

Training Waste Composition Analysis (WCA)

Yerevan June 2019

ace.aua.am/waste/wqcs

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INTRODUCTION

This guide describes the Swedish methodology for manual sorting of municipal solid waste – also referred to as **Waste Composition Analysis** - for the purpose of determining the composition of waste, split into a number of well defined fractions.

The methodology, Report U2013:11), is a result of the collective work of the **Swedish Waste Management Association** which represents all 290 Swedish municipalities and has been used in over 4,000 tests

The methodology is to a large extent coherent with **the EU document “Methodology for the Analysis of Solid Waste (SWA-Tool)”** of 2004, which is also a guide only and not an EU Directive.

Sorting analyses become more and more important as a result of the municipalities’ strive to introduce or **improve source separation and quality of waste** e.g. to identify volumes of recyclables and food waste (for biogas) or to remove hazardous waste.

DEFINITIONS

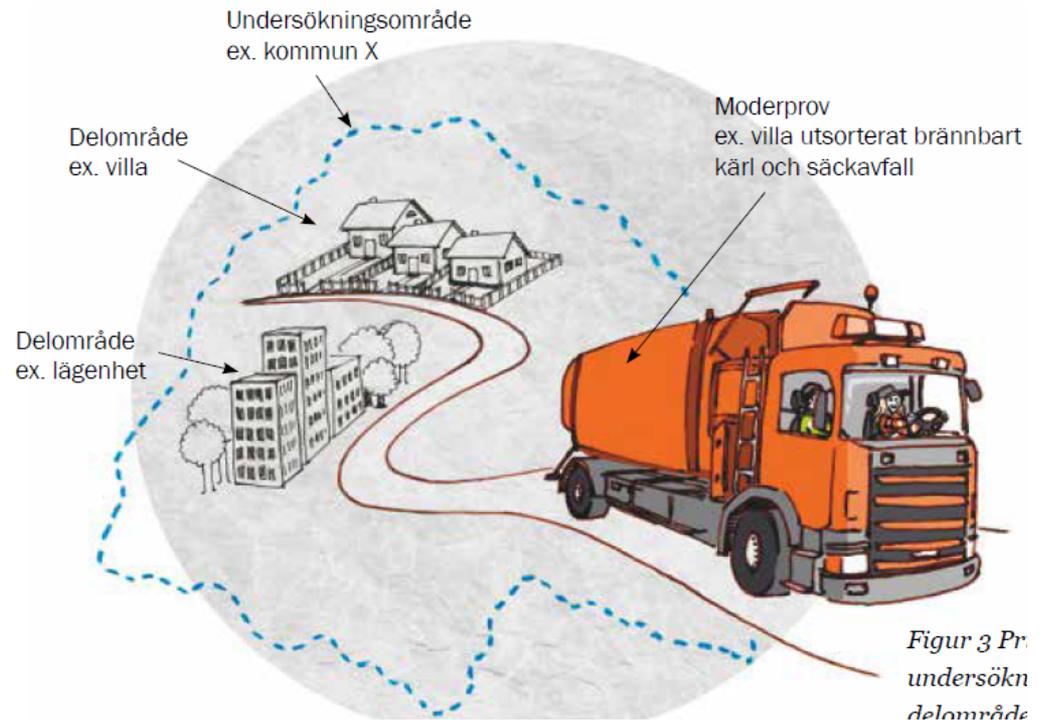
Sorting analysis	Analysis of composition in a certain defined quantity of waste by sorting out a number of predetermined fractions and subsequent weighing of each fraction
Analysis area	The geographical area which has been selected for analysis, e.g a city or a part of a city
Sub-area	The area from where the samples for sorting is collected
Sampling route	A selected collection route, representing a sub-area
Mother sample	The total quantity of waste collected in the analysis area
Splitting of samples	Taking out samples from the mother sample
Stratification	The statistical subdivision of the in-homogenous population into more homogenous sub-populations called strata . The variation within strata is usually smaller than the overall population, thus stratification increases the accuracy of the results
Sub-samples	The amount of waste , in the form of one or several samples, taken from the mother sample
Correction factors	Factors, based on experience, which can be used to correct the weight of a fraction for abnormal moisture and dirt . Generally used for packages and paper

