

# Waste as a renewable energy source

-a success story



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# Tekniska Verken i Linköping

Public Multi-utility company

Vertically integrated through the whole value chain  
from waste collection to heat and power deliveries

Customers:	215,000
Employees:	984
Turnover:	€ 600 million
Profit:	€ 60 million
Owner:	The municipality



# 50 years of development

1954



1958



1964



1982



2005



2007



# The Swedish model

*“The overall aim is to hand over, to the next generation, a society in which the major environmental problems have been solved.”*

*The Swedish Parliament (Riksdagen) 1999 Unanimous decision*

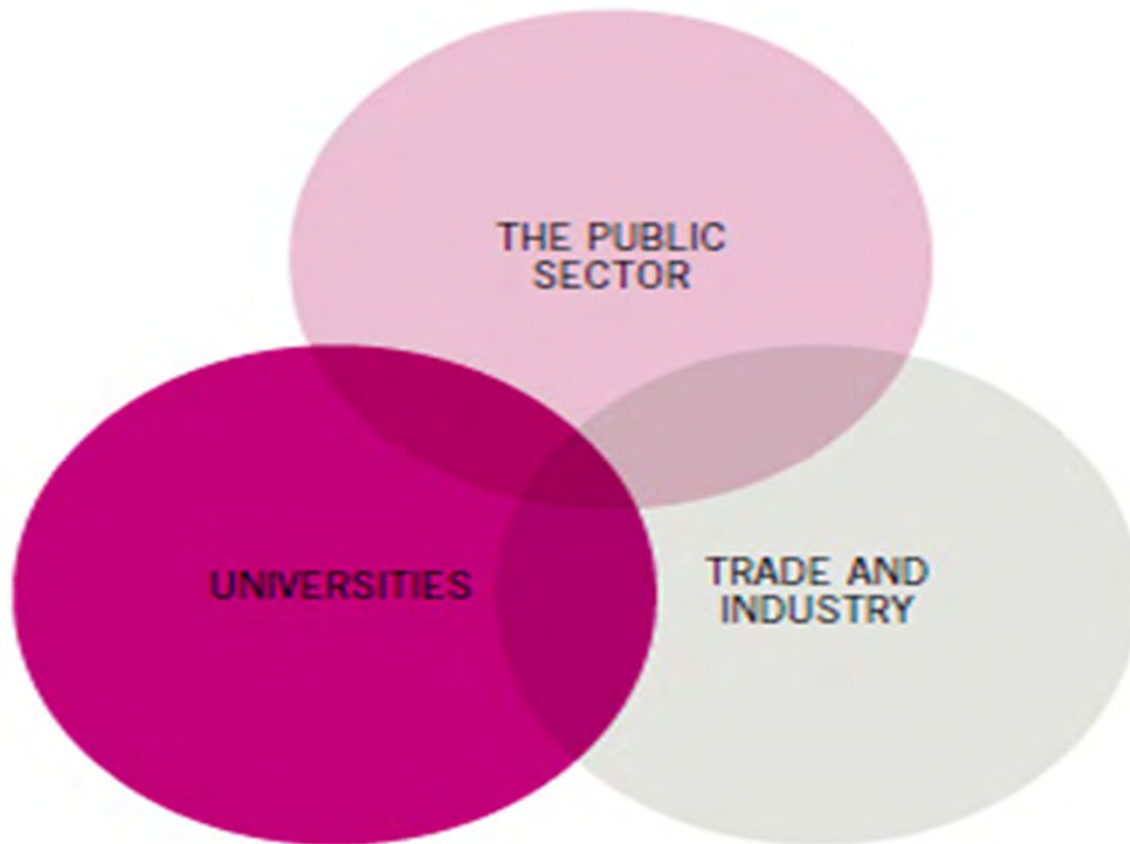
## **Sustainability**

- Waste hierarchy
- Systems perspective
- Best available technology

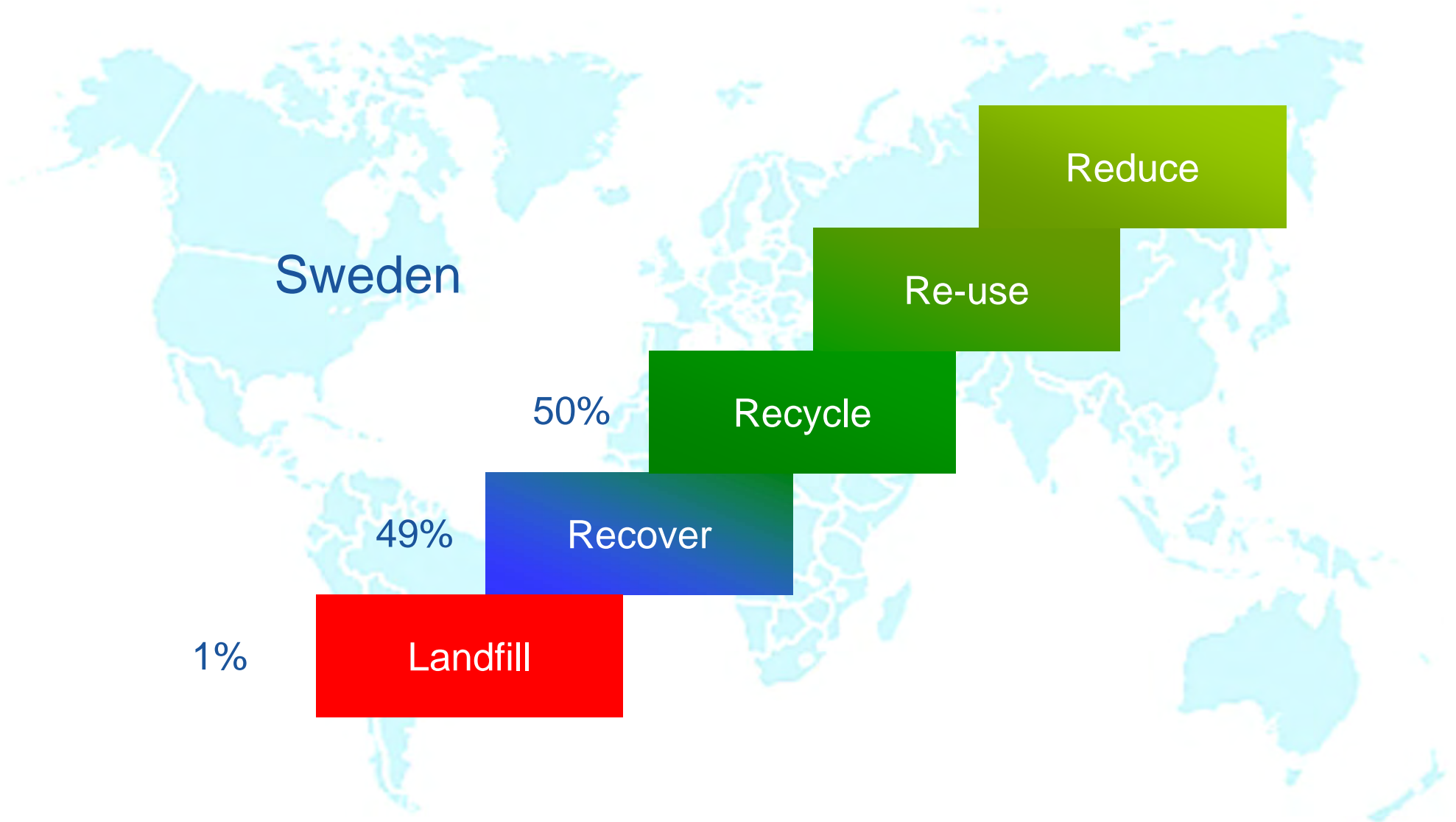
## **Instruments**

- Legislation
- Taxation
- Directives
- National targets

# Triple helix cooperation



# Climbing the waste hierarchy



# Waste as renewable fuel

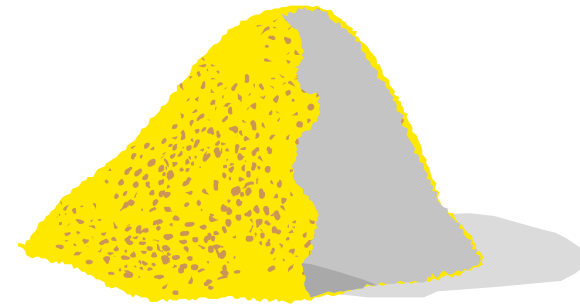


1 ton oil

=



