of Waste Incineration in Denmark: Recent Developments

- EU Policy Conditions
- New plants to BAT
- Focus on Efficiency
- Market Saturation
- 25% of all district heating is from waste incineration
- 5% of electricity is from waste incineration









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Waste Policy Overview

Denmark became member in 1973

Since then growing environmental regulation including:

- Environmental regulation of landfills and incineration
- Recycling targets
- Producer responsibility





Waste Policy Overview: Waste Management Breakdown





2011: Roadmap to a resource efficient Europe

MILESTONES BY 2020:

- Waste is managed as a resource
- Waste generated per capita is in absolute decline
- Waste legislation is fully implemented
- Energy recovery (by waste-toenergy) is limited to non recyclable materials
- Landfilling is virtually eliminated
- High quality recycling is ensured





Circular Economy and Waste Hierarchy



- ERF important measure to ensure energy recovery from "last cascade" of recycling
- ERF important measure to ensure a safe sink for polluted materials
- ERF can ensure recovery of the small metal fractions



Hierarchy of Waste and Cost incentives

RECYCLING



- Pre-sorting and recycling
- "Free" entrance for households
- Gate fee for companies: 20-60 €/visit
- 20-30 waste types

WASTE TO ENERGY

Average fee 2011	\$/ ton	37%
Fee	42	
Тах	39	House
Gate fee	81	Comm



LANDFILL

Average fee 2011	\$/ ton
Fee	65
Тах	85
Gate fee	150



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Integration of Policy: Heat Act

- Initial Heat Supply Act
 - obligatory connection to DH or gas where available
 - Established the principle for co-generation
 - Established pricing principles
- Electric heating
 - 1979 Minister for energy empowered to ban electric heating in new buildings within a DH or gas network
 - 1988 ban enforced, extended to existing building conversion



Copenhagen district heating system



Still expanding, still innovating



SMART systems need smart operators



Balancing supply and demand

Merit order of production to minimise cost and carbon emissions

Energy and price forecasting to avoiding spilling and to maximise value of within NORDPOOL

Capturing, storing and dispatching "free heat"

Minimising heat losses though continuous optimisation



Prioritized heat production

Located in city suburbs

Built to toughest emission standards

Highest efficiencies through flue gas heat recovery

Designed for public acceptance through good architectural design

Good neighbors

Pathway to 2050

Increasing role for district heating

Waste incineration CHP and fossil fuel CHP continuing as predominant sources

Large scale program of conversion to biomass CHP

Increasing integration of heat pumps, solar thermal and wind into district heating systems

Phasing out of individual gas boilers and small gas engine CHP





Source: Heat Plan Denmark, Ramboll

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4. Challenges for Energy Recovery Facilities and District Energy



Challenges for ERFs

- Commercial and Financial Environment
 - High investment costs and long development timescales
 - Risk reward profile deters private sector and 3rd party investors
 - Immature supply chain drives up costs
 - Complex stakeholder arrangements
- Policy environment
 - No direct support for heat networks
 - Policy instability at national level
 - Local planning policy insufficient leverage
- Technical challenges
 - Retrofitting costs (building temperatures and heating systems)
 - Development density
 - Existing utilities and grid connection
 - Supply chain lacks capacity and knowhow
- Capacity and appetite to deliver
 - Internal resources, funds, relevant skills
 - Access to finance
 - Appetite for risk





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