STEP 1. PLANNING

- **Decide the purpose of the sorting project**
- **Planning practical work**
 - Select a suitable site
 - Location in regard to the collection route(s) and the landfill to avoid long driving distances
 - No disturbance of neighbors
 - Permits in place
 - A paved area for mixing of the mother sample (or a thick tarpaulin)
 - A roof or a simple building is recommendable for the manual sorting to prevent waste spreading, rainfall and summer heat for the staff
 - Agree with a waste contractor or municipality to borrow a waste truck with staff for the sampling and a front end loader (JCB) for mixing and sampling
 - Employ and educate sorting staff in due time. Calculate with 3-5 persons for each test
 - Make preparations to acquire all necessary equipment as per the list
- **Time schedule and a budget for the project**
- **Plan the working environment early including vaccinations, protecting clothing, and training for the sorting staff**

STEP 2. PREPARATORY STUDY

- **Collect facts about the analysis area** – e.g. population, various types of housing, age distribution, income level, seasonal variation - (see the [Project Report](#), Appendix 1.4)
- **Decide stratification criteria with regard to the desired results**
 - Subdivision into more homogenous areas, criteria can be
 - Residential structure (high-rise apartment buildings, villas, etc.)
 - Commercial influx, e.g. high restaurant density
 - Seasonable variations



STEP 2. PREPARATORY STUDY

- **In this project stratification has been agreed as follows:**
 - In Yerevan:
 - Sub-area 1: High-rise residential areas
 - Sub-area 2: Villas and low-rise residential areas
 - Sub-area 3: Commercial areas with high restaurant density
 - Outside Yerevan
 - 15 sorting tests will be done in 5 cities selected on basis on
 - Population
 - Geographical size
 - Tourism
 - Development, industry, etc.

The selected cities are: **Vanadzor, Hrazdan, Ararat, Kapan** and **Gyumri**.

In each city, 3 sub-areas will be selected:

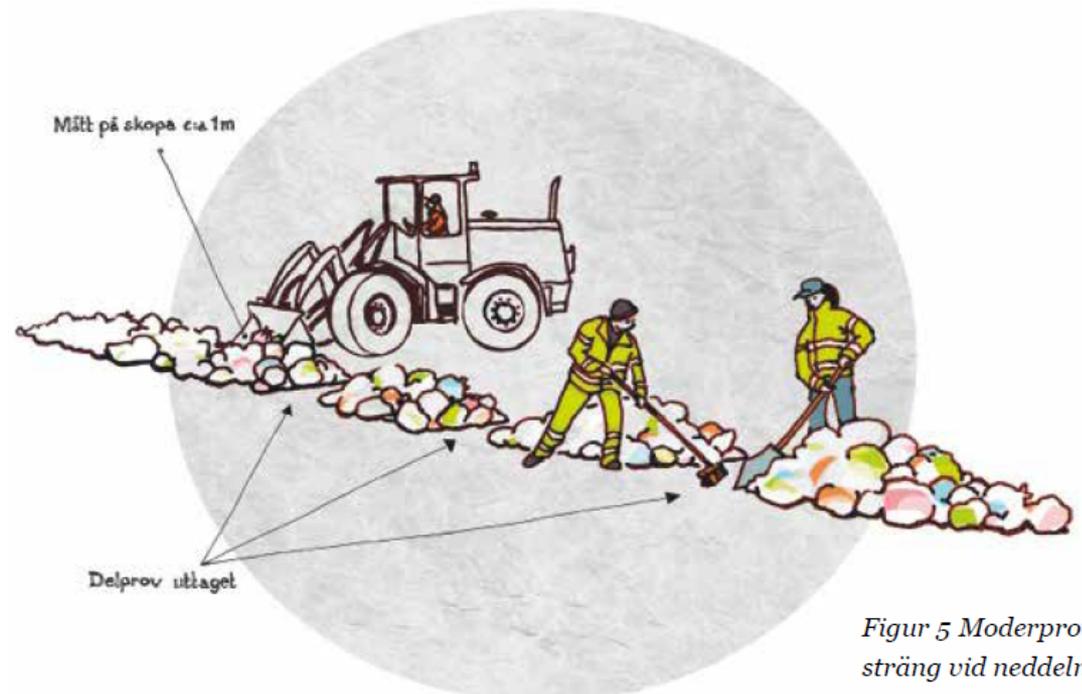
- sub-areas with focus on urban households
 - sub-areas with focus on urban mixed household/commerce
 - sub-areas with focus on rural/villages households
- **Plan representative routes within each sub-area which have the desired waste types**
 - Make sure enough waste is collected - minimum 4 tons or approximately 45 m³ corresponding to ca 45 bins (1100 L)
 - Plan the routes in normal periods without big holidays, tourist invasions, etc.
 - Give each mother sample a unique name (e.g. based on location)

