

Zero Waste Society in Borås City, Sweden Strategies to Action.

Dr Hans Björk
School of Engineering
Director of Waste Recovery
University of Borås
Sweden

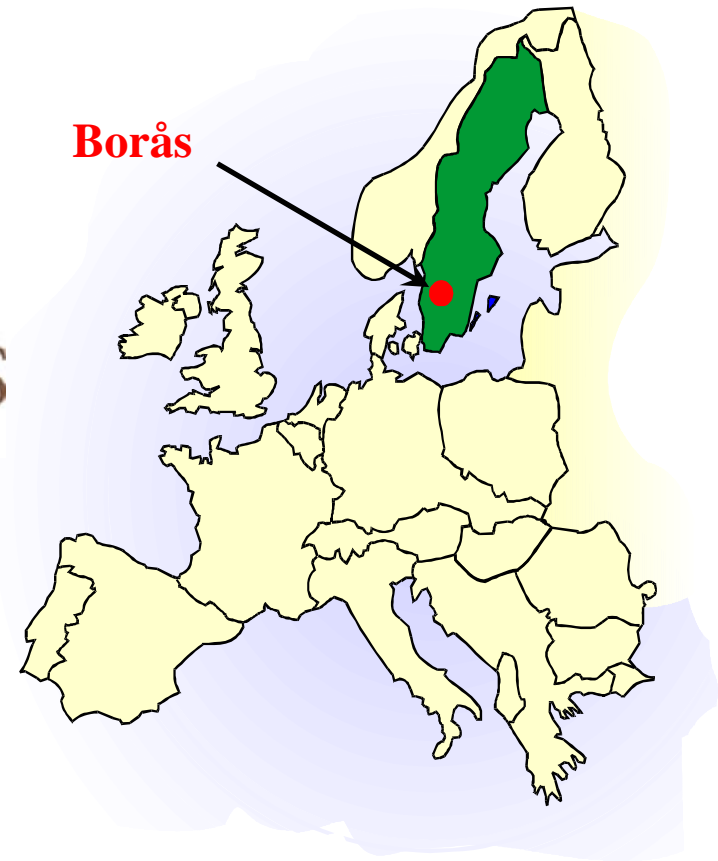




HÖGSKOLAN I BORÅS

VETENSKAP FÖR PROFESSION

- government university
- ~11,000 students (6000 full time)
- ~500 employees
- ~40 full professors
- ~20 Master programs
- ~130 PhD students



Borås

105,000 inhabitants



Closing the loops

BORAS, SUÉCIA

A CIDADE CAMPEÃ DA LIMPEZA...

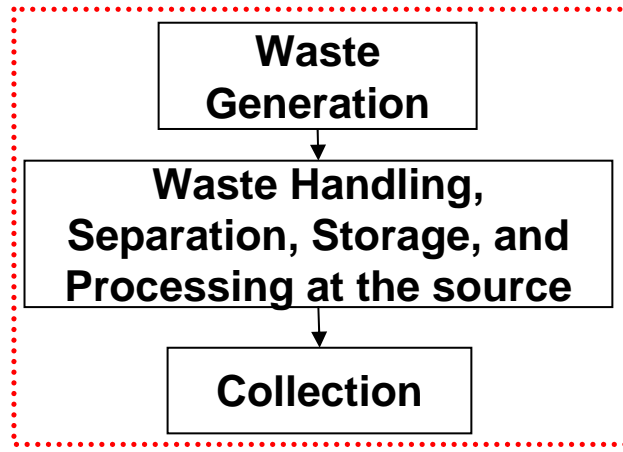
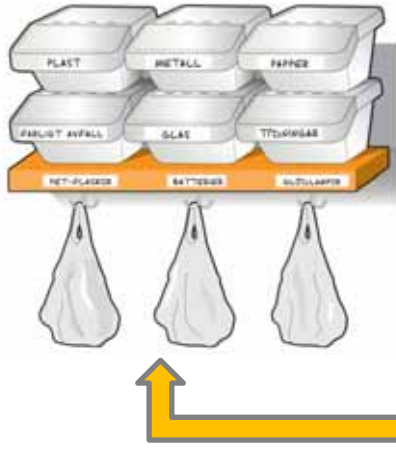
O município reaproveita 99% de tudo o que joga fora e ganha tanto com isso que já está importando lixo da Noruega, para poder gerar mais energia

MARCELO SPERANDIO

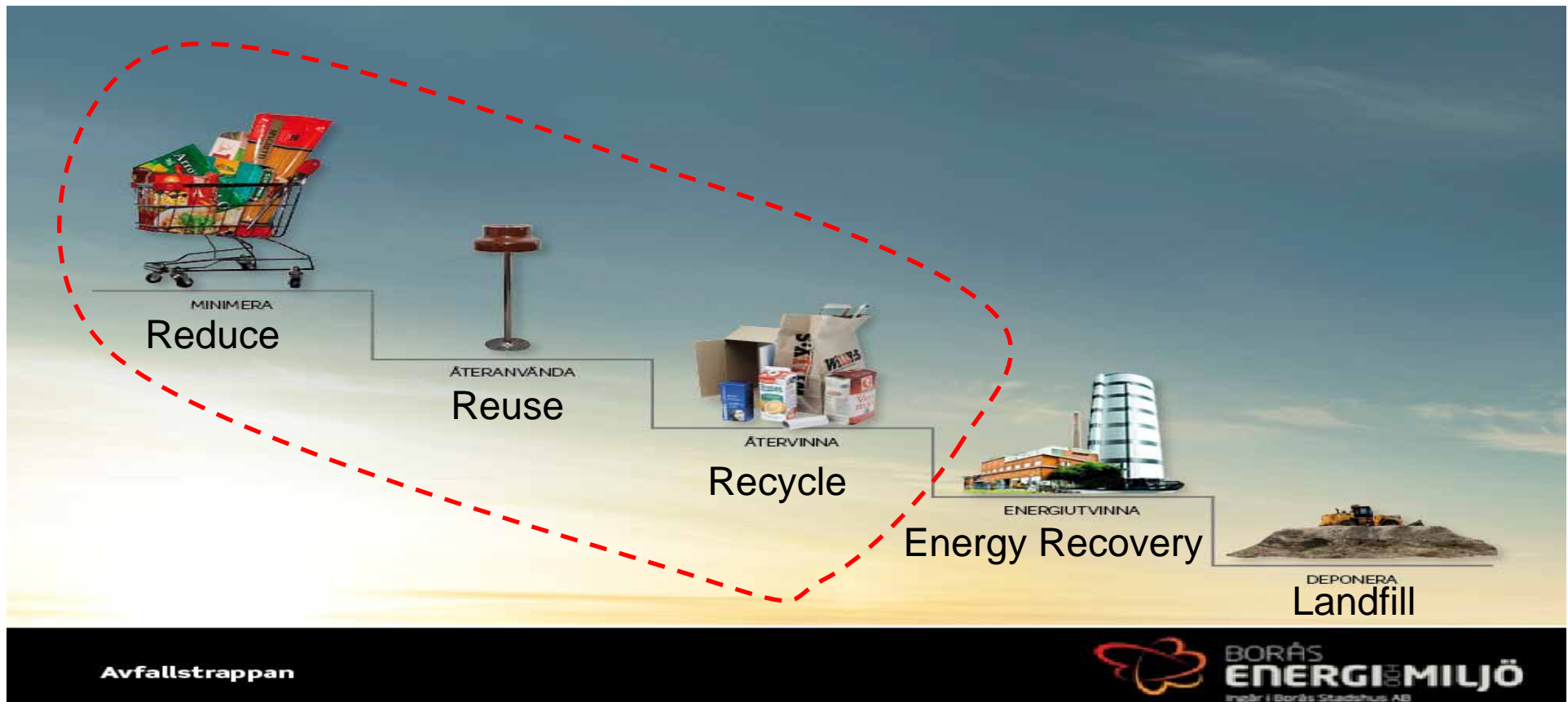
A cidade de Borås, na Suécia, tem 105 000 habitantes, 1 300 indústrias e nem 1 grama de lixo. Seus resíduos têm três destinos: 42% são incinerados e convertidos em energia elétrica, 30% são tratados biologicamente e transformados em biocombustível e 27% são reciclados. A reciclagem é feita inteiramente pela população, que se encarrega de separar e levar o material até os postos de coleta espalhados por toda a cidade. Caminhões recolhem o lixo orgânico (em sacos pretos, destinados à obtenção de biogás em usina inteiramente automatizada) e o resto (em sacos brancos, incinerados em fornos não poluentes). Menos de 1% do lixo é enterrado, porque o imposto para usar aterro é muito alto. O modelo foi iniciado em 1988, com 300 famílias, e é exportado — a universidade local presta assessoria de reaproveitamento de lixo a cidades no mundo inteiro, brasileiras, inclusive (Macaé, no Rio de Janeiro, e Sobral, no Ceará). Localmente, a experiência deu tão certo que falta lixo: o município hoje importa detritos da Noruega para gerar mais energia limpa. E o esforço continua. O diretor da escola de engenharia da Universidade de Borås, Hans Björk, diz: “Depois do lixo zero, nosso investimento agora é na eliminação total dos combustíveis fósseis”.

