Welcome to the MSW Webinar Series
Part I: Key Factors for a Successful MSW Collection Service

THE WEBINAR WILL START SHORTLY
PLEASE MUTE YOUR MICROPHONE AND KEEP YOUR WEBCAM SWITCHED OFF

Mitigating SLCPs from the Municipal Waste Sector
http://waste.ccac-knowledge.net/
MSW Webinar Series
Part I: Key Factors for a Successful MSW Collection Service

Mitigating SLCPs from the Municipal Waste Sector
http://waste.ccac-knowledge.net/
Presenters

City of Vienna (MA48)

Urban Ecology Agency of Barcelona

ISWA

CIC – Italian Composting Association
WHAT IS WASTE COLLECTION
Different definitions of municipal solid waste

- **Urban waste** (f. ex. IT, SP, AU, FR, etc.)
  
  Includes waste collected from households and commercial activities
  
  All waste producer are served by a municipal collection service

- **Household waste** (D, UK, USA, others)
  
  Waste is collected mainly from households only and a limited amount of commercial activities
  
  Larger commercial activities are served with specific collection service on contract-base (PAYT....)
What waste streams are usually collected as MSW

- Residual waste or mixed MSW
- Food waste and Green Waste (Depending on the model collected separately, specially wood green fraction)
- Dry Recyclables and Packaging waste (paper- cupboard, glass, metals, plastics)
- Bulky waste
- Hazardous waste (i.e. batteries, pharmaceuticals, etc.)
- WEEE
- Textiles and shoes

Packaging waste often not collected as/with MSW
Which waste streams are collected as MSW

- Effectiveness for specific collection schemes do affect the organization of other collections.
- Example 2: when the biowaste collection is introduced, the quality and quantity of the other dry fractions increase + reduction of residual waste.

→ Integrated MSW management (do not look at one collection scheme only!)
COLLECTION SERVICES AND MSW PRODUCTION
GDP USD/pct VS MSW kg/pct

MSW and wealth

- MSW rises with GDP of an Economy
- Other factors can influence MSW arising (or decreasing)
  - Prevention policy and home composting experiences
  - Collection schemes
  - Amounts of commercial and industrial waste collected as MSW
  - Increase of packaging, WEES, textiles and furniture
  - Deliveries of industrial waste to the MSW collection schemes
  - Excessive deliveries of yard waste, construction and demolition waste
  - Application of PAYT schemes
  - Tourism affluence
Italy: MSW production and GDP

![Graph showing MSW production (kg/inhab/y) vs. GDP per inhabitant (mill Lit/y) for different regions in Italy. The equation $y = 0.0823x - 7.7748$ with $R^2 = 0.4367$ is shown.]](image)
Italy: MSW increase due to changes in collection services
The two collection schemes in place in Lombardy

Collection scheme
Road containers
Kerbside
## Collection scheme comparison

<table>
<thead>
<tr>
<th>Collection scheme</th>
<th>N municipalities</th>
<th>Average % Separate Collection Rate</th>
<th>Overall MSW per capita</th>
<th>Normalized overall costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road container</td>
<td>424</td>
<td>32,8%</td>
<td>564,0</td>
<td>€ 77,46</td>
</tr>
<tr>
<td>Kerbside, WITH food waste separation</td>
<td>690</td>
<td>62,3%</td>
<td>445,2</td>
<td>€ 74,55</td>
</tr>
<tr>
<td>Kerbside, NO food waste separation</td>
<td>360</td>
<td>44,8%</td>
<td>446,7</td>
<td>€ 66,35</td>
</tr>
</tbody>
</table>
Collection schemes with excessive deliveries of green waste

MSW arisings VS collected yard waste - Cremona District

\[ y = 1.4878x + 369.73 \]

\[ R^2 = 0.2675 \]
How to assess performances of a collection route?

- **Amounts: kg/inhab or kg/hh**
  - Example from Catalunya: food waste in Barcelona 77kg/inhab/y
  - Example from Germany: biowaste in München 51kg/inhab/y
  - Example from UK: biowaste in Bristol 68kg/inhab/y

- **Amounts per collection crew: kg/h or kg/day**
  - Example from Italy: Cinisello (MI)
    - Food waste crew → collects max 3.7ton/operator/day
    - Plastic waste crew → collects max 1ton/operator/day
How to assess performances of a collection route?

- Cost: €/inhabit or €/HH or €/t
- Amounts per collection crew: kg/h or kg/day
Cost analysis with different parameters

- cost/kg
- cost/inhabitant
- cost/hh

**Suitable for:**
- different treatment option
- different materials collected with same schemes (f.ex. dry recyclables)

**Distorted by:**
- overall production of MSW
- reduction strategies (f.ex Home composting
- municipal dimension (optimising schemes on larger scale)
Cost analysis with different parameters

- cost/kg
- **cost/inhabitant**
- cost/hh

**Suitable** for:
- different municipalities
- reflects the cost-charge relation
- independent from specific MSW production

**Distorted** by:
- non-domestic users
- non-residents and tourists
Comparison between different cost-assessments

Specific waste production:
- RC 456 kg/inhab/y
- DD 235 kg/inhab/y
Lessons to be learned

- Cost-assessment per unit weight NOT the best indicator – cost per inhabitant (or household) much more significant
  - At a given cost per inhabitant, waste minimisation might misleadingly show a higher “cost per tonne”
  - Higher cost per kilo of biowaste exerts a positive effect on lower costs for residual waste
DIFFERENT COLLECTION SCHEMES
The integrate MSW scheme

