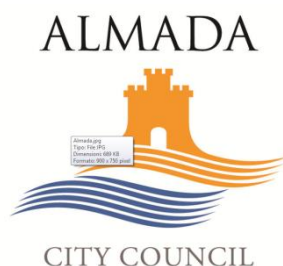




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## Deliverable D3.4B

### Feasibility and Transferability Analysis of energy-efficient and sustainable freight logistics solutions in Almada

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## 1. Almada context

The city of Almada is located on the south bank of the Tejo river, across from Lisbon (Fig. 1).

With 174.030 residents living in 70 km<sup>2</sup> (2355 people/km<sup>2</sup>), including urban, suburban and rural areas with and 35 km of water front, Almada is one of the 18 municipalities forming part of Lisbon Metropolitan Area. Almada is directly connected to Lisbon by the “25 de Abril” bridge over the Tejo (Tagus) river, for trains and cars, and by boats (passenger and ferries). Almada territory lives the constant pressure of simultaneously making part of an intensively living metropolitan region while playing a major role as a touristic destination.

Almada local economy is primarily based on Tourism, Services and Public Administration. The Almada area presents natural resources, several green protected areas with high biodiversity, geological sites of recognized importance, significant terrestrial, coastal and marine ecosystems, etc.

Almada Atlantic Ocean beachfront (Costa de Caparica) extends for approximately 13 km and is a popular summertime destination for Lisbon residents as well as for tourist, receiving more than 8 million visitors each year, with an increased demand for tourism-related services.

Almada is substantially composed by three main areas:

- Almada City, north peninsular area, with nearly 100.000 inhabitants;
- Costa de Caparica, including the seaside area with 13 km of beaches.
- The central areas of Almada, a mixture of lower density residential areas and green and semi-rural areas.

From the geographic point of view, the City of Almada forms a sort of peninsula and extends itself along the Tagus river, facing Lisbon, and progressing to South, with some residential areas close to the neighbouring Municipality of Seixal.

This urban area, which is not very circumscribed (unlike Lucca, for instance), as well as the particular road network, reduce the access points to the main urban area to only 4 (see section 2.2 below for details). This is the area that most requires the development of a study on urban logistics.

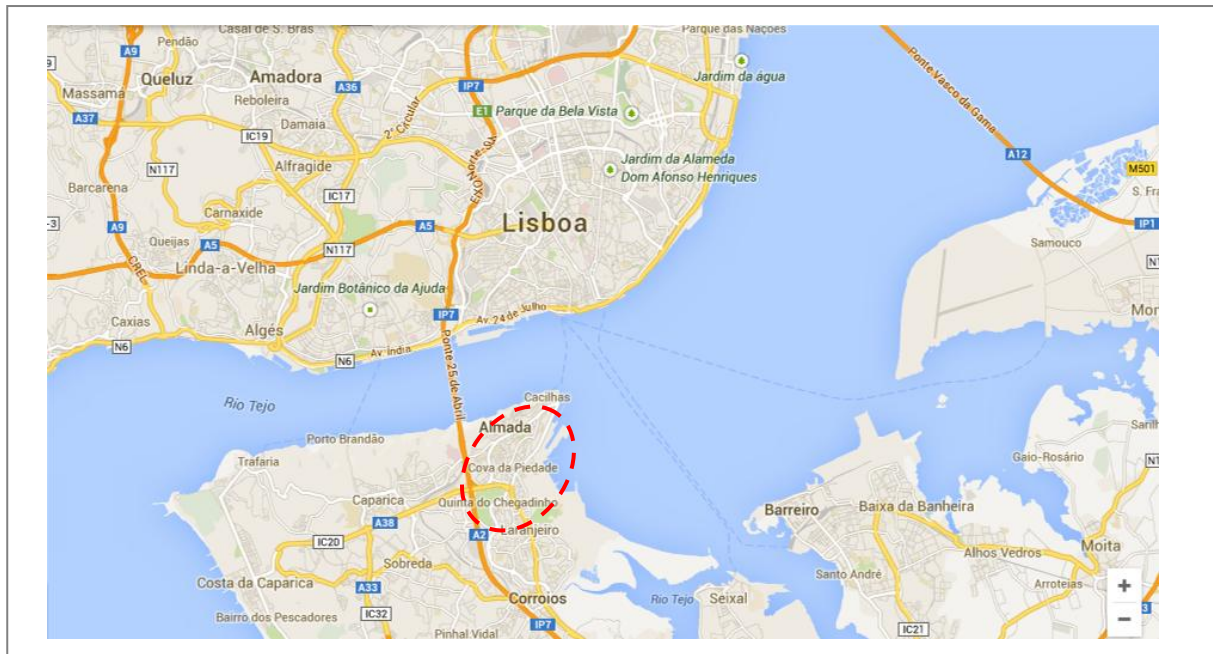


Fig. 1 - Almada city in relation to the Lisbon metropolitan area

## 1.1 Mobility and traffic figures

The Almada motorization value reached 443 cars/1000 inh. (2006 data), with 71% of the population having access to a car, and its modal split shows that 50% of commuting trips are made by private motorized vehicle, 30% by public transport and 20% by soft modes.

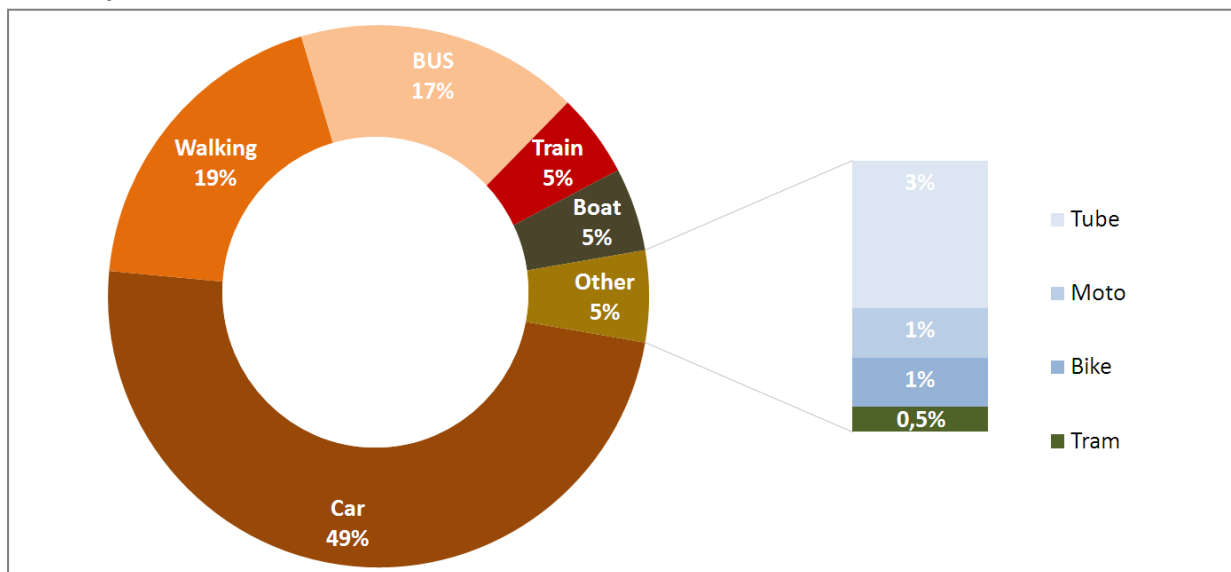


Fig. 2 – Almada residents commuting modal split (2006)

Nearly 50% of the trips made in Almada refer to “crossing traffic”, since Almada is the southern gateway to Lisbon: the “25 de Abril” bridge (Fig. 3) crossing the Tejo river, connecting Almada and Lisbon, serves nearly 160.000 vehicles a day.

The traffic is strongly influenced by the commuters living in Almada and moving every day to Lisbon by car (main modality), train and boats.

The contribution of transport to the GHG emissions is about 33% of the total CO2 emission in the Almada urban area.



*Fig. 3 – Highways and “25 de Abril” bridge*

In synthesis the main problems to be faced by the Almada Municipality with its mobility strategy are the following:

- No metropolitan coordination and management;
- Lack of an efficient Public Transport network (incl. intermodality);
- High development of road infrastructures;
- Very easy access to the inner city centre for private cars (low-cost parking services);
- Lack of an updated and effective regulation and of adequate infrastructures for freight delivery processes in urban area;
- Walking and cycling infrastructures (public space) occupied by cars.

## 1.2 Road network and main access axis

Private cars and commercial vehicles traffic flows, from and to the urban peninsular Almada area, usually use the following main road axis (Fig. 4):

- Axis n.1: along the eastern harbour zone, through Av. 23 de Julho, Av. Aliança Povo MFA.
- Axis n.2: across the central area, from Av. Bento Gonçalves and Rua Dom João de Castro to Av. Dom Nuno Álvares Pereira, Av. Dom Afonso Henriques and Av. 25 de Abril, connecting the “25 de Abril” bridge junction (Rotunda do Centro-Sul) and Pragal to Cacilhas boat, metro and bus terminal, the most important in the south region of Lisbon metropolitan area.
- Axis n.3: an additional access point (less used) to the centre-southern area of the urban area through Av. Henrique Barbeito, Rua Cabo da Boa Esperança and Av. Rainha Dona Leonor.

According to a 2001 survey, the daily traffic along the above mentioned axis was:

- Axis 1: around 30.000 vehicles;
- Axis 2: around 37.000 vehicles from Av. Bento Gonçalves and 23.000 from Rua Dom João de Castro;
- Axis 3: around 20.000 vehicles.

The introduction of the light rail system changed this scenario, and in 2009 the traffic values in this 3 axis were down to:

- Axis 1: around 20.000 vehicles;
- Axis 2: around 16.000 vehicles from Av. Bento Gonçalves and 14.000 from Rua Dom João de Castro;
- Axis 3: around 18.000 vehicles.

Remarkable traffic flows also characterize the Centro-Sul junction, the intersection between “25 de Abril” bridge, A2 and IC20 highways connecting Almada respectively with Lisbon, the south municipalities and Costa da Caparica. Here, traffic flows account for some 160.000 vehicles per day in the bridge, 130.000 in the A2 and nearly 100.000 in the IC20 axes.

Another important factor affecting traffic in this area is the high usage of car parks located in Cova da Piedade area (see car parks n. 4, 15, 22, 23, BG and LS - Fig. 5) by some of the commuters. From parking spaces located in this area commuters have an easy access to Metro Sul do Tejo lines 1 & 3 to the city centre. Also important is the use of parks in multimodal interfaces, for commuters going to Lisbon by train (see car parks n. 8 and 9 - Fig. 5) or boat (see car parks n. 10, 11, 12, 19 e 21 - Fig. 5), terminating at Cacilhas where to Lisbon depart from.



Fig. 4 – Main axes towards North Almada area

### 1.3 Main mobility and transport systems

An overview of the main mobility and transport system components is provided in the following sections. This could be suitable (with different modalities and roles) for the implementation of the logistics solutions analysed in the study.

#### 1.3.1 Parking system

In the overall Almada area the parking system is composed of infrastructures (parking houses) and a high number of surface car parks (in total about 13.000 parking places) as showed in the table below. Around 5% of these (650) have restricted time windows, while 20% (2.600) have a fee.

5 parking houses located in Almada centre are of particular importance::

- 3 parking houses in the old town: Capitão Leitão 146 parking places; Conde Ferreira 215 parking places; Afonso Henriques (former Citroen garage) 70 parking places. These are managed by ECALMA (this municipal parking and mobility company in also in charge of the management and the control of the street parking spaces).

- 1 parking house named Gabriel Pedro, close to the Courthouse, with 280 parking places, managed by a private company.
- 1 parking house located in Liberdade Square (Praça da Liberdade), with 780 parking places, managed by a private company.