1.6 tons coal/rubber waste



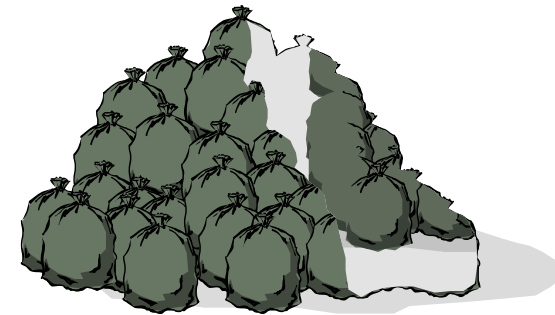
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4.5 tons wood chips/"grot"



= 2.5 tons wood waste

=



4 tons waste

Source: Bioenergihandboken

# Examples of inputs for biogas production

- **Waste from food industry**
- **Waste from slaughter house and meat industry**
- **Residuals from other industries**
- **Sludge from waste water treatment plant**

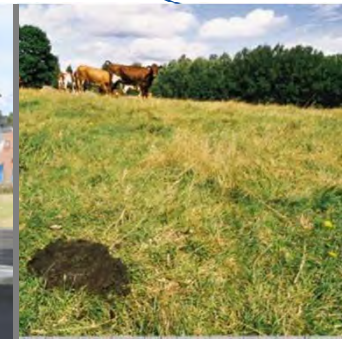
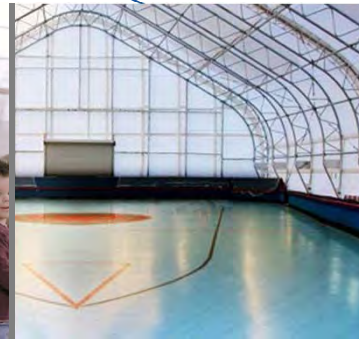
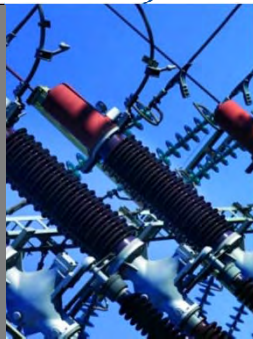


