Investigating electric garbage trucks use for waste collection in urban and rural communities

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A purpose of this study

This study focuses on the novel electric vehicles that can be used for waste collections in urban and rural communities.

The key points we explore are:

• Availability of electric garbage trucks
• Possibility of replacement of the currently used vehicles
• Operational conditions
• Investment and operational costs
• Environmental and social benefits
• Disadvantages and weaknesses
Availability of electric garbage trucks

Electric garbage trucks are becoming a new category of vehicles offered by manufacturers of heavy trucks and light commercial vehicles for the collection of various categories of waste:

• **Heavy duty garbage trucks – fully electric**

• **Electric drive system that replaces the conventional auxiliary drive of a truck. The vehicle itself is driven by a diesel engine but chassis has electric motor**

• **Light commercial vehicles – Vans – numerous producers already offering broad range of these vehicles**
Replacement of the currently used vehicles - is it necessary and possible?

• Environmental issues - replacing older diesel vehicles with all-electric versions would be very helpful in reducing air pollution.

• Possibility of the delivery of the vehicles – from ordering to delivery;

• Existing infrastructure – charging stations, service points and for vehicle maintenance;

• Seasons of the year – influence on the humidity and temperature on the operation of a vehicle;

• Costs – purchase, use, service, end-of-life (recycling);
Operational conditions

• Various categories of waste
• Various vehicles required for the collections
• Various types of urban development and settings

Garbage truck

Light commercial vehicles
Technical parameters of an electric garbage truck

<table>
<thead>
<tr>
<th>Volvo FE Electric</th>
<th>Main parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of axes</td>
<td>3</td>
</tr>
<tr>
<td>Maximal power [peak/continuous]</td>
<td>400 kW/330 kW</td>
</tr>
<tr>
<td>Number of batteries</td>
<td>4</td>
</tr>
<tr>
<td>Batteries capacity</td>
<td>265 kWh</td>
</tr>
<tr>
<td>Energy recouperation unit</td>
<td>70 kW, 270 Nm</td>
</tr>
<tr>
<td>Charging time [quick-charge, standard]</td>
<td>1.5 h/ 11.5h</td>
</tr>
<tr>
<td>Nominal distance</td>
<td>120 km</td>
</tr>
</tbody>
</table>
Operational parameters – large city

- [%] – battery charge
  - Trace of the routing
  - 85.2%

- [kg] – mass of the collected waste
  - 5900 kg
Operational parameters – large city (more stops)

- [%] – battery charge
  - Trace of the routing
  - 133.4%

- [kg] – mass of the collected waste
  - 8000 kg
  - 4500 kg

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# Investment and operational costs of garbage trucks

<table>
<thead>
<tr>
<th></th>
<th>Diesel powered garbage truck</th>
<th>Electric garbage truck</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchase of a new vehicle</td>
<td>170,000 EUR</td>
<td>400,000 EUR</td>
</tr>
<tr>
<td>Leasing (5 years) payment per year</td>
<td>44,000 EUR</td>
<td>105,000 EUR</td>
</tr>
<tr>
<td>Operational cost per year Parts and service</td>
<td>6500 EUR 6300 EUR</td>
<td>8700 EUR ? – unknown *</td>
</tr>
<tr>
<td>Energy/fuel cost (average) Waste collection – per day</td>
<td>67 EUR</td>
<td>40 EUR</td>
</tr>
</tbody>
</table>

* Unknown costs of parts and frequency replacement for Electric garbage truck
Environmental and social benefits

- Decreased pollution, especially in densely populated areas – city centers
- Decreased noise during waste collections
- Possibility of energy recuperation
- Creation of environmentally friendly – zero emission waste collections
Disadvantages and weaknesses of electric garbage trucks

- More expensive than diesel powered vehicles
- High cost of batteries replacement
- Unknown durability of components (spare parts)
- Necessity to invest in charging stations
- Long time of charging batteries (comparing to filling the tank)
- Much higher risk of dangerous fire in case of accident
- Variations of distance depending on humidity and temperature
- Uncertainty of return to a company’s base in case of low battery level and traffic
Conclusions

• Waste collections can be supported by moder electric garbage trucks.
• Several manufacturers offer vehicles – fully electric or electric split bin lift
• Decision of purchase of the electric garbage trucks must be supported by multi-criteria analysis taking into consideration pros and cons of costs, environmental and social benefits and potential risks
• Tests conducted in municipalities in Poland indicated flexibility of operation and driving on a one battery charging per one shift
• Recouperation of electric energy is one of the greatest achievements in efficient operation
• The residents especially in densely populated communities would benefit zero-emission waste collections and decreased noise during a garbage truck movement and lifting the container
• Detailed tests in variable climates conditions are necessary for evaluation of the electric garbage trucks by the collection companies.
Thank you for your attention

Σας ευχαριστώ για την προσοχή σας
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