1. Collection at the kerbside (for strategic fractions)

2. Collection with bring-banks or road-containers

3. Municipal Collection Centers (drop-off)

4. Collection on Demand
MSW different composition - affects the collection services

- Different composition depending on the country and evolution tendency of the composition: initially more biowaste flows and as the country evolves WEES, CDW, plastics and other fractions increase
MSW different composition- affects the collection services

So the key fractions to consider:

- Biowaste (food waste)
- Green waste (specially pruning)
- Light packaging
- Bulky materials-WEEE
- CDW
Achievable separate collection rates for different schemes-systems

- Kerbside collection & PAYT charges
- Kerbside collection for food-, residual waste and packaging waste
- Roac container collection & some kerbside collection
- Roac container collection incl. food waste
- Road container collection
The integrate MSW scheme (examples)

1. Collection at the kerbside (for strategic fractions)
   - Residual waste
   - Food waste

2. Collection with bring-banks or road-containers
   - Glass banks
   - Batteries

3. Municipal Collection Centers (drop-off)
   - Bulky waste
   - Garden waste

4. Collection on Demand
   - WEEE
   - Large bulky waste
## Collection of foodwaste

<table>
<thead>
<tr>
<th></th>
<th>Bulk</th>
<th>Door to Door</th>
<th>Road container</th>
<th>Municipal collection center</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bins &amp; buckets</strong></td>
<td>- - -</td>
<td>20-30 liter</td>
<td>240 liter</td>
<td>Container (as emergency point for DtD)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>120-240 liter</td>
<td>2000 liter</td>
<td></td>
</tr>
<tr>
<td><strong>Amounts (kg/inhab)</strong></td>
<td></td>
<td>50-120 kg</td>
<td>20-70kg (mixed with green waste)</td>
<td></td>
</tr>
<tr>
<td><strong>Quality</strong></td>
<td>+++</td>
<td>+</td>
<td>+++</td>
<td></td>
</tr>
<tr>
<td><strong>Q-check (at waste producer)</strong></td>
<td>Easy</td>
<td>Critical</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Vehicles</strong></td>
<td>Non-compacting</td>
<td>Compacting</td>
<td>Fork-lift or non-compacting</td>
<td></td>
</tr>
</tbody>
</table>
## Collection of foodwaste

<table>
<thead>
<tr>
<th></th>
<th>Bulk</th>
<th>Door to Door</th>
<th>Road container</th>
<th>Municipal collection center</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bins &amp; Buckets</strong></td>
<td></td>
<td><img src="image" alt="Bin" /></td>
<td><img src="image" alt="Road Container" /></td>
<td><img src="image" alt="Municipal Collection Center" /></td>
</tr>
<tr>
<td><strong>Vehicles</strong></td>
<td></td>
<td><img src="image" alt="Vehicles" /></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Collection of residual waste

<table>
<thead>
<tr>
<th></th>
<th>Bulk</th>
<th>Door to Door</th>
<th>Road container</th>
<th>Municipal collection center</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bins &amp; buckets</strong></td>
<td>-</td>
<td>Bags, buckets, bins</td>
<td>600-3200 liter</td>
<td>Not done (as emergency point for DtD)</td>
</tr>
<tr>
<td><strong>Amounts (kg/inhab)</strong></td>
<td>70-150kg/inhab</td>
<td>100-400 kg/inhab</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Applying PAYT charges</strong></td>
<td>Possible</td>
<td>Possible</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Producer responsibility</strong></td>
<td>medium</td>
<td>low</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Vehicles</strong></td>
<td>compacting</td>
<td>compacting</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Collection of residual waste

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Bins &amp; Buckets</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Vehicles</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Collection of recyclables: glass

<table>
<thead>
<tr>
<th></th>
<th>Bulk</th>
<th>Door to Door</th>
<th>Road container</th>
<th>Municipal collection center</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bins &amp; buckets</td>
<td>-</td>
<td>Bags, buckets, bins</td>
<td>120-240liter</td>
<td>5000-20000 liter</td>
</tr>
<tr>
<td>Amounts (kg/inhab)</td>
<td>20-40kg</td>
<td>10-30kg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quality</td>
<td>+++</td>
<td>+</td>
<td></td>
<td>+++</td>
</tr>
<tr>
<td>Q-check (at waste producer)</td>
<td>Easy</td>
<td>Critical</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vehicles</td>
<td>Non-compacting</td>
<td>Non-compacting</td>
<td>Non-compacting</td>
<td>Non-compacting</td>
</tr>
</tbody>
</table>
Collection of recyclables: glass

<table>
<thead>
<tr>
<th></th>
<th>Bulk</th>
<th>Door to Door</th>
<th>Road container</th>
<th>Municipal collection center</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bins &amp; Buckets</td>
<td></td>
<td><img src="image1" alt="Bin Image" /></td>
<td><img src="image2" alt="Bin Image" /></td>
<td><img src="image3" alt="Bin Image" /></td>
</tr>
<tr>
<td>Vehicles</td>
<td></td>
<td><img src="image4" alt="Vehicles Image" /></td>
<td><img src="image5" alt="Vehicles Image" /></td>
<td><img src="image6" alt="Vehicles Image" /></td>
</tr>
</tbody>
</table>
Models of surface containers for street collection

• On the surface

  • Rear loading (4-wheels-containers 700l, 1000l, 1700l; 2-wheels bins 90l, 120l, 240l, 360l, 660l)

  • Lateral loading (2400l, 3600l)

  • Bi-compartmented (impurities problems)

  • Igloos (made of metal 3000l, 5000l or plastic 2500l, 3000l)

  • Bilateral Loading (Easy 1800l, 3200l)

• Semi-undergrounded

  • Moloks
Focus on high-tech solution

- Underground systems
- Vacuum systems

Main Remarks:

- High investment cost and maintenance
- Suitable for high-density areas only for high-income countries (specially new constructed urban zones)
Underground containers systems

Strong points

1. Free up public space
2. Reduction of the visual impact (surface elem.)
3. Big capacity storage
4. Fix location (can avoid complains and displacements cause by car parking).