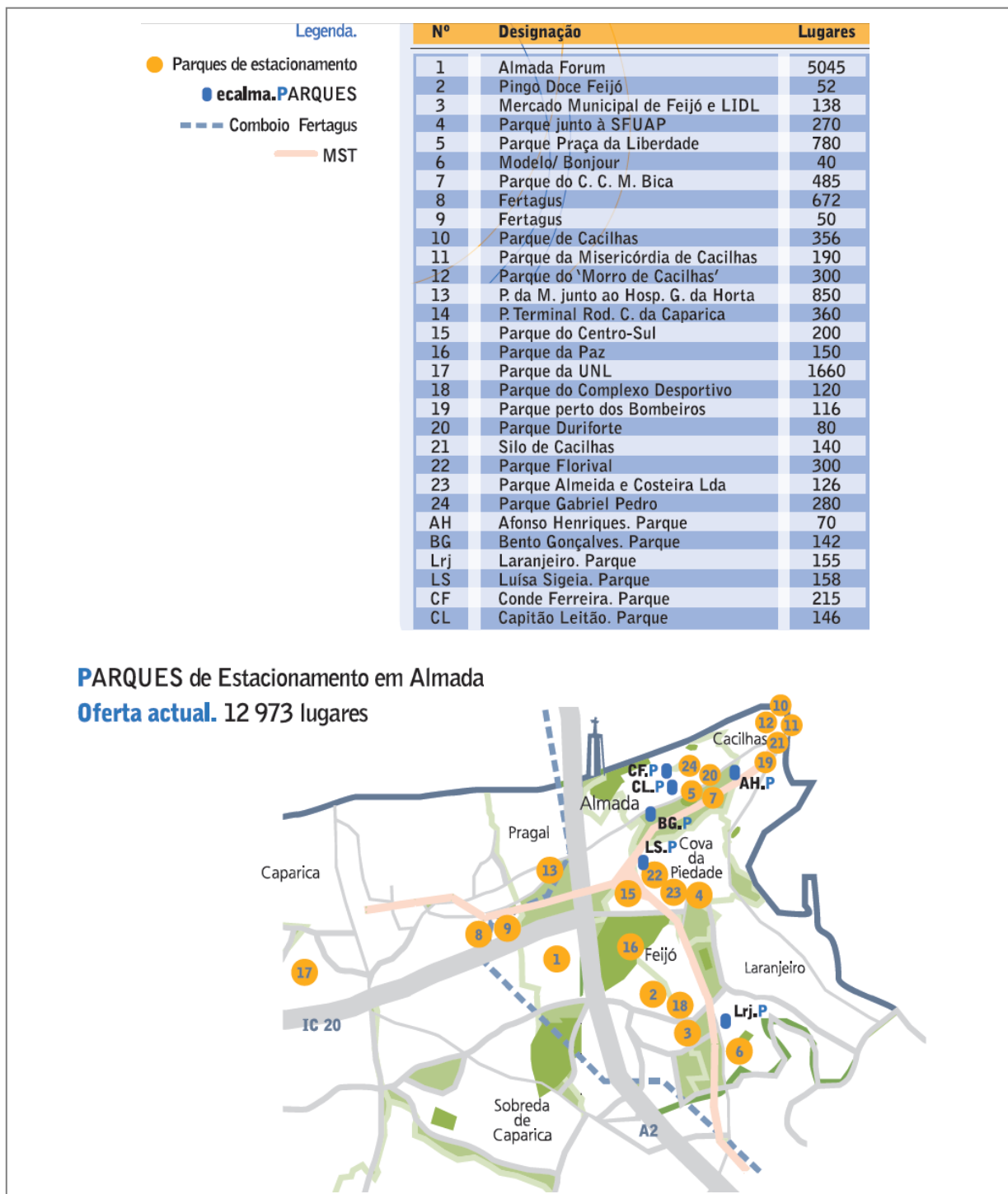


Fig. 5 – Almada parking system

The parking occupancy level of the different parking houses amounts to around 80% in the case of the parking infrastructures managed by the private operators, while for the ECALMA parking houses it is around 40%.

In order to control parking payments along the street, ECALMA operators are monitoring the streets by checking vehicles parked in the blue lots. Such operators are also in charge of checking the time that the commercial vehicles stop in the loading/unloading lots.

One of the main needs is now to update the current parking regulation/normative (defined nearly 20 years ago) and to act with a strong and continuous control on road.

### 1.3.2 Public Transport

The Public transport system in Almada is based on the following main components:

- Train, bus and boat services (including ferries), for the commuters from and to Lisbon and the southern regions,
- Bus and tram services for the transport services inside the Almada area.

Train services operated by Fertagus (main private train operator in Portugal) connect Lisbon to Setúbal (south) with a frequency of 5 to 10 minutes in peak hours (20 minutes outside peak hours) and 10 minutes between Almada and central Lisbon (business district).

The boat service is based on 2 lines connecting Lisbon every 10 minutes and operated by Transtejo (public – private owned).



*Fig. 6 – Transtejo Boat connections and ferry boats Cacilhas station*

The Bus service is operated by TST (private company) with 120 buses, 66 bus routes and 83 million passengers per year. The most important bus terminal is located in Cacilhas, near the boat station (Fig. 7).

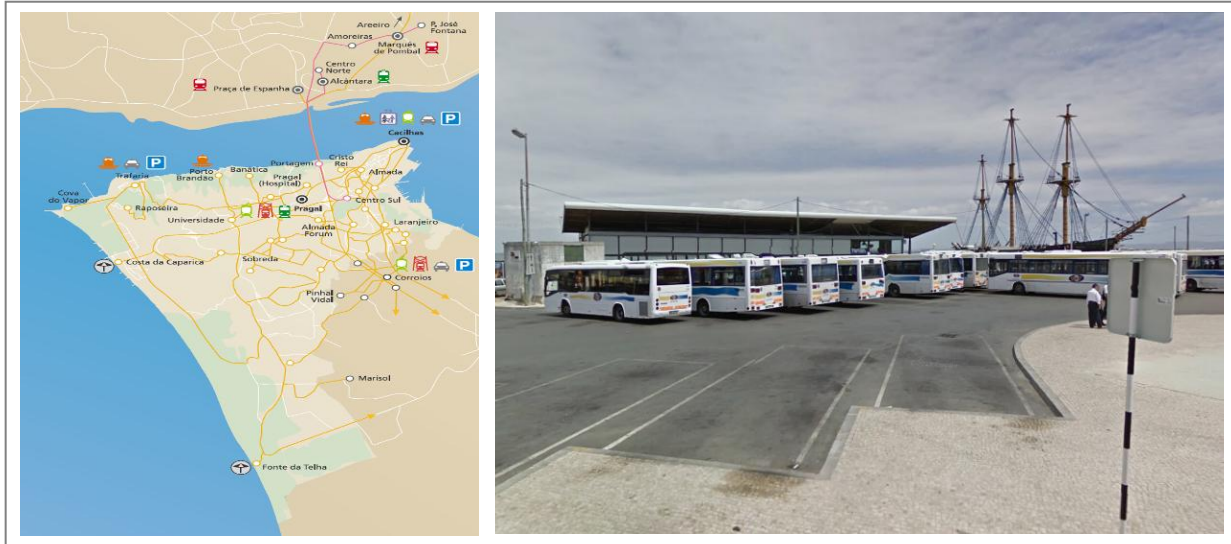


*Fig. 7 - Bus network and Cacilhas bus terminal*

The new tram system (started operating in 2008) significantly enhanced the public transport offer and service quality and the integration with the other modalities (bus, train and ferry).

The tram network indicated as Almada Metro Sul do Tejo (Fig. 8) is operated by MTS (a private company) and composed of 3 main lines:

- Line 1 Cacilhas – Corroios
- Line 2 Corroios – Pragal
- Line 3 Cacilhas – University

Currently the frequency is 5 minutes in peak hours (10 minutes outside peak hours) and the number of passengers transported is 25.000 to 30.000/day that, despite being a considerable amount, is significantly less than the initial estimates of expected users that were the demand hypothesis for its realization (and as requested by these kind of modality/service).

There are still problems regarding the integration of tram lines and bus services. Some bus line are overlapping the tram line (in particular tram Line 1) and a discussion concerning their modification in bus feeder lines to the tram is ongoing.

Taking into account that the Bus and Tram services are managed by two different operators it is clear that the effort to be carried out by the Municipality for redefining the overall PT network based on dedicated corridor (represented by the tram line)

and feeder services (to be operated by the bus) should be focused on the dialogue of the two different operators and in realizing an integrated payment system/card.

The recent creation of the Lisbon Metropolitan Transport Authority should solve this type of problems, but it has still no capacity to do it.



Fig. 8 – Almada Metro Sul do Tejo network and Line 1

In the frame of TP system it is worth noticing the FLEXIBUS initiative, a public service based on the demand responsive approach with a high level of flexibility, adapted to the needs and requirements of the citizens.

FLEXIBUS is in operation since 1<sup>st</sup> July 2010 on a network of about 5,5 Km from Monday to Friday: 7:00 – 19:00 (Saturdays: 8:00 to 13:00). The average waiting time at the bus stop is 20 minutes. It allows route deviations by request, for instance to serve the users of the day care centres.



Fig. 9 – FLEXIBUS services network

FLEXIBUS is managed by ECALMA, the Municipal Company for Parking and Circulation, and uses 4 drivers and 2 electric mini-buses: parking place for the buses and to charge/replace batteries in the Afonso Henriques parking located in the city centre (former Citroen garage).



Fig. 10 – FLEXIBUS electric bus in Afonso Henriques parking terminal and on the road

### 1.3.3 Existing Electric vehicles charge points

Regarding e-mobility, the Municipality has already a network of 48 electric recharging points, located at parking houses and road parking areas (Fig. 11).

Moreover, the 6 parking houses managed by ECALMA are some of the spots equipped with electric charging points.



Fig. 11 – EV charging points location and devices at Conde Ferreira parking and on the road

## 1.4 Mobility plan

Concerned with environmental sustainability and energy saving issues, the Municipality of Almada has set up relevant policies on transport and mobility in the last decade in order to face significant traffic problems due to the large number of private cars and commercial vehicles, as described in the previous sections.

This strategy is focused on the development of a multimodal transport system by the integration of the different mobility services, the enhancement of the overall accessibility to the public transport network, the promotion of soft mobility modes and alternative vehicles and fuels.

The development of the Almada Mobility Plan foreseen four main objectives:

- Planning and developing a Multimodal Transport System;
- Creating better infrastructures for Public Transport and Soft Modes;
- Promoting the use of new and more efficient technologies/alternative fuels (including electric mobility);
- Involving citizens in the decisions, informing and raising awareness.

The key goals are:

- Diversifying the transport offer;
- Achieving an adequate integration between transport modes;
- Improving accessibility;
- Reducing car use by boosting modal shift from private cars to PT and soft modes;
- Improving public space, creating safety and adequate conditions for pedestrians and cyclists;
- Promoting bike use for daily commuting (< 6 km);
- Enhancing the city logistics processes mainly related to "last mile" freight distribution;
- Enhancing the quality of life in Almada, mitigating CO<sub>2</sub> emissions and contributing to the EU burden sharing of the Kyoto Protocol.

The following pictures provide an overview of some infrastructures, solutions and area of Almada



*Fig. 12 – Pedestrian area and 20 km/h speed limit area along tram line*



*Fig. 13 – Pedestrian street in Cacilhas and Capitão Leitão parking entrance*

The second generation Mobility Plan (called PUMA), for the overall Almada municipal area (based on a SUMP approach) is currently under development with the adoption of some specific services and development of support infrastructures and includes until now the following areas:

- Almada Centre and the “Old town”: creation of shared zones (20km/h) and pedestrian areas in the street network;
- Residential areas: traffic calming measures, speed limits and parking specific rules;
- Cacilhas area and the ferry harbour zone: traffic calming measures and pedestrian streets;

Other projects to be included in PUMA are: a Mobility House to accommodate mobility services (public and private), the restructuring of the BUS network, an Almada pedestrian plan, a safety and security observatory, etc.

## 1.5 Almada Study Area

The area identified in Almada for the analysis of commercial and logistic activities and possible solutions (hereinafter "study area"), is the peninsular northern part of the city and consists of three districts: Cacilhas, Almada Velha and Almada Centre.

Each city district forming part of the study area is characterized by specific features, as indicated below:

**Cacilhas district** is the Almada downtown neighbourhood and it is one of the more traffic congested areas. The ferry terminal (from and to Lisbon), with around 50.000 people arriving/departing daily, and the bus terminal, with a traffic of around 800-900 bus daily trips are located in Cacilhas.

This neighbourhood presents a strong commercial area as well, with restaurants and small shops attracting local residents, Lisbon visitors and foreign tourists..

- **Almada Centro** is the town commercial centre, with a large shared space where pedestrians, public transports, bike and cars circulate daily. The area is called an "open air commercial district", although the economic crisis has reduced its dynamism in the last couple of years with the closure of relevant number of shops.
- **Almada Velha** is the historical area of the city, with small streets, old shops, little restaurants, churches, gardens, theatres, museums and service facilities. Most part of Almada Velha streets is so narrow that not all types of vehicle can pass, which makes the district particularly difficult when it comes to logistics.

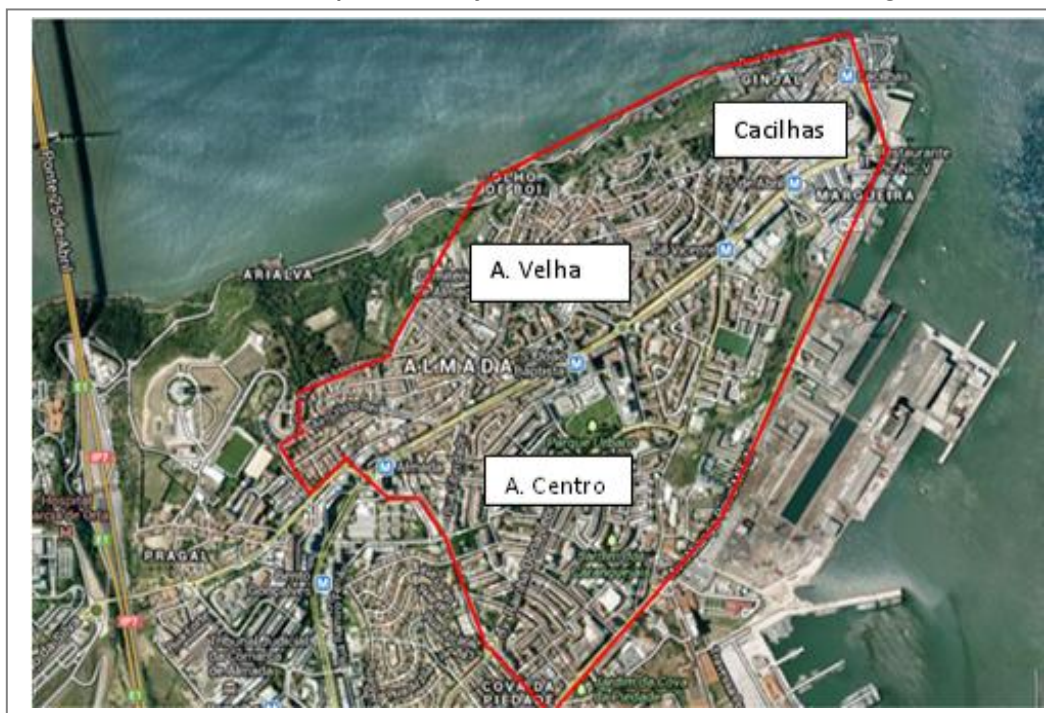


Fig. 14 – Almada study area

The overall study area is characterized by the following features :

- Cacilhas old area includes the tram/boat/bus terminals and Rua Cândido dos Reis (connecting the Largo Bombeiros Voluntários to the PT interface in Largo Alfredo Dinís), the most emblematic street of Cacilhas, recently turned into pedestrian (June 2012) and where no vehicles are allowed, except for bikes, electric mini-bus and commercial vehicles in restricted time windows for I/u operations.
- The commercial and residential areas (Av. Dom Nuno Alvares Pereira, Av. Afonso Henriques, etc.) around the tram line 1, crossing Almada for a total 2.8 km and starting from the boat terminal, with lateral traffic lanes and the possibility to park for 15 minutes on the lateral sides.
- The main Almada square, Praça Movimento das Forças Armadas, a shared zone with speed limit of 20 km/h, connecting with two pedestrian streets and the possibility for the commercial vehicles in I/u operation to park for 15 minutes on central slots.
- A road network characterized by narrow streets, often one-way.