BRANCO MAIS BRANCO
Inverno limpo: até a incineração do lixo inaproveitável se transforma em energia usada em aquecimento

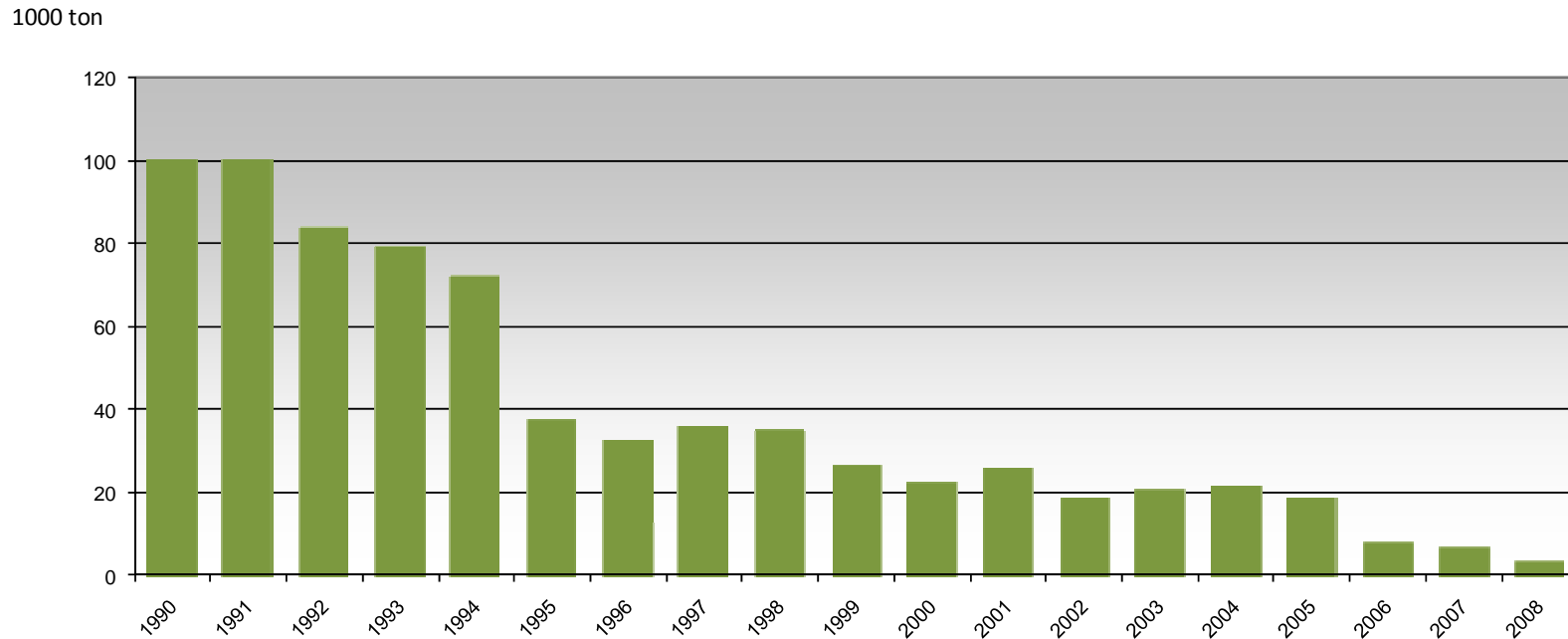
Ref.BEM brochure



Ref.BEM brochure



Landfill reduction in Borås, From 1992 presented at RIO + 20



Today

Landfilling

~0 %

Recycling

27 %

Biological treatment

30 %

Incineration

43 %

Long development toward zero waste in Borås

- The first planning of biogas plant 1940
- Investigation and planning 1986
- **Start of source sorting in 3000 households** 1988
- **10-years planning 1989-2000** 1989
- **Full scale sorting with optical sorting system** 1991
- Anaerobic digestion and composting 1995
- Interim storage of hazardous waste 1998
- First collecting vehicle run with gas 2002
- Waste plan 2001 - 2010 2003
- First public gas station opened 2003
- **New digester ready** 2003
- **New incineration plant ready** 2004
- First bus inside the city run on biogas 2004
- 39 buses inside the city run on biogas 2008
- A second new gas station for private cars 2009
- **All 59 buses inside the city run on biogas** 2010
- A third new gas station for private cars 2011
- **Planning for a new energy complex** 2011

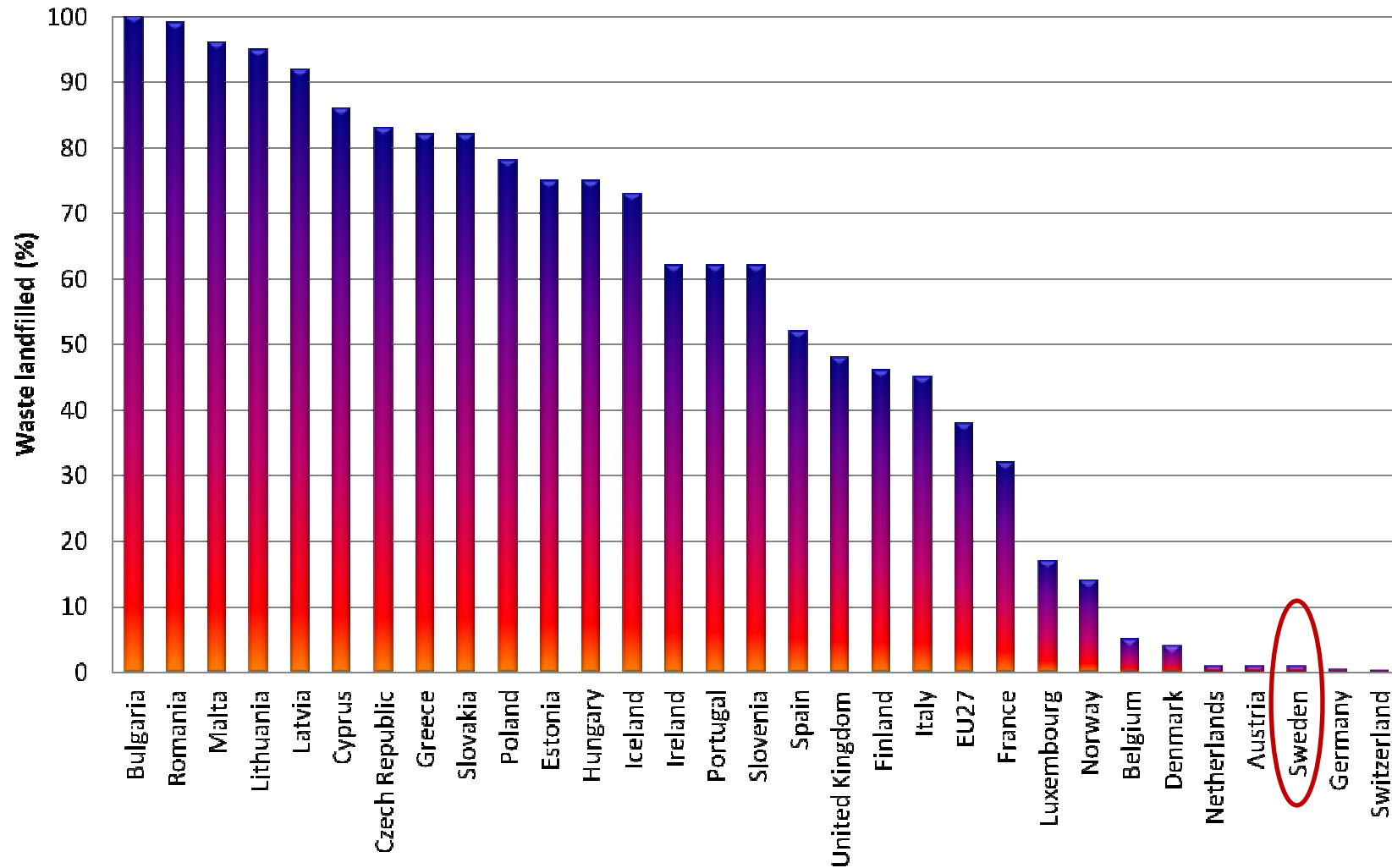


Waste planning is like doing a puzzle

Waste planing is like doing a jig-saw



Municipal waste landfilling in Europe (2010)