Weak points

1. Cost
   • Higher investment cost vs surface containers
   • Civil work costs for installation.
   • Higher maintenance cost vs surface containers
3. Low flexibility (location, system modifications)

4. Underground occupation (conflicts with other services)
5. More capacity/point can suppose less delivery points and more distance for users.

6. Traffic affectation (higher downloading time).

7. Limitation of the delivery holes/boxes. Presence of waste around /need for complementary cleaning service

8. Negative influence on the user (waste seems to disappear)
### Calculation for Sant Just Desvern municipality in Catalonia

#### Rear loading containers vs Underground containers

<table>
<thead>
<tr>
<th></th>
<th>Rear loading containers</th>
<th>Underground containers</th>
<th>% variation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operation cost</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total collection cost/Litre</td>
<td>0.16</td>
<td>0.30</td>
<td>84%</td>
</tr>
<tr>
<td>installed (without cleaning)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collection cost/Litre</td>
<td>0.14</td>
<td>0.19</td>
<td>35%</td>
</tr>
<tr>
<td>installed (without maintenance + amortization + renting + taxes)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maintenance cost – new offer</td>
<td>0.03</td>
<td>0.06</td>
<td>100%</td>
</tr>
<tr>
<td>/ Litre installed €/L</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Civil work</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Civil work cost (per container) €</td>
<td>-</td>
<td>3.000</td>
<td></td>
</tr>
<tr>
<td><strong>Investment cost</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Truck cost (21m³) €</td>
<td>169.000</td>
<td>215.000</td>
<td>27%</td>
</tr>
<tr>
<td>Container €</td>
<td>260</td>
<td>6.000</td>
<td>2.208%</td>
</tr>
<tr>
<td>Service life</td>
<td>5</td>
<td>15</td>
<td>200%</td>
</tr>
<tr>
<td>€ container, equivalent per</td>
<td>2.340</td>
<td>6.000</td>
<td>156%</td>
</tr>
<tr>
<td>service life and litre</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>installed</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Annex PROGREMIC 2007-2012 – Catalonia Waste Plan

#### Time for emptying

<table>
<thead>
<tr>
<th></th>
<th>Rear loading containers</th>
<th>Underground containers</th>
<th>% variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time for emptying each point</td>
<td>40</td>
<td>120</td>
<td>200%</td>
</tr>
<tr>
<td>(s)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time for emptying per</td>
<td>120</td>
<td>120</td>
<td>0%</td>
</tr>
<tr>
<td>equivalent installed capacity</td>
<td></td>
<td></td>
<td>Finally same time</td>
</tr>
</tbody>
</table>
Static Vacuum systems

Strong points
1. Free up public space, less visual impact
2. Reduction bad odours
3. Reduction of acoustic contamination
4. With delivery holes/boxes installed in the building, more participation

Week points
1. Very high civil work and investment costs
2. Need for the collection central location
3. Difficult to extend/modify the service once installed
4. Negative influence on the user (waste seems to disappear)

Alternative: MOBIL SYSTEM
Comparison: vacuum vs containers in Vitoria (Basque County, Spain)

• **Investment 11 times higher vacuum** (amortization 30 y+ amortization compactor transport), vs containers (amortization 8 y).

• **Operation cost 20% higher vacuum vs containers.**

• **Energetic consumption 2,95 times higher per ton vacuum vs containers.**
Comparison for other big city (Spain)

Energy consumption MJ/t

- Bilateral
- DtD
- Rear
- Vacuum small network 1
- Vacuum small network 2
- Vacuum big network 3
- Vacuum big network 4
- Vacuum big network 5

% impurities in biowaste in red

Waste capture

Biowaste+ Residual

• Average vacuum networks study 0.4-0.5 kg/inhab/d
• Average other systems 0.8-1 kg/inhab/d
The role of municipal collection centers/other services
Fix collection centers

• Collection of recyclables, re-usables, hazardous, bulky materials, green wastes, etc (basically materials non solicited in street collection. Also used as emergency points in DtD systems.

• When these centres are outside the city the household deliveries are low, more participation of small industrials and economic activities

• Low costs of operation per ton
Mini-centres or neighbourhood centers

- Service more close to the citizen, more deliveries from waste-producers
- Important success in the municipalities already implemented
- Complementary to the fixed collection center, also can be used as reutilization/exchange centers.

Collaborative centers

- Private collection services associated to the Council, usually managed by past scrap dealers. Similar functions as mini-centers.

