

## CITY MOVE: new concept for urban delivery vehicles

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## **Abstract**

The Freight Transport Logistic Action Plan (6) states that the freight transport logistics has an essential urban dimension: *distribution in urban conurbations requires efficient interfaces between truck deliveries over longer distances and distribution to the final destination over shorter distances. In addition, the distribution process between production centres and customers inside an urban area needs to be efficient and clean.*

This emphasis has been confirmed in the more recent Urban Mobility Action Plan, in which the distribution of freight in urban area is considered as one of the key issues (6).

The delivery of freight in urban areas is based on general purpose commercial vehicles; light, under 3,5 tons, but also medium vehicles (7,5-12 tons) are widely used in towns. CITY MOVE aims to develop a new concept for urban delivery vehicles, a real breakthrough from the actual vehicle platforms, using latest state-of-the-art technologies to guarantee the market introduction in short term (2014 i.e. two years after the end of the project).

It is a joint initiative between the leading freight vehicle manufacturers in Europe and other key stakeholders. The aim is to develop an innovative freight vehicle solution that is adaptable to the different needs of European cities. The solution will provide freight transport vehicles that are secure, flexible, reliable, clean, CO<sub>2</sub> energy efficient and safe.

Developing this common industrial platform for future freight transport systems in Europe requires a greater emphasis on operation cost efficiency, but combined with a strong attention on social, energy and environmental aspects.

Developing such a range of freight vehicles requires a co-ordinated effort by all stakeholders, so that future freight vehicles have the flexibility to adapt to changes in the city commercial environment over the short, medium and long terms.

CITY MOVE to integrate new technologies into a urban multi-role solution with the intent to optimize the vehicle capacity and vehicle weight ratio.

CITY MOVE will reconsider all the vehicle architecture starting from a hybrid powertrain base architecture and exploiting all possible benefits of such technology in terms of:

- improved efficiency
- reduced environmental impact
- better management of auxiliaries and services

The paper describes the CITY MOVE technical contents showing the main features of the vehicle concepts.

## 1. Introduction

Transport plays a basic role in the European sustainable growth and competitiveness, and the importance of road transport should involve all stakeholders acting a bridge between the freight operators, industrial vehicles manufacturers, national and local authorities, transport research programs and local business communities and last but not least the citizens.

In fact, commercial vehicles carry nearly 80% of all freight in industrialised countries and deliver around 70 kg of goods to each European citizen, every day (1), moreover from 1995 to 2006, intra-EU freight transport, measured in tonne-kilometres, has increased by 2,8% per year on average (2).

The transport policy should be based on the effective end user needs, taking in account the economic context, the environment protection, the safety and the security.

This approach is much more critical for road transport especially in the urban contests. The benefits that transport brings to the society and its direct link to Gross Domestic Product (GDP) indicators have to be highlighted. All efforts should be made to improve its efficiency but at the same time efforts should be made to avoid weighting down the sector with additional taxes, charges and restrictions.

Transport is correlated with all sector of the economy, therefore a closed link between transport and economy should be address to fulfil the European sustainable growth in all sectors (production, distribution and consumption) taking in account the common goals.

We are facing an unprecedented crisis that is twofold in nature: financial and economic. The demand is dramatically fallen down with consequences on the mobility scenario. The crisis had not been anticipated and nobody knows exactly how long it will last and which will be its actual impact on the economy and on transport in particular.

Reduced pollutant emissions, traffic congestions and noise from road transport are seen as an important factor driven by the need to improve air quality and to guarantee an adequate well being level, at the same the transport efficiency and logistic optimization.

Pollutant emissions from road transport have been drastically reduced in the recent years and further progress will be obtained thanks to the new vehicles' compliance with the upcoming Euro emission standards.

In this direction the Euro 6 Regulation will revise the current emission limits for whole motor vehicle (the Euro 4/5 standards). The technical requirements coming into force from 1st September, 2014 and will set the emissions of nitrogen oxide from (2.0 g/kWh to 0.4 g/kWh) (an additional reduction of 80% in comparison to the Euro 5 limit).

On the other hand the freight transport is based on the utilization of its capacity, which depends on the volume and the weight of transported goods, the need for loading and unloading, the density of its network, source of energy, energy need loaded compared with unloaded and specific needs with respect to the commodity to be transported.