Fig. 15 – Praça Movimento Forças Armada

## 1.6 Traffic surveys

During the investigation about logistics activities in the reference area, the counting of vehicles entering/leaving from the study area was carried-out in 4 main access sections (Fig. 16).

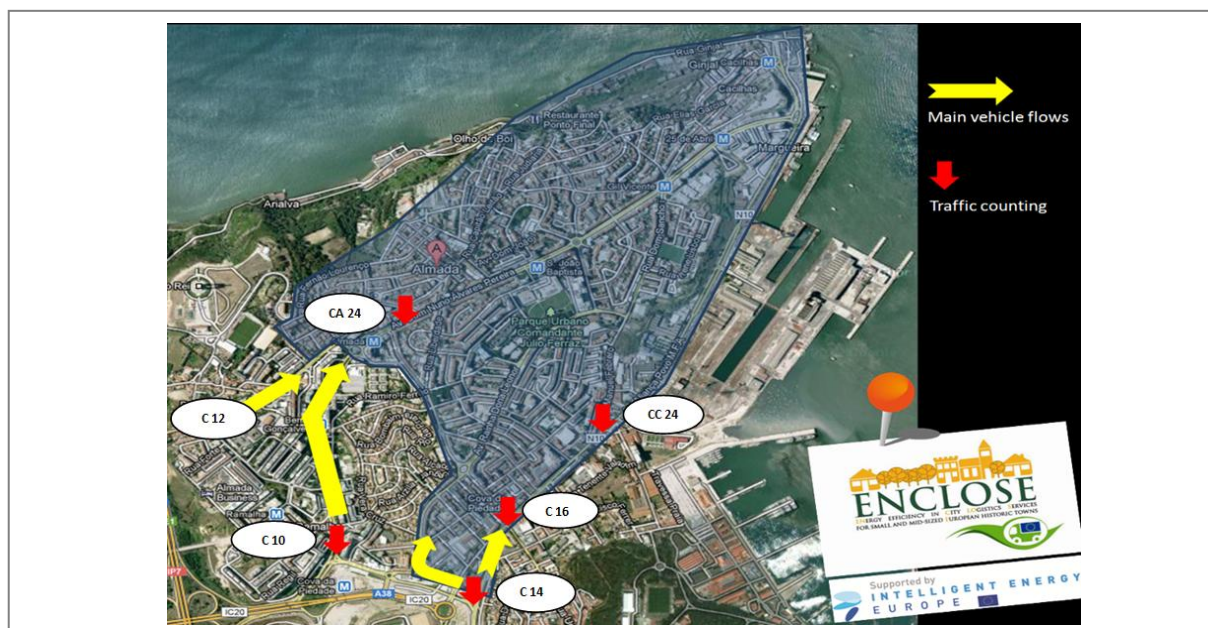


Fig. 16 – Almada study area including vehicles counting point

The results of vehicle counting are reported in the following table:

| Counting point | Location                                     | Vehicles tot |        | Trucks and buses |      | Vehicles tot      |
|----------------|----------------------------------------------|--------------|--------|------------------|------|-------------------|
|                |                                              | 07-20        | Day    | 07-20            | Day  | 2 hours rush time |
| CA 24          | Av. Dom Nuno Álvares Pereira                 | 20.730       | 24.600 | 497              | 620  |                   |
| CC 24          | Av. António José Gomes                       | 10.703       | 13.100 | 907              | 1260 |                   |
| C 12           | Rua D. João de Castro / Rua Cidade de Ostava |              |        |                  |      | 7.500             |
| C 10           | Rua Henrique Mota (Acesso ao Almada Fórum)   |              |        |                  |      | 1.450             |
| C 16           | Largo 5 de Outubro                           |              |        |                  |      | 3.100             |
| C 14           | EN 10 / Viaduto acesso Centro Sul            |              |        |                  |      | 2.800             |

Table 1 - Almada traffic data updated March 2013

As it was expectable, the above data show that the higher volume of traffic flow (82-85%), both private and commercial, is observed during the timeslot 07:00 ÷ 20:00.

Most interesting data for this study are the 24h counting points CA 24 (Axis 1 - Avenida Dom Nuno Álvares Pereira ) and CC24 ( Axis 2 - Avenida António José Gomes ), which are located on the major road axis.

It is worth noticing the considerable diminution of traffic, with respect to the 2001 survey. In fact:

- Axis 1 (Av. Antonio Jose Gomez, counting point CC 24): from 30.000 vehicles of 2001 to 13.100 of March 2013;
- Axis 2 (Av. Dom Nuno Álvares Pereira, counting point CA 24): from 42.000 vehicles of 2001 to 24.600 of March 2013.

The above does surely depend on recent policies adopted by Almada Municipality in the last few years, aiming to foster the modal shift from private to public transport (tramway, pedestrian areas, speed limit long Axis 2, increase of bus lines and frequencies, etc.).

## 2. General logistics context

### 2.1 Overview of characteristics and main types of city logistics flows

As detailed in the above Table 1 (traffic dealing with data collected in Almada), the more significant flows of commercial vehicles entering/leaving the study area, originate from the three penetration axis.

- Axis n.1: (CC24 - Av. Aliança Povo MFA)

|                                 |            |
|---------------------------------|------------|
| Total heavy vehicles            | 1.261 /day |
| Total buses                     | 722 /day   |
| Total heavy commercial vehicles | 539/day    |
- Axis n.2: ( CA 24 - Av Dom Nuno Álvares Pereira)

|                                 |          |
|---------------------------------|----------|
| Total heavy vehicles            | 624 /day |
| Total buses                     | 495 /day |
| Total heavy commercial vehicles | 129/day  |
- Axis n.3: (Rua Cabo da Boa Esperança and Av. Rainha Dona Lionor)

|                                 |          |
|---------------------------------|----------|
| Total heavy vehicles            | 500 /day |
| Total buses                     | 144 /day |
| Total heavy commercial vehicles | 356/day  |

The total number of heavy commercial vehicles daily counting's (entering and exiting) the Almada study area is :

$$539 + 129 + 356 = 1024 \text{ heavy commercial vehicles/day}$$

So, the total heavy commercial vehicles number that circulates in the Almada study area every day is roughly 512.

Considering, based on the ENCLOSE surveys, that 1/3 of all commercial vehicles are heavy and 2/3 are light, we would have roughly 1024 light commercial vehicle circulating in Almada every day.

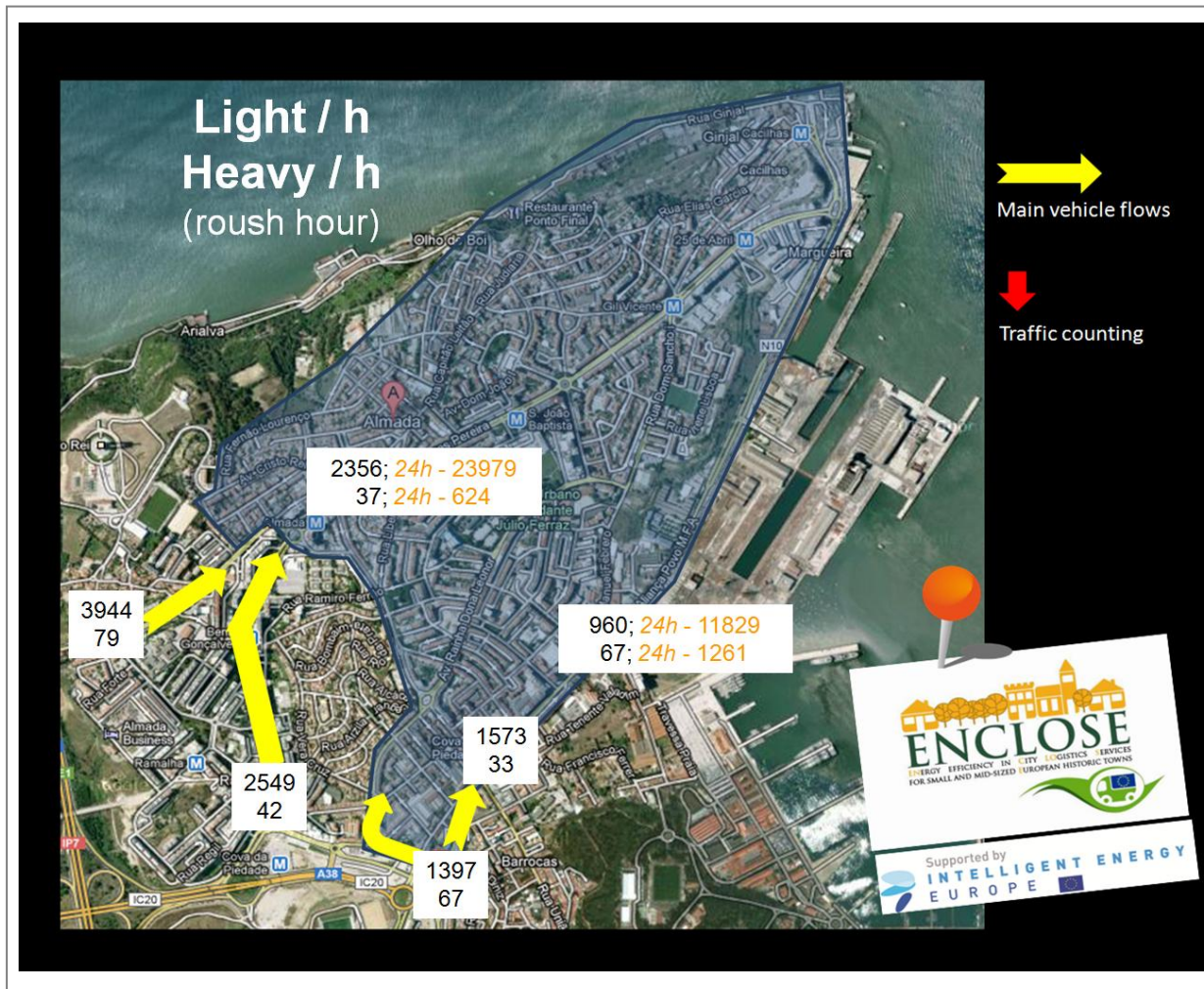


Fig. 17 – Some traffic countings in the entrances of the study zone

## 2.2 Freight vehicles regulation

The circulation, access and parking of freight/good vehicles is regulated as follows:

- Loading and unloading parking lots are signalized by a yellow line and specific panels (Fig. 18).
- Time windows for l/u operation in working days are foreseen from 10.00÷12.00 and 15.00÷17.00 or from 10:00÷17:00 (depending on the districts), but parking lots are often misused by commercial vehicles for the whole day, also due to the lack of an effective and continuous control. Outside the above mentioned timeslots parking spaces can be used also by private cars.
- L/u parking lots are very often occupied by private cars also in the time windows reserved to commercial vehicles (Fig. 18).

- In some areas, maximum parking time allowed to the commercial vehicles is 15 minutes. Vehicles in any case, should keep open doors, demonstrating they are loading or unloading.
- Panels indicating loading/unloading rules and timing are located next to the parking lots .



Fig. 18 – Reserved l/u parking lots in front of minimarket and l/u lots occupied by private cars

- Along Avenida Dom Nuno Álvares Pereira, as for any private vehicle, commercial vehicles must circulate with a speed limit of 20 Km/h in the two lateral lanes separated by the tram tracks.
- Commercial vehicles during l/u operation could parking free of charge in the "common" white horizontal sign lots and paying a normal fee in the blue ones, according to the specific fares that could change from zone to zone.
- No specific parking normative is foreseen for big trucks during deliveries to the several minimarkets (Pingo Doce, M. Bica, Mini Preço, etc.) and this often causes risks for pedestrians, with vehicles occupying sidewalk space
- No specific permit (paper or electronic) are foreseen for commercial vehicles, while paper permits are issued to residents (to be put on the car window) allowing to park only in limited areas.

## 2.3 Existing logistics services

Freight delivery processes in the urban area are currently performed individually by every single operator.