Micro-points/collection panels (small sized wastes)
Mobile collection points

- To be applied for
  - Small amounts
  - Hazardous waste
  - On specific calendar events
Mobile collection points

- Vehicle equipped with different containers
  - Collection at specific waste producers
  - Collection during weekly markets
  - Established route with timetable stop points
  - Collection on demand
  - Collection in low-density pop zones
## Cost of collection centers

### Investment

<table>
<thead>
<tr>
<th>Type of collection centre</th>
<th>Investment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobile- auto-charging container</td>
<td>35,669.39 €</td>
</tr>
<tr>
<td>Mobile-bodywork on truck</td>
<td>81,141.75 €</td>
</tr>
<tr>
<td>Mini-collection centre</td>
<td>85,354.79 €</td>
</tr>
<tr>
<td>Basic collection centre</td>
<td>107,201.64 €</td>
</tr>
<tr>
<td>Collection centre type A -625 m²</td>
<td>212,259.31 €</td>
</tr>
<tr>
<td>Collection centre type B -2.275 m²</td>
<td>399,511.32 €</td>
</tr>
<tr>
<td>Collection centre type C -4.500 m²</td>
<td>716,034.57 €</td>
</tr>
</tbody>
</table>

### Operation

<table>
<thead>
<tr>
<th>Municipality in Catalonia-16,000 inhab (2009)</th>
<th>Cost/y</th>
<th>kg</th>
<th>€/t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fix Collection centre</td>
<td>50.193</td>
<td>2,410,556</td>
<td>21</td>
</tr>
<tr>
<td>Collection Residual-Biowaste (road-container)</td>
<td>380.294</td>
<td>4,883,440</td>
<td>78</td>
</tr>
</tbody>
</table>
Other services
Collection of green wastes/pruning

Priority systems (considering characteristics and generation periodicity)

- Home composting
- **Shredded and** used as bulking for home composting or *mulching*
- Composting in open piles

When that is not possible, the green wastes can be collected using:

- Door-to-Door collection or on demand collection
- Established **delivery points** on street
- **Big capacity container** in strategic points (permanent or in pruning periods).
- Collection centers

Shredding is an oblige operation to optimise the collection and management of pruning
Commercial collection

• Application of rules that oblige activities to contract private services or adhere to public services provided by councils.
• Obtaining good results of quantity and quality, contribution to improve total selective rate.
• Extended use of door-to-door systems (especially residual-biowaste, cardboard)
• Using weight and identification systems to apply collection taxes by generation.

<table>
<thead>
<tr>
<th>Model</th>
<th>Characteristics</th>
<th>Priority scopes</th>
</tr>
</thead>
</table>
| Integrated model    | Low costs
Using same containers and service as households  | Low density commercial zones
Activities with low generation similar as HH          |
| Mix model           | Medium costs
Using own containers but same service as households| Medium density commercial zones,
medium density of HH
Medium and big producers |
| Segregated model    | High costs
Using own containers and specific collection service| High density commercial zones,
high density of HH
Big producers       |
| Model combinations  | Depending on the needs                               | Municipalities with zones combination               |
Comparison of collection efficiency of different collection models: the case of food waste in Catalunja
Generation/Selective collection

Generation 4M t/y
1.48kg/inhab/y- Reduction of generation per habitant since 2008
40,62% selective collection- experimented an increase when the landfill tax was introduced and new increment expected when tax rises (until 50€/t in 2020 )
25% proportion of SC of biowaste, 24% paper, 24 others
Success in capture rate depending on the model: biowaste

<table>
<thead>
<tr>
<th></th>
<th>DtD</th>
<th>Containers</th>
<th>Commercial</th>
<th>Mix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Captures</td>
<td>282 g/hab·día</td>
<td>128 g/hab·día</td>
<td>128 g/hab·día</td>
<td>128 g/hab·día</td>
</tr>
<tr>
<td>%</td>
<td>5.2%</td>
<td>14.7%</td>
<td>5.6%</td>
<td>10.3%</td>
</tr>
</tbody>
</table>

DtD systems:
- Higher captures
- Less impurities
Success of biowaste collection in comparison to other countries

Catalonia obtains good results but lower rates for biowaste in comparison to other countries like Germany or Italy (and higher % of impurities). Future improvements:

- Extension of DtD systems, PAYT charges
- Increase of the landfill tax to promote the participation in separate collection
- Other complementary measures: communication, grants, etc.
Comparative study of cost for Door-to-Door vs Container

Study comparing cost of DtD vs Containers systems in Catalanian municipalities (80)

Result: final balance of costs is almost equivalent

El estudio se fundamenta en datos reales de 81 municipios catalanes de hasta 20,000 habitantes, de los cuales 41 con recogida puerta a puerta y 40 con recogida en contenedores.

Para la comparación entre ambos modelos el indicador que se ha considerado más adecuado es el coste global de gestión por habitante empadronado. El coste global de gestión se calcula de la siguiente manera:

\[
\text{Coste global de gestión} = \text{Costes de recogida} + \text{costes de tratamiento} - \text{ingresos}
\]

Associació Municipis Catalans per la recollida selectiva porta a porta y Fundació ENT, 2013
Applying PAYT charges

- The fee must be simple and understandable
- The fee must interact easily with the collection system (cost convenient)
- Avoid additional cost for measurement systems
- The fee must be simple and understandable
Identification and weighing systems

PAYT = (accountability to the waste generator thru)

- User identification
  - Volume based accounting
    - Chamber system (volume chamber)
  - Weight based accounting
    - Chamber system with weighing
- Bin identification
  - Individually assigned bin
    - Volume based accounting
    - Weight based accounting
      - Ident system
        - individual scheme
        - routine scheme
        - Pre-paid system
          - tag, sticker or token
          - pre-paid sack
Keep it basic and understandable!

