Mappost

Customized route and resource optimization solutions

# Making cities greener:

## how to reduce the environmental impact of municipal waste collection


eBook by Mappost

# Introduction

> ***The average European generates 502 kg of municipal waste a year (2019).***

This waste must be stored, collected, transported, sorted, processed, and disposed of. While a lot of attention is paid to what happens to waste on either end of its journey—are you sorting trash at home? How much waste is recycled?—the collection and transport part usually evades public scrutiny.

**It shouldn't.**

Waste collection and transport produces significant greenhouse gas emissions, as well as contributes to traffic congestion and noise pollution. Plus, the situation on the road is getting worse, not better – the number of refuse collection trucks is increasing as a side-effect to people sorting waste because now each fraction of waste requires either a specialized vehicle or repeat trips. On top of that, waste collection logistics costs constitute up to **50-85% of total waste management expenditures.**

The waste collection industry is generally resistant to standardization, given that each service provider operates in a unique environment and under different circumstances. It typically relies on legacy practices and, sometimes, outdated technologies to get the job done. As a result, more vehicles spend more time on the road, burn more fuel, cause more traffic jams, and cost taxpayers and customers more money.

> ***how route and logistics optimization can improve waste collection and transport***

In this eBook, we'll explore how route and logistics optimization can improve waste collection and transport, reducing its environmental impact and making it more cost-effective, while meeting the calls for increased digitization. We'll begin by taking a look at the challenges of waste management, set out the requirements for a modern route optimization solution, explain how such a solution works, and conclude with a framework for the evaluation of the state of waste management.

# Waste management challenges of today

Preventing waste from being created is the best way to reduce it. This is a top priority for the European Union, with various **directives** and **action plans** seeking to reduce the number of materials used in production, extend product lifespan, and ensure more efficient product design.

Still, **waste generated per capita is increasing** and with it grows the relevance of proper waste management and recycling in particular. As part of its Waste Framework Directive, the EU has set out a municipal waste recycling rate of 55% by 2025, improving incrementally to 60% by 2030 and to 65% by 2035.

# A side-effect of recycling - more trucks on the road

Among other things, this presents logistics and infrastructure challenges – citizens must have easy access to recycling containers, waste collection and transportation fleets must be expanded with suitable vehicles, and the capacity of recycling centers must be increased.

> ***The sorting of waste puts extra strain on the collection process and leads to an increase in refuse collection vehicles on the road.***

Where previously all waste was mixed and required a single trip, now different waste fractions need separate collection and transportation, resulting in more emissions, noise pollution, and traffic congestion.

This is generally viewed as an acceptable trade-off. The benefits of improved recycling outweigh the increase in environmental and operational costs. Nevertheless, to hinder these harmful side-effects, the EU is calling on member states to **optimize their waste collection logistics.**

# How to optimize waste collection logistics

There are several ways to optimize waste collection logistics – switching to a cleaner fuel (CNG, electric), using low-emission vehicles, installing Stop-Start systems, training drivers in eco-driving techniques. However, studies show that **optimized route planning is the single most impactful factor** that should be prioritized above everything else.

By using a modern solution that charts the most efficient trash pickup routes and provides drivers with the necessary information for speedy collection, it's possible to reduce vehicle time spent on the road, which, in turn, reduces the carbon footprint of waste collection and improves the cityscape for its inhabitants.


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# Key requirements of a comprehensive modern routing solution

A modern route optimization solution for efficient waste collection is much more complex than it may seem at first glance. It's more than just about getting from point A to point B to point C in the fastest way possible.