The different logistics processes can be summarized as follows:

- Direct delivery by the producer: this is a wide percentage of the overall freight transport in the urban area (32%) and it is generally operated by the actors who produce goods and deliver these to shop owners directly from their production centres or warehouses;
- Direct delivery from the wholesaler: this represents a minor part of freight urban transport (4%) and it is operated by mono/multi brand wholesalers delivering goods to shop owners directly in their small vehicles;;
- Large scale deliveries: this refers to the delivery/stocking processes of the big commercial operators (i.e. supermarket chains) towards their sales points or franchising partners;
- Third party delivery: is the most common logistics process in the urban area and it is based on the “classic” delivery process managed by freight operators (including express couriers) from their warehouses to shop owners, offices, authorities and private people;
- Self-supply: around 44% of shop owners make use of this form of freight transport and it is hard to quantify the volume of freight involved;
- Transport by pedlars: concerns around 5% of freight and usually deals with small markets;.
- Private freight transport: regards the goods that are transported by purchasers’ private cars.

At present, with the exception of the I/u timewindows, no specific city logistics solutions, aiming at rationalizing freight distribution and at reducing CO2 emissions and Energy consumption, exist in the study area.

Moreover, no significant agreements among freight operators (mainly based in Lisbon), for consolidating and optimized deliveries and trips to Almada, is known.

### 3. Setting logistics baseline

#### 3.1 Commercial activities

In order to identify the best measures to be undertaken in the field of urban logistics AGENEAL, at the beginning of 2013, carried-out a survey in the study area, in order to classify shops and circulating logistic vehicles.

Data gathered with this detailed survey describe the dynamics of the study area, that accounts for a total of around 2.300 shops located in the city areas of Cacilhas, Almada Velha and Almada Centre.

A total of 700 shop owners were interviewed during the survey.

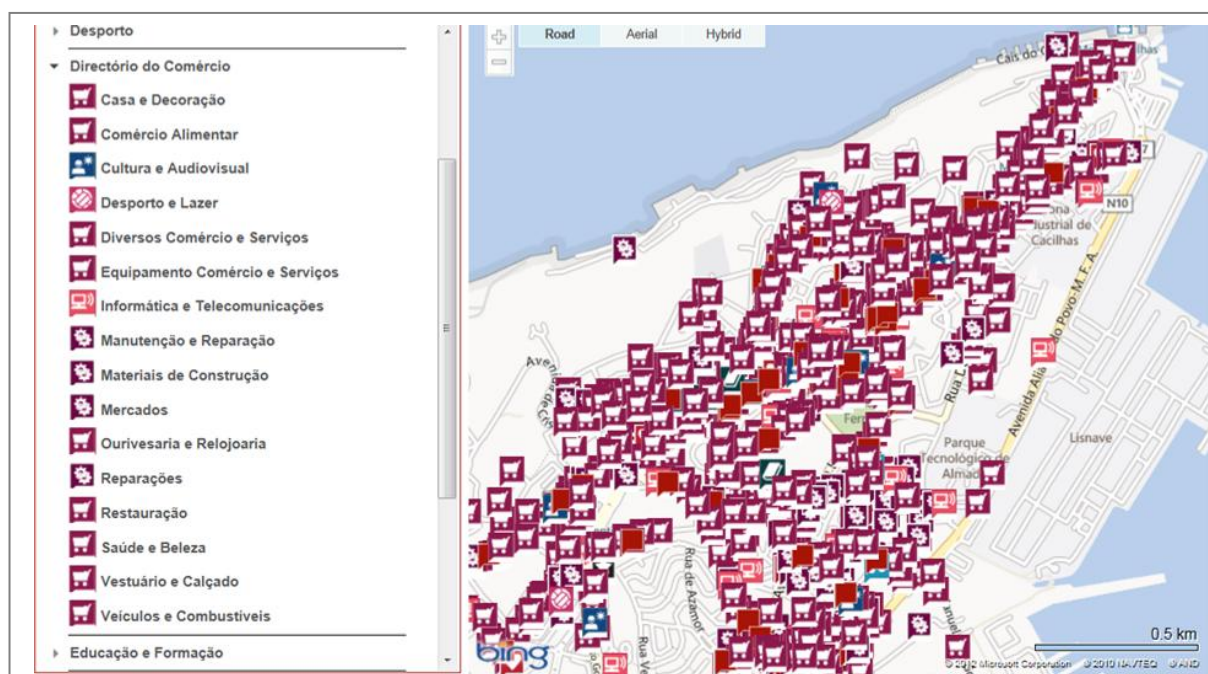


Fig. 19 –Almada commercial activities overview

The following tables show the results of the analysis carried out in January 2013 in the study area.

#### TYPE OF ACTIVITY

|                     |      |      |
|---------------------|------|------|
| Shop                | 1287 | 56 % |
| Crafts work         | 138  | 6 %  |
| Restaurants & Cafés | 552  | 24 % |
| Services            | 336  | 14 % |

## ORGANIZATION STRUCTURE OF COMMERCIAL ACTIVITIES

|             |      |      |
|-------------|------|------|
| Single      | 1920 | 83 % |
| Network     | 347  | 15 % |
| Franchising | 46   | 2 %  |

## TYPE AND WEIGHT OF PRODUCT CONTAINERS

|                  |     | Average Weight (Kg) |
|------------------|-----|---------------------|
| Cardboard boxes  | 43% | 8,0                 |
| Big plastic bags | 17% | 5,4                 |
| Pallets          | 3%  | 85,0                |
| Plastic boxes    | 15% | 7,6                 |
| Rolls/Bobbins    | 3%  | 18,0                |
| Tins /Drums      | 6%  | 10,8                |
| Other            | 12% | 27,5                |

## WHO DELIVER?

|                     |     |
|---------------------|-----|
| Transport operators | 59% |
| Producers           | 32% |
| Hawkers             | 5%  |
| Wholesalers         | 4%  |

\* excluding self supply

## TYPE OF VEHICLE

|                     | Light vehicles | Vans  | Heavy trucks |
|---------------------|----------------|-------|--------------|
| Transport operators | 1,6%           | 52,4% | 46,0%        |
| Producers           | 3,1%           | 59,4% | 37,5%        |
| Hawkers             | 45,5%          | 52,3% | 2,2%         |
| Wholesalers         | 59,0%          | 41,0% | -            |

## DELIVERY FREQUENCIES TO THE SHOPS

|              | 2 or + times/day | 1 time/day | 4 times/ week  | 3 times/ week | 2 times/ week | 1 time/ week |
|--------------|------------------|------------|----------------|---------------|---------------|--------------|
| Transporters | 10,2%            | 8,5%       | 6,7%           | 6,8%          | 11,8%         | 17,0%        |
| Producers    | 9,4%             | 15,6%      | 6,2%           | 6,0%          | 12,8%         | 25,0%        |
|              | 3 times/ month   |            | 2 times/ month |               | 1 time/ month |              |
| Transporters | 3,4%             |            | 6,8%           |               | 28,8%         |              |
| Producers    | 3,0%             |            | 3,2%           |               | 18,8%         |              |

## SELF-SUPPLY FREQUENCIES

| 2 or + times/ day | 1 time/ day | 4 times/ week | 3 times/ week | 2 times/ week | 1 time/ week | 3 times/ month | 2 times/ month | 1 time/ month |
|-------------------|-------------|---------------|---------------|---------------|--------------|----------------|----------------|---------------|
| 6,8%              | 29,5%       |               | 6,4%          | 4,7%          | 31,8%        |                | 7,2%%          | 13,6%         |

## DELIVERY TIMEFRAME

| 06-08 am | 08-10 am | 10-12 am | 12-14 pm | 14-16 pm | 16-18 pm | 18-20 pm |
|----------|----------|----------|----------|----------|----------|----------|
| 9%       | 46%      | 29%      | 6%       | 4%       | 5%       | 1%       |

#### REVERSE LOGISTIC - SHOPS

|     |      |
|-----|------|
| Yes | 29 % |
| No  | 71 % |

#### REVERSE LOGISTIC PRODUCTS (IN WEIGHT)

|                                 |     |
|---------------------------------|-----|
| Cardboards                      | 46% |
| Plastic packages                | 16% |
| Other packages                  | 25% |
| Refillable bottles              | 8%  |
| Goods from inner city producers | 5%  |

As showed by the above data, goods are supplied almost completely by cardboard boxes (43%) and are delivered by transport companies (59%) and by producers (32%). The weight of packaged goods, excluding pallets, is usually between 5 to 20 Kg.

The significant presence of shops in the study area implies a large amount of delivered goods, estimated in an average of more than 60 tons/day, excluding self supply with an average of 512 freight vehicles/day circulating in the reference area (peaks of 240 heavy commercial vehicles during the time window 08:00-10:00). To these, also the vehicles (private small vans/cars) of shopkeepers in self-supply must be added.

Considering this last transport modality, a very important factor issuing from the interviews is that the current economic crisis significantly changed shop owners behaviour in terms of supply of goods. In particular, instead of stocking goods on a regular basis, most of them do stock considering only missing goods. Moreover, in order to cut-off costs as much as possible, the use of private vehicles in self-supply transport activity has recently increased.

The same applies to restaurants and cafés, directly using the services of their suppliers or their own vehicles, in order to avoid transport costs.

Food suppliers operating consigned goods, represent a very small part of transport operators, and the freight volume they supply restaurants and shops with is relatively limited. In fact, they visit food shops weekly/monthly and restaurants every week.

This kind of activity is becoming less frequent recently, due to the fact that it is not convenient for suppliers to visit shops, as the owners only buy missing goods and do not buy for stockpile.

### ***3.2 Freight transport operators***

According to December 2012 interviews, one third of the operators that were interviewed declared collecting goods from warehouses located in Palmela, Sesimbra, Lisbon and Cova da Piedade.

Products are packed in cardboard boxes (13%), ice boxes (10%) or cooled (1%). Both light (<3,5ton gross weight) and heavy freight vehicles come mainly from Lisbon metropolitan area. 10% of the interviewees confirm that freight transport processes respect EU regulation.

Average length of every trip is of around 100 km, with 10 to 25 deliveries. Average weight of deliveries is about 100 kg for major shops and 10-15 kg for minor ones.

All the operators that were interviewed use diesel vehicles (mainly Euro2 and Euro3): in particular, for 17% of interviewees this is the only vehicle owned, while for the remaining interviewees it represents part of their commercial fleet (up to 50 vehicles).

Loading capacity ranges from 600 kg to 12.500 kg and most common vehicles have a gross capacity from 2.500 kg to 7.500 kg. Despite operators declare that 30% of commercial vehicles start delivery services with a full load, investigations carried-out during the study showed that the actual average is of around 50% (or less) of the full capacity for the most part of the transport trips.

During the interviews performed in December 2012 freight operators were also asked to provide useful suggestions for improving delivery service: 30% did not give any answer/suggestion, 50% suggested to enhance the control of loading/unloading areas, due to the fact that these are frequently occupied by private vehicles, 17% declare that more reserved parking spaces are needed and that some areas do not have any (7%). For Cacilhas area the interviewees suggest to shorten administrative times for issuing access permits.

### **3.3 Main environmental and energy aspects**

Almada Municipality published in 2003 a plan for CO<sub>2</sub> and energy consumption reduction within its area named "Estratégia Local Para as Alterações Climáticas do Município de Almada", a strategy that was updated in 2008 and is now under a new revision. In particular, a series of actions have been adopted in order to reduce emissions and energy consumption of 20% by 2020, comparing to 2006 reference value.

Specific initiatives were developed in the fields of constructions (i.e. thermal insulation of buildings), industry (i.e. incentives to firms enhancing energy class and producing renewable energy) and transport (i.e. light railway MST, electric vehicles), in line with the provisions of Kyoto agreements.

Regarding urban logistics, baseline situation of study area environmental data is calculated based on traffic analysis carried-out in December 2012, as indicated in the above Table 1.

Approximately 512 heavy commercial vehicles enter per day in Almada study area, making an average trip of 6 km, for a total of 3.072 km/day.

From the survey we can estimate that 1/3 of the commercial vehicles are heavy and 2/3 are light vehicles, making this account for around 1024, with a similar trip length.

Heavy commercial vehicles have a total average consumption of 24lt/100km, corresponding to an average vehicle CO<sub>2</sub> emission of 730 gr/km (Euro 2 COPER III).

On the other hand, light commercial vehicles consume roughly 11 l/100km, emitting 334 gr CO<sub>2</sub>/100km.

The daily total of CO<sub>2</sub> emissions amounts to 4,3 ton/day, which adds up to 4,3 x 300 days = **1289 ton CO<sub>2</sub>/year**.

The same applies to the energy situation:

1.024 light commercial vehicles doing 6km trips with a average consumption of 11l/100km for 300 days, and 512 Heavy commercial vehicles doing 6km trips with a average consumption of 24l/100km for 300 days leads to a consumption of fuel (gasoil) of 173 + 188 = **361 TOE/year**.

### **3.4 Highlight logistics problems**

Logistics services in Almada do not feature particular issues similar to those of many small historic towns, due that the main commercial streets are usually rather wider (except for some streets in Cacilhas center and the old neighbourhoods of Almada) and do allow freight vehicles to transit and stop without implying significant problems

to mobility Even when illegal parking is used, it does not represent major problems for traffic flow.