STEP 3. COLLECTION OF MOTHER SAMPLE

- **The mother sample is ca 4-5 tons of waste, 45 m³ or 45 bins – (0,5-1 truck load)**
- **Plan as representative routes as possible**
 - Longer routes give more representative samples
 - Avoid collection points which are known to be abnormal
 - For analysis of household waste, avoid waste from small industries, mechanical workshops and commercial activities, like large markets and restaurants
 - For analysis of the broader sense of MSW, commercial waste can be included (curbside bins)
- **Follow the collection staff**, preferably the whole route, or contact by phone
- **Avoid too much compaction in the collection truck to simplify sorting**
- **Follow the planned route and remove bulky items**
- **Weigh the truck full (after the collection) and empty**
- **Record relevant facts about the route** (no. of households, the number of days the waste represents, etc.)
- **Protect the collected mother sample** from e.g. rain, wind, animals etc. , while it is stored and prepared for taking out sub-samples
- **Sorting area is ready including staff, equipment and protecting clothing**
- **Tipping area is paved and clean**

STEP 4. TAKING OUT SUB-SAMPLES

- **Mix the mother sample with a JCB – avoid crushing!**
- **Put the waste in a long string or in a square - take sub-samples randomly along the string**, or choose every second square when using the quartering method
- **Take out 5 sub-samples of 100 kg each – totally about 500 kg**
- Remove any obviously misplaced sizeable item, such as an A/C, big computer, etc. that may have been found only after emptying the truck/ bins
- **All sub-samples must be weighed exactly**
- **Place the sub-samples in marked plastic bins with lids for protection**
- **Sorting should commence within 1-2 days after collection** depending on season



Figur 5 Moderprov sträng vid neddelni

STEP 5. MANUAL SORTING

- **Check that the sorting staff is educated and equipped in accordance with the specified lists before the work starts**
 - Go through the safety routines including protecting clothing and personal hygiene
 - Repeat the definition of the sorting fractions
 - Clarify the roles and responsibilities of the staff
 - Describe the closing of each work session
- **Start the manual sorting**
- Sort the waste carefully, including all waste
- **Sort each sub-sample separately**
- Place a suitable amount of waste on the table. Cut the bags open carefully and investigate the contents before it is spread over the table.
- Any **visible sharp objects** (needles, syringes, razor blades, knives) or poisonous material (rodenticides, medical waste, etc.) should be identified and sorted out first.
- If **weapons or ammunition** is found the police/military should be contacted for advice.
- Sort out **fine material** like cat sand or coffee grounds early



STEP 5. MANUAL SORTING

- Sort in the **22 secondary fractions** (see the [Project Report](#), Appendix 1.1)
- Mark the bags/containers clearly with the fraction to be placed in them.
- Fine materials like cat sand and coffee grounds shall be brushed together and placed in the correct fraction. Use brush and a small hand shovel
- **Food remains** shall be removed from packaging and put in “kitchen waste”. Only clean packaging is put in the respective packaging fractions (paper, plastics, metals, etc.). Unopened food containers can be put in the food waste fraction
- **Packaging containing liquids** or paints which can be hazardous shall not be opened. The whole packaging including its content is classified as hazardous materials
- Bottles or cans with liquid food should be emptied and the contents (except water) shall be put in the food fraction. In order not to put too much liquids in the food fraction the contents can be weighed and then discarded
- All small objects shall be identified and taken out for sorting in the relevant fraction. Examples: cigarette butts, tops, paper clips, capsules and button batteries

STEP 5. MANUAL SORTING, cont'd

- Take photos of the work and the fractions . This is useful for the reporting work
- Weigh all fractions after the sorting is done.
- Fill in the weighed numbers in the protocol (see the Project Report, Appendix 1.2)