## The unique factors of waste collection

An efficient route solution must take into account and optimize for 3 key elements:

**Collection point specifics**

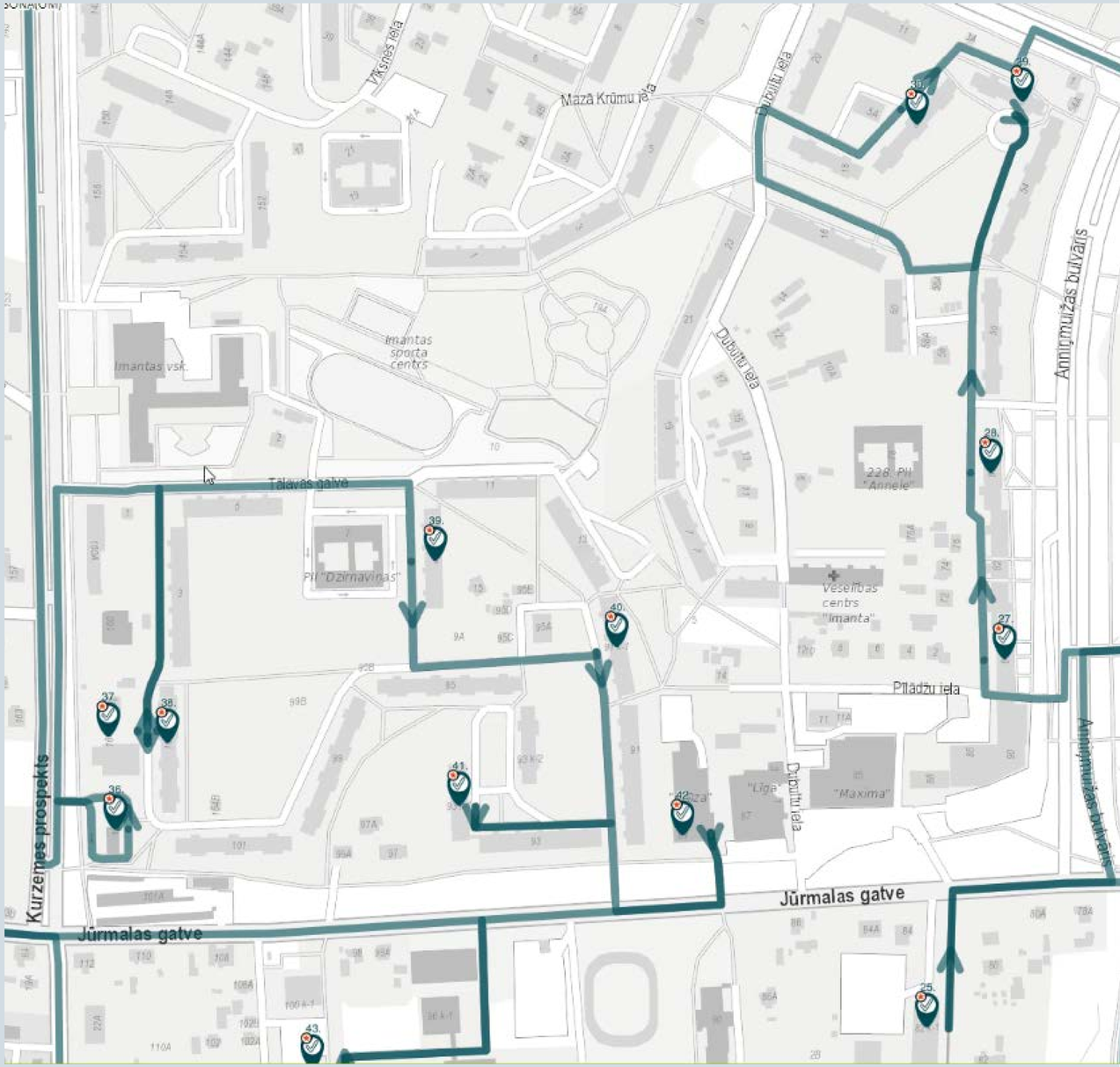
**Driving permissions and collection requirements**

**Idling periods**

Each of these things can affect collection efficiency and its environmental impact.

# 1. Collection point specifics

Drivers deal with a lot of non-standard scenarios on their collection routes. One of the most common ones is accessing waste containers in gated and restricted areas. Typically, the drivers will have an access code or a key, but sometimes they must call someone shortly before arrival to open the gate.