In the general overview of the future transport scenario is also fundamental to highlight the following aspects:

- The demand for mobility would grow: reactions during previous recession periods confirm the transport demand tend to restore more quickly than other economy sectors probably due to a faster growth in the international trade.
- Urbanization has increased over the past decade and the negative consequences (traffic, air and noise pollution, energy consumption and security) are far higher in the urban contexts. The European cities have expanded on average by 78%, whereas the population has grown by only 33% (1), moreover the transport-related energy consumption is inversely correlated to the city density (*Figure 1*) (4).

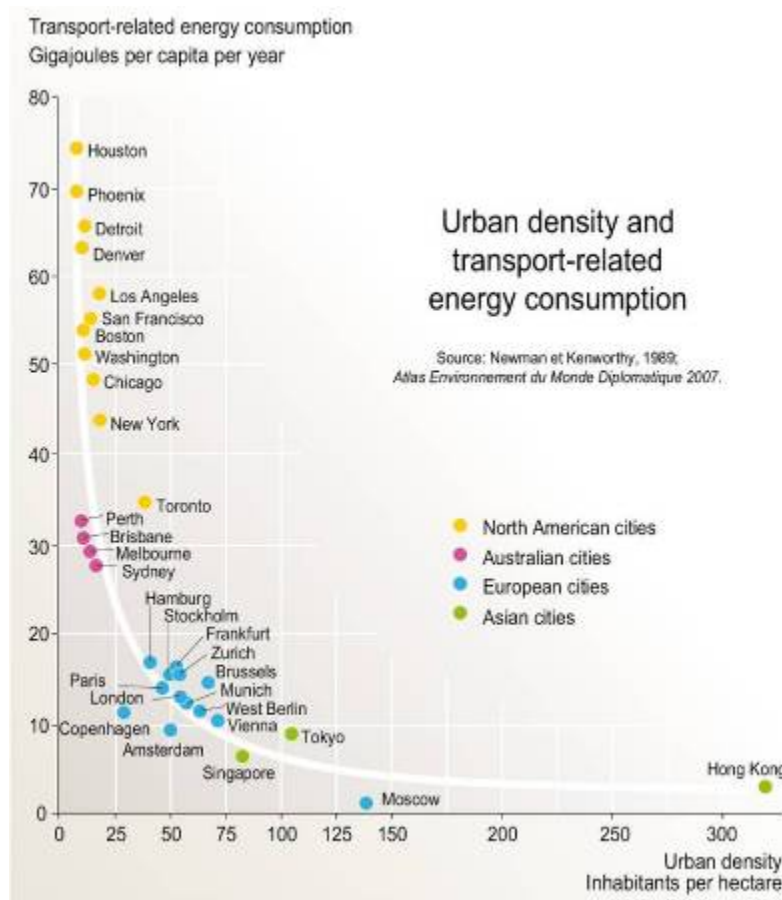


Figure 1 Urban density and transport –related energy consumption

An evident effect of the urban sprawl is the suburbanization which is turning the mono-centric urban areas into complex polycentric urban conurbations based on local and regional centres. (*Figure 2*).

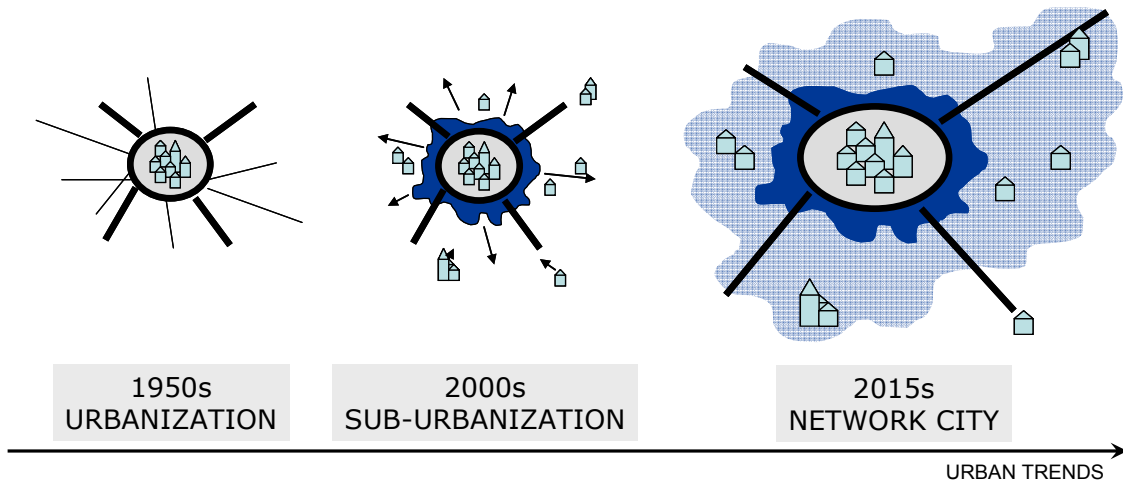


Figure 2 Evolution of urban mobility

In this scenario, several companies are strongly motivated to invest in new technologies in order to maintain a positive revenue trend and competitiveness with a clear focus on the evolution of the freight delivery in the urban areas.

