

# Exploring the potential of compact e-LCVs in different use cases - URBANIZED - modUlaR and flexible solutions for urBAN-sIzed Zero-Emissions last-mile Delivery and services vehicles

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In recent years, urban policies and increased logistics competition are forcing a shift towards higher delivery frequencies and fragmentation, as well as electrified logistics. The on-demand economy has caused customers to expect recurrent, affordable, and fast delivery of their goods. Moreover, city centres are becoming increasingly pedestrianised and the decrease in available land has pushed up inner-city rent prices, leading to consolidation in suburban areas (Buldeo Rai, 2022). Together with (sub)urban consolidation centres (UCCs), the rising presence of inner-city microhubs is enabling flexible and electrified logistics.

Compact, electric light commercial vehicles (e-LCVs) are under consideration as the drivers of flexible, silent, environmentally friendly and less space-demanding deliveries. This article considers the following vehicles as part of this category: e-cargo bikes, e-trailers, e-scooters, electric quadricycles and electric vans up to a loading capacity of 5m<sup>3</sup> (see figure 1 for illustration). Compact e-LCVs are expected to become a competing force to larger vehicles like the Mercedes Benz Sprinter, which is one of the current market leaders in light commercial vehicles (Carrier, 2022).

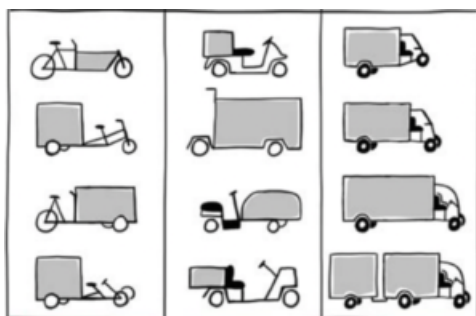


Figure 1: Illustration of compact electric light commercial vehicles(Ploos van Amstel et al., 2018)

As with most innovative transformations, there are early adopters of compact e-LCVs and those who prefer to wait-and-see (di Foggia, 2021). This article explores factors that can determine the usefulness of compact e-LCVs to logistic operators, and thus affect their adoption rate. Here, we differentiate between the external, business, and operational layers (figure 2). Consequently, this insight highlights the factors that are unique for the URBANIZED vehicle, after which we discuss different urban logistics use cases and their potential for compact e-LCV adoption.

The aim of this insight is to support different stakeholders in their decision-making by delineating application areas of compact e-LCVs, and conditions that need to be met for their adoption. Our previous [observatory article](#) and research such as the [publication](#) by Ploos van Amstel et al. (2018) present more elaborate overviews of operational barriers for compact e-LCV uptake.

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## General Criteria

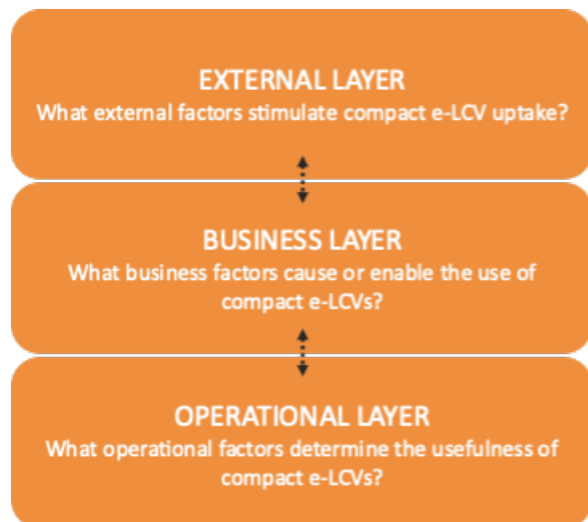


Figure 2: Layers characterising factors for compact e-LCV logistics operations

### EXTERNAL LAYER

The factors in the external layer relate to the context in which the logistics actors operate. This context is shaped by external parties, such as the national or local public authorities, rather than by the logistics operators themselves. Although the external layer may seem inflexible, recognizing its influence is crucial, as it defines the scope in which logistics actors make their business and operational choices. While this layer encompasses a wide variety of factors, we select the ones most relevant to the use of compact e-LCVs for logistics.