# Energy outputs

**Thermal treatment  
(incineration)**

**Biological treatment  
(digestion)**

**Waste**



**Electricity**

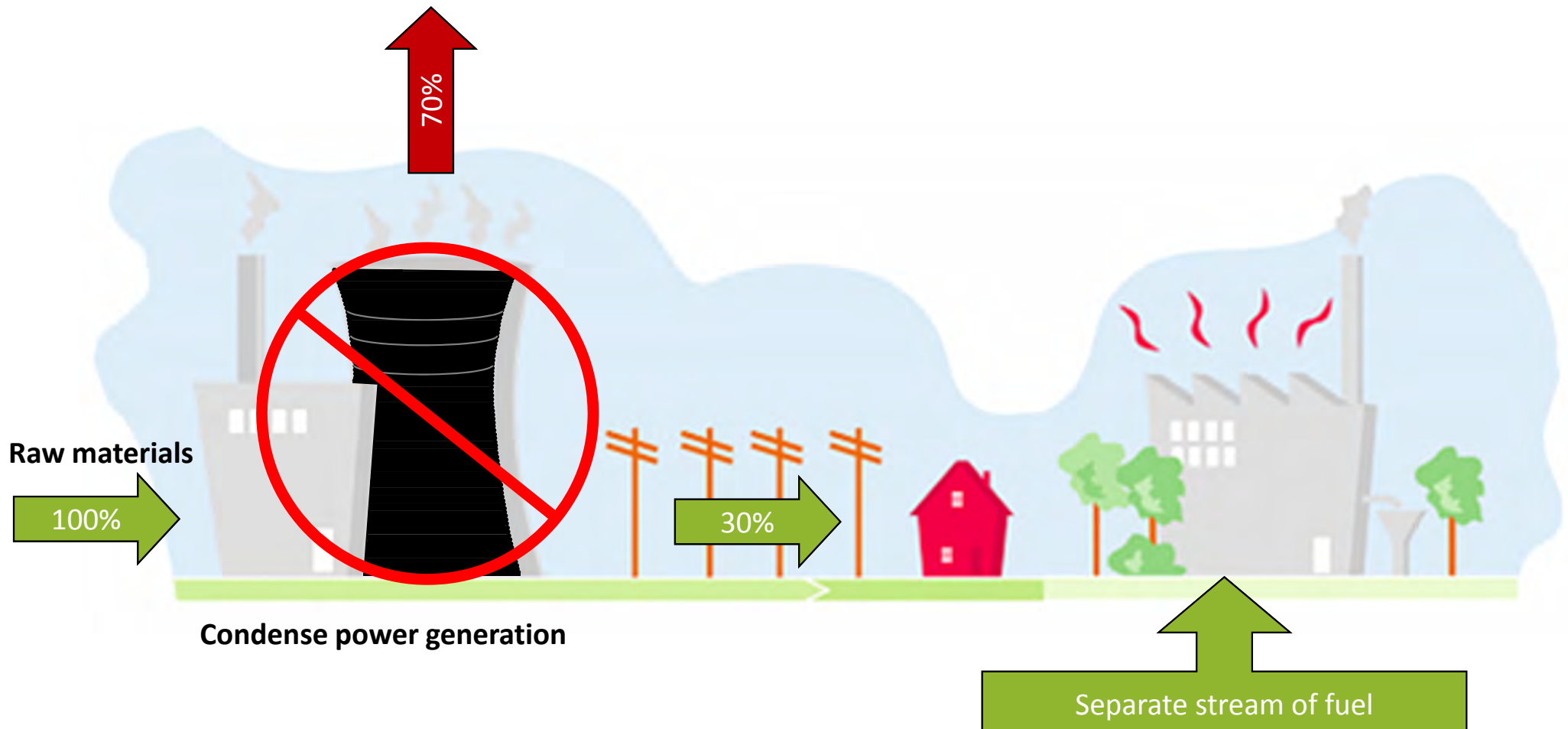
**District heating**

**District cooling**