Yet the following critical factors can be identified:

- Lack of loading/unloading areas
  - Interviews highlighted a lack of loading/unloading areas. In fact, only 26,4% of the interviewees declared using reserved areas for deliveries, while the majority (40,4%) double parks and 28,3% stops right in front of the shop. Finally, 4,8% declares parking elsewhere, in particular on the sidewalks.
  - This behaviour is said to be mostly due to the fact that reserved slots are always full (77%) or not available (73%). Other minor reasons are: forbidden entry to the area, lack of space for performing operations and need to be quicker.
- Poor signalling and control of reserved lots
  - Existing loading/unloading spaces are sometimes not adequately indicated with panels or with road markings (i.e. specific lines along with different coloured asphalt). Moreover, control pressure by the municipal parking management company and police is low, thus resulting in a frequent misuse of reserved parking lots by private vehicles. These are often occupied for extended periods by vehicles belonging to shop owners themselves, removing it only in case of control, thus obliging other logistic actors (like , por instance)to double park.
- Lack of knowledge of freight regulation by operators
  - The majority (90%) of the operators do not know specific regulation dealing with restricted access (i.e. time windows) to the areas they deliver goods to. The highest knowledge concerns Cacilhas pedestrian zone. In fact, 7% of operators declares the access is limited to residents only, while 3% states that the entry is forbidden to vehicles of over 3.500 kg.
- Minimarkets
  - The shops of different minimarket chains account for more than twenty. The trucks supplying the two main mini market chains (Pingo Doce and Mini Preço) are considered as one of the main factors of the negative environmental situation and congestion problems in Almada (Fig. 20). This is both because these markets are located in the inner Almada area and because they use, in addition to the big trucks, also small vehicles during the whole day for transporting fresh products (in particular fruits and vegetables).



Fig. 20 – Truck supplying minimarket

- Self supply

- As explained above, the reduction of commercial activities due to the economic crisis led to a growing number of shop owners/keepers using self supply to stock up goods, above all in case of low quantities. This results in an increase of traffic of light freight vehicles or cars and, in particular, implies that many shop owners do park their vehicles right in front of their shops, often occupying loading/unloading areas or prohibited parking lots, for the overall day.

- The main Almada fish and vegetables market

- The vegetables and fish market (Fig. 21) is an "hexagonal" building located in Almada old town (Praça do Comércio), 150 m away from the main street where the tram line 1 is running. The market acts also as a "big roundabout" around which freight vans, owned by market workers, are parked during the overall market operating time - from 6 am to 2 pm. These vehicles work as small mobile depots, preventing market customers from using parking lots (Fig. 22).



Fig. 21 – Vegetables and fish market



Fig. 22 – Parked vans used as depots outside the market

## **4. Candidate Measures/services identification and selection**

In this Chapter, a synthesis of the logistics solutions/services identified as suitable for Almada context and needs is provided. These services/solutions have been assessed and selected according to the requirements foreseen by the new Almada mobility plan (PUMA) and especially to the specific key goal of "Enhancing the city logistics processes mainly related to last mile freight distribution", as mentioned in section 2.3..

In particular, general approaches, infrastructural and operative aspects and strengths/weaknesses related to Almada situation are described for the following measures/services:

- Urban Consolidation Centre (UCC)
- Electric Van sharing service
- Self-supply services
- Park and buy service
- Pick-up points service (PuP)
- Loading/unloading areas
- B2C services (e-logistics Agency)

### **4.1 Urban Consolidation Centre (UCC)**

The Urban Consolidation Centre (UCC) is a complex structure, based on a physical infrastructure (i.e warehouse) as a primary component (indicated also as Logistics Base) connected with a range of organization and service measures.

For this reason the UCC is also indicated with other different names and acronyms (i.e. Freight Consolidation Centre, Freight Transshipment Centre, Transit Point, Public Logistics Terminal, Urban Logistics Platform, Freight Collection Point etc.), but it substantially presents a common structure and approach: main reference point for rationalizing urban logistics processes and providing logistics services that can significantly improve the environmental sustainability of freight delivery in urban areas and city centres.

Freight consolidation management is the key activity of UCC. The expression "Freight consolidation" refers to a group of operation models and commercial relationships among the UCC and different logistics operators or between the UCC

and shop owners, aiming at reducing the number of freight delivery trips within the urban area.

The UCC will act as base for gathering goods of different operators (groupage) and implementing “last mile” delivery services managed by UCC fleet. The Fig. 23 shows the operation model of the UCC solutions.

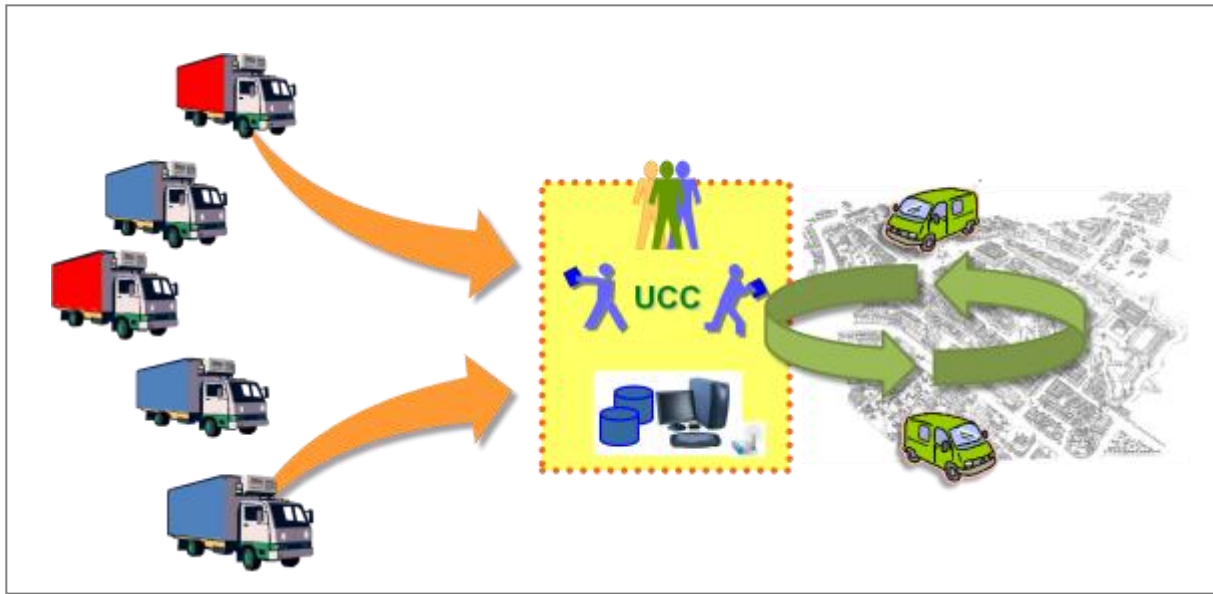


*Fig. 23 – Urban Consolidation Centre and last mile delivery services*

Normally the UCC can result from a private (i.e. an operator or a consortium of operators) or, more frequently, a public enterprise (i.e. Municipality or other Local Authority). In the latter case the Public Authority is in charge of setting-up the structures, purchasing the vehicles of the fleet (if possible eco-friendly) and managing the service, also availing itself of external staff.

At a following stage, once UCC experience consolidated, the Authority may also involve private actors in the overall UCC management, only maintaining the functions of control and regulation, thus establishing, in practice, some form of public-private partnership (PPP - public private partnership).

The UCC can operate, from the commercial point of view, basing on two different approaches:

1. the UCC makes an agreement with the main long range transport operators that often prefer avoiding to enter the inner city centre for delivering low volumes of freight. In this case the transport operator goes directly to the UCC bases leaving the parcels to be delivered in the city centre by the UCC fleet. The operator bears the cost of these last mile transport service. This scheme was implemented in several European cities (with different characteristics and dimensions), such as

Berlin, Bremen, Bristol, La Rochelle, Malmo, Parma, Vicenza, Siena, Barcelona, Lucca, etc.

2. the UCC makes an agreement with the owners/responsibles of the main commercial activities located in the city centre or urban area (shops, restaurants, cafés, minimarkets, etc.). This agreement foresees that the delivery of the ordered freight is to be made directly to the UCC address. In this case the shop bears the cost of last mile service but, at the same time, can also benefit from a lower delivery price applied by the freight operator, thanks to the agreement that guarantees significant quantities of freight to deliver during the year.

In addition, shopkeepers do also benefit from added advantages, due that they can avoid the costs for other related logistics activities e.g storage management, reverse logistics processes (i.e. carton boxes, pallets, plastics), etc. Moreover additional benefits can also be represented by the possible lower delivery prices got thanks to the possibility for the shopkeepers to order larger quantity of goods without any problem of storage.

This is the scheme adopted in 's-Hertogenbosch (NL) by the private company Eco2city.

The two different schemes detailed above highlight the fundamental characteristic of a successful UCC: for operators not having a logistics centre in the reference city the delivery of freight to UCC, upon payment of a fare, shall be more convenient than to overcome the difficulties for its-own vehicles to entre in the city centre.

Such a convenience can either be “pushed” by the Municipality (i.e Vicenza, Lucca, etc.) imposing tight city access restrictions (i.e. time windows, parking time on l/u lots, vehicles sizes, vehicle emissions, one way streets, pedestrian areas, etc.), or be already present in the city morphology itself (i.e. Siena), where the characteristics of the historic centre, with narrow and steep streets and alleys, are a first deterrent for entering in the inner centre along with regulations and restrictions.

As already pointed out, the UCC is based on significant investments on infrastructures, fleet and organization, therefore this solution can be only the final step of a process aiming to identify the most suitable solutions and it can only result from a strong political willingness and from the capability to evaluate the different benefits and costs (directly and indirectly).

For this reason UCC are normally viable solutions for big cities or metropolitan areas, where these usually play the role of urban interports. As regards small/medium size cities these structures should, if possible, be based on existing infrastructures and operators.

The experience of two ENCLOSE towns can be taken as reference in evaluating the feasibility of a UCC in Almada:

- Lucca, where the Municipality, taking advantage of significant European and National co-funding, realized its UCC (infrastructures and vehicles fleet) after a long process lasted 8-10 years, adopting as logistics base (during the experimental phase) an existing minor public warehouse;
- Trondheim where the system implemented by Posten Norge is composed by two hubs at the opposite sides of the city. Large vehicles bring freight to the hubs, from where electric vehicles collect goods to be delivered to the city centre.

Moreover, an interesting solution is given by the possibility to adopt a logistic "cross docking" approach consisting of a service operated by the UCC where the freights were collected by the UCC vehicles directly at national operators warehouses and delivered to the shops in the city centre for last mile distribution.

Whatever the chosen solution is, the implementation of a UCC usually produces several advantages, mainly dealing with freight flows and environmental sustainability of the logistics system. Among these, the most important are:

- Enhancement of the loading factor and reduction of half-load trips with lower transport unit cost;
- Reduction of fuel consumption (energy savings) and of polluting emissions (air and noise);
- Possibility to use low impact vehicles – electric, CNG or hybrid – for last mile deliveries management;
- Compatibility with different transport, environmental and social policies.

Moreover, logistics operators can also benefit from significant advantages by using UCC services, such as:

- Reduction of km covered by freight vehicles;
- Reduction of time waste due to traffic congestions;
- Reduction of delivery times.

Finally, from the Almada point of view, shop owners also enjoy positive advantages by using new delivery services:

- Possibility to receive useful delivery information from UCC (tracking) and to indicate specific hours for delivery;
- Possibility to enjoy other added-value logistics services based on UCC infrastructure (ie. third party warehousing services, packaging collection, etc.).

The main problem concerning UCC is the economic sustainability, in particular:

- Costs for building the logistic base infrastructure (when already existing infrastructures cannot be utilized);
- Costs for supporting infrastructures and devices;
- Costs for purchasing commercial vehicles, in particular EVs, hybrids and low emission vans in general;
- Costs for freight transshipment.

Finally, marketing problems include the unwillingness of the national transport operators to allow deliver operation of "their" freight made with vans showing different brands.

## ***4.2 Electric van sharing service***

Usually van sharing service is more focused on the needs and requirements of shopkeepers in self supply, than on those of transport operators, and can be implemented by adopting different approaches.

In any case this solution can be also suitable for those small transport operators that not having the economic possibility to directly buy commercial EV (characterized by high purchasing costs) but are in the needs to satisfy demand of freight deliveries in those cities having wide pedestrian zones or traffic restricted areas, and/or rules/normative allowing the access only to electric vehicles.

In order to adopt a van sharing solution the municipality, or better a transport operator consortium, purchases a fleet of electric vehicles (the number is to be defined based on local needs and area dimensions and funds availability) which are at freight operators disposal upon reservation. An advanced version of this service could include an ICT platform to manage bookings and the use of electric vans (equipped with specific on board terminals and a smart card reader).

Electric vans can be located either at strategic points in the city or at the headquarters of one operator.

The cost of the service should be related to the effective time of usage and to the agreement criteria among transport operators (including, not last, the operation and maintenance costs). Some of the advantages of such a scheme for the operators are, among the others:

- No significant investment and management costs are needed;
- The courier is led to optimize the number of trips by trying to drive a full-load van (in order to reduce the cost for renting the electric vehicle);
- The historic centre is preserved from emissions and noise pollution.

Yet, the sharing concept also features disadvantages:

- It is not convenient for the transport operators based far from the city;
- Couriers are not often able to optimize shipments and may use half-loaded vehicles (i.e. in the case of urgent deliveries);
- Managing and maintaining the fleet;
- Need for a call-centre and/or suitable ICT platform (including development and maintenance costs) for managing booking, operation and revenues and the fleet.