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#### Favourable Policies

##### *Regulations*

One tool for cities to stimulate the use of compact e-LCVs is to limit conventional vehicle movement in specific zones. Urban vehicle access regulations (UVARs), such as the implementation of low-emission zones (LEZs) or car-free areas during certain periods are successful methods to deter companies from using more polluting vehicles. When considering cargo bikes for example, this “*deterioration of conditions for conventional vehicles*” is found to be one of the most influential factors determining enterprises to buy new or swap vehicles (Narayanan et al., 2022, p. 43). Additionally, as pointed out during interviews with logistics operators, having governments clearly distinguish between different vehicles and adjust policies accordingly would further help the uptake of compact e-LCVs.

##### *Financial Incentives*

Governments can stimulate the uptake of compact e-LCVs by offering subsidies, which lower the threshold for companies to start working with a new vehicle. However, it is important to note that subsidies may pose the risk of discouraging producers to cut down the price of the vehicles (Ploos van Amstel et al., 2018). Additionally, interviews with logistics operators indicate that it can be challenging to find alternative financing after subsidies or funding schemes for compact e-LCVs end. This highlights that a careful examination of the impacts of financial incentives is crucial.

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#### Favourable Infrastructure

##### *Integration into urban traffic*

Compared to conventional delivery vans, the compactness of the e-LCVs is beneficial, especially in urban areas with

limited space. However, from a driver's point of view, a safe and comfortable integration into a dense urban traffic network is crucial. This can be facilitated by ensuring safe roads where the speed of all road users is aligned (Ploos van Amstel et al., 2018). Providing this infrastructure is important to guarantee that the compact e-LCVs can exploit their potential and advantages compared to conventional delivery vans.

#### *Parking and (un)loading space*

Finding parking and (un)loading spaces takes time during deliveries. An urban area that offers sufficient space for these activities allows for compact e-LCVs to be a more efficient means of transport than conventional vehicles, and thus a more appealing choice for fleet managers.

#### *Charging infrastructure*

The availability of charging infrastructure has been associated with fleet managers' uptake of electric vehicles (Sierzchula, 2014). An increasing number of public charging points could reduce logistics operators' range anxiety (Morganti & Browne, 2018). As indicated in our [quantitative report](#), easily accessible fast-charging points would be an important element to enable the adoption of compact e-LCVs in logistics.

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## **BUSINESS LAYER**

The business layer refers to a company's strategy and positioning in the market. This is often influenced by operational factors as well as external factors, and typically determined by top level management. It is expected that early adopters of compact e-LCVs are businesses that deal with high pressure customer demands and high vehicle utilisation.

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### **High pressure customer demands**

With the rise of the on-demand economy, last-mile industry logistics have seen a disruption in management and operations (Lozzi et al., 2022). Several city logistics streams have been affected, spurred by e-commerce and mostly present in business-to-customer operations. Here, especially businesses that handle time-critical delivery (e.g., same-day delivery or perishable goods) can benefit from compact e-LCV s' ability to operate more quickly than conventional vehicles (Balm et al., 2017). An important condition to enable such logistics is short trips, in turn enabled by a nearby storage space (e.g., warehouse or store/restaurant).

### **High utilisation rate, depreciation rate and available capital**

Due to the comparatively high purchase costs of most electric vehicles compared to conventional internal combustion engines (ICEs), a high depreciation rate is required to balance out the purchase costs. An important decision-making factor for fleet acquisition is the depreciation rate of vehicles in stock and the available capital for new vehicles. The yearly depreciation rate is dependent on the revenue made per kilometre and the number of kilometres driven. Thus, a high vehicle utilisation rate would justify the purchase of (thus far more expensive) electric vehicles. Moreover, a high utilisation rate would leverage the full effects of comparably cost-effective e-LCV maintenance and energy-efficiency (Rouquette & Gragera, 2022).