**Biogas**

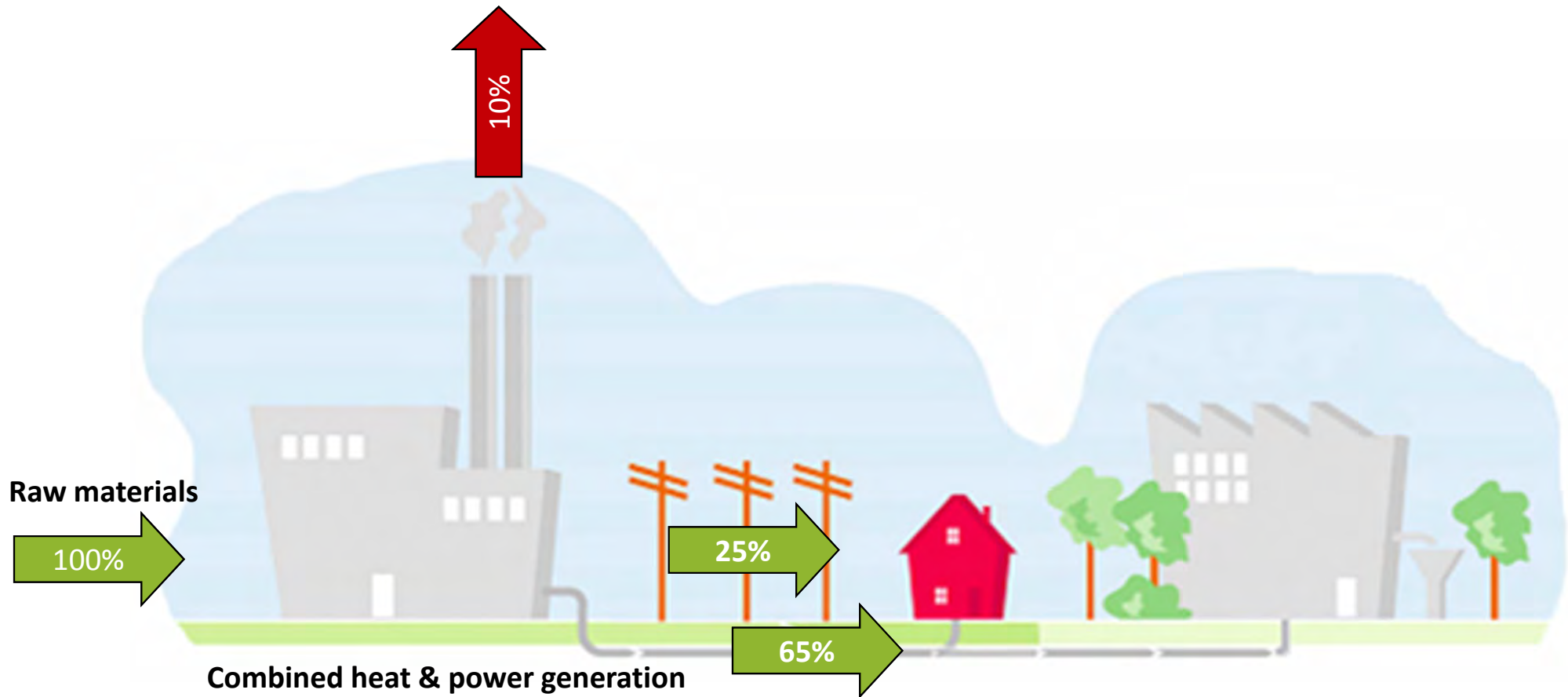
**Bio  
fertiliser**

# We can't afford to waste heat...



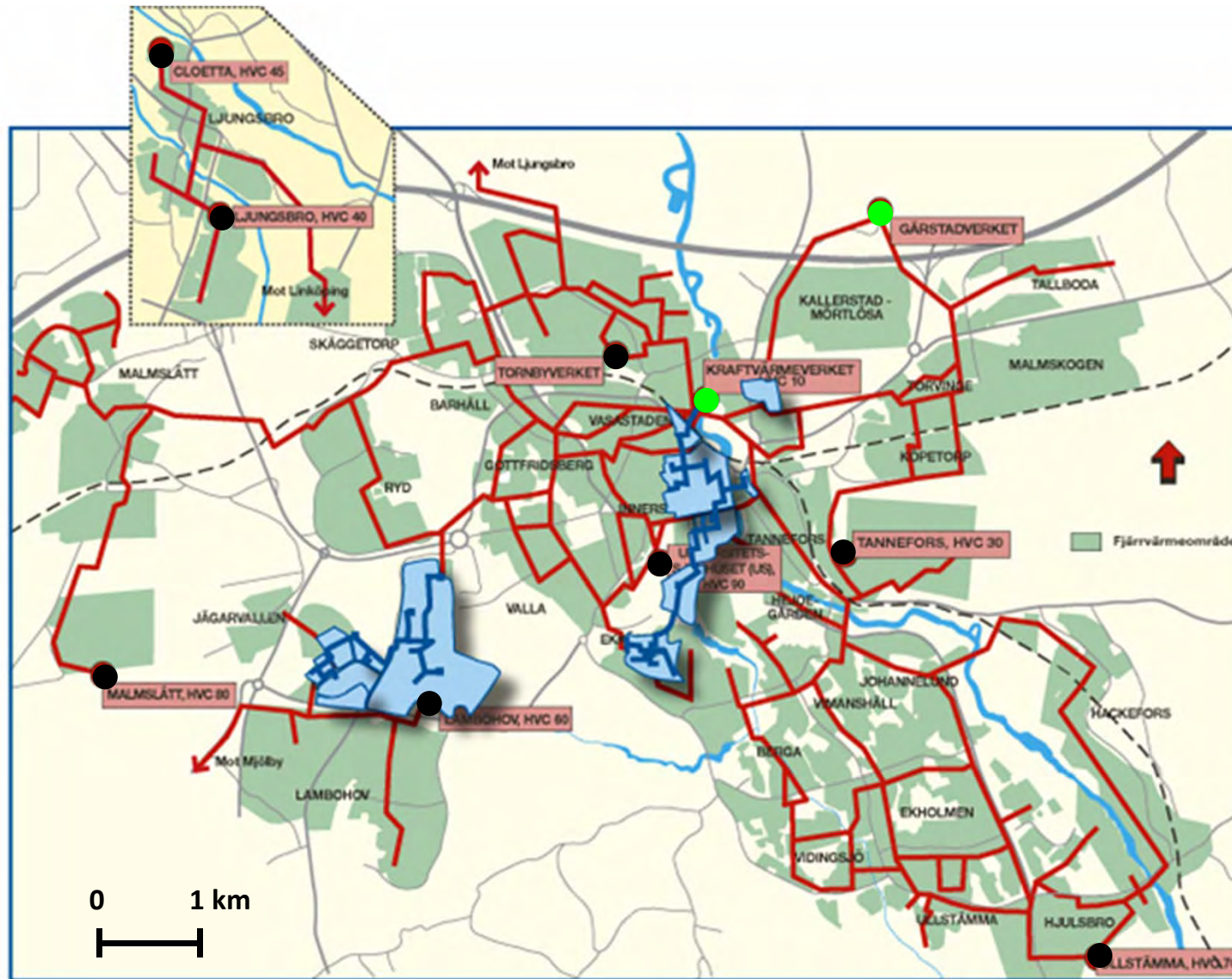
Source: The Swedish District Heating Association

# ...Efficient co-generation



Source: The Swedish District Heating Association

# Network for heating and cooling (500km)



- Base load plants; operational approx 8000h per year
- Peak load plants; operational only a few days per year