## 2. City Move project

### 2.1 Project overview

City Move is the acronym of “CITY Multi-role Optimized Vehicle” (5) a collaborative project part of the UE 7<sup>th</sup> Framework Programme. The project proposal started from some recent European Community indications and key points in urban mobility scenario and road transport trend in the medium and long term.

In particular the EC publication “Green Paper towards a new culture for urban mobility”(5) points out the principles on which the City Move projects is well framed.

In particular, the distribution in urban areas needs to introduce efficient interfaces between truck deliveries over longer distances and distribution to the final destination over shorter distances. Moreover, the distribution process between production centres and customers inside an urban area should be efficient and clean. The development of these solutions requires the involvement of all stakeholders.

Therefore City Move aims at developing an innovative vehicle concept for the delivery of goods and urban services introducing new technologies with a good chance to be applied in future products (short-medium term applications).

### 2.2 Concept and objectives

City Move aims to use the latest state of the art technology in freight vehicle design and contents. It is a joint initiative between the leading freight vehicle manufacturers in Europe and other key stakeholders.

The main objective is to develop an innovative freight vehicle solution that is adaptable to different urban contexts such population density and distribution, local mobility and end users

needs. In addition the solution provides freight transport vehicles that are secure, flexible, reliable, clean, CO<sub>2</sub> energy efficient and finally safe.

Developing this common industrial platform for future freight transport systems in Europe requires a greater emphasis on economic efficiency, but combined with a necessary a strong cooperation with the local and central actors and the economic bodies.

This ambitious project plan goes straight on the EC previsions by integrating new technologies into a urban multi-role solution in a interoperable environment bringing to a significant breakthrough increasing in terms of efficiency and safety (in-vehicles) and reduction in CO<sub>2</sub> emissions and noise.

Another key aspect is related to the optimisation of the vehicle capacity and vehicle weight ratio. The performances improvement in terms of environment and safety are not always positively correlated to the limits imposed by load capacity of vehicles. The project approach puts in relation both the performances and the load boundaries with the scope to optimize the global efficiency of the commercial vehicle.

The effective goods transport as lever, potential and opportunity and not as barrier to sustainable development and competitiveness, taking in consideration relevant key factors, such as improvement of socio-economic benefits, cities attractiveness, reduction of adverse environmental and social impacts, by guaranteeing fair and equal accessibility for all.

In order to pursue such goals, City Move considers the active involvement of a significant critical mass of Stakeholders from the early project stage acting as bridge between vehicle manufacturers, research institutes, universities, relevant research agencies and the “real world” with the intent to create an integration between urban transport and freight logistics.

The stakeholders involvement is function of the contents in each project phases. In particular the first cluster defines the user needs and the functional specifications, therefore it requires all the working group members participation in order to provide a workable development process for the next work packages (*Figure 3*).