- MSW management is a service → PAYT is the payment for the service
- Some PAYT scheme can (positively) influence the behaviour of waste producers:
  - Ex: Door to Door collection of residual waste + PAYT: collection frequencies drop from 1/week → 1/3 weeks
  - Advantage for collection service: collection done 1/month!!!
- Keep it simple and comprehensive
- Do not weight single grams…….
PAYT charges with kerbside collection

- Easy to apply
- Cost – convenient
- Volume base (fee fairness)

Pre-paid system: homologated bags or sticks

Pre-paid bags or RFID bags
PAYT charges applied on large containers

Different “chamber systems” to identify the user and measure the volume (or weight) delivered.
Simple tariff systems for kerbside collection

- Residual waste:
  - 4€/emptying
  - 20x year
  - 80€/household/year

- 4€/bag
  - 20x year
  - 80€/household/year

- 1,5€/bag
  - 15x year
  - 22,5€/household/year
Positive effects of this approach

- PAYT charges with door to door collection (volume based)
- Residual waste drops significantly (below 100kg/inhab/year)
- Households put waste on the kerbside less frequently (1/month)
- Collection of full bags/bins/buckets only
Q&A
DIFFERENT OPERATOR MODELS
Waste Collection in Vienna
– A successful model of the public sector

Martina Ableidinger, City of Vienna
Volkmar Kloud, City of Vienna
Operator Models

There are many ways to reach the goal:

Source of figure: Operator Models - Respecting Diversity
MD 48 – within the City of Vienna (politics – administration)
Main Tasks of MD 48

- collection of residual waste and recyclables (municipal waste)
- waste treatment
- street cleaning
- winter service
- vehicle fleet
Residual Waste - Vienna is responsible for the whole disposal chain

- Ca. 600,000 t/a residual waste, bulky waste etc.
  - incineration plant Flötzersteig
  - incineration plant Spittelau
  - incineration plant Pfaffenau
  - Fluidized bed incinerator 4

- Approx. 200,000 t/a residuals from incineration (ashes/slags)
  - Treatment of slags with separation of metals

- Approx. 280,000 t/a stabilized ash-, slag concrete
  - Landfill site Rautenweg
Importance of public owned and operated waste collection and treatment for the City of Vienna:

- guarantee of orderly waste collection, treatment and disposal at any time – independent of requirements or needs of private participants
  - no matter if it works profitably
  - no risk of insolvency

- orderly waste collection and treatment is essential and vitally important for large cities (prevention of epidemics etc.)

- continuity of know how, systems and long term focussed plans (e.g.: long term investments for incineration plants, vehicles, waste bins etc.)
432.000 Bins for Collection

<table>
<thead>
<tr>
<th>fraction</th>
<th>sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>residual waste</td>
<td>224.857</td>
</tr>
<tr>
<td>paper</td>
<td>95.042</td>
</tr>
<tr>
<td>glass (white + coloured)</td>
<td>6.757</td>
</tr>
<tr>
<td>metals</td>
<td>6.177</td>
</tr>
<tr>
<td>plastics</td>
<td>12.619</td>
</tr>
<tr>
<td>organic (incl. garden + kitchen waste)</td>
<td>86.255</td>
</tr>
<tr>
<td>sum</td>
<td>432.000</td>
</tr>
</tbody>
</table>
Collection Schemas

Municipal Waste collected by MA 48 (2013): 1,036,879 t = 587 kg /Inh.a

<table>
<thead>
<tr>
<th>Waste Category</th>
<th>kerbside collection</th>
<th>bring sites</th>
<th>recycling center</th>
<th>mobile collection hazardous waste</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(pick up collection)</td>
<td>(bring collection)</td>
<td>(bring collection)</td>
<td>(bring collection)</td>
</tr>
<tr>
<td>residual waste</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>organics</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>paper</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>glass</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>metal</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>plastics</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>other recyclables</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>WEEE</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X &lt; 50 cm</td>
</tr>
<tr>
<td>hazardous waste</td>
<td></td>
<td></td>
<td>X</td>
<td>X (&amp; kitchen oil)</td>
</tr>
</tbody>
</table>
4.300 Bring Sites for Recyclables
19 Recycling Centers

- recyclables
- hazardous waste
- WEEE
- bulky waste
- demolition waste
- flea market goods
- goods to sell
111 Collection Points for Hazardous Waste, Kitchen Oil & WEEE (88 Collection Stops, 24 fixed)
Collection Vehicles

total number of collection vehicles: 294
daily on duty: 256
reserve: 38
Fee system - example Vienna

Basis for fee charging

- charge for residual waste (depending on emptying interval & bin size)

120 l

residual waste

€ 4.41/emptying times 52 weeks

229.32 €/a per household

landlord pays for residual waste

City of Vienna

residual waste

waste call-center

fee covers

bio waste

collection for hazardous waste

paper + metals (non packaging)

recycling center
Financing - example Vienna

on behalf of legal order (Vienna Waste Management Act):

- Residual waste
- Bio waste
- Recyclables (non-packaging waste)
- Hazardous waste

=> - waste fee

on behalf of collection and recovery systems:

- WEEE
- Batteries

=> - waste fee

- Packaging waste

=> - full producer responsibility
Dust free waste collection - we are doing it for 95 years all the best for the future!
# Comparison: private vs public operators