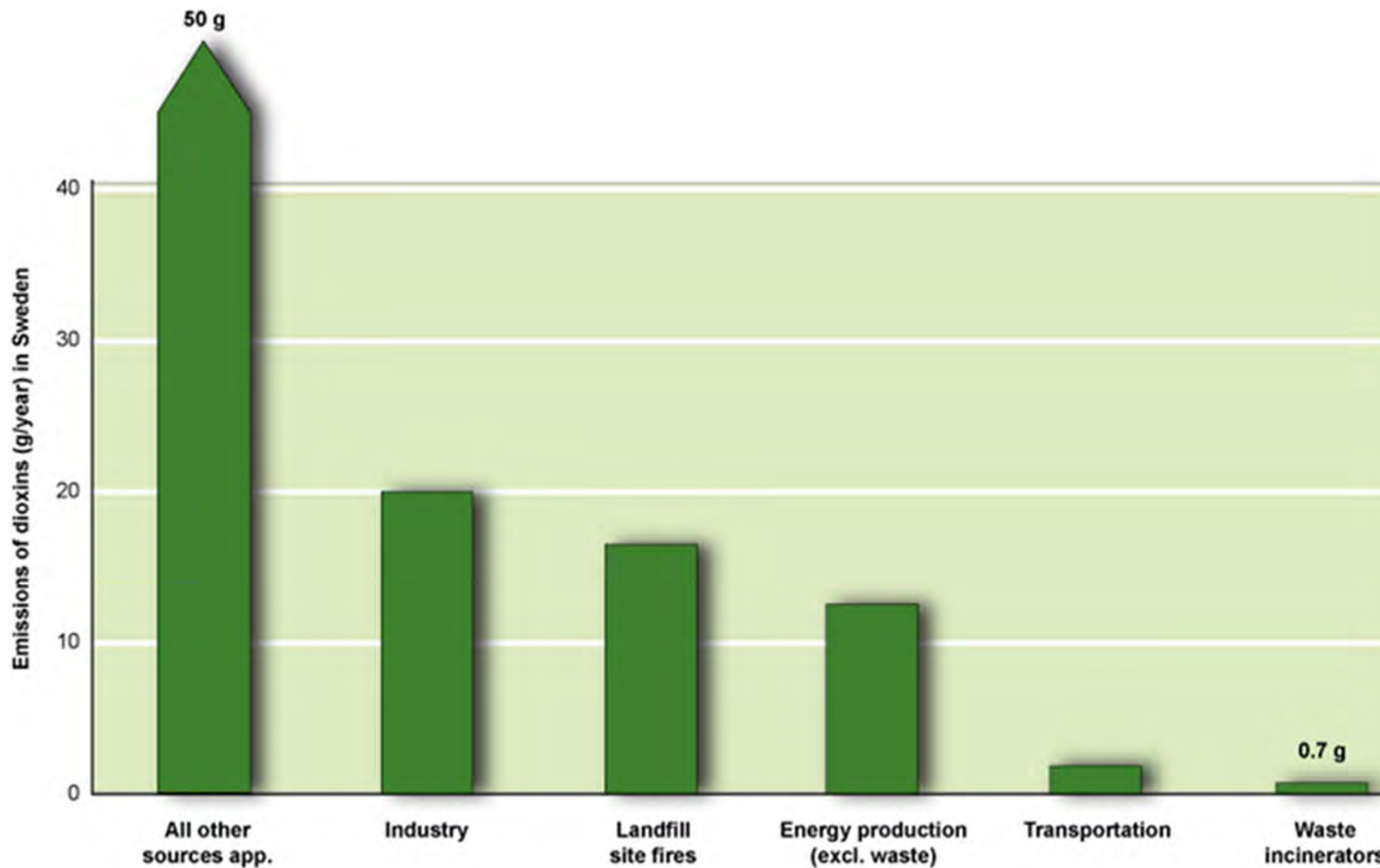
# Emissions from waste-to-energy

## -improvements

	1985	2008	Change
<b>Dust</b> tons/year	420	30	-92.9%
<b>Hydrogen chloride (HCl)</b> tons/year	8 400	39	-99.5%
<b>Sulphur dioxide (SO<sub>x</sub>)</b> tons/year	3 400	154	-95.5%
<b>Nitrogen oxide (NO<sub>x</sub>)</b> tons/year	3 400	2 190	-35.6%
<b>Mercury (Hg)</b> kg/year	3 300	44	-98.7%
<b>Cadmium (Cd)</b> kg/year	400	6	-98.5%
<b>Lead (Pb)</b> kg/year	25 000	136	-99.5%
<b>Dioxins</b> g/year	90	0,8	-99.1%
<b>Waste incinerated</b> tons/year	1 432 000	4 567 000	+320%
<b>Energy produced</b> MWh/year	2 800 000	13 724 000	+490%

