

SWEDISH ENVIRONMENTAL PROTECTION AGENCY



SWEDISH WASTE MANAGEMENT

AN OVERVIEW

Klas Svensson International Cooperation Unit



Outline

- 1. Waste Managment Principles and Legislation
- 2. From Landfilling to Recycling
- 3. Collection Schemes
- 4. Financing
- 5. Lessons learned
- 6. E-waste
- 7. Hazardous Waste



Waste Management Principles and Legislation



Naturvårdsverket | Swedish Environmental Protection Agency

2018-09-11

SWEDISH ENVIRONMENTAL PROTECTION AGENCY



How we started



An integrated part of a holistic system





Naturvårdsverket | Swedish Environmental Protection Agency 2018-09-11

SWEDISH ENVIRONMENTAL PROTECTION AGENCY

The waste hierarchy – basic principle for waste management





Waste Framework Directive (= EU DIRECTIVE 2008/98/EC on Waste and repealing certain Directives)

- Waste means any substance or object which the holder discards or intends or is required to discard.
- The Waste Hierarchy is the basic principle.
- EU directives for Waste Incineration, Landfilling also relevant for municipal waste treatment
- Several directives for specific waste streams, such as Waste Electronic Equipment, Packaging, End of Life-Vehicles, Batteries etc.
- These directives contain recycling targets. Sweden has sometimes chosen to set higher national targets, for example on packaging.
- Implemented Environmental Code, regulations, ordinances





National Waste Management Plan – Principles

- Reduce amounts of waste
- Use resources in waste
- Resource Efficiency
- Minimize negative impacts on health and environment



National Waste Prevention Programme – areas of priority

- Food waste
- Textiles
- Electronics
- Construction and Demolition Waste



9



Naturvårdsverket | Swedish Environmental Protection Agency

2018-09-11

SWEDISH ENVIRONMENTAL Protection Agency

National targets on waste

- 2018 at least 50% of food waste from households, restaurants, institutional catering and shops is recycled by biological treatment (40% digestion)
- 70 % reuse and recycle of construction- and demolition waste by 2020









National material recycling targets for packages and newsprint per year according to legislation

- Glass 70%
- Metal 70%, (beverage containers 90%)
- Paper/cardboard 65%
- Plastic 30% (beverage containers 90%)
- Wood 15%
- Newsprint/paper 80%
- Also several targets for ELV, E-Waste and Batteries

2. From Landfilling to Recycling



Naturvårdsverket | Swedish Environmental Protection Agency

2018-09-11

SWEDISH ENVIRONMENTAL PROTECTION AGENCY

Treatment of household waste, 1975-2016



SWEDISH ENVIRONMENTAL PROTECTION AGENCY

NATU

VÅRDS Verket





Naturvårdsverket | Swedish Environmental Protection Agency

2018-09-11

14

SWEDISH ENVIRONMENTAL PROTECTION AGENCY

Extended producer responsibility – 1994

The producer responsibility makes producers responsible for the collection, disposal and recycling of their discarded products.

It is intended to **reduce waste** volumes and encourage cleaner production and environmentally sound product development.





Producer responsibilities in Sweden

- Packaging (1994), including refund/deposit system for beverage containers Newsprint/paper 1994
- Tyres 1994
- Cars 1997





Naturvårdsverket | Swedish Environmental Protection Agency

16

2018-09-11

SWEDISH ENVIRONMENTAL PROTECTION AGENCY

Producer responsibilities in Sweden, continued

- Electrical and electronic products (WEEE) and light bulbs 2000
- Radioactive products and orphan sources 2007
- Batteries 2009
- Medical waste 2009
- Refund deposit system for bottles 1885
 Later extended to plastic bottles and metal cans
- Voluntary agreements for farming plastics, C&D waste



Naturvårdsverket | Swedish Environmental Protection Agency

2018-09-11

17

WEDISH ENVIRONMENTA PROTECTION AGENCY



Landfill tax – 2000 Tax on incineration – 2006 (later removed, but might come back)



Landfilling

- Landfilling is the last, however necessary, alternative for waste that we want to exclude from the eco-cycle
- From 1600 landfills in 1976 to 265 landfills in 2015:
- ✓ Hazardous waste: 60
- ✓ Non-hazardous waste: 133
- ✓ Inert waste: 72
- Total amount landfilled waste excl. mining waste (2015):
- ✓ Non-hazardous waste: 3,3 M ton (soil, construction materials, ash)
- ✓ Hazardous waste: 430 T tons (polluted soil, industrial waste)
- ✓ Household waste: 100 T tons (mixed fractions, construction materials)