<table>
<thead>
<tr>
<th></th>
<th>Strong points</th>
<th>Week points</th>
</tr>
</thead>
</table>
| **Direct management - public operator** | - More control of the service  
- More control of the staff  
- More capacity of reaction  
- More agility for applying service modifications and directives transmission | - More economic charge on the staff budget line  
- Necessity of staff and equipment management  
- Less capacity of investment or borrowing  
- Less capacity of replacing staff or equipment in case of incidences, or starting the service (until equips arrival) |
| **Indirect management - private operator** | - Less economic charge on the budget because of staff externalisation  
- More efficient/simple economic management  
- More capacity of investment or borrowing (especially for small municipalities) | - Use of technical resources for service definition, payment and monitoring  
- Less capacity for controlling the service, results and incidences  
- Less agility for applying service modifications and directives transmission  
- Less capacity of reaction |
Instruments to improve service and specially contracts with private operators* (1)

- Specific targets (separate collection, impurities levels, time to solve incidences, etc.) and clear definition of the services and quality in the public tender.*


- Control and monitoring system of the service.*

- External auditing service.*

- Remuneration to the company based on the service provided and its quality, as well as compliance with objectives. Clear remuneration request forms, including details of the services provided and any discount or extra service*

- Continuous improvement programs.
Instruments to improve service and specially contracts with private operators*(2)

- Traceability and certified weighing systems.
- Periodic characterizations of the different fractions collected.
- Periodic citizens surveys to assess the level of satisfaction, expectations and needs.
- Citizen call service (run by the operator in collaboration with the municipality).
- Specific annual budget dedicated to environmental education and specifically to prevention.
- Other important elements:
  - Flexibility to adapt to the continuous changes of the city: the cities are dynamic and so its planning.
  - Impact of the collection system on public space and people.
  - Image of the service / user-access / clarity of information
Importance of communication/information and participation

Information  Facilitation  Participation
DIFFERENT COLLECTION MODELS
Waste types and collection vehicles

A) No compaction
- Food waste
- Glass
- Batteries, Pharma.
- Bulky waste

B) Compaction needed
- Garden waste
- Paper & Card
- Plastic & Cans
- Residual waste
Cost of a collection vehicle

- Investment cost and amortization
- Fuel
- Oils
- Maintenance (ordinary and extraordinary)
- Others

→ Cost per year (or per day)

<table>
<thead>
<tr>
<th>Volume</th>
<th>16/18 m^3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total weight</td>
<td>13/18 ton</td>
</tr>
<tr>
<td>Axes</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Compactor, back-l</th>
<th>16 - 18 mc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment</td>
<td>€ 125,000,00</td>
</tr>
<tr>
<td>Ammortisation</td>
<td>7 years</td>
</tr>
<tr>
<td>Ammortisation</td>
<td>€ 16,400,00</td>
</tr>
<tr>
<td>Maitenance</td>
<td>€ 6,000,00</td>
</tr>
<tr>
<td>Fuel</td>
<td>€ 14,850,00</td>
</tr>
<tr>
<td>Oils and lubricants</td>
<td>€ 1,330,00</td>
</tr>
<tr>
<td>Tyres</td>
<td>€ 3,400,00</td>
</tr>
<tr>
<td>Insurance, taxes, etc</td>
<td>€ 1,650,00</td>
</tr>
<tr>
<td></td>
<td>€ 43,630,00</td>
</tr>
<tr>
<td>Working h/year</td>
<td>€ 2,080,00</td>
</tr>
<tr>
<td>Cost/h</td>
<td>€ 20,98</td>
</tr>
</tbody>
</table>
Cost of a collection vehicle

- Investment cost and amortization
- Fuel
- Oils
- Maintenance (ordinary and extraordinary)
- Others

→ Cost per year (or per day)
Cost of a collection vehicle

- Investment cost and amortization
- Fuel
- Oils
- Maintenance (ordinary and extraordinary)
- Others

→ Cost per year (or per day)

<table>
<thead>
<tr>
<th>Volume</th>
<th>5/7 m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total weight</td>
<td>3,5/7 ton</td>
</tr>
<tr>
<td>Axes</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Non-compacting skip</th>
<th>5-7 m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment</td>
<td>€</td>
</tr>
<tr>
<td>Ammortisation</td>
<td>7 years</td>
</tr>
<tr>
<td>Ammortisation</td>
<td>€</td>
</tr>
<tr>
<td>Maintenance</td>
<td>€</td>
</tr>
<tr>
<td>Fuel</td>
<td>€</td>
</tr>
<tr>
<td>Oils and lubricants</td>
<td>€</td>
</tr>
<tr>
<td>Tyres</td>
<td>€</td>
</tr>
<tr>
<td>Insurance, taxes, etc</td>
<td>€</td>
</tr>
<tr>
<td>€</td>
<td>19,425,00</td>
</tr>
<tr>
<td>Working h/year</td>
<td>€</td>
</tr>
<tr>
<td>Cost/h</td>
<td>€</td>
</tr>
</tbody>
</table>
Cost of a collection vehicle

- Investment cost and amortization
- Fuel
- Oils
- Maintenance (ordinary and extraordinary)
- Others

→ Cost per year (or per day)
Cost of waste-workers

- Country specific
- Low-income/high income countries
- Existence of National contracts
- Public/Private companies