Drivers for the waste management in Europe & Sweden

1991	Municipal waste treatment plan
1994	Producer responsibility
1998	The local investment program (LIP)
2000	Landfilling tax (~ 27 EUR/tonne)
2002	Landfill ban on combustible waste
2005	Landfill ban extended to include all organic waste
2006	Landfill tax increased for the 3rd time (~ 47 EUR/tonne)
2006	Incineration tax (~ 8 - 47 EUR/tonne)



BORÅS

ENERGY AND
ENVIRONMENT

A subsidiary of Borås Stadshus AB



BORÅS ENERGI & MILJÖ

- District heating
- District cooling
- Biogas
- Hydropower
- Waste management
- Drinking water production
- Waste water cleaning
- Producer of Electricity
- Services within waste management and effective energy use

SOBACKEN

Waste management plant



Recycling of ~30 fractions

Waste collecting methods

Waste from residential and commercial buildings in Borås and surroundings

- Approximately 125 000 inhabitants. Total amount 420 kg/person
- 4 methods – a complete solution towards our dream



48.500 households
–Waste separation
at home



80 Recycling
stations



5 Recycling
centers



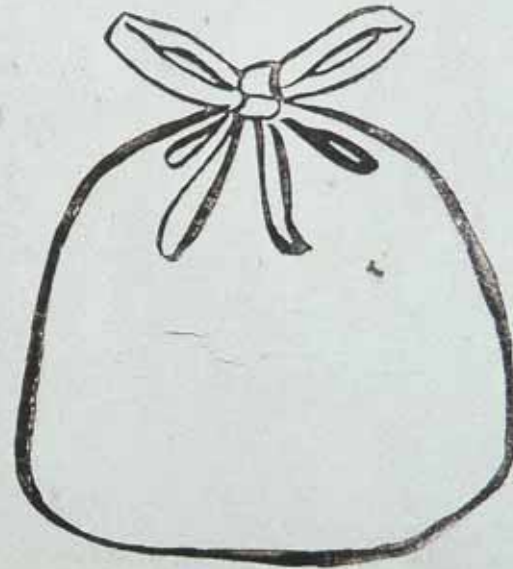