# 2. Driving permissions and collection requirements

There are several factors that are unique to waste collection and impact optimal route calculation:

**Special driving permissions –**
to assist with efficient waste collection, municipalities often allow refuse collection trucks to make turns that are illegal to other vehicles, drive in reverse through one-way streets, and move through private zones inaccessible to regular traffic. This means the system must be able to support the use of non-standard street-road networks and configurable routing parameters.

**Vehicle size –**
other trucks (e.g. semi-trailers) of similar height, width, and weight are typically barred from traveling through urban areas, hence, infrastructure can pose a challenge in the form of low bridges, narrow streets, and weight limits.

**Restricted areas –**
airports, prisons, military objects, and other restricted areas require certain procedures to enter and might only be accessible during particular hours and by approved drivers.

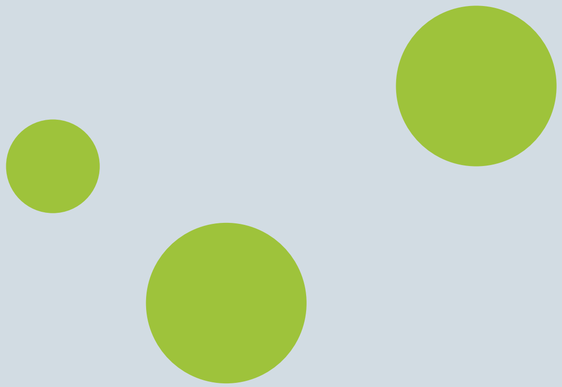
**Time of operations –**
beyond location-specific time constraints, other time-related considerations come into effect for minimizing noise pollution, avoiding traffic, and improving safety. For instance, routes might need to be customized if residents in a particular area complain about collection noises disturbing sleep during early hours.

# 3. Idling periods

> *To that end, avoiding traffic and optimizing the efficiency of workers must be a core part of the solution*

An optimal solution will minimize how long a vehicle spends waiting in one spot. The main causes for vehicle idling are congestion and time spent on manual labor while finding, accessing, and emptying waste containers. **To that end, avoiding traffic and optimizing the efficiency of workers must be a core part of the solution**, which must consider real-time traffic status, as well as equip workers with the necessary location-specific information to minimize idle time.

# The advantages of optimized route planning



All of the above must be included in planning calculations alongside a plethora of other criteria to produce an efficient route. With such a system at hand, it becomes possible to make meaningful operational decisions about the waste collection ecosystem at large and work with stakeholders and citizens to integrate custom requirements.

This kind of solution is, by default, more eco-friendly and cost-efficient compared to existing practices. It allows reducing waste collection management and transport costs by up to 30-40% and serves as a prime example of an economically viable green initiative.

# How a modern solution should work

By now, it should be clear that we're not talking about simple routing solutions such as Google Maps or Waze. A modern waste collection routing solution must consider all of the elements described in the previous section and it grows exponentially more complex with each added element. On top of that, to be as efficient as possible, it must be able to recalculate routes every day and work with real-time data.

The resulting tool is a sophisticated, compute-intensive system that must be able to operate with thousands of data points, perform continuous calculations, and run complex optimization tasks, all of which must be made accessible to drivers and waste collection operators through a simple and understandable user interface.

# Powered by today’s discoveries

The data science behind it all is cutting-edge. In order to provide truly optimized routes, such a **solution must employ the newest algorithms and latest scientific developments in graph theory, discrete optimization, operations research, etc., as well as be open to integrating future discoveries.** Furthermore, the hordes of data gathered on a run today must serve as input for optimizing the routes for tomorrow.

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# A synergy between data science and real-world know-how

Research teams and data scientists must be involved in adopting these latest developments to the nuances and real-world challenges of waste collection and transport through the codification of industry-specific rules and continuous optimization of weighting structures.