### ***4.3 Self-supply restrictions***

As pointed out in the previous section, one of the main mobility problems in the inner centre is related to the self-supply processes operated by shopkeepers using their own private vehicles (small vans and/or cars).

This problem is becoming even more evident due to the current economic crisis that is pushing many shop owners to economize on freight transport by using their own vehicles for transporting goods from and to the shops.

Because of this, not only traffic but also parking related problems got worse: really often shop owners park their vehicles (either vans or minivans) in loading/unloading areas illegally for long periods, or even (double)park in no-parking zones close to their shops.

In order to solve this issue some European cities (i.e. Burgos with the solutions identified as ENCLOSE soft-measures) set up restrictions on the number of vehicles that can circulate in the same time window in the restricted traffic area, by implementing specific measures such as: access control devices (i.e. bollards) operated under specific code/psw, a limited number of access permits issued to the shopkeepers (managed by their association) with specific rules both for booking the permits, the time period and for pickup and delivery the permits.

This measure has the advantage of regulating and limiting the number of shopkeepers vans/cars circulating of the in urban city centres, especially to those featuring large pedestrian areas, without penalizing shopkeepers too much.

### ***4.4 Park and buy***

“Park and buy” - P&B service (Fig. 24) is applicable to any tourist city having parking infrastructures (parking house) with presence of operators. The tourist who leaves his

car in parking houses, usually at the border of the city centre, is not willing to buy bulky items as carrying such kind of goods during the visit is uncomfortable.

In order to solve this problem the P&B service, thanks to an agreement between shopkeepers and the parking manager, allow tourists to make shopping and find the purchased items later on directly at the parking house.

This service is based on a operative scheme allowing the shopkeeper to alert the P&B transport operator to collect the goods and to deliver it to the specific parking indicated by the client. Once the delivery is done, a sms is sent to the customer for informing that the parcel is at the parking house. The same system can be used for delivery purchased items to hotels.

The following figure is related to park-buy scheme demonstrated in the Italian historic city of Siena some years ago.



Fig. 24 – “Park and Buy” service scheme implemented in Siena

The results of the service demonstration implemented in Siena showed that the dedicated infrastructure and organization for the parking house are relevant (security boxes, electric van, booking system, personnel presence, goods insurances, etc.) and can be successful faced only if this service is one of several logistics services provided by a transport operator or is one of the services provided by an UCC.

## 4.5 Pick-up Points (PuP) services

B2C commerce, and in particular Web commerce, is constantly growing, pushing the increase of the volume of delivery services requested to the transport operators (mainly express couriers). One of the main problems that these operators have to face in this process is represented by the absence of addressees at the final destination (usually home) during working hours.

This implies that the transport operator shall do one or more unsuccessful trips to attempt the delivery and often the customer is obliged to go to the depot for collecting the item(s), thus generating additional traffic.

In order to avoid (or minimize) this problem, several interesting experiences were implemented in Europe, usually consisting in the setup, by the main freight operators, of some pick-up points either in public areas or at commercial activities (i.e. fuel stations, railway stations, etc.) with a h24 operating time.



Fig. 25 – Pick up point DHL (Packstation) and Kiala PuP service

The courier delivers the parcel(s) at PuP (usually located in close peripheral and easy accessible areas) and sends a sms to the consignee providing the reference number to self-collect the freight. This way, freight operators avoid useless trips within the city and customers do not need to travel to the courier warehouses that are frequently far from the city and have opening times coinciding with customer working hours.

One of the main successful PuP service experience in Europe (and in particular in Germany) is represented by the Packstation™ service operated by DHL/Deutsch Poste, characterized by a specific technological infrastructure (advanced boxes with IT) directly managed by the courier.

The main limit of this solution, from the operation point of view (apart relevant costs, area to be reserved to the infrastructure, etc.) is represented by the fact that the boxes "fulfilment" can be only operated by one courier.

Despite the willing of the different transport operator to reach an agreement for a common and integrated solution, the real possibility to share this infrastructure among different couriers is very low, due the different information systems and flow integration required.

Other minor experiences have been developed in the last few years (i.e. Kiala services), based on similar concept, but although foreseeing more practicable solutions, these require in any case a specific agreements among transport operators and the PuP responsables, that limit their diffusion..

## 4.6 B2C services

Apart from freight transport/distribution related to Web commerce a city logistics transport scheme in B2C commerce is represented by the delivery of purchased goods (not only heavy freights) from shops and supermarkets to customer house.

This service is very useful above all for elderly people facing mobility problems or for people that don't use private car to shopping and wish to have their purchased goods directly at home.

This service is mainly provided by shopping centres and supermarket organizations, while for small/single shops a call centre and a small fleet (often electric vehicles) are needed.

## 4.7 e-Logistic Agency

In some European cities, on the basis also of significant pilot experiences developed under EU programmes (i.e. eDRUL Project - "eCommerce Enabled Demand Responsive Urban Logistics", FAMS Project - "Flexible Agency for Collective Demand Responsive Mobility Services" - 5th Framework Programme R&D EU-IST) the concept of the e-Logistics Agency for the provision of urban logistics services is emerging.

The e-Logistics Agency involves four main components:

- **B2C services**, enabling interaction among the customers and the goods retail/distribution system (last mile, added value service and eCommerce interface);
- **B2B services**, enabling the networking and collaboration of the different actors of freight distribution chain (goods delivery operators, transshipment and logistics

platform operators, retail operators, etc.) and allowing dynamic cooperation among these actors;

- **B2A City oriented services** in order to realize flexible, under mobility constraints, demand-driven goods distribution schemes integrated (if exists) with the ITS urban scenario and the mobility policies.
- **Base Planning services** to enable optimal management of the available resources related to freight distribution process (fleets and available capacity, logistics bases, consolidation, routing, etc.)

Fig. 26 shows the e-Logistics Agency concept developed by FAMS project.

The e-Logistics Agency concept has been often developed (and in some pilot case demonstrated) as an extension of the existing demand responsive transport services operate for people (DRTS), as carried out in Almada with the FLEXIBUS service, where passengers can book their trip and choose the hour and the meeting point for pick-up.

DRTS services are based on a Travel Dispatch Centre (TDC), for managing reservations and planning optimised trips.

In a perspective of enhancement towards the e-Logistics Agency concept, the TDC should be also involved in city logistics management as a "tool" for collecting requests and planning deliveries (preferably operated by FEV) in an optimized way.

In order to perform these tasks the e-Logistics Agency needs to be equipped with a specific web based ICT platform.

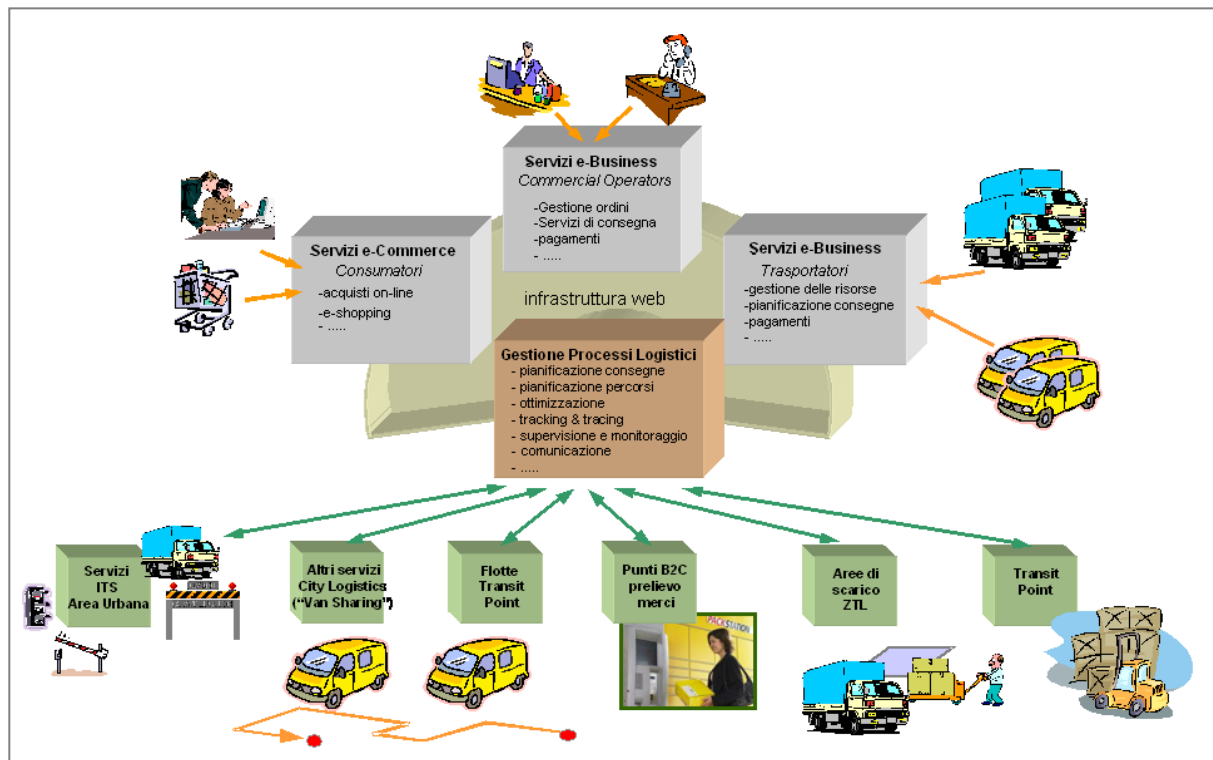


Fig. 26 – e-Logistics Agency concept

## 4.8 Loading/Unloading areas

This measure, which has been commonly adopted in most part of European cities since many years, is characterized by a low level of complexity and investments, but requires to be accompanied by specific rules and regulation defined by the Municipality (not simple/fast process as well known), and operated under a strong control activity.

In general normative aspects for l/u areas concern time windows, time occupancy, type of vehicles allowed, type of goods allowed, etc.

The main problem of these simple road infrastructures, in case of no close surveillance, is represented by a very frequent abusive lot occupation, both by privates not allowed and by commercial vehicles exceeding the maximum parking time. This implies that often the transport operator double parks (provoking traffic congestion) or, looking for a free parking lot, drives for more meters contributing to traffic congestion, energy consumption and pollution emissions.

The following actions can be undertaken for facing this issue:

- Enhancing on-street surveillance. This simple solution is hindered by the lack of staff, which is often occupied in other activities ( i.e. traffic management);

- Make loading/unloading areas more visible by using panels and road signs. Yet, this measure need to be strengthened by an accurate surveillance;
- Concentrate loading/unloading lots in a same area. Instead of having different parking lots located far from each other it is better to concentrate these in some areas which is easier to be controlled, even though couriers must walk freight (using carts) for some meters.

A more advanced solution, based on ICT devices, is related to the installation of specific sensors under the road pavement that, interacting via Wi-Fi to the closest parking meter, control the effective occupancy time of each single slot. Authorized vehicles are endowed with a smart card to be inserted in the parking meters. In case the l/u lot is occupied by a non authorized vehicle or for longer than allowed, the sensor signal the irregularity to the surveillance authority for a prompt control/fine.

Such kind of l/u areas parking system is under development in Treviso (Fig. 27), where an advanced parking system already exists, aiming to control parking lots occupancy by private cars, and working under the above described scheme.

Considering the significant costs of technological devices and the specific organization required, this solution could be taken into account only if the investment costs could be shared with other parking services.

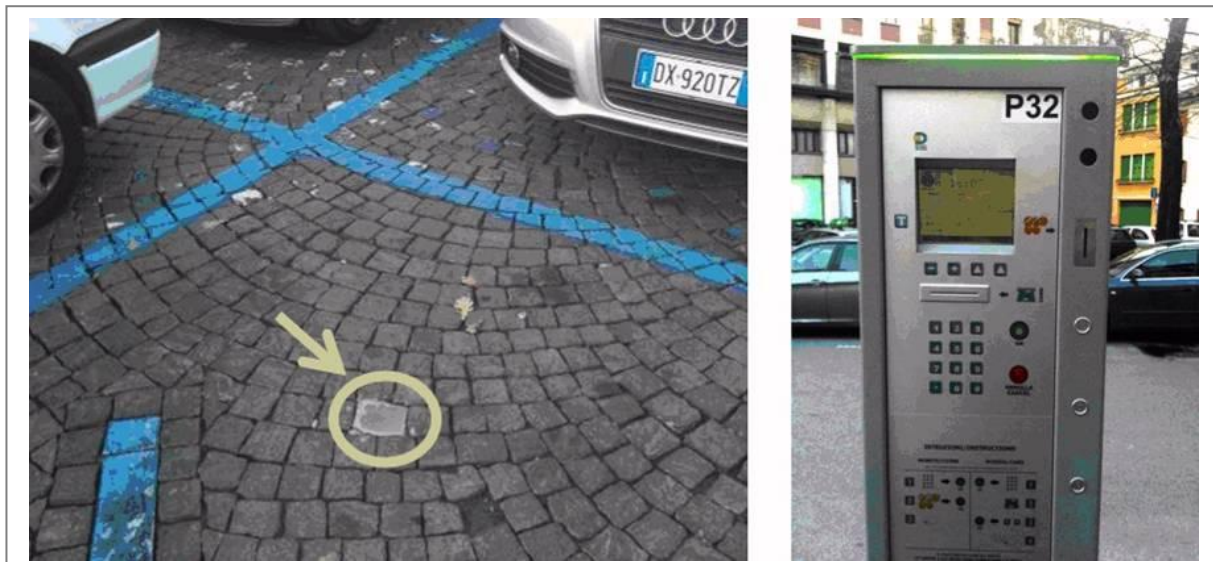


Fig. 27 – Treviso parking system

## 4.9 Selection of the most suitable measures

Based on the characteristics of Almada study area (see Chapters 2 and 3), on the Project Deliverable D2.2 - “Sustainable logistics in European small-/mid-size historic towns: stakeholders goals and User Needs Analysis” and on the exchange of experiences with the other ENCLOSE towns, a selection of the most suitable measures that could be implemented in Almada in the future was made.