800 Containers
for delivery

At HOME

komposterbart avfall



övrigt avfall





Households In Borås: Source-separation in black and white bags

Combustible
wastes ←



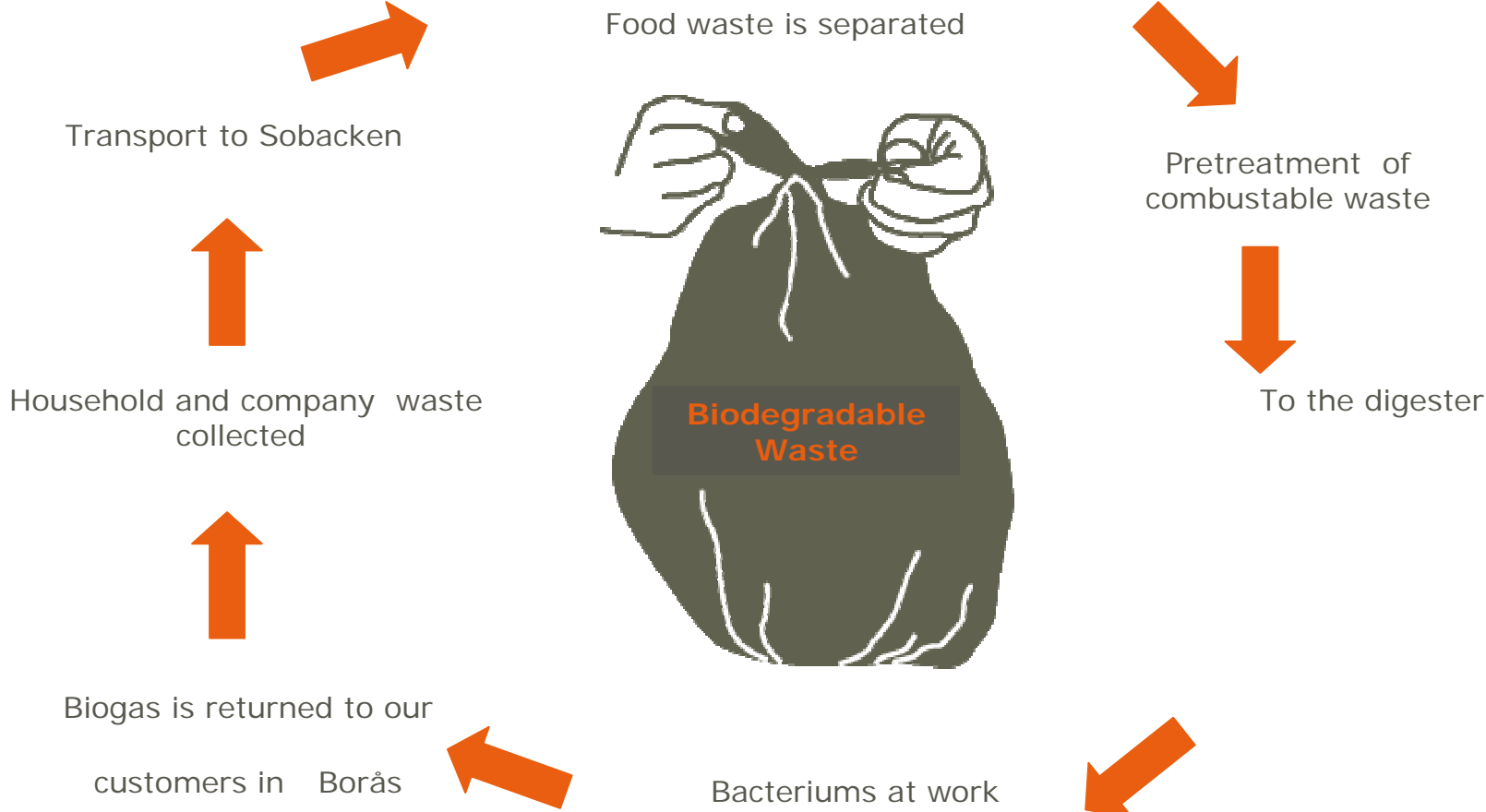
Organic wastes
(food wastes, etc.) ←



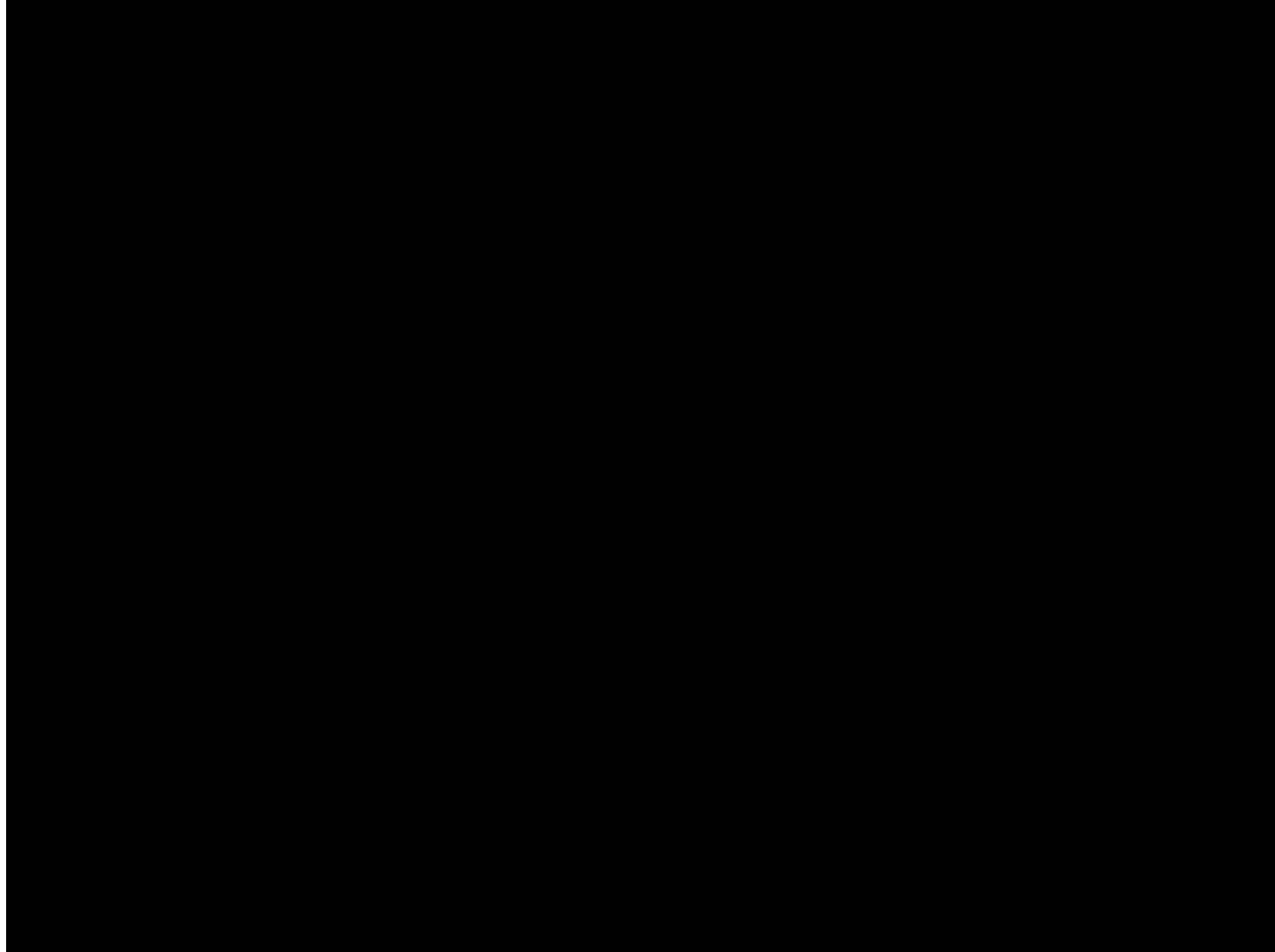
Burnable waste becomes district heating and electricity



Food waste becomes biogas

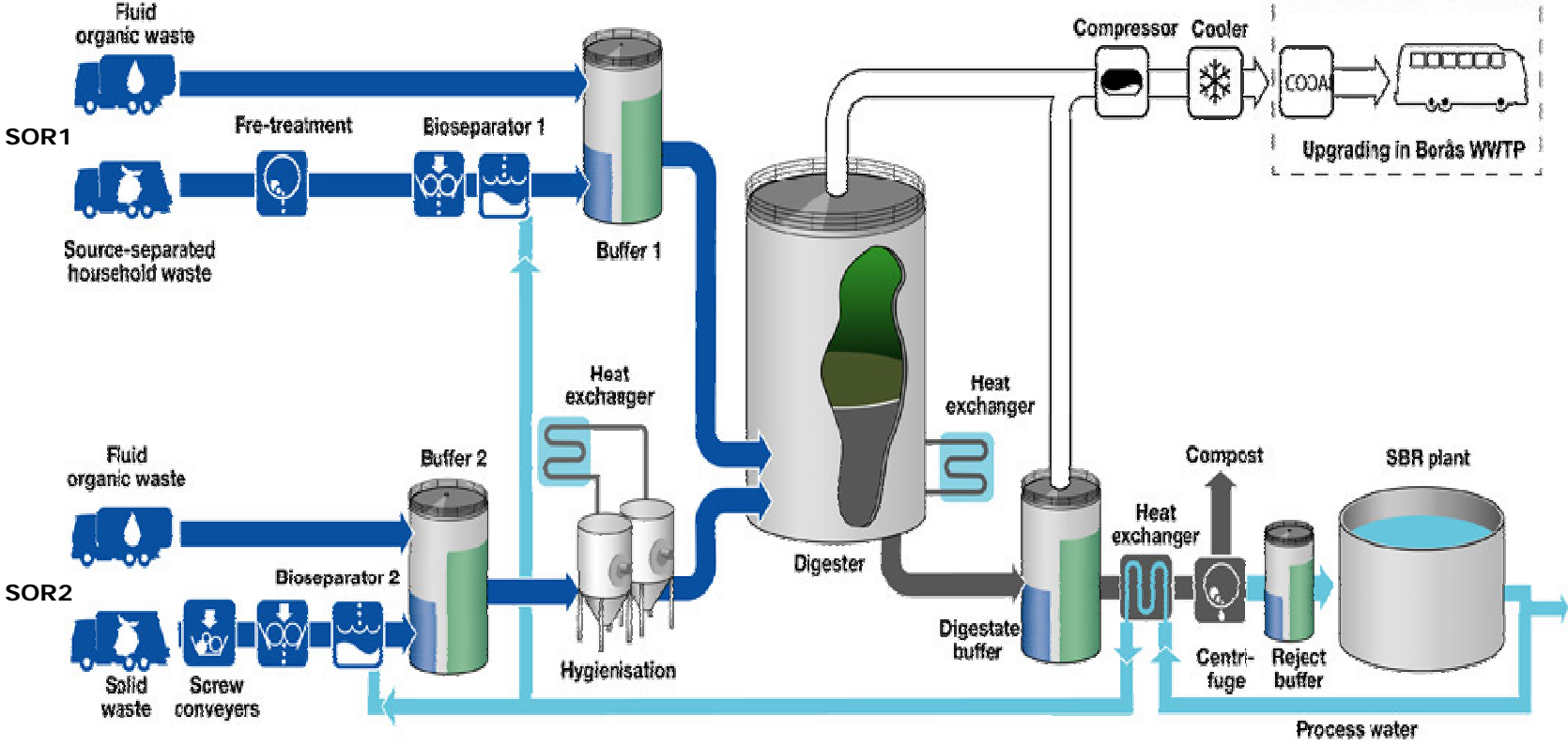


Separation of organic wastes!

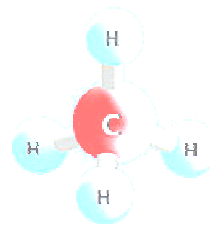




Biogas from waste



Biogas production



Substrate [Ton]

• Biogradable waste - Black bags (Household Borås)	4 000
• Biogradable waste (Household suburbs)	7 500
• Biogradable waste (Commercial)	2 464
• Biogradable liquid waste (Commercial)	9 719
	23683

Gas production [Nm³]

• Raw Gas	2 546 629
• Vehicle fuel	1 123 407 (11,2 GWh)
• Methane gas for heating	308 976 (3,08 GWh)
• Residual product (fertilizer)	1982 Ton

[Amount 2009, metric ton]



Use for the gas

- 12 waste collection cars
 - 59 local busses
- and a number of office cars uses biomethane as fuel



Preparing wastes for combustion!