Main strategies on landfilling

- Reducing long term emissions from landfills through better design of landfills
- Reduce the quantity and hazardous nature of the waste landfilled
- Less than 1% of all municipal waste is landfilled today
- Stricter landfilling requirements (example):
- ✓ Ban of landfilling some waste; liquid, explosive, flammable, oxidizing, infectious waste, etc.
- ✓ Waste must be treated prior to landfilling
- Amount of landfills have been reduced:
- \checkmark From 1600 landfills in 1976 to 265 landfills in 2015



Waste incineration

- Approximately 7,6 M Tons of waste was incinerated where energy was recovered
- ✓ 2,2 M tons household waste (49 % of MSW)
- ✓ 150 T tons hazardous waste
- About 33 waste incineration plants (except industries)
- Incineration plants are effective
- ✓ 95-100% efficiency rate (requirement 65%)
- ✓ Emissions of dioxins and heavy metals down 95-99 %

Waste To Energy

- ✓ Powerful instruments steering from landfilling (tax on landfilling in 2000, ban on landfilling of combustible waste in 2002 and organic waste in 2005)
- \checkmark Waste is an important fuel for district heating (21%)
- ✓ Provides heat for 800 000 homes
- ✓ Provides electricity for 250 000 households
- Also produces 1.2 M/year tons of slag and large amounts of fly ash 2018-09-11 21



Gärstadverken, Linköping. Source: Tekniska Verken Photo by Åke E:son Lindman



Incineration, energy production and dioxins to air



INCINERATION, ENERGY PRODUCTION AND DIOXIN INTO THE AIR FROM WASTE INCINERATION 1985-2006



Naturvårdsverket | Swedish Environmental Protection Agency

2018-09-11

22

SWEDISH ENVIRONMENTAL PROTECTION AGENCY

Waste to energy – turning garbage into business

- 2,5 million tons of waste was imported for incineration from other EU countries
- Countries such as UK, Norway and Ireland pay Swedish energy plants to treat their garbage
- Energy plants sell heat and electricity on the market





Biological treatment

- Approximately 757 T tons of organic waste was biologically treated in 2017
- Biological treatment of food waste and garden waste
- 37 larger composting facilities
- 36 anaerobic co-digestion plants
- Sewage treatment plants produce biogas
- Organic waste as a resource
- Bio-fertilizer returned to agricultural land
- The biogas is upgraded to vehicle fuel. Mostly for buses.





Material recycling

- Material recycling in 2017
- ✓ Some 35 % of household waste was recycled through material recycling
- ✓ Mainly packaging materials, return paper, construction materials and metal scraps
- EPR has been important for recycling results. Municipal recycling centers and other services that municipalities provide for households also contribute significantly.

Producer responsibility:

- Packaging materials (plastic, paper, glass and metal)
- Return paper
- Tires
- Cars
- Electrical and electronic products
- Batteries
- Pharmaceuticals
- Radioactive products and unclaimed radioactive sources





25

SWEDISH ENVIRONMENTAI PROTECTION AGENCY

3. Collection schemes for waste



Naturvårdsverket | Swedish Environmental Protection Agency

2018-09-11

SWEDISH ENVIRONMENTAL PROTECTION AGENCY

Source separation is the key!

 An average household is required to source separate between 10-15 different waste fractions



Example on fractions that households source separate:

- Food waste
- Garden waste
- Packaging of metal, plastic, paper and glass
- Electronics
- Newspapers
- Hazardous waste
- Pharmaceuticals
- Tires
- Batteries
- Bulky waste
- Etc...



Division of roles and responsibilities

- Extended Producer Responsibility (EPR) for 8 product groups
- ✓ Collection and treatment of waste within the EPR
- Packaging waste Paper waste- Electrical and electronical waste -Batteries – Tires - End of life vehicles – Pharmaceuticals - Radioactive products/unclaimed radioactive sources
- ✓ National recycling targets

Municipalities

- ✓ Collection and treatment of household waste that does not fall under EPR
- Residual waste Food waste Garden waste Hazardous waste Bulky waste
- ✓ Responsible for urban planning

✓ Business/industries

- ✓ Handling commercial waste
- Households/Individuals
- \checkmark Source separate





SWEDISH ENVIRONMENTAI Protection Agency

2018-09-11

Municipal Collection Schemes

- All collection of household waste is carried out by the municipality or it's contractors
- Many types of collection systems are used in Sweden
- \checkmark Type of systems vary between the municipalities
- ✓ The choice of system depends on logistics, physical conditions, desired collection results and costs
- ✓ The systems are often used in combination