Source: Avfall Sverige

# Emissions of dioxins in Sweden



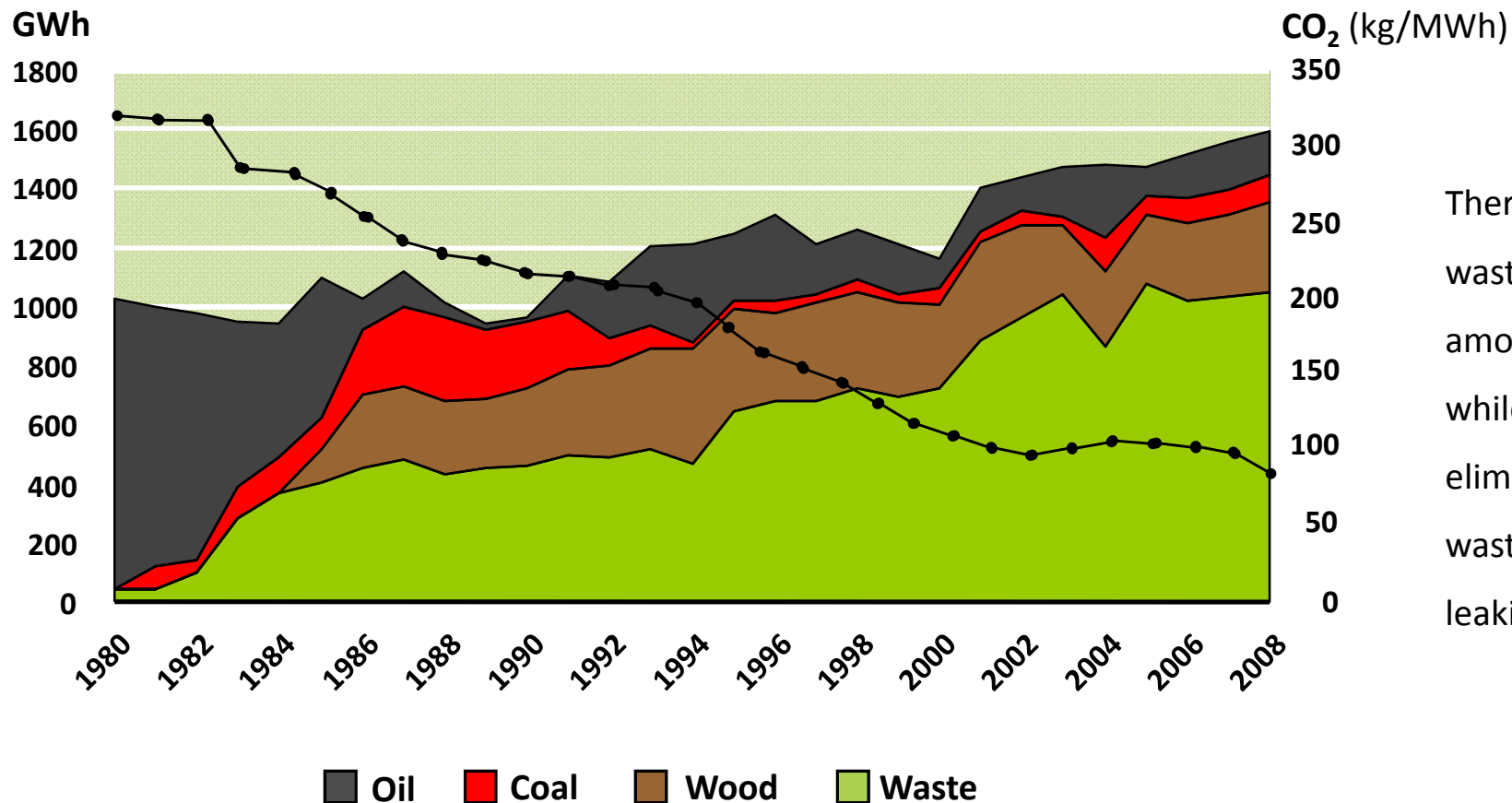
Source: RVF and the ÅF Group

# Biogas train - Amanda



# Replacement of fossil fuels for heat

– The municipality of Linköping, Sweden 1980-2008



Thermal treatment of waste replaces large amounts of fossil fuels while simultaneously eliminating growing waste mountains and leaking landfills

Thank you!