RYAVERKET

Heat- and powerplant



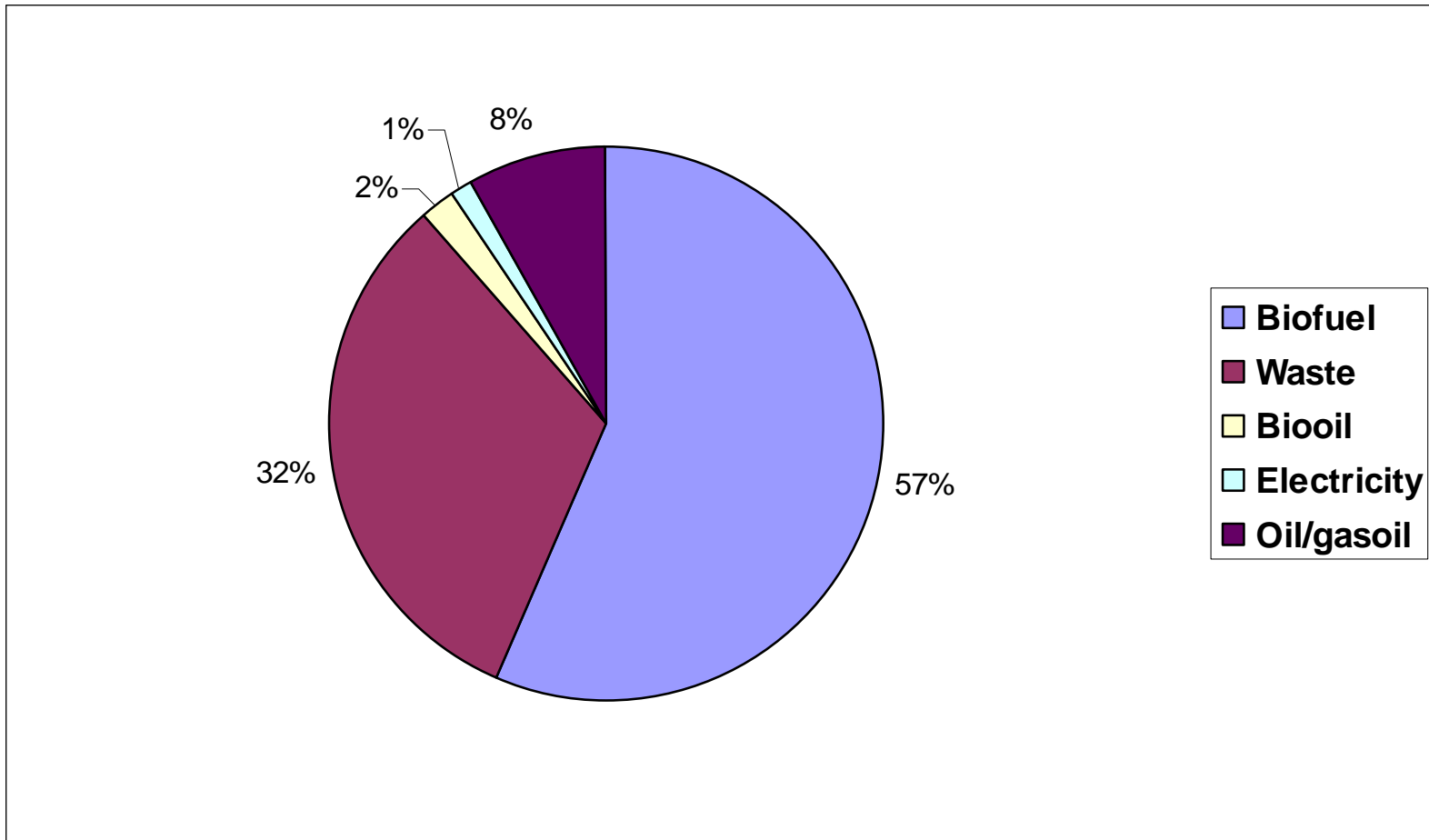
Why combustion of Wastes?

- Treatment
 - Volume reduction
- Prevention
 - Decrease green house gas emissions
 - Avoid methane formation
 - Control emissions – leakages
- Production
 - Energy recovery
- MSW can be a raw material and **not** only waste





Mix of fuels



What is combustion?

- Chemical reaction with oxygen
- Exothermic = generates heat
- Mainly carbon and hydrogen