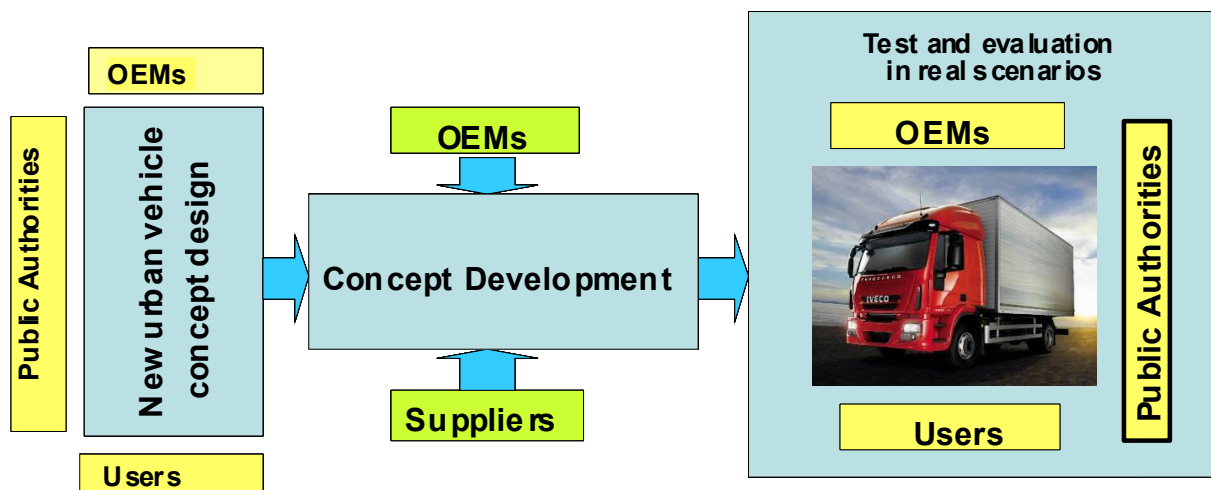


Figure 3 Involvement in the project stages

The main innovative aspect of City Move project is to look head the real transport needs in a integrated multi-disciplinary approach, developing a new vehicle architecture specifically designed for freight operating in urban context. The same strategy is applied for other vehicle characteristics and layout like external dimensions, safety, security and noise reduction.

### 3. Concepts implementation

A delivery vehicle is typically designed around a general architecture adapted to the specific design. In contrast with the conventional approach, City Move reconsiders all the vehicle architecture in term of:

- Vehicle layout: optimization of capability with extension to a typical multi-role concept for usage in different delivery missions.
- Modular architecture: investigation of a new vehicle architecture concept with a modular mindset.
- Body solution integration: development of an innovative vehicle body integrated with the new vehicle concept.

The contents under development have an effective industrial plan, that will guarantee a complete deployment in the next few years after the project expiration.

The innovative solutions aim to remove the technical and economic barriers creating the best conditions for add value in freight transport sector. This ambitious target is motivate through the following key drivers:

- Efficiency
- Clean and quiet
- Safety

For each of them the partners of the project work together in strong cooperation to develop a number of objectives. In the *Figure 4* are reported the implementations for each cluster. The modularity is a content of the efficiency driver with a significant impact on the other developments.

The City Move plan expects to bring into scene sound improvements on transport system efficiency through a reduction in term of vehicle circulating, shorter missions that will help in respecting just in time deliveries and costs per vehicles and per unit of payload delivered. The mission optimization includes the modelling simulations with the target to introduce some benefits in the global freight transport management.

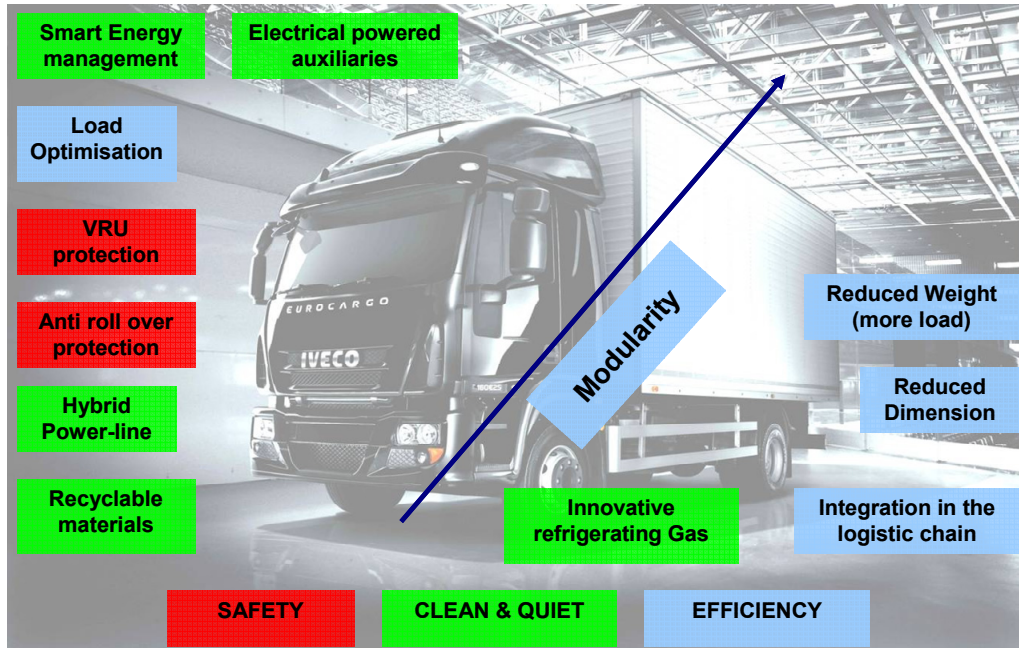


Figure 4 Contents chart

### 3.1 Efficiency

Usually the on-board vehicle auxiliaries are mainly mechanically driven through the internal combustion engine, with limitations and constraints that produce inefficiencies.