<table>
<thead>
<tr>
<th>Country</th>
<th>Italy - Western Europe</th>
<th>Bulgaria - Eastern Europe</th>
<th>Chile - Latin America</th>
</tr>
</thead>
<tbody>
<tr>
<td>h worked</td>
<td>1877/year</td>
<td>2000h/year</td>
<td></td>
</tr>
<tr>
<td>Driver</td>
<td>€ 44.650,00</td>
<td>€ 6.144,00</td>
<td>€ 9.576,00</td>
</tr>
<tr>
<td>Driver/Collector</td>
<td>€ 41.350,00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collector</td>
<td>€ 37.350,00</td>
<td>€ 3.072,00</td>
<td>€ 5.745,60</td>
</tr>
<tr>
<td>Driver/Collector</td>
<td>120</td>
<td>200</td>
<td>167</td>
</tr>
</tbody>
</table>
Cost of waste workers and designing collection tours

- **Typical labour cost - Italy**
  - Vehicle cost: 71%
  - Waste workers cost: 29%

- **Typical labour cost - East-EU**
  - Vehicle cost: 81%
  - Waste workers cost: 19%
How to plan a separate collection route

Basic questions
- What type of waste?
- What population size
- What amount of waste?
- What frequencies (collections/week)?
- Distance from treatment plant?

Examples
- Residual waste
- 10,000 pop
- 2500ton/yr
- 2 collections per week with road containers
- 30-40 km
How to plan a separate collection route

- 500 road containers
- 1 Compactor (backloader) with
  - 1 Driver
  - 2 collectors

Examples
- Residual waste
- 10,000 pop
- 2500ton/yr
- 2 week
- 30 km
- With road containers
How to plan a separate collection route

<table>
<thead>
<tr>
<th>Personas</th>
<th>Inhab</th>
<th>10.000</th>
</tr>
</thead>
<tbody>
<tr>
<td>RSU kg/año</td>
<td>Waste kg/yr</td>
<td>2.500.000</td>
</tr>
<tr>
<td>RSU kg/semana</td>
<td>Waste/week (kg)</td>
<td>48.077</td>
</tr>
<tr>
<td>Zonas de recogida</td>
<td>Areas/Zones</td>
<td>3</td>
</tr>
<tr>
<td>Regogidas/semana</td>
<td>Collections/week</td>
<td>2</td>
</tr>
<tr>
<td><strong>RSU/Zona/semana</strong></td>
<td>Waste/week/zone (kg)</td>
<td><strong>8.013</strong></td>
</tr>
<tr>
<td>Contenedores</td>
<td>Road container</td>
<td>524</td>
</tr>
<tr>
<td>Contenedores/Zona</td>
<td>Containers/zone</td>
<td>175</td>
</tr>
</tbody>
</table>
How to plan a separate collection route

The collection team

<table>
<thead>
<tr>
<th></th>
<th>Compactor 16-18m^3</th>
<th>Compactor 16-18m^3</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autista</td>
<td>Driver</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Peon</td>
<td>Collector</td>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>

| Collection performance kg/Collector/h | 616 |

- The team works 2 days for each zone → **6 days = full employment**
- Collection performance 600 kg/operator/h
- The Driver will work also for transporting the waste from the collection Zone to the disposal site (35 km = 30-45 min drive)
How to plan a separate collection route

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>€/h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compactor 16-18m³</td>
<td>1</td>
<td>21,00</td>
</tr>
<tr>
<td>Autista/Driver</td>
<td>1</td>
<td>23,79</td>
</tr>
<tr>
<td>Peon/Collector</td>
<td>2</td>
<td>19,90</td>
</tr>
</tbody>
</table>

Cost for collection round € 581,31
Cost for collection €/t 72,55
Cost for collection €/inhab/yr 18,14
How to plan a separate collection route

**The collection route**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Personas</td>
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<td>Waste/week/zone (kg)</td>
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<td>Road container</td>
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<tr>
<td>Contenedores/Zona</td>
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<td>175</td>
</tr>
</tbody>
</table>

**The collection team**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Compactor 16-18m³</td>
<td>Compactor 16-18m³</td>
<td>1</td>
</tr>
<tr>
<td>Autista</td>
<td>Driver</td>
<td>1</td>
</tr>
<tr>
<td>Peon</td>
<td>Collector</td>
<td>2</td>
</tr>
</tbody>
</table>

Collection performance kg/Collector/h 616

**The collection cost**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>€/h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>Compactor 16-18m³</td>
<td>1</td>
<td>21,00</td>
</tr>
<tr>
<td>Autista/Driver</td>
<td>1</td>
<td>23,79</td>
</tr>
<tr>
<td>Peon/Collector</td>
<td>2</td>
<td>19,90</td>
</tr>
</tbody>
</table>

Cost for collection round € 581,31
Cost for collection €/t 72,55
Cost for collection €/inhab/yr 18,14

**Examples**

- Residual waste
- 10,000 pop
- 2500ton/yr
- 2coll/week
- 30 km
- With road containers
Labor intensive schemes: example on food waste collection

- Collection at the doorstep
- Buckets and bins
- Use of non compacting vehicles (for collection)
- Transfer
- Transport with packer-trucks
Labor intensive schemes: example on food waste collection

<table>
<thead>
<tr>
<th>notes</th>
<th>N°</th>
<th>Working-time h/day</th>
<th>Cost C/h</th>
<th>Partial cost in C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driver&amp;Collector satellite vehicle</td>
<td>4</td>
<td>6,25</td>
<td>€ 21,09</td>
<td>€ 527,25</td>
</tr>
<tr>
<td>Driver for 6 collection vehicles</td>
<td>1</td>
<td>2</td>
<td>€ 22,30</td>
<td>€ 44,60</td>
</tr>
<tr>
<td>Open skip satellite vehicle</td>
<td>4</td>
<td>6,25</td>
<td>€ 8,84</td>
<td>€ 221,00</td>
</tr>
<tr>
<td>Compactor for 6 satellite vehicles</td>
<td>1</td>
<td>2</td>
<td>€ 24,20</td>
<td>€ 48,40</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>t/day/crew</th>
<th>unit cost per crew</th>
<th>unit cost per t</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 per collection crew</td>
<td>€ 841,25</td>
<td>€ 105,16</td>
</tr>
<tr>
<td>308 kg/collector/h</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: D. Gotti, M. Ricci waste analysis on West Milan District
Labor intensive schemes: example on residual waste