Municipal Property Close Collection Schemes















SWEDISH ENVIRONMENTAL Protection Agency

Naturvårdsverket | Swedish Environmental Protection Agency

Municipal Collection Schemes

- Main systems for residual waste, food waste, packaging and paper:
- ✓ Separate bins for each fraction
- ✓ Multi compartment bins (four compartments)
- ✓ Colored bags with optical sorting
- Complementary systems, for example:
- ✓ Underground container
- ✓ Vacuum system (mobile and stationary)
- ✓ Waste disposal unit / to sewage system or tank (only for shredded food waste)



Municipal public recycling schemes



Municipal Recycling Center

There are some 600 municipal recycling centers in Sweden. Annually they receive about 20 million visits. At these centers households can recycle most waste types such as bulky waste, hazardous waste, small amounts of construction/demolition waste, electronics, tires, packaging, garden waste etc. Entry to recycling centers is included in the municipal waste management fee.







Naturvårdsverket | Swedish Environmental F

Municipal Public Collection Schemes











SWEDISH ENVIRONMENTAL Protection Agency

Extended Producer Responsibility Collection Schemes



For packaging and return paper



Deposit system for PET bottles and cans



Collaboration with municipalities for WEEE, packaging, return paper, portable batteries, tires etc.



Portable batteries



2018-09-11

4. Financing



Naturvårdsverket | Swedish Environmental Protection Agency

2018-09-11

36

SWEDISH ENVIRONMENTAL PROTECTION AGENCY

Financing waste management

Two main financing streams for household waste:

- Municipal waste management
- ✓ Local waste management fees
- Extended Producers Responsibility
- \checkmark Financing own systems trough product fees and revenue from sold material



Municipal Waste Management Fees



- The municipalities have the right to decide on a local fee for waste management under their responsibility
- Full cost coverage for collection, separation, treatment, recycling, planning and information
- Allowed to be differentiated (e.g. weight based) to encourage source separation
- Basic charge and variable charge
- Non-profit!



Municipal Waste Management Fees

- In 2015, the average annual fee was 79 Euro per person (≈6000 rupees)
- The fee is usually charged per household





5. Lessons Learned



Naturvårdsverket | Swedish Environmental Protection Agency

2018-09-11

40

SWEDISH ENVIRONMENTAL PROTECTION AGENCY

Lesson learned - Success Factors

- Source separation in households (10-15 fractions)
- Extended Producer responsibility for 8 waste streams (with targets)
- Clear responsibilities for municipalities
- Cooperation between municipalties and producers when establishing collective schemes
- Cooperation between municipalities (Swedish Waste Association)
- Sustainable financing of waste management (EPR, Municipal waste)
- A mix of policy tools



A mix of policy tools

- Legal instruments (Waste hierarchy, National Waste Management Plan, Mandatory recycling targets, bans on landfilling of combustible waste and organic waste etc.)
- Economic instruments (Tax on landfilling, municipal fee incentives, investment grants etc.)
- Engineering instruments (spatial planning, sustainable planning of infrastructure)
- Informative instruments (education, awareness-raising, communication, knowledge exchange)



Lessons learned - continued

- Clear national environmental targets. Clear regional and local policies.
- A well-functioning system including the whole chain
- Good cooperation between actors (The Waste Council)
- Good governance principles implemented (transparency, participation, accountability, rule of law, anti-corruption)
- Credibility
- Focus on awareness raising and public engagement



6. E-Waste



Naturvårdsverket | Swedish Environmental Protection Agency

2018-09-11

44

SWEDISH ENVIRONMENTAL PROTECTION AGENCY





Photo: © Basel Action Network .

- Why is E-waste important
- It consists of more than 1000 different substances some hazardous like lead, cadmium, zinc, copper and flame retardants.
- During inadequate recycling harmful pollutants can be released (for example dioxins from open burning.)
- It has a value both from a natural resources perspective and from an economic perspective



Producer responsibility in Sweden

- Producers of electrical and electronic products, electrical equipment and batteries must organise collection, transportation and treatment.
- The producers must notify the Electric Equipment and Battery Register at the Swedish EPA.
- The Swedish EPA and the municipalities has the inspection responsibility.



Collection



- Municipal recycling centres
- One system for collection and transportation to recycling companies.



Recycling in Sweden

• C-activity (municipal notice)



- Electrical and electronic waste undergo pre-treatment by certified facilities (separation and/or disassembly) before being forwarded for further treatment
- Metals recovered electromagnetically or with eddy current separation or smelting
- No longer possible to send plastic to China
- Spent batteries are collected, separated, and delivered to a recycling facility or final disposal site.



CFC and HCFC

• Products containing CFC and HCFC are emptied and the CFC and HCFC are incinerated.