STEP 6. ANALYSIS

- **Put together documentation from the sorting analyses** including purpose, methodology, background information about the areas and the waste, the achieved results and photos
- **Calculate the relevant results of the sorting operation**
 - Calculate the share of each fraction by dividing the weight of the fraction by the weight of the total sub-sample. Give the results in %
 - Calculate the average value for all 5 sub-samples of each fraction
 - Calculate the standard deviation of the 5 sub-samples for each fraction, (see the [Project Report](#), Appendix 1.3)
 - **Make corrections for moisture and dirt**
 - To avoid too high weights for wet or dirty packaging , standard correction factors can be used to compensate this. The measured weight is multiplied with the below to get the dry/clean weight:
 - Packaging of paper and plastics 0,56
 - Metal packaging and newsprint 0,65
- **Make comparison with other results of sorting analyses, if any**
- **Analyze possible sources of errors; examples:**
 - Difficulty in defining a representative analyze area
 - Unwanted waste like bulky, industrial, etc. in the bins
 - The truck didn't follow the decided route
 - The mixing is not done properly
 - Considerable amounts of special waste, such as leaves, soil, etc.
 - Seasonable effects of the waste compositions
- **Write a report which should contain all documentation**, important observations/conclusions and a discussion about possible error sources and their effects on the results

STEP 7. CLOSURE OF THE SORTING PROJECT

- **Save excess materials** like bags, containers, paper rolls, etc. for future tests
- **Clean all plant and equipment** carefully with cleaning agents and water
- **Clean floors and tipping area** with water and brushes
- **Make sure no waste or other debris is left on the site**

TENTATIVE SCHEDULE

DAY 1: 7 June

- **10 pm – waste collection for TEST 2 (villas, curbside bins)**
5 districts with geographical spread, ca 30 collection points, 3 bins per collection point = 90 bins, total over 5 tons

DAY 2: 8 June

- early morning - Unloading of TEST 2 truckload at Sorting station mixing area, Nubarashen
 - Mixing with JCB, putting in string, taking out 5 samples of 100 kg each, each sample in one bin (660 L)
- **6 am - Weighing and Sorting**
- **10 pm – waste collection for TEST 3 (commercial, bins)**
20 collection points, 4 bins each = 80 bins (ca 70 kg/bin), total ca 5 tons

DAY 3: 9 June

- early morning - Unloading of TEST 2 truckload at Sorting station mixing area, Nubarashen
 - Mixing with JCB, putting in string, taking out 5 samples of 100 kg each, each sample in one bin (660 L)
- **6 am - Weighing and Sorting**
- **8 am – collection for TEST 1 (multistory buildings, chutes)**
5 districts with geographical spread, 10 chutes in each district, 50 collection points, 2 bins per chute = 100 bins

DAY 4: 10 June

- early morning - Unloading of TEST 2 truckload at Sorting station mixing area, Nubarashen
 - Mixing with JCB, putting in string, taking out 5 samples of 100 kg each, each sample in one bin (660L)
- **6 am - Weighing and Sorting**
- **Final documentation, lessons learned**