### **Willingness to use**

Even when all other factors are in favour of using compact e-LCVs, an important consideration is the willingness and ability of involved parties to change their ways of working. The adoption of compact e-LCVs calls for a careful rearrangement of current logistics operations, including the use of extra hubs, different routes, or recruitment of extra employees, to name a few. While the size of compact e-LCVs is an advantage considering dense urban areas, the smaller load capacity can cause the need for more employees, and thus higher costs. Interviews with logistics operators clarified that companies are unlikely to change their operations unless the costs associated with conventional vehicles are high enough, bringing to light the potential of compact e-LCVs.

It is not only fleet managers that must be willing to rethink their system (see also our [insight on fleet diversification](#)); all employees whose daily operations change need consideration. As pointed out in several interviews with logistics providers, change management is crucial to decrease reluctance towards the use of compact e-LCVs. Offering trials and spreading awareness and enthusiasm within the company have shown to be effective for this.

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## **OPERATIONAL LAYER**

This layer entails the operational and logistics aspects of the business model. This is typically handled by supply chain managers, drivers, warehouse staff, planners, dispatchers, etc. In summary, compact e-LCVs are most applicable to relatively predictable, short, stop-and-go trips with small payloads (both in terms of volume and weight).

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### High proportion of short, predictable journeys

In the adoption of electric delivery vehicles, range and queue (waiting for available charging points) anxiety remains an operational barrier for fleet managers. Here, logistics with a high share of predictable journeys that fall within the battery range are especially favourable for the use of electric delivery vehicles (Rouquette & Gragera, 2022). An enabler of this factor is a high proportion of supply from a well-organised UCC or microhub located in the proximity of delivery destinations.

### Low average speed

Journeys characterised by low average speeds (~50 km/h) are most suited for electric delivery vehicles, due to their higher energy-efficiency at that speed compared to conventional ICE vehicles (Patella et al., 2020). In general, urban areas showcase this driving profile the most.

### High drop density

Delivery profiles with a high network density reap the most benefits of small and electric delivery vehicles (Balm & Ploos Van Amstel, 2017). This profile includes frequent stop-and-go operations, as well as delivery in congested areas. Energy efficiency and smaller vehicle sizes allow for more sustainable and rapid deliveries, respectively. The latter is possible due to the ease of parking compact e-LCVs, as well as their ability to use short-cuts, in some cases (Ploos van Amstel et al., 2018).

### Small payload

Considering the relatively small cargo volume and weight capacity of compact e-LCVs, payloads will need to be adapted to fall within the vehicle dimensions. As in most logistics operations, the goal is to achieve the highest load factor. Here, the standardisation of volume and load unit can help to increase average load factor (Ploos van Amstel et al., 2018). Moreover, the use of cross-docking and consolidation at UCCs shows to be an effective way to increase load factor in the last mile (Duin et al., 2016).

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## Unique factors of the URBANIZED vehicle

While the aforementioned factors enable several types of compact e-LCV uptake, it is worthwhile to consider factors that focus specifically on the URBANIZED vehicle. The innovative vehicle offers a modular cargo body, which is a unique aspect in the light commercial vehicles market.

The URBANIZED project intends to solve the vehicle trade-off between 'cost' and 'design for purpose' by designing adaptable and modular all-electric Commercial Vehicles (e-LCVs). The plug-and-play, modular and adaptable cargo bodies are designed for both refrigerated and non-refrigerated purposes.



Besides the fleet cost reductions of the adaptable vehicle, two additional operational factors could stimulate early adopters of this vehicle type: fast (un)loading and multi-purpose fleets.