- Collection at the doorstep with packer truck and open skip
- Bags (and containers)
- Use of compacting vehicles (for collection)
- Transfer into packer-truck
- Transport with packer-trucks
Labor intensive schemes: example on residual waste collection

<table>
<thead>
<tr>
<th>notes</th>
<th>Nº</th>
<th>Working-time h/day</th>
<th>Cost €/h</th>
<th>Partial cost in €</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driver compactor</td>
<td>1</td>
<td>8</td>
<td>€ 22,30</td>
<td>€ 178,40</td>
</tr>
<tr>
<td>Driver - skips satellite vehicle</td>
<td>2</td>
<td>6,5</td>
<td>€ 21,09</td>
<td>€ 274,17</td>
</tr>
<tr>
<td>Collector on compactor</td>
<td>1</td>
<td>6,5</td>
<td>€ 19,88</td>
<td>€ 129,22</td>
</tr>
<tr>
<td>Compactor for 2 satellite vehicles</td>
<td>1</td>
<td>8</td>
<td>€ 31,14</td>
<td>€ 249,12</td>
</tr>
<tr>
<td>Skip satellite vehicle</td>
<td>2</td>
<td>6,5</td>
<td>€ 8,84</td>
<td>€ 114,92</td>
</tr>
</tbody>
</table>

Source: D. Gotti, M. Ricci waste analysis on West Milan District

<table>
<thead>
<tr>
<th>t/day/crew</th>
<th>unit cost per crew</th>
<th>unit cost per t</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 per collection crew</td>
<td>€ 945,83</td>
<td></td>
</tr>
<tr>
<td>564 kg/collector/h</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
How to optimize use of fleets

<table>
<thead>
<tr>
<th></th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
<th>Saturday</th>
<th>Sunday</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone A</td>
<td>Food waste</td>
<td>Food waste</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 crew full time</td>
</tr>
<tr>
<td></td>
<td>Res. de comida</td>
<td>Res. de comida</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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Other means for waste collection

Horse-drawn vehicle for DtD collection.

According to the association Equiterra [www.equiterra.fr], a French association that promotes the use of energy of the horses in the territory, both urban and rural, the replacement of a waste collection truck for horse-drawn vehicle (hipomobil) can reduce CO2 emissions by 35%. With a investment and maintenance cost (food instead of fossil fuel) lower than motor vehicles and with a longer lifetime (15 years compared to the usual 8 years of vehicle), is presented as an interesting alternative. Also, they do not pollute and do not cause noise, which makes them even more attractive options.

Also other alternatives are donkeys, tractors, etc.
No roads for cars or trucks.....
Municipality of Castelbuono (Sicily)
Municipality of Castelbuono

- Collection done mainly with donkeys from towncenter to transferpoints
- Transport to composting plant done with non-compacting vehicles
- Collection of foodwaste done 3/week
- Most HH live in building up to 6 families
Transfer systems

- **Direct transfer:** A collection vehicle "satellite" download its content inside another rear loading vehicle of greater capacity.

- **Transfer point:** unloading at a dock, from a rear loading vehicle directly into a container or open box of 20-30 m³ which will then be transported.

- **Transfer facility:** collecting vehicle discharge directly into the transfer hopper, which feeds a compactor container.

- **Transfer area:** discharge of waste by the collection vehicle directly to the ground and then the residue is re-charged with a front-loader in a container or open box of 20-30 m³ which will then be transported.

- **Transfer in a collection center**
Application of transfer

- Areas where facilities are far from the generation points: advisable above 30 km and essential from 50 km away.
- Door to door systems using small vehicles (not compactors in some cases).
- Collection from rural areas with low weekly / monthly amounts.
- Fractions collected in low quantities with storage in collection centers: commercial cardboard collection, batteries in stores, pruning on demand, etc.
- Biowaste compaction due to its high density, would fail to reduce the volume and generate, unnecessarily, a large amount of leachates.
Q&A
Links to our organisations

- Urban Ecology Agency of Barcelona: [www.bcnecologia.net](http://www.bcnecologia.net)

- Waste Agency of Catalonia: ARC [www.arc-cat.net](http://www.arc-cat.net)

- City of Vienna [https://www.wien.gv.at/umwelt/ma48/](https://www.wien.gv.at/umwelt/ma48/)

- SCOW Project [www.scow-biowaste.eu](http://www.scow-biowaste.eu)

- CIC- Italian Composting and Biogas Consortium [www.compost.it](http://www.compost.it)

- ISWA : [www.iswa.org](http://www.iswa.org)

- ARS ambiente [www.arsambiente.it](http://www.arsambiente.it)

- City of Vienna [www.wien.gv.at/english/](http://www.wien.gv.at/english/)
Thank you

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  - Gemma Nohales: nohales@bcnecologia.net
  - Martina Ableidencyer: martina.ableidencyer@wien.gv.at
Please kindly provide your feedback on the webinar by filling in the very brief questionnaire

https://www.surveymonkey.com/s/RV66DMN