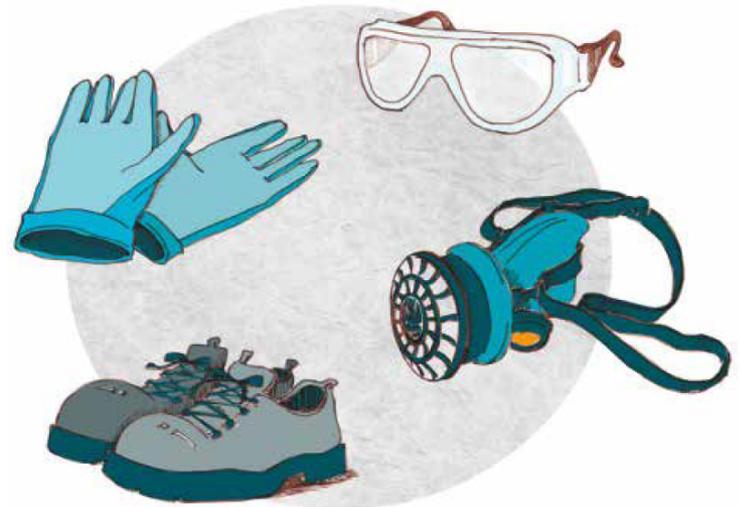
LIST OF EQUIPMENT

- Minimum 1 waste truck with minimum 6 ton capacity
- A front-end loader or similar to mix the waste and to take out samples
- A weigh-bridge to record the weight of the truck load
- A surfaced area where garbage can be unloaded from trucks and be mixed , or a large tarpaulin.
Minimum size 10x10 m.
- Roofing, preferably a building, electrical light
- Sorting tables - about 2-3 m² table area per sorting staff. Table should be water resistant, easy to clean and with holes to allow waste fractions to be dropped into bags/containers
- Electronic scale with 0,1 kg accuracy
- A number of paper bags and small containers (bucket size an upwards) for solid waste
- Plastic bags , minimum 100 l
- Tape to fix the bags at the table
- A pair of heavy scissors to separate various material - Sharp knife to open waste bags
- Shovels and small spades to handle waste and fractions
- A magnet to separate magnetic metals from non-magnetic
- A 10 mm sieve
- Marking pens for plastic and paper surfaces - Sorting protocol and pen
- Mobile phone with camera
- Wet napkins for hand cleaning - Disinfection liquid to clean table and equipment
- Dish brush and rags for cleaning - Dish washing liquid
- Brooms and brushes for cleaning floors and other surfaces

LIST OF SAFETY EQUIPMENT FOR STAFF

- Overall or jacket/trousers which protect against moisture and sharp objects
- Disposable overall
- Rubber aprons
- Heavy shoes with steel front top and nail protection
- Thick gloves which give protection against sharp objects, injection needles, etc.
- Fresh air mask or other breathing protection with gas filter, extra filters
- Eye protection glasses
- Hearing protection
- Eye wash
- Anti-bacterial wash for hands and face
- First aid kit

- All staff should be vaccinated against tetanus, polio and hepatitis A.