The selected measures, that will be described in detail in the following, aim to enhance the overall management of city logistics, in order to improve and optimize these processes, thus producing significant benefits not only from a logistics/commercial perspective, but also from the eco-sustainability point of view and in particular for energy saving and CO2 emissions reduction.

Moreover, such kind of measures will also imply positive effects on the overall city mobility, as these will contribute to lowering traffic congestions (and related problems) depending on logistics processes.

The selected measures for further analysis are the following:

1. Urban Consolidation Centre (UCC) - this measure is deemed feasible in Almada context, due to the fact that there is a suitable area with an easy access to/from the city centre, connected to the main road axis,. Moreover, the geographic situation of the area (peninsular) allows the adoption and implementation of specific access control measures addressed to commercial vehicles and aiming to boost UCC use. Yet, due to freight volumes, a “light” infrastructural/operational solution is preferred, in order to enhance the economic sustainability of this measure.
2. Extension of FLEXIBUS service: Pick up point PuP service – Due to the existence of a flexible BUS service and thanks to the availability of a specific location suitable to the set up of this service, this measure is feasible in Almada context and sustainable from the economic point of view, also in case of (initially) low freight quantities.
3. Restructuring of Vegetable and fish market area - This measure was deemed particularly useful for improving road and pedestrian circulation in the study area, also thanks to the existence of appropriate infrastructures allowing an easy implementation along with reasonable and sustainable costs.
4. Loading/unloading areas - This measure is focused on the restructuring and new layout of road signage and panels, in the framework of the overall Municipality revision of parking regulation for commercial vehicles, which is now planned for

Cacilhas area in the scope of ENCLOSE, and planned to be extended in the future to the whole study area. The preliminary pilot application of these actions is being implemented as a two steps “soft measure” within ENCLOSE project: SM1A – Regulation Update & SM1B – Applying the new regulation.

The other measures described were not selected because they are not sustainable from the economic point of view and would not have a significant impact of pollution reduction and energy saving in the study area, in particular:

- Electric van sharing : for the disadvantages mentioned at par. 5.2;
- Surveillance of self-supply vehicles: an access control system monitoring the whole area need to be installed. The main obstacle is the high cost of a such sophisticated control system, able to identify and select vans/trucks and private car from the vehicles used by the shop-keepers for self-supply. The related cost is not justified by the small benefits in terms of energy consumption end emission reduction.
- Park and buy: besides the specific characteristics that a city shall have for making this scheme a successful one (see above par. 5.4), it is important to notice that most part of the few tourists visiting Almada come from Lisbon by boat (not by car), thus no parking is used.
- Packstation : for Almada, considering the current level of freight deliveries related to web commerce and the predictable low revenues, the high installation costs of this system makes it not convenient (at least for the moment), also taking into account that this scheme is usually implemented by main freight operators/express courier (as DHL).
- B2C Service and e-Logistics Agency: rather high investment and management costs are not justified by the limited dimension of the city logistics in Almada, and in particular in the study area. Consequently, the reduction of energy consumption and pollution emission achieved by these solutions would not be sufficient to justify the investment and operative costs.

## **5. Feasibility of the selected solutions**

A deep analysis of prerequisites and operating conditions of the measures identified above is provided in the following section, along with a description of infrastructures/equipment, staff, operation schemes and supporting regulation. Also, a deep analysis of investment and operation costs is given.

Finally, specific benefits in terms of mobility, energy savings and emission reductions are discussed.

### **5.1 Urban Consolidation Centre (UCC)**

#### **5.1.1 Preconditions and requirements**

Before starting any feasibility analysis it is fundamental to highlight that an UCC can be successful only if the Almada Municipality is strongly willing to implement it, with real administrative acts, which in this cases are bylaw acts.

This means that specific regulation aiming at limiting the access of commercial vehicles to the study area (i.e. time windows, access control, extension of limited parking areas, typology of authorized vehicles - in weight/dimension and fuel, etc.) should be define and applied in Almada, in order to make it more convenient for freight operators to bear a relatively low cost for charging the UCC with final delivery, thus avoiding to enter the area and saving time.

Finally, it is important to consider, as a pre-condition, the possibility to implement a “light” solution both in terms of infrastructures and of operating management in order to ensure, above all during the critical initial phase, economic sustainability of the solution.

#### **5.1.2 Almada UCC city logistics services**

The city logistics services provided by the studied Almada UCC can be distinguished in two main categories::

1. Base city logistics services,
2. Additional, added-value city logistics services.

##### **5.1.2.1 Almada UCC base city logistics services**

The key function of the Almada UCC is to provide services to support “last mile/km” deliveries to the reference centre area, within the wider scale regional (and national) freight logistics chains.

Almada UCC provides all typical logistics services to support cooperation between long-/mid-range freight operators and the local distribution actors, including:

- transshipment of goods at the UCC logistic platform;
- organisation of best operations possible (e.g. groupage, load consolidation, etc.) for deliveries of goods to their final destinations by the UCC eco-fleet;
- provision of ICT services enabling the exchange of updated information – including particularly track-and-trace information – between transport operators making use of Almada UCC delivery services, the UCC itself and all the actors throughout the logistics service chain.

The UCC will also provide services to operate freight transport in the opposite direction (reverse logistics), i.e. logistic flows with goods collected from locations within Almada centre and final destinations outside the area.

#### **5.1.2.2 Possible future Almada UCC added -value on city logistics services**

In addition to the base services introduced in the previous section, the Almada UCC foresees, at a later stage, also a number of value-added services that will be gradually implemented and offered to the users and operators of the city logistics system in Almada, after the start up phase and consolidation of base services.

Such additional services address different city logistics market segments, as well as some services with a social relevance, and include:

- Home delivery services, for generic users (i.e. citizens living in the service area) or specific user categories (e.g. elderly people, people with mobility problems, etc.).
- Delivery services to specific locations within the reference area, such as parkings, hotels and other service locations.
- Reverse logistics services, for collection and delivery (through the UCC) of refused/returned goods, packaging materials, logistics waste, etc.

#### **5.1.3 Location**

When choosing the UCC location, some key requisites are to be considered:

- Easily accessible for long range operators (i.e. close to main roads and/or railways);
- Not too far from the main city delivery area (in order to avoid excessive-length trips, enhancing trips/day, also for having the possibility to adopt electric vehicles.

According to these pre-requisites, for the Almada case the area which best suits is the one located at the beginning of Avenida Bento Gonçalves close to the Centro-Sul

roundabout, which is currently exclusively dedicated to a parking area, close to the Metro line 1.

This location is particularly close to the junction connecting Almada to the main northern (“25 de Abril” bridge), southern (A2) and western roads (IC20 and A38 ), it is roughly 2,5 km far from Praça Movimento das Forças Armadas, which can be considered as the central point of the study area and, finally, it is 3,3 km far from the farthest point of Cacilhas.

Area location and distance from Praça Movimento das Forças Armadas are indicated in Fig. 28.



Fig. 28 – Selected best area for setting up UCC and study area

#### 5.1.4 Infrastructure: general features and dimension

In principle the first elements to be considered in planning an UCC basic structure are a warehouse (including offices) and a loading/unloading operation external area.

##### Warehouse

In order to keep the initial investment as low as possible it would be important to start with a small/medium modular structure, which could be enlarged in order to satisfy any future need for a wider space.

Based on the volume of freight to be managed (around 4.2 tons/day – considering to capture around 7% of freight entering the study area), requiring at least 8 trips per day, a 600 m<sup>2</sup>. (i.e. 20x30 m, including a small office and facilities) warehouse with unloading/loading portals along two opposite façade and side doors would be enough. At the very beginning only two loading areas could be enough, and would be used for both loading and unloading freight vehicles. Loading areas door shall be equipped with canopies in order to protect goods and operators from rain.

An example of such kind of structure, with two loading doors, is shown in Fig. 29.



Fig. 29 – Example of prefab warehouse – Front view with loading spaces and Interior

### External area

An external manoeuvre area of 500 m<sup>2</sup> (i.e. 20x25 m) is the minimum space required for allowing trucks operations in front of the downloading portals. The side of loading portals, occupied by vans needs a small external area of 200 m<sup>2</sup>.

In principle all these infrastructures should be fenced (and CCTV controlled) for security and safety reasons.

With the above detailed infrastructure dimensions a total surface of around 1500 m<sup>2</sup> is needed. The selected Almada UCC location, with an overall extension of around 13.500 m<sup>2</sup> well meets all these requirements in terms of available space. It is important to highlight that this area is at present a car parking space (mainly used by commuters travelling on the close tram line) and that the UCC would occupy but around 11% of it.

This way the UCC would not create any problem to parking users (considering that a reduction of a maximum of 100 parking lots would be needed), thus fostering the acceptance of new logistics services by citizens.

### 5.1.5 Eco-fleet typology

Besides being an efficient logistics service for customers, UCC activities in Almada shall also represent an example of environmental sustainability. For this reason a fleet of eco-sustainable commercial vehicles is preferred.

The suitable options shall be found among one of the following (featuring a decreasing environmental impact):

- New generation diesel vehicles (i.e. Euro 5 with DPF - Diesel Particulate Filter)
- Bi-modal (diesel/electric) vehicles
- Hybrid vehicles
- Electric vehicles (FEVs)

Logistics base location and operating conditions for the Almada UCC (the average distance between the UCC and the delivery area is rather limited 2,5 km, with a maximum of 4,0 km) and the total distance to be covered by each van (from 40 up to 60 km in the worst case of 4 trips/day), are fully compatible with electric vehicles, which are the most suitable solution, in terms of pollution reduction.

Considering the peculiar characteristics of the reference area (with many narrow and steep roads and alleys), vehicle fleet, at least at an initial phase, could consist of n. 2 electric vehicles of 3,5 tons mgw - 1,1-1,2 tons of loading capacity, and operating on distances up to 120 km full-load (i.e. IVECO Ducato, Fig. 30).



Fig. 30 –Electric van Micro-Vett IVECO Ducato 3.5 tons

At a following stage the possibility to widen UCC fleet, in order to diversify vehicle typology and satisfy different needs, could be considered. For instance, deliveries in the narrowest roads could be performed by means of electric mini-vans, such as Fiat Fiorino, showed in Fig. 31).



Fig. 31 – Electric mini-van Fiat Fiorino

### 5.1.6 ICT support tools/system

Although in the initial phase and in case of a limited activity all the procedures can be essentially managed manually, it would be important for an UCC to be equipped with an ICT system for managing freight services and planning, thus ensuring a fundamental support all along the delivery process phases: from freight collection, to trip planning, parcels and final delivery tracking despite the accounting report and administrative documents.

In any case the platform and related functional modules can be realized by steps foreseeing specific main modules for the management of:

- Last-Mile Management
  - Delivery Request Submission*
  - Parcel Labelling*
  - Parcel Collection*
  - Load Consolidation & Trip Planning*
  - Parcel Delivery*

## Delivery Failure Management

- Reverse Logistics Management
- System Resource Management
- Track & Trace Service
- Vehicle Localization Service
- Internal Logistics Management

The following Fig. 32 shows a possible reference software architecture.