Collection results for electric and electronic equipment, in kg per capita and year





Lessons learned in Sweden

- One system for collection makes it more efficient.
- Cooperation between public and private actors is strictly regulated in agreements
- The system for collection was built on already existing collection systems (municipal recycling centres)
- Control of transports
- A well-functioning system must be in place including the whole chain





A well-functioning waste management system including the whole chain

- Legislation including enforcement, other relevant measures
- Responsibilities and financing must be clear
- Accessible and convenient
- Clear communication, easy to understand
- A fair playing field

7. Hazardous Waste



Naturvårdsverket | Swedish Environmental Protection Agency

2018-09-11

SWEDISH ENVIRONMENTAL PROTECTION AGENCY



Hazardous Waste Management

Improper handling of hazardous waste has caused numerous cases of contamination of soil and groundwater, and has threatened both environment and health.





Investigation of contaminated areas

• 1300 areas with high risk

• 14 000 with lower risk



2018-09-11



European Legislation of Hazardous Waste

- EU DIRECTIVE 2008/98/EC on Waste and repealing certain Directives
- COMMISSION DECISION 2014-955-EU establishing a list of waste including hazardous waste

European Waste Classification



- 1. Gather information on origin, generation process, physical properties etc.
- 2. Choose EWC-code, Source (2 digits) and Type (4 or 6 digits).
 - Single entries always have the same classification.
 - If the waste has a double entry it can be either non hazardous or hazardous. (Example: Waste Incineration Bottom Ash 19 01 11* or 19 01 11)

3. Assess by chemical analysis if the waste has any of 15 hazardous properties specified in "Annex 3". For example HP1 Explosive, HP7 Carcinogenic, HP14 Ecotoxic
4. Classification criteria and hazard definitions (GHS) for the assessment are found in the CLP-regulation. For example, H350, May cause cancer

NATL



Hazardous chemicals and hazardous waste.



 The production of chemicals has in 50 years increased from less than 10 million tonnes to over 400 million tonnes per year in the world.

• Over 100 000 chemicals are in use globally, around 30 000 are in use daily. (Source: ECHA)



How is hazardous waste handled and treated?

- Classification
- Separation
- Collection
- Transportation
- Treatment





Transport of hazardous waste

- Permit for proffessional transportation of waste and of hazardous waste is required from the County Administrative Board.
- Hazadous waste can be classified as dangeorus goods with strict regulations on packaging, labelling etc.



Customize the treatment, examples on different methods

- Recycling (construction not allowed)
- Solidification, stabilization
- Physicochemical treatment (filtration, sedimentation, distillation, precipitation etc)
- Soil remediation with biological treatment
- Covered landfill with liner, geological barriers, leachate treatment
- Thermal treatment (for separation of volatile substances)
- Underground storage is prohibited in Sweden except for nuclear waste
- Incineration and energy recovery



Requirements for incineration of waste

- > 1 100°C for at least 2 sec. For hazardous waste containing > 1/% halogenated organic compounds, (for example PCBcontaining waste, pesticides and hazardous chemicals)
- > 850°C for at least 2 sec. For household waste, industrial waste and less complex waste.





Emission control

- Requirements: continuous measurements of dust, TOC, HCI, HF, SO2, NOx and CO.
- Requirements: measurement of Hg, Cd, As, Pb, Cr, Cu, Zn, dioxines and furanes at least every 2 year.
- One plant has continuous sampling of dioxins in the flue gases.





Landfills for HW

- Directive EEG 1999/31/EC on the landfill of waste sets requirements on classification, waste and treatment not acceptable in landfills, acceptable waste, conditions for permits, monitoring, closure and after-care procedures etc.
- Not acceptable waste: liquids, tyres, medical waste (infectous), explosives, oxidizing, corrosive, flammable.
- The transport time for leachate should not be less than 200 years for hazardous waste.
- Acceptance criteria for waste, leaching criteria



For more information, see

- <u>http://eur-</u> <u>lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:312:0003:</u> <u>0030:en:PDF (Waste Directive)</u>
- <u>https://eur-lex.europa.eu/legal-</u> <u>content/EN/TXT/?uri=uriserv%3AOJ.L_.2014.370.01.0044.01.ENG</u> (European Waste List)
- http://eur-

<u>lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31999L0031:</u> <u>EN:NOT</u> (Landfill Directive)

<u>http://eur-</u>

<u>lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32010L0075:</u> <u>EN:NOT</u> (Industrial Emissions Directive)

- <u>http://ec.europa.eu/environment/waste/plans/pdf/2012_guidance_n</u> <u>ote.pdf</u> (Guidance for Waste Management Plans)
- <a>www.echa.europa.eu/ (European Chemical Agency)

Thank you for your attention!

Klas Svensson(klas.svensson@naturvardsverket.se)



Naturvårdsverket | Swedish Environmental Protection Agency

2018-09-11