EXTRA SLIDES

Recyclables

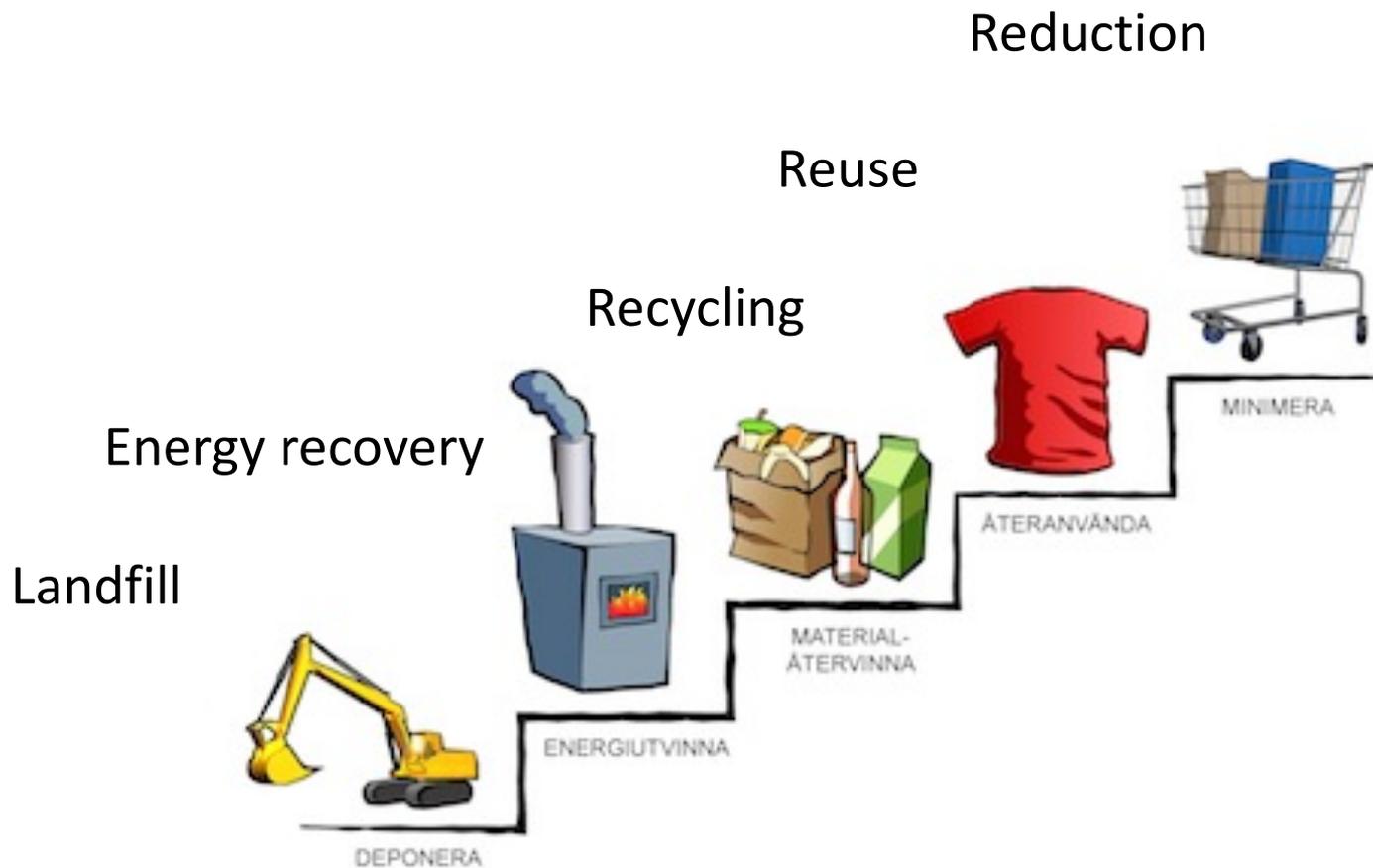


Collection of recyclable wastes in two-compartment truck



Avfallshantering i skärgården <https://www.youtube.com/watch?v=XrcrX9Qaw2o> (1,5 min)