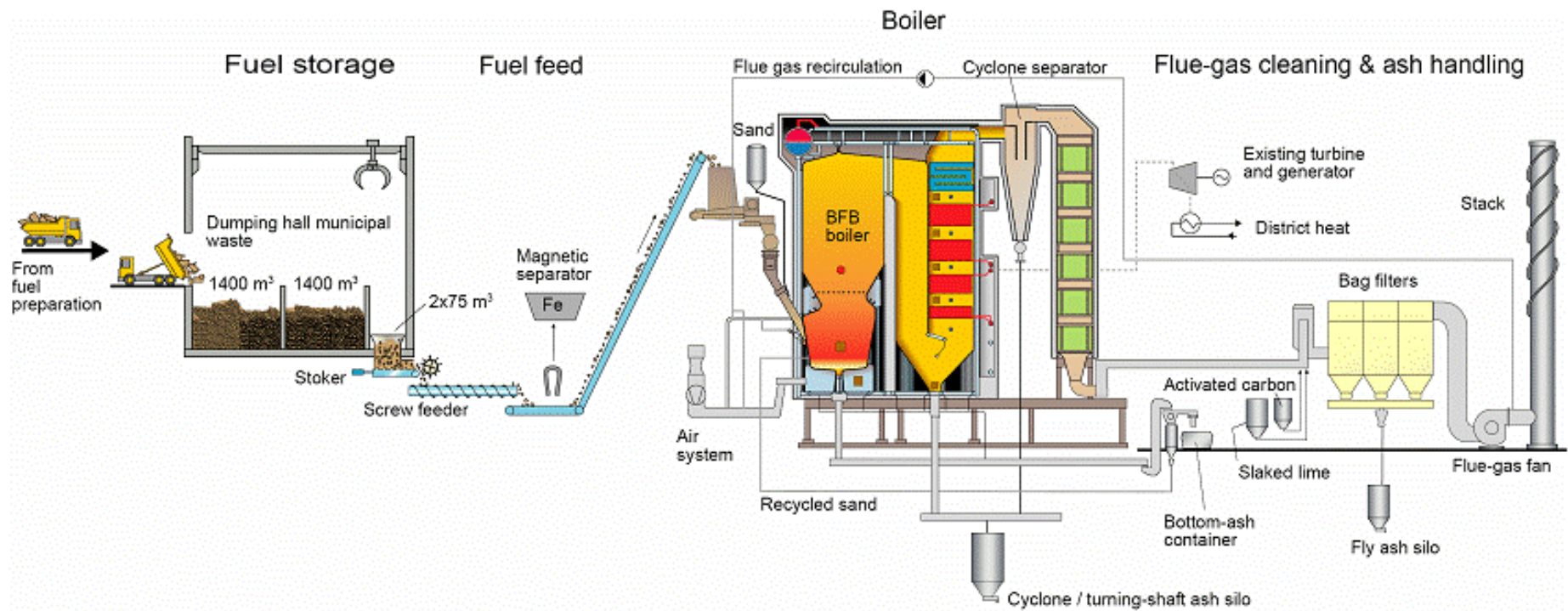








Combustion of Wastes



Energy and customers

Energy amounts

District heating (GWh)	632
District cooling (GWh)	10
Electricity (GWh)	132

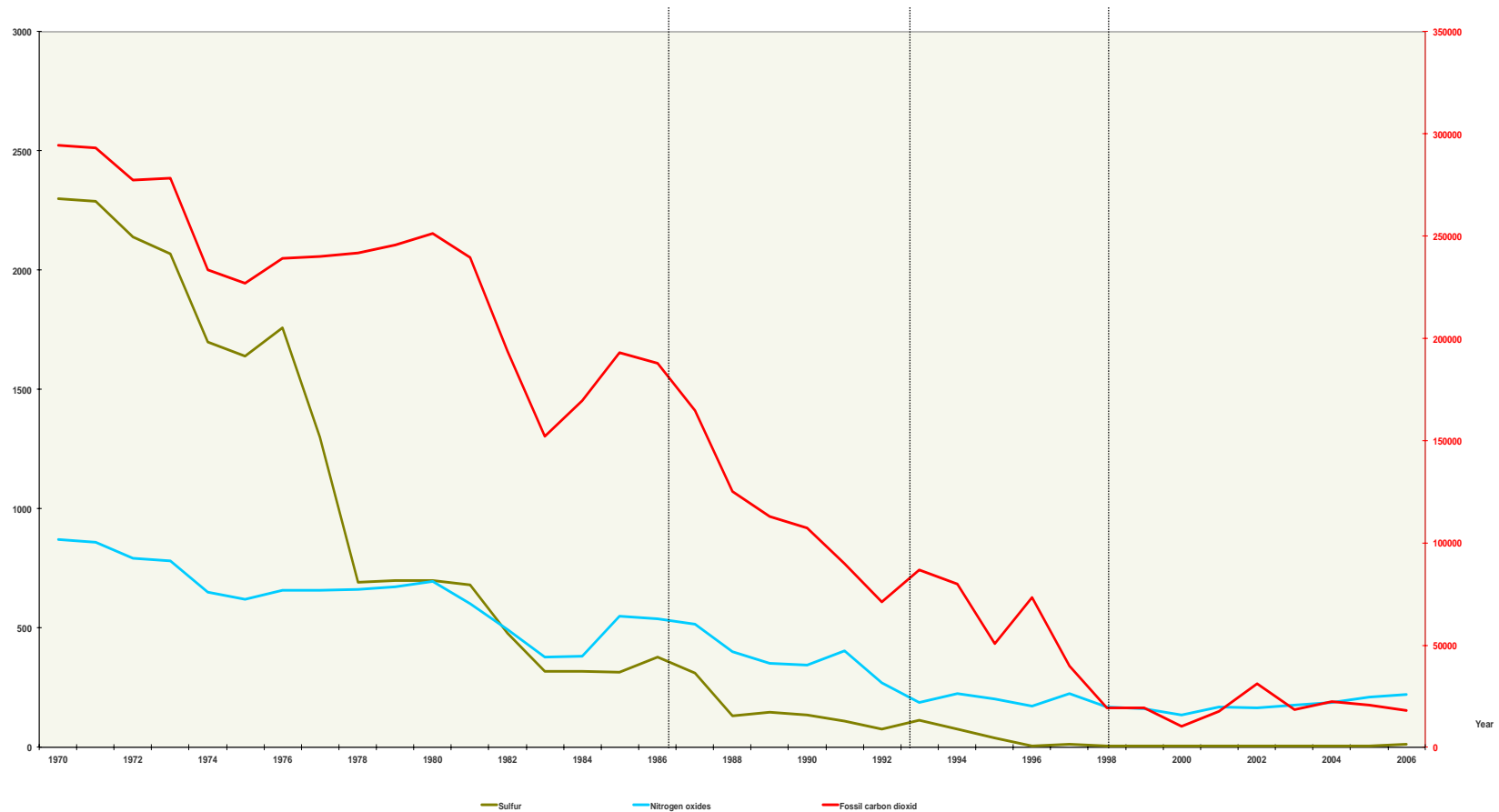
Number of costumers

District heating	4137
District cooling	53

[Amount 2009]



Low Emission



Red CO2
Blue Nox
Green SOx

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Recycling of materials at recycling stations

Collection of packages and papers

- Paper packages
- Newspaper
- Metal packages
- Hard plastic packages
- Batteries
- Glass (no colour)
- Glass (coloured)









Other wastes at the recycling centers (ex big size)



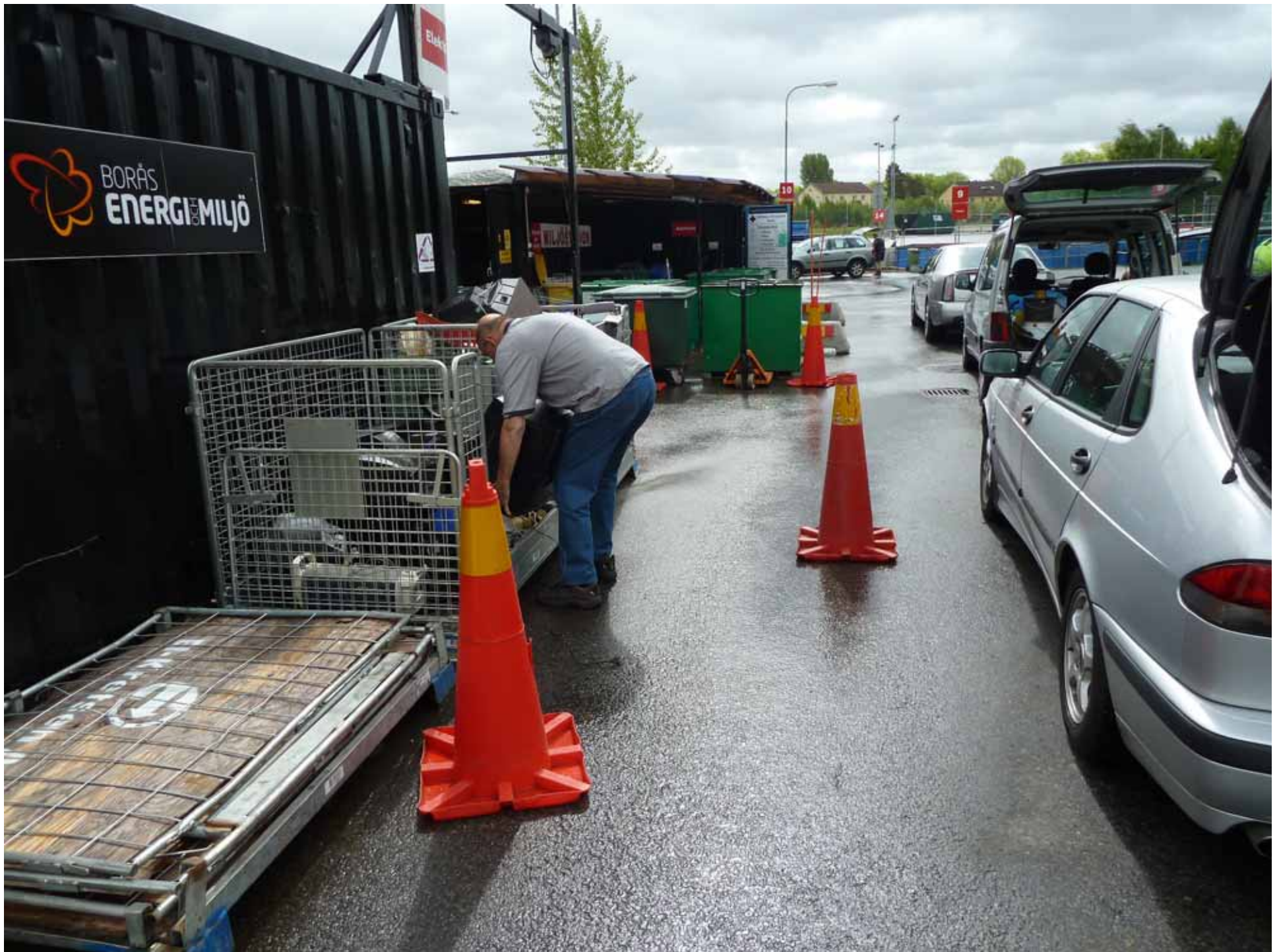
 **BORÅS
ENERGI & MILJÖ**



STÄNGT

OSRAM





ELEKTRONIK

STÄNGT

OSRAM

MELISA
14/10





- KLÄDER
- PRYLAR
- BÖCKER
- HEM-EL
- SMÅ MÖBLER

Skänk helt, rent & användbart.
Cärens gör till försäljning i våra
butiker. Tack!