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### Fast (un)loading operations

With the swappable and modular cargo body comes the opportunity to organise loading/unloading operations faster. For example, cargo bodies can be loaded before a driver returns for pickup to speed up loading operations. Moreover, the vehicle can function as a consolidation point due to the compartmentalised cargo body which considers several relevant standards (e.g., ISO and EURO-Pallet size), allowing for easy reverse logistics on the delivery site. One condition to facilitate such efficient procedures is preparing warehouses' readiness, both in the spatial layout and training of staff.

### Multi-purpose fleets

Increased modularity allows changing between delivery types, especially in volatile markets. Subsequently, a logistics operator serving multiple markets can easily adapt vehicle cargo bodies for various uses. An interesting example is an urban consolidation centre that handles different types of goods for different supplier types, using one cargo body for service engineering during the day, for example, and another cargo body for the delivery of food or post and parcel in the evening. Here, both drivers and warehouse handlers will require additional training to properly handle the modular cargo body.

### Examples of use cases and compact e-LCV potential

This section applies the aforementioned factors (summarised in table 1) to different use cases. Six different use cases are described and subsequently assessed as application areas for compact e-LCV and specifically the URBANIZED vehicle.

|                                  |                                                                |
|----------------------------------|----------------------------------------------------------------|
| <b>External layer</b>            | Favourable policies                                            |
|                                  | Favourable infrastructure                                      |
| <b>Business layer</b>            | High pressure customer demands                                 |
|                                  | High utilisation rate, depreciation rate and available capital |
| <b>Operational layer</b>         | Willingness to use                                             |
|                                  | High proportion of short, predictable journeys                 |
|                                  | Low average speed                                              |
|                                  | High drop density                                              |
| <b>URBANIZED special factors</b> | Small payload                                                  |
|                                  | Fast (un)loading operations                                    |
|                                  | Multi-purpose fleets                                           |

Table 1: Factors relevant to compact e-LCV adoption

In this section, we will focus solely on the operational layer, to simplify the comparison between different use cases. The aim here is to show that use cases can differ in suitability with compact e-LCVs or the URBANIZED vehicle specifically. These differences are visualised in a spider chart (see figure 3). Please note that this is merely an example of how the assessment of use cases can be approached.

#### Use case example 1: Service engineers

Service engineers are involved in logistics, not necessarily to deliver goods, but rather a service, such as installing internet, fixing water systems, or cleaning. Still, their vehicles require enough loading space for them to carry their tools. Daily journeys of service engineers are relatively unpredictable, since not every household needs these types of services every day and many occasions represent emergencies. In some cases, service engineers have the opportunity to reserve a parking space for their vans from which they can operate with smaller e-LCVs, allowing them to carry only the tools needed for the day (see e.g., the initiative by [DOCKR](#)). This way, the payload would be sufficiently low for them to use a compact e-LCV. However, with a larger loading capacity such as the one offered by the URBANIZED vehicle, this additional microhub may not even be needed.

#### Use case example 2: Large supermarket chains

Groceries are increasingly being delivered by compact e-LCVs. For example, the large Dutch supermarket chain [Albert Heijn](#) uses trucks to deliver groceries to a city hub, from which compact e-LCVs and cargo bikes operate the last miles, both towards shops and end customers. Journeys are relatively predictable in B2C operations, as it is possible to subscribe and get groceries delivered on a regular basis. For a large chain, network/drop density may be relatively high due to the customer base. However, the payload is often also high compared to, for example, post volumes.

#### Use case example 3: Meal box deliverers

Businesses that deliver food items such as meal boxes (see e.g., [Foodlogica](#)) may generally have a small to average payload. This enables them to do a relatively high number of drops in one journey. As meal boxes are often delivered as part of a subscription, the proportion of predictable journeys is likely to be high. However, considering a smaller customer base when compared to larger supermarket chains, the network/drop density may be lower, requiring them to cover larger distances.