EU Waste Hierarchy

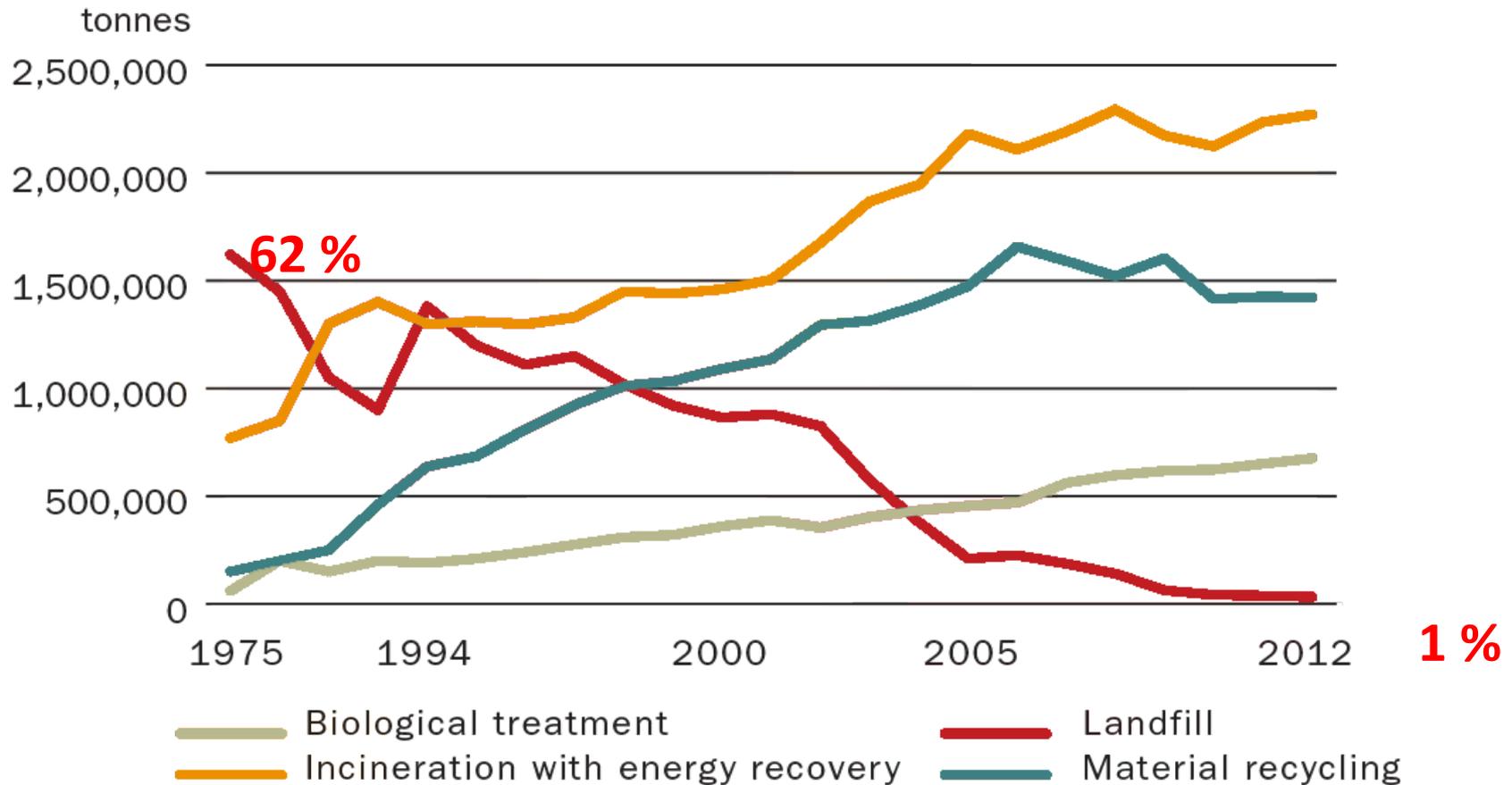


EPR – collection of recyclables

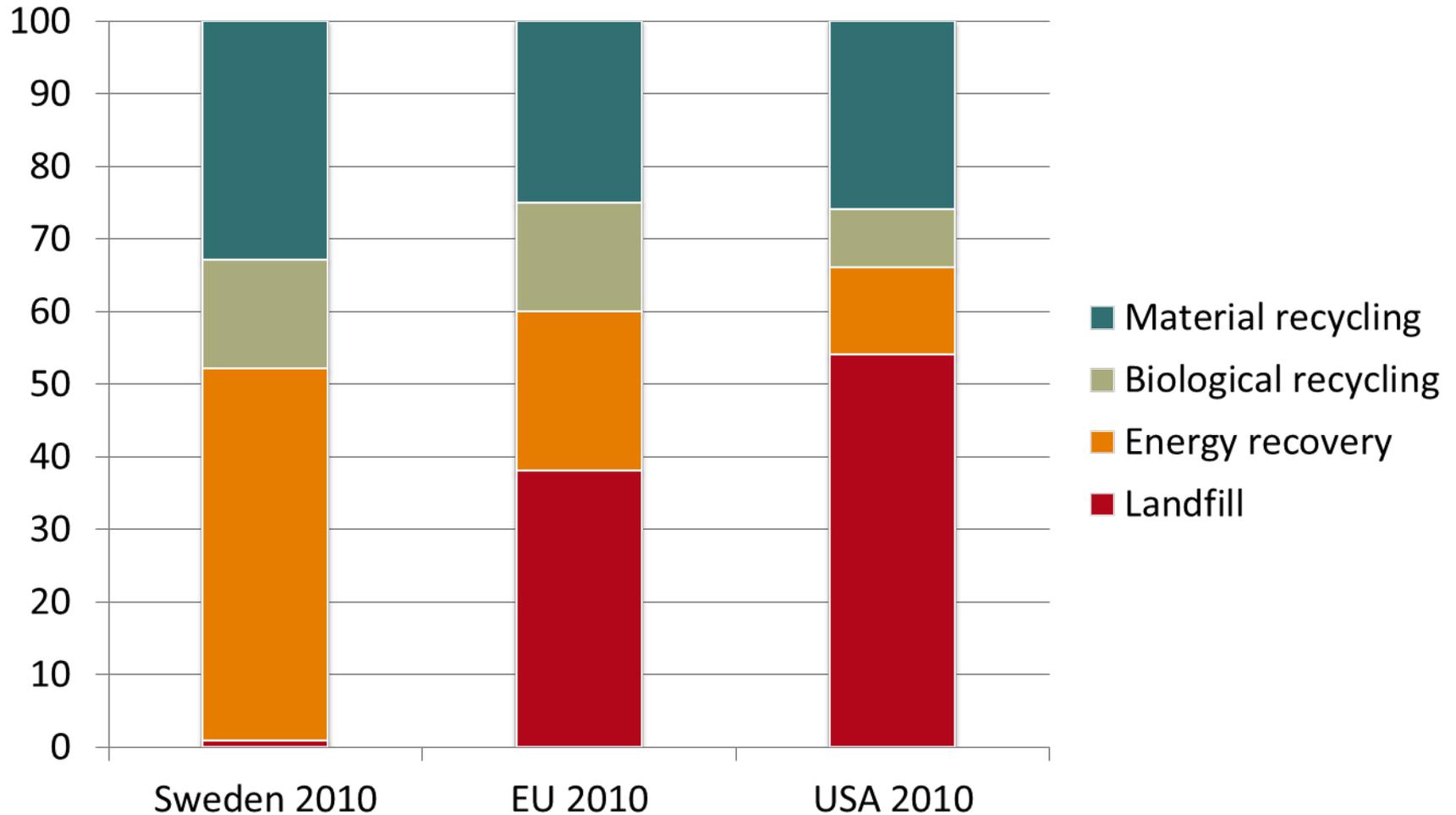


Sweden – 1% to landfill

OVERVIEW 1975-2012



Waste treatment in Sweden vs EU and USA



Halmstad avfallsförbränning <https://www.youtube.com/watch?v=6jismGMFqwFw>

Så här mycket energi sparar man på att använda återvunna råvaror istället för nytt material

1 återvunnen burk = ett dygns användning av datorn

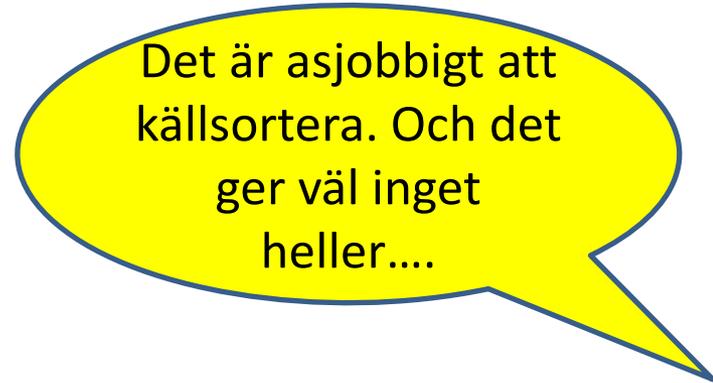
En påse matavfall = köra bil i 2,5 km

11 återvunna burkar = 5 min varm dusch

1 kg tidningar = nästan 5 månaders mobiltelefonsamtal

300 miljoner återvunna värmeljus kan värma 8500 hus

Metall och glas kan återvinnas hur många gånger som helst,
Varje pappersfiber kan användas 7 gånger i olika produkter.



Kjell Sortering <https://www.youtube.com/watch?v=c9XRhYViF44>

Halmstad avfallsförbränning <https://www.youtube.com/watch?v=6jsmGMFqwFw>

Waste fractions



Returpapper – Tidningar- Pappersförpackningar – Wellpapp
80-90% återvinns

Så här återvinns papper IL Returpapper <https://www.youtube.com/watch?v=p8tSAwVSFWo>



Metallförpackningar
73% återvinns



Plastförpackningar
30% återvinns, resten går till förbränning för produktion av el och värme



Glasförpackningar
70% återvinns

Om glasåtervinning FTI <http://www.ftiab.se/187.html>



Waste collection trucks can be fueled with biogas or HVO (renewable diesel from organic waste)

Telge Återvinnings Gröna Påsen <https://www.youtube.com/watch?v=2hScsJl1oJ0>

Jönköping <https://www.youtube.com/watch?v=l7pCY7NZ0J8> Kjell biogass

Waste collection in Yerevan (2013)



Waste collection in two fractions



Waste collection in Yerevan (2013)



Source-separation of waste



South Africa



Indonesia



Maldives



Philippines