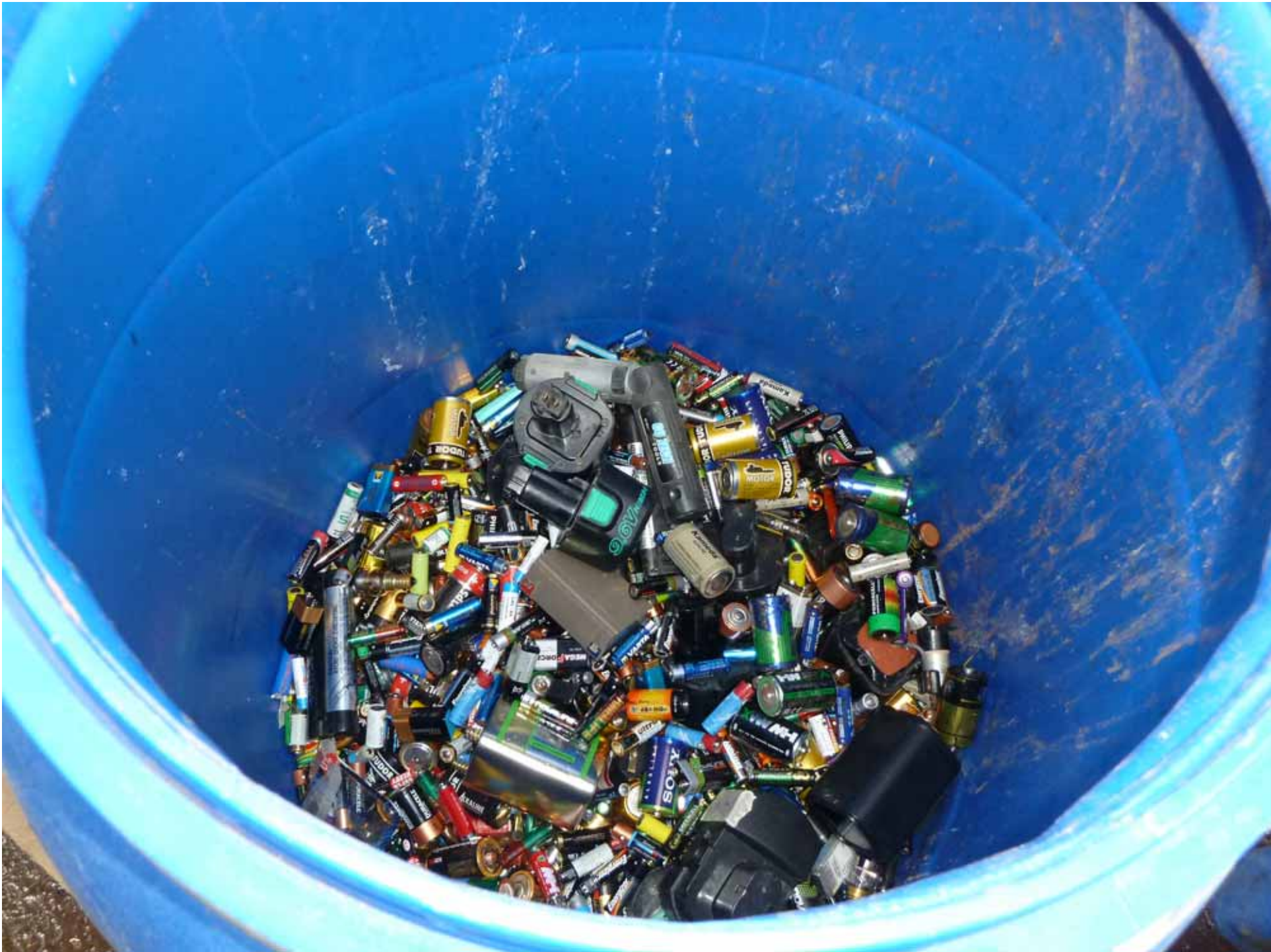
08 337 23 30 • www.emil.se















Recycling Gold





Stena Metall AB

The Group in figures

- Operations at 250 locations in 15 countries
- Net sales 4 billion \$US
- Number of employees, 3500

Stena Technoworld, WEEE

Stena Aluminium AB

Stena Recycling, AB, A/S, AS, OY

- 10 car shredders
- NF-plants
- Cable Recycling plants
- Plastics separation plants
- Transformer / Capacitor recycling plant
- Hazardous waste treatment plants
- Paper recycling plants

Driving forces

- 1. Legislation (Environmental, Tax, Producer responsibility, etc.)**
- 2. Material value**



Value of Recycling

Metals (energy requirement, compared to virgin production)

Aluminium (Al)	5%
Copper (Cu)	20 %

Plastics

Energy content in plastics about the same as in oil.
To replace plastics, energy recovered, 2-9 kg of oil/kg of plastic is needed

Stena recycling avoids emissions corresponding to 8 million ton CO₂

An aerial photograph of a city, likely Gothenburg, Sweden, taken from a high vantage point. The city is densely packed with buildings, many with red-tiled roofs, and is surrounded by lush green trees. In the background, rolling hills are visible under a sky with soft, golden light from a low sun, creating a hazy atmosphere. The text "OUR DREAM" is written in large, bold, white capital letters across the upper middle of the image, and "A CITY FREE FROM FOSSIL FUELS" is written in smaller, bold, white capital letters directly below it.

OUR DREAM

A CITY FREE FROM FOSSIL FUELS

The journey to realise our dream

– from infrastructure to the environment



2009. Accumulator brought on-stream. Second public biogas filling station opened.

2006. Borås Energi och Miljö formed. Coordination of energy and waste operations.

2005. Return to waste incineration!

1996. Local heating, district cooling and biogas.

1995. Bio-drier brought on-stream.

1984. Introduction of coal and biofuel.

1959. District heating introduced in Borås.

1965. Completion of Ryaverket plant.

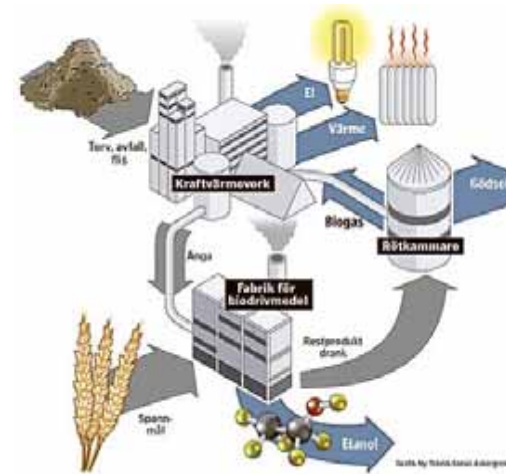


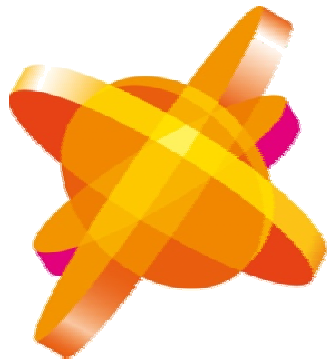
**BORÅS
ENERGI & MILJÖ**

Ingår i Borås Stadshus AB

What is our challenges?

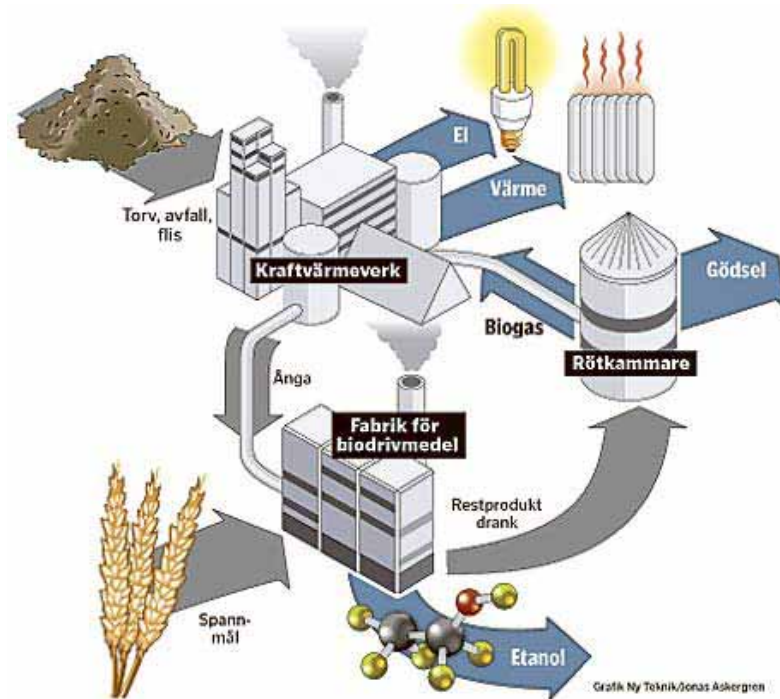
- Fossilfree heating
- Fossilfree vehicle fuels
- More renewable electricity
- Save energy!
- Recycle material and energy