That said, they must be guided by experts in waste collection to ensure that the resulting solution is suitable for the environments it's designed for and takes into consideration all the intricacies of waste collection and transportation. For example, a truck may be able to cross a bridge when empty, but exceed the load limit when full, which must be taken into account by any potential solution.

> ***the solution should include the tacit knowledge accumulated by drivers over years of hands-on experience***

In the same vein, **the solution should include the tacit knowledge accumulated by drivers over years of hands-on experience**. This type of knowledge is often undocumented, yet essential for completing collection rounds in an efficient manner.

# Runs on green energy

Running the necessary computations is an energy-demanding task, requiring multiple virtual servers and specialized hardware. As such, the ideal routing solutions not only help to minimize truck emissions but are also in themselves environmentally friendly, which can be achieved by powering the physical system using green energy from renewable sources.

# How to evaluate the state of waste management

Optimized waste collection and transportation is a cornerstone of a healthy waste management ecosystem and, alongside sorting and recycling, will play a major role in fostering a greener future.

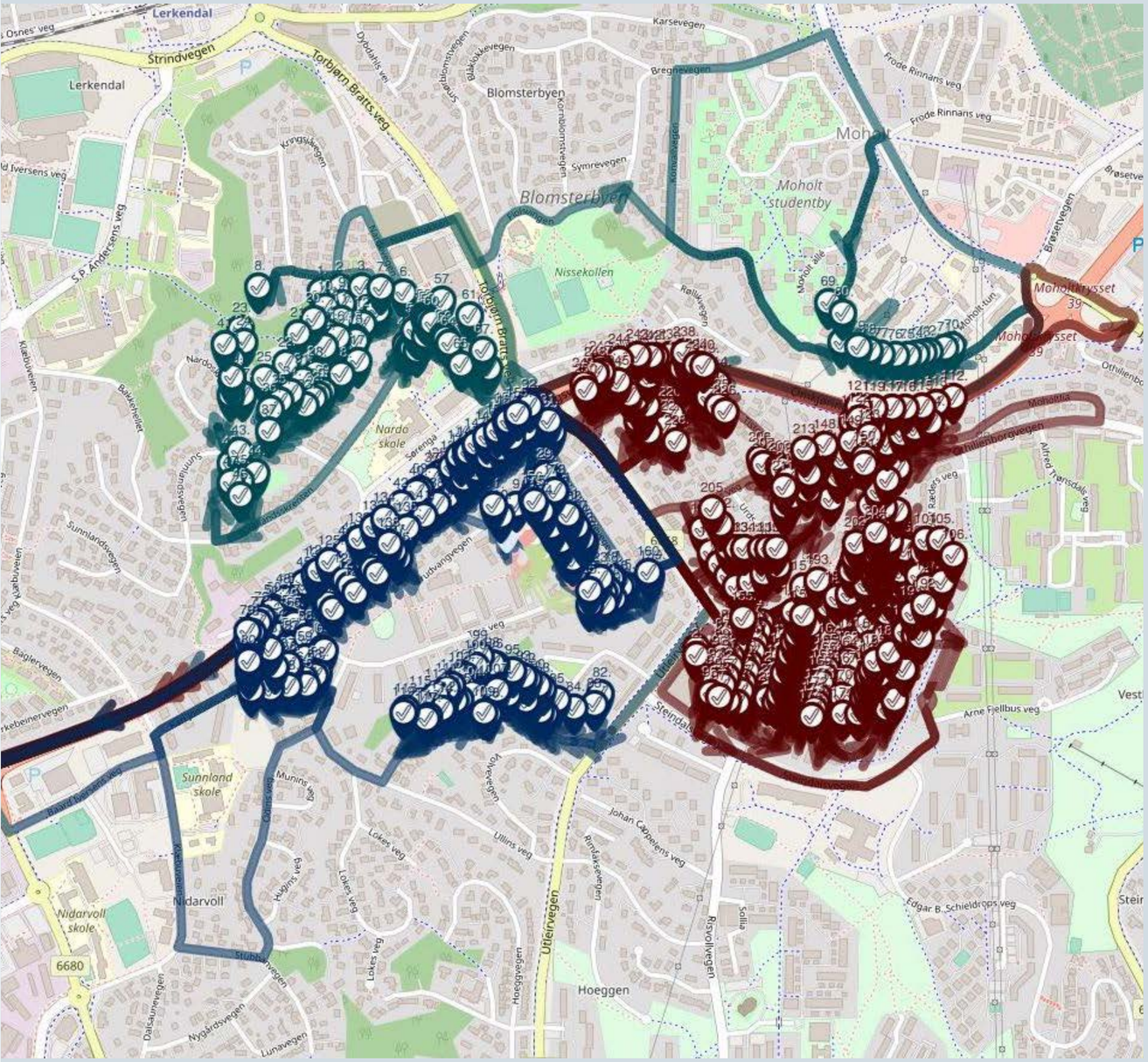
Today, however, most waste collection operators either use a subpar routing solution or use no routing technology at all and rely almost entirely on driver knowledge. While the latter is a seemingly simpler way of doing things, there's significant potential for human error and a lack of accountability. Plus, knowledge of routes and best practices is tied to individuals and cannot easily be shared.