City Move reconsiders all the vehicle architecture starting from parallel hybrid electric architecture and exploiting all possible benefits of such technology in terms of:

- Improved efficiency
- Reduced environmental impact
- Better management of auxiliaries and services

A parallel hybrid electric vehicle employs an additional power source (electric motogenerator) in combination with the conventional diesel engine. This architecture takes advantage of both power sources in order to reduce the fuel consumption, increase the overall power, and above all, decrease CO<sub>2</sub> emissions.

Additional fuel consumption reductions comes from service auxiliaries electrification and through a smart energy management. Others important features to improve the overall vehicle efficiency are linked to the vehicle structure such capability, kerbweight, and external dimensions.

### 3.2 Clean and quiet

The CO<sub>2</sub> emission is related with the global efficiency taking in account both the delivery mission and the energy of the vehicle. Three dedicated tasks of the project will produce significant benefits on the noise reduction:

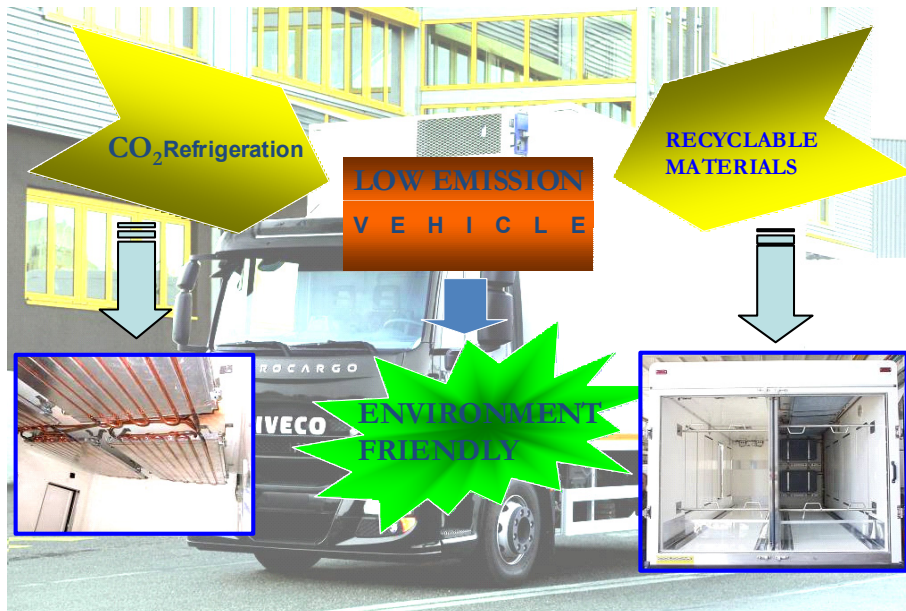
- Engine noise: through the hybrid driveline.
- Noise during loading/unloading operations: through the electrical actuators.

- Noise on engine, transmission and cooling system: development of specific shields/recovery actions in order to reduce the external noise of the vehicle during the main disturbing operations.

Considering GHG emissions, City Move includes various actions in the vehicle architecture to improve the current scenario (*Figure 5*). The vehicle body foresees recyclable materials as an evident improvement from the today standard, for instance the refrigerated boxes are nowadays built with synthetic resins which are not environment friendly.

With reference to chilled goods delivering, a strong effort is dedicated to enhance the efficiency of the refrigerated system introducing materials with a low environment impact. The commonly used refrigerating fluids, such as R4040A and R507A, are not environmental friendly since they generate a high greenhouse effect.

In the project will be evaluated a potential “green” solution using a non conventional refrigerated gas like CO<sub>2</sub>, which can generate a very low Global Warming Power (GWP).



*Figure 5 "Eco-compatible" refrigerated box*

### 3.3 Safety

Considering the safety driver, all the activities are oriented to design an active safety system which provide recommendations and warning in urban contests encouraging safer behaviour of drivers. The vehicle is monitored through a specific all around sensing with a dedicate set up for the urban environment.

