Energy optimal urban Logistics As A Service (E-Laas)

Zero pipe tail emission solutions for distribution in urban areas to transport goods are becoming increasingly popular, in line with regional EU, Chinese, and UN directives. Electromobility in urban logistics is accompanied by a sharp increase in the volume of goods and population. Many zero-emission freight transport modes are emerging in the current urban logistics system: electric vehicles, drones, cargo bikes, etc. However, these modes are often asynchronous. Furthermore, due to urbanization, the landscape is changing too (e.g., tight, increased density), and customers' social habits shift towards the digital world (increasing the volume of shipments even more). These effects and changes claim more from the service providers and the other actors in urban freight transport. Due to cities' sizes and volume constraints, electric and micro delivery platforms have become very popular. These new fossil-free platforms help with space and zero pipe tail emissions if well interfaced. This latter raises questions on the synchronization, modal shift, and optimization of urban logistics solutions. While the positive effect of electrification and modularity of urban logistics operations is unarguable, this transition must be combined with other stakeholders' behavior, bringing new challenges to be addressed. The limited sets of means of transport and dependence on external charging infrastructure require an intelligent combination of city logistics to the power grid to ensure optimal operational conditions. Service delays, interruptions, or external threats (e.g., the COVID pandemic and armed conflicts) block the delivery process. Hence adaptive and reconfigurable solutions are requested. Dense urban areas and the lack of space call for innovative and smart multimodal solutions that scale well with the volume of goods, city size, and modular solution cardinality. Greater attention should be placed on improving coordination in increasing social responsibility that stimulates the development of socio-ecological solutions for transport systems.

The E-Laas project proposes a novel and operational energy-based description of a multimodal urban logistics system. Urban delivery systems are compared by their energy usage, including modal shifts (micro platforms) and novel ways of combining charging and freight parking infrastructure. This energy-based quantitative framework enables us to define sustainability aims systematically and naturally. Thus, our overall objective with E-Laas is to create a novel energy minimizing platform, including processes from consolidation centers to the customers' doors, incentivizing energy savings at each level. Furthermore, the energy-based framework enables us to contrast different modular solutions via the concept of interlaced energy footprinting.

Additionally, the aspect of enhancing social responsibility at various levels (customer, service provider, city) will be considered in E-Laas. In addition, analyses will be carried out on how the power grid and related infrastructure may influence logistics missions. In the project, we aim to:

- represent urban logistics missions as logistics flows,
- define operational (and complementary) energy use in logistics flows,
- analyze spatio-temporal energy usage in urban logistics missions and perform sensitivity analysis (grid interruption, scalability),
- incentivize energy awareness on multiple levels (from customers to authorities).

Objectives of the projects include: contributing to sustainable developments of cities and communities, creating resilient logistics methods, digital and physical infrastructure for sustainable transport solutions, develop sustainable and climate-responsive urban logistic systems. We assume the following effects:

- Develop energy-optimal urban logistics solutions with quantified energy use.
- Develop smart multimodal and energy optimizing micro delivery systems.
- Analyze logistics mission interruptions and advise with reconfiguration solutions to regain energy optimality.
- Organization of delivery platforms and unloading zones via charging facilities and the power grid including smart charging policies and the effect of energy price on shipment costs.
- Quantify demand for freight and analyze the customer behavior change. Analyze the digital and physical components and the holistic concept of logistics as a service.
- Scalability of multimodal and energy optimal distribution system.
- Devise new ways to enhance societal responsibility by E-Laas.