# Not all solutions are made equal, nor should they be

Some operators try to avoid knowledge silos and improve the efficiency of collection rounds by introducing simple routing and management solutions. Unfortunately, such solutions are often rather basic and rigid, unable to optimize daily routes, nor work with real-time data.

Other important factors to consider when evaluating a potential system are whether it. →

- allows you to optimize according to various existing and future criteria;
- will be able to integrate new functionalities in the future;
- still receives updates and support from the developers;
- can be customized to suit your situation.




> ***Every area of operations is different, so every solution should be different, too.***

**Every area of operations is different, so every solution should be different, too.** With the developer and client working in tandem, routing solutions should be tailored to the specific needs and quirks of the respective environment and populace.

# Re-evaluating existing systems every 3 years

With the EU pushing for optimization and digitization and new regulations emerging, it is more important than ever to stay in the know about the latest developments in route optimization and ensure the use of the most eco-friendly and cost-effective solution available. To that end, **regularly reevaluating the existing solution and benchmarking it against other options will have long-term benefits for all stakeholders.**

Running a few pilot projects and trying out different systems every few years will help with making the best decision for ensuring operational excellence. For companies, this means increased efficiency and profits. For citizens – a city that's nicer to live in and more purposeful use of their tax contributions.

> ***"regularly reevaluating the existing solution and benchmarking it against other options will have long-term benefits for all stakeholders.***

# Conclusion

> ***companies should regularly benchmark their existing solutions against the latest developments in the market.***

Route optimization has the potential to significantly and positively impact the overall emissions related to waste collection and transportation, improve the use of resources, and contribute to a better quality of life.

To ensure waste collection doesn't itself become a source of excessive waste and emissions, **companies should regularly benchmark their existing solutions against the latest developments in the market.**

It falls on the shoulders of waste collection companies to actively seek out, test, and implement suitable platforms. Meanwhile, it's in the interest of society to hold these companies accountable and ensure they run their operations in the most environmentally responsible way while making efficient use of taxpayer funds.

The shift to greener and more efficient waste management is already slowly taking shape and will only accelerate as various regulations and profit-driven considerations force companies to either evolve or be left behind.

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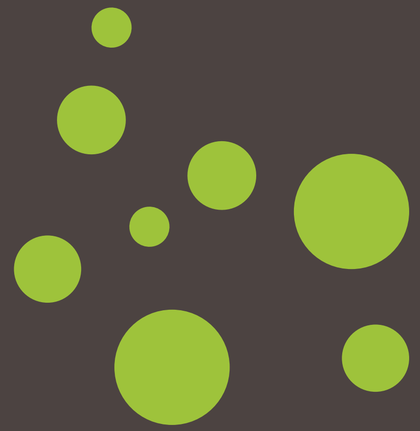

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