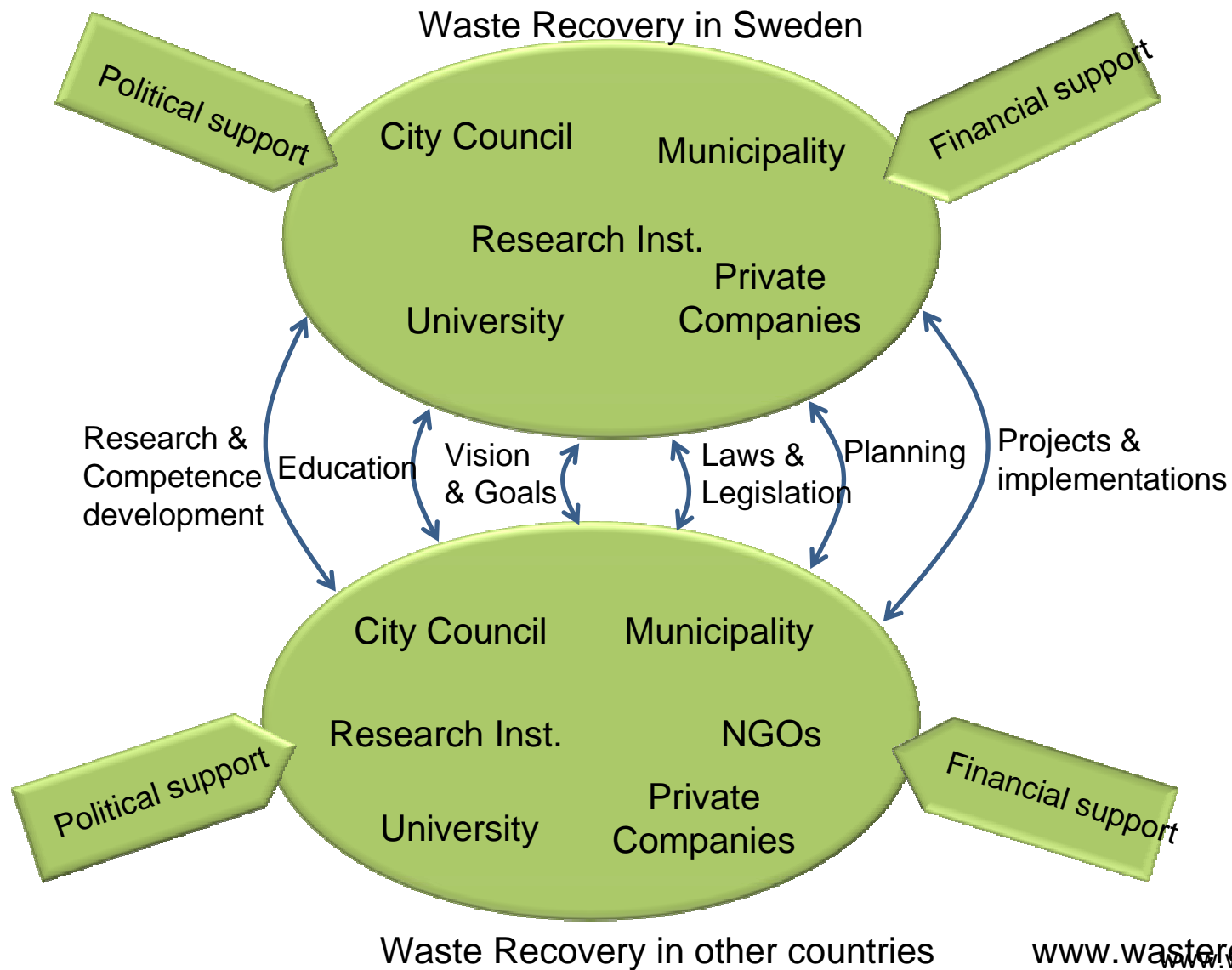


ENERGI-KOMBINAT 2013

- The energy facility of the future.
- Necessary to achieve the vision of a city free of fossil fuels!



Collaboration model of "Waste Recovery -International Partnership"





Resource Recovery

two international master programs

Industrial Biotechnology (Two-year master)

Prereq: BSc in Chemical engineering or chemistry

Features: Industrial application of biotechnology for a sustainable development

Sustainable Engineering (Two-year master)

Prereq: BSc Engineering or chemistry (chemical, industrial, electrical or civil) course in thermodynamics

Features: Resource management and recovery of energy and material resources

Resource Recovery

PhD-program



A multidisciplinary PhD-program with specialities in:

- Biotechnology
- Polymer technology
- Energy technology
- Simulation technologies
- Social aspects

*All competence on waste treatment in one organization:
"Waste Recovery International Partnership"*

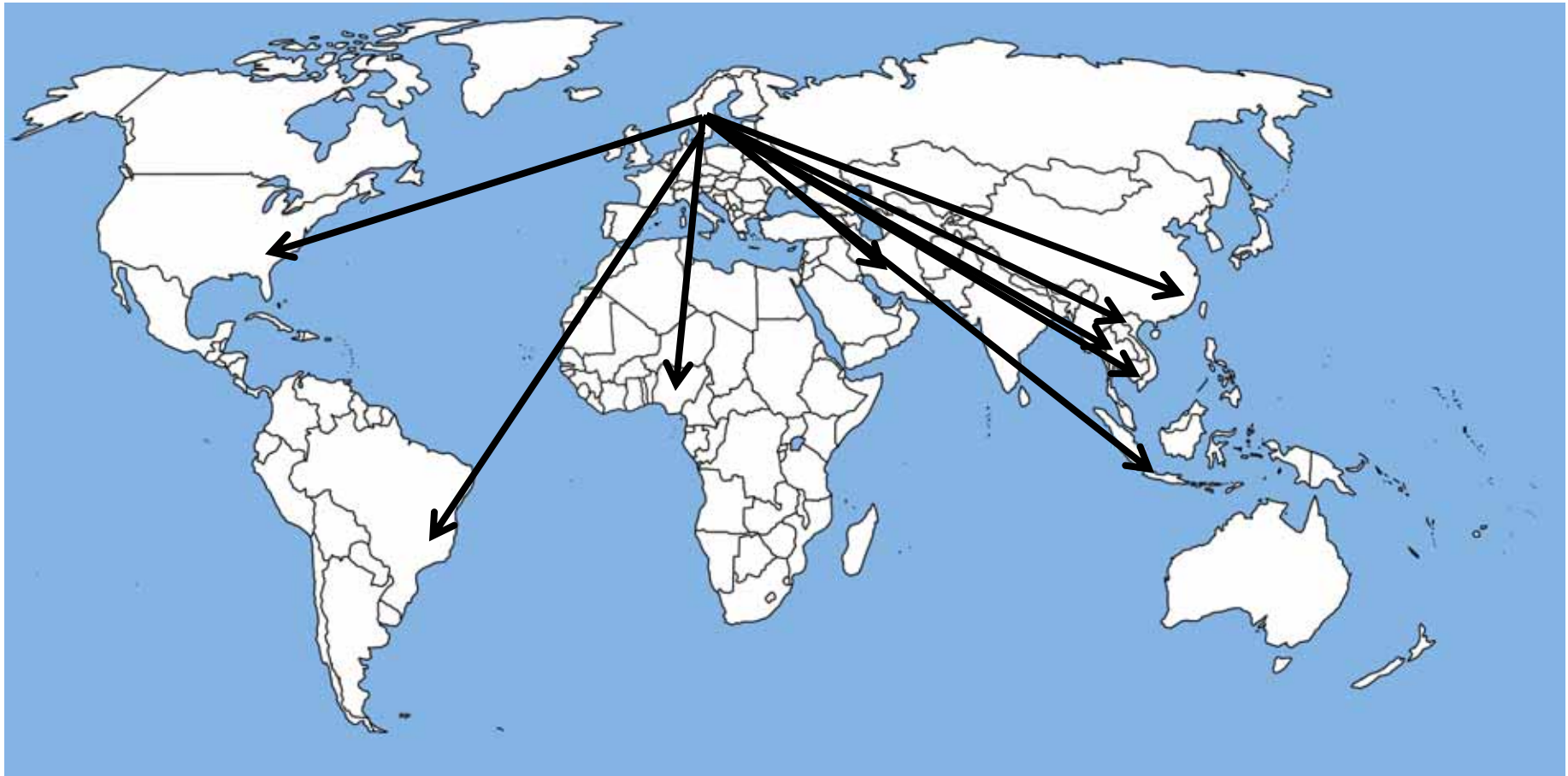


Plus:

- Biogas System
- F.O.V. Fabrics AB
- KTH Architecture and the Built Environment
- Läckeby Water AB
- Metso Power
- Navet Science Center (for children)
- SAAB AB
- Scandfiltet
- Sweco Architects
- Uponor
- Sakab
- Stena Metal
- VA – Teknik (SP)
-



Waste Recovery in Asia, Africa and America



Pilot plant Biogas Yogyakarta Indonesien

4 ton fruit waste/day
→ 550 kWh/day electricity

Reduced amount of
greenhouse gases
2716 ton CO₂/year

The total cost for the plant:
340.000 US dollar



Together we can work for
a sustainable world



Converting Waste into
Value-added Products