The main objectives in this cluster are:

- Develop the predictive anti-rollover functionality for freight delivery vehicle in the urban scenario
- Develop the collision avoidance functionality for freight delivery vehicle in the urban scenario

### 3.3.1 Predictive anti-rollover

The curve warning systems typically inform the drivers when approaching a curve at high speed; they are based on an algorithm that uses an average barycentre position and vehicle mass to calculate the lateral limit acceleration of the vehicle (*Figure 6*).

Such systems are currently already investigated for cars, but when higher accuracy is needed as for urban goods delivery where frequent loading/unloading operations may change the vehicle mass and barycentre position during the mission, other more precise systems and algorithms are needed.

City Move aims to apply special “intelligent tyres” that, giving as output the forces exchanged between tyre and ground, enabling an accurate calculation of the barycentre, therefore a reliable predictive anti-rollover action.

Other tasks define and develop solutions specifically designed to avoid rollover for truck moving in the city (roundabout, intersections, curve at high vehicle speed). The control strategies provide an estimation of the rollover limit alerting the driver when this event happen.

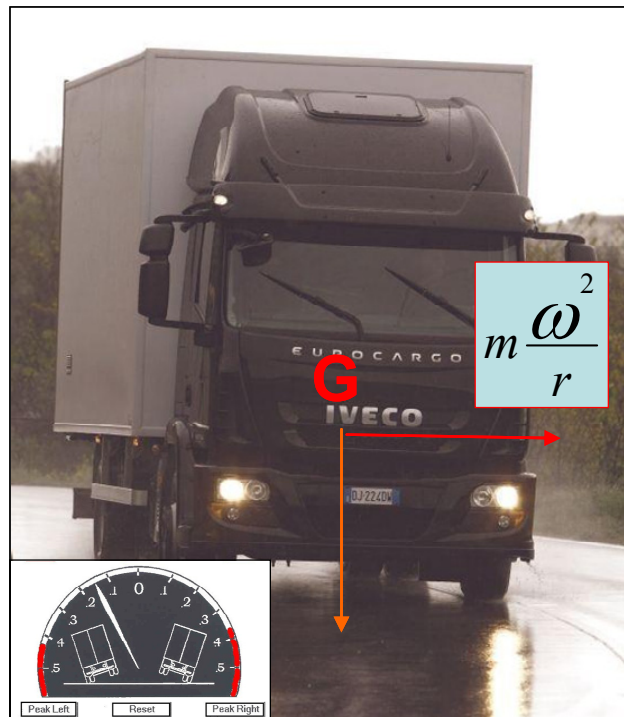


Figure 6 Predictive stability support functionality

### 3.3.2 Collision avoidance

This activity defines and develops solutions specifically designed for truck moving inside the city to allow the driver to react appropriately in case of typically urban risks.

The all around sensing, with appropriate a human machine interface and control system, is able to support the driver for safe manoeuvres at low speed (start inhibit, turning assistance).

An additional functionality foreseen in the collision avoidance cluster is the Collision Warning System (CWS) specific for the urban scenarios where the surrounding area monitoring is more severe than an extra urban contest. The system is based on the ACC sensor technology plus a front camera necessary for the data fusion algorithm.

A warning is only generated in collision critical situations. The warning is calculated assuming a typical driver reaction time, assuming a typical driver emergency braking reaction and predicting the movement of host and preceding vehicle to the future.

#### 4. Conclusions

The global demand for sustainable urban mobility is continuously increasing in Europe with relevant impacts especially on the goods transportation. In fact, several restrictions in urban areas are extended to reduce the congestion creating negative effects on the delivery operations.

The City Move project is designed starting from a user needs analysis to guarantee the complete acceptance of the solutions. The applications are focused on the urban transportation of freight, but the benefits could be transferred to the mass transport.

The main contents are:

- Low emissions
- Less noise (engine, auxiliaries and operation modes)
- New urban architecture (same payload with reduced dimensions and kerbweight)
- Enhanced safety (urban ADAS)

In conclusion, City Move represents a good opportunity to change the transport system bringing into scene sound improvements on the efficiency through a significant reduction in term of vehicle circulating, shorter missions that will help in respecting just in time deliveries with a real cost-benefits improvement.

Moreover, all the project stakeholders plays a fundamental role in the final success.

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