Use case example 4: Municipal services

These services typically range from gardening to street cleaning and waste collection. The average speed is very low since most operations take place in urban areas, journeys are scheduled and thus predictable, and within battery range. Municipal fleet managers could potentially have high benefits from the URBANIZED vehicle, as their fleets serve a wide variety of purposes.

Use case example 5: Post and parcel

Although the volume of post has decreased, some logistics providers see the number and size of ordered parcels increasing. Still, the drop density remains high, especially for large postal businesses. Therefore, large post and parcel logistics providers often have a high proportion of predictable journeys.

Use case example 6: Urban consolidation centres

UCCs can differ much in size and location, although they are mostly found in the outskirts of a city. Still, it can be expected that most of their transport flows into the city are characterised by low average speeds, relatively high predictability, and payloads within the dimensions of compact e-LCVs if well managed. Moreover, depending on the business model of the UCC, it can be used for different logistics flows, and maintain a fleet that serves multiple purposes. Therefore, UCCs do not strictly represent one logistics use case, but an approach to consolidate different flows and optimize the efficiency of urban logistics.

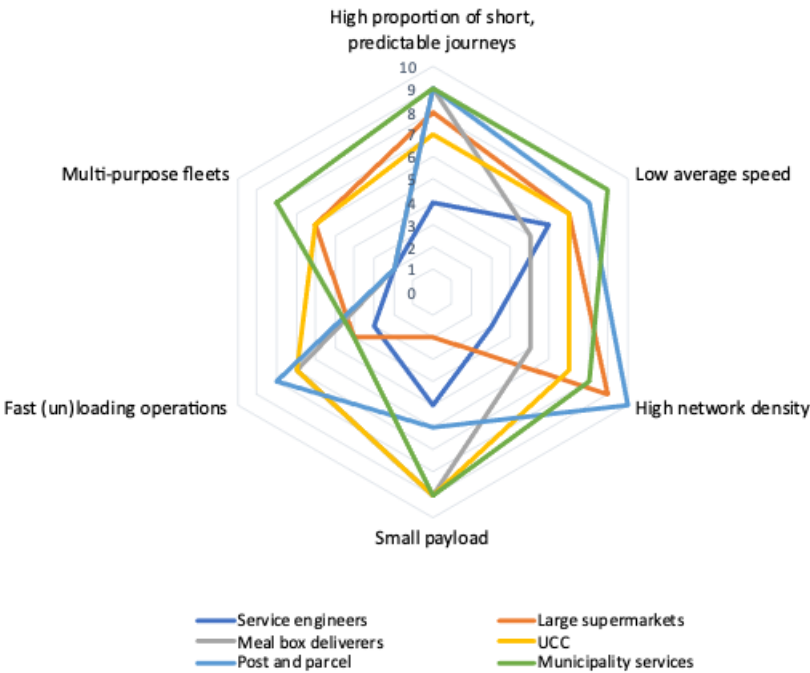


Figure 3: Evaluation of exemplary use cases, considering operational factors

The use case examples as plotted in figure 3 are hypothetical, and the operational factors can vary a lot depending on the exact business and external layers. The spider chart therefore merely illustrates that the potential of compact e-LCVs and the URBANIZED vehicle is not guaranteed for every use case. In case of misfits, businesses could adjust their operations, or choose between different types of vehicles that would best fit their needs. The URBANIZED vehicle would offer most potential in use cases where there is a need for fast (un)loading operations, and where multi-purpose fleets are included, such as UCCs or municipal services.

Conclusion

Logistics operators increasingly recognise the potential of compact e-LCVs and Light Electric Vehicles. However, these vehicles are varyingly applicable to different logistics use cases. This article has delineated the factors that determine this applicability, ranging from external, to business and operational factors. Assessing these factors enables stakeholders to estimate if compact e-LCVs suit their operations and creates awareness of their potential. The URBANIZED project can complement current logistics trends and markets by providing easily swappable and modular cargo bodies. This is expected to significantly decrease operational as well as fleet acquisition costs, if used in suitable cases.

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