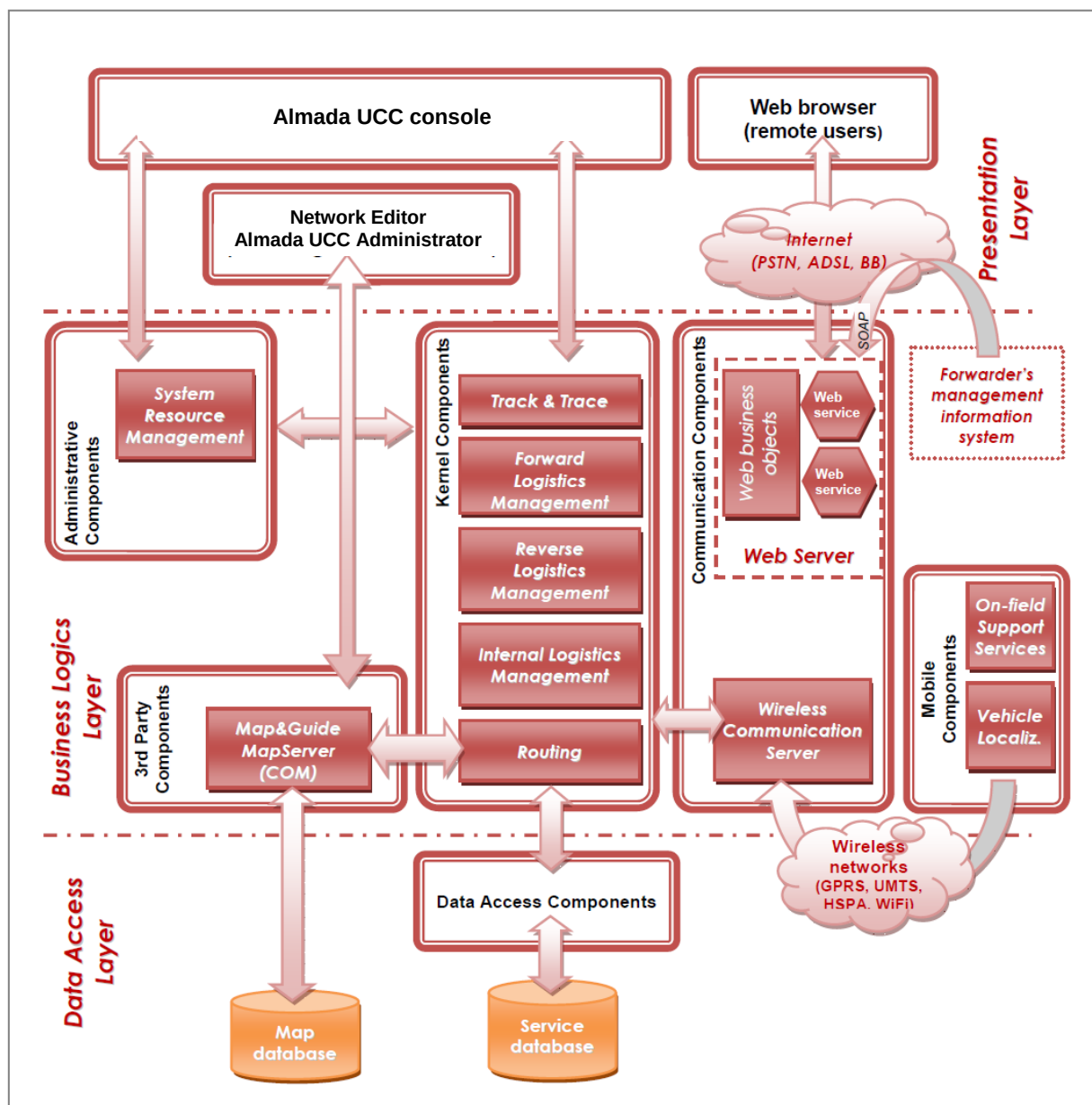


Fig. 32 – Almada UCC ICT platform: possible sw architecture

Therefore, from a functional architecture perspective, ICT platform should include:

- specific services for users allowing an interaction among the customer/transport operator and the UCC;
- web interfaces easing the operability and the collaboration among the different actors involved in the freight distribution chain;
- services for the use and the optimal management of the available resources of the freight distribution process, so as to realize freight distribution flexible schemes assigned to the B2B, B2C and B2A services.

The system shall be implemented in order to easily allow a later seamless integration of advanced solutions, providing tools and systems for the integration with the overall freight distribution system.

In any case the introduction of an ICT platform to manage the logistics processes related to the Almada UCC will be evaluated in a future phase, after a deep analysis of the level of services and of the quantity of freight delivered.

Therefore it is not a preliminary priority in setting the UCC for Almada.

### 5.1.7 Key Stakeholders

Apart from the Almada City Council and the institution who will manage the system, the main stakeholders to be involved for UCC activities are: freight transport operators and shopkeepers in the reference area.

Both of these groups shall be addressed before making any decision on UCC, in order to make clear that, despite adding transshipment costs to delivery processes, the UCC is also an important opportunity for achieving a more efficient and sustainable freight delivery system, producing benefits for both freight transport operators (time saving avoiding access to the inner city centre for small deliveries, possibility to use bigger vehicles, etc.) and for shopkeepers (more delivery flexibility, reverse logistics for carton box packaging, better urban environment, better accessibility and safety for pedestrians, increase the possibility of parking, possibility to use the UCC as third party warehouse with ecosustainable delivery on shop demand, etc.).

Finally, it is important to outline that the introduction of an UCC should be a participative process involving several public and private stakeholders. Several unsuccessful experiences stressed that innovative logistics services like UCCs can be implemented only with a close collaboration and agreement among public authorities, parking management company (ECALMA), Police, logistics and transport operators, shopkeepers, citizen associations, etc.

### 5.1.8 Preliminary organization/operation dimension hypothesis

The main UCC service priority is represented by last-mile delivery. Usually, for these basic services, the main national long-range freight transport companies/operators, that in many cases have a depot in the surrounding city areas (as in Almada) avail themselves of small local operators, owning one vehicle, or of small local transport cooperatives.

In the starting phase it is important to set-up a light structure (i.e. existing depot for the physical base) and to collaborate with local small operators (by means of individual or collective service contracts), in order to use their vehicles (before purchasing UCC electric ones).

In the initial phase, taking into account the logistics and transport situation, the following resources (in terms of staff, equipment, etc.) are required:

- n. 2 3,5 tons trucks
- n. 1 electric transpallet
- n. 2 truck drivers
- n. 1 loading/uploading responsible person (supported by the drivers)
- n. 1 administrative employee

At a later stage (i.e. from 6 to 12 months) on the basis of the real development of the UCC activities in Almada the following elements should be redefined:

- Equipments, in terms of vehicle fleet, devices for freight handling, etc.
- Warehouse (and office) size;
- ICT platform installation (see above par. 6.1.4 for details);
- Staff resources.

As regards the management structure, at the beginning a full public (Municipal) management (in a direct way or by means of a Municipally-owned Company – i.e. ECALMA) is to be preferred while, at a later stage, one of the following solutions can be adopted:

- “In house” company; a structure belonging to the Public Administration (public owned company), entrusted with service management.
- Public-private partnership; where a private company, in collaboration with the public one, participates as a partner in the mixed capital company set-up for the management of the services. This kind of partnership is foreseen by the European Commission (Green paper on public-private partnerships, Bruxelles 30/04/2004, COM(2004) 327 final).

- Service procurement partnership; this approach is based on a public tender and on a relevant contract regulating the relationship between Public Administration and Private Company.

In any case, besides the Service Contract, a detailed “Management Performance Chart” between the Municipality and the operator contracted for UCC management should be defined, in order to clearly define since the beginning not only contractual issues (in terms of rights and obligations) but also the level of performances that the operator shall guarantee for the whole contract duration.

Some of the provisions to be included in the two above mentioned documents are listed, as an example, below.

- Contracted operator manages Logistics Services and has the right to use the infrastructures, technologies and all the tools for the UCC, provided by the Municipality, which is the only owner;
- Contracted operator must guarantee the service with respect to market standards and quality indicators,, directly and/or with sub-contractors (sub-contracting part of the service should be allowed);
- Contracted operator must guarantee service fares in line with market prices;
- Contracted operator must guarantee maintenance of infrastructures, vehicles and devices, all logistics operations and related expenditure;
- Contracted operator must guarantee the ICT platform operation and maintenance and all the accessibility services;
- Last mile services should be carried out with zero emission vehicles;
- Contracted operator shall comply with quality and quantity service indicators (defined by the Municipality and agreed before the start of the contract);
- Contracted operator shall perform at least 2 promotion campaigns and customer satisfaction surveys.
- Municipality can act on the UCC for the extension of business and obtaining funds;
- etc.

### 5.1.9 Cost and impact dimensions

#### 5.1.9.1 Management model

As already highlighted, in synthesis, the key objectives for the Almada UCC are represented by the freight collection and the last-mile delivery in the reference area. In order to achieve economic self-sustainability of these services in a short time,, it is

mandatory, in particular during the early stage of the implementation, to adopt a "light and simple" management in terms of infrastructures, procedures (administrative and operational) and human resources.

This approach cannot fail to carefully appraise two crucial elements:

- i) Logistics services shall guarantee a level of quality, efficiency and safety (i.e. freight insurance) which is equal to the one offered by National/International freight operators (if not better, considering the advantages of a small-scale structure);
- ii) Besides performing basic functions dealing with daily logistics management (i.e. collection and delivery planning, real-time monitoring of vehicles/deliveries, administrative management, etc.), the ICT platform shall guarantee a correct exchange and integration of data with the information systems of the different operators, in order to have continuity in delivery tracking and tracing.

Concerning the human resources needed to perform the Almada UCC activities (administrative and operational), at least at the early stage of the UCC implementation, the employment of workers with "multifunctional" skills would be preferable, in order to minimize staff costs (i.e. drivers shall collaborate also to loading/unloading operation, etc.).

A possible alternative solution consists in externalizing some activities by sub-contracting service providers cooperatives (i.e. driver cooperatives) allowing a flexible management of the fleet, "tailored" on the volume of freight to deliver, that, in particular for those operators located in Almada and supplying the Caparica area, is characterized by significant season variation, due to the touristic importance of the beach front, that attracts nearly 8 million visitors per year.

According to these considerations on staff members, a minimum of n. 3 professional skills is needed for managing the studied Almada UCC:

- Technical manager and administrative manager (1 person at the start, 2 people in case of future expansion);
- Delivery planner and warehouse responsible (1 person);
- Drivers (also collaborating to loading/unloading).

As already stated above, after a very first phase when administrative/planning procedures can be performed with no ICT systems, at a later stage an appropriate IT management platform should be implemented, paying particular attention to the integration aspects.

The management model should foresee the "classic" operational schemes dealing with freight collection (direct or cross-docking), consolidation, delivery, track and tracing (using GPS equipped vehicles), management, administration, etc.

### 5.1.9.2 Investment costs

Considering the Almada UCC as built on a public (Municipal) area, the overall costs interest the following categories:

1. Warehouse and fence;
2. Office furniture and equipment;
3. ICT platform;
4. Electric transpallet and freight handling equipments;
5. Electric commercial vehicles (n. 2).

In order to reduce investments in the start-up phase, second-hand transpallet and electric vehicles can be purchased (considering 50% of full price) or hired.

#### Costs detail (in €) – maximum estimation

##### 1. Realization of 600 sqm warehouse and related fence (see Annexes for details)

|                                              |               |                     |
|----------------------------------------------|---------------|---------------------|
| - Iron structure and insulation              | 110.000       | (72.200 basic cost) |
| - Construction works                         | 30.000        |                     |
| - Electrical and the hydraulic systems/phone | 5.000         |                     |
| - <u>Fencing</u>                             | <u>30.000</u> |                     |
|                                              | TOTAL         | 175.000             |

##### 2. Office

|                           |              |        |
|---------------------------|--------------|--------|
| - Furniture and equipment | 10.000       |        |
| - <u>Service box</u>      | <u>5.000</u> |        |
|                           | TOTAL        | 15.000 |

##### 3. ICT systems

|                                |               |        |
|--------------------------------|---------------|--------|
| - <u>SW logistics platform</u> | <u>15.000</u> |        |
|                                | TOTAL         | 15.000 |

##### 4. Electric transpallet and freight handling equipments

|                                       |              |                                                                     |
|---------------------------------------|--------------|---------------------------------------------------------------------|
| - <u>Transpallet 1600 kg capacity</u> | <u>4.000</u> | (for details <a href="http://www.carrelli.eu">www.carrelli.eu</a> ) |
|                                       | TOTAL        | 4.000                                                               |

##### 5. Electric vehicles

|                                                       |                |         |
|-------------------------------------------------------|----------------|---------|
| - <u>n. 2 electric commercial vehicles - 3,5 tons</u> | <u>140.000</u> |         |
|                                                       | TOTAL          | 140.000 |

The estimated initial investment amounts to around 370.000 €, +25% unexpected costs, for a total of around **470.000 €**, while in case of renting electric vehicles (around 600 €/ vehicle/month), the total estimated investment costs is reduced to **290.000 €**.

### 5.1.9.3 Operating and maintenance costs

#### a) Management costs

1. Almada UCC operation costs in the start-up phase (minimum staff)

|                              | Costs/year €                                              |
|------------------------------|-----------------------------------------------------------|
| - n. 1 administrative person | 35.000                                                    |
| - n. 1,5 warehouse staff     | 45.000 (with substitute staff for holiday periods)        |
| - <u>n. 2,5 drivers</u>      | <u>75.000</u> (with substitute staff for holiday periods) |
| <b>TOTAL</b>                 | <b>155.000</b>                                            |

2. Almada UCC operation costs in full activity (minimum staff).

|                              | Costs/year €                                              |
|------------------------------|-----------------------------------------------------------|
| - n. 2 administrative people | 70.000                                                    |
| - n. 1,5 warehouse staff     | 45.000 (with substitute staff for holiday periods)        |
| - <u>n. 2,5 drivers</u>      | <u>75.000</u> (with substitute staff for holiday periods) |
| <b>TOTAL</b>                 | <b>190.000</b>                                            |

This second configuration can be also considered as a "reinforced" staff in the start-up phase.

#### b) Structure and equipment/fleet maintenance costs

This item can be considered as a yearly 10% of investment costs (470.000 €): **47.000 €/year**.

In case of electric commercial vehicles renting:

|                                                         |                                  |
|---------------------------------------------------------|----------------------------------|
| - Structure and equipment maintenance costs             | 29.000 €/year (10% of 290.000 €) |
| - <u>Renting of 2 electric vehicles (600 € * 2 *12)</u> | <u>14.400 €/year</u>             |
|                                                         | <b>43.400 €/year</b>             |

**The initial yearly management costs amount to around 200.000 €/year** (155.000+44.000 €/year). This amount does not include buildings depreciation costs (around 14.000 €/year) and electric vehicles consumption costs (in terms of batteries and recharging).

#### 5.1.9.4 Estimate Business plan

The initial configuration of the Almada UCC foresees the use of n. 2 FEV (3,5 tons vans) that can run 2 trips/day each (2 trips in the morning + 2 trips in the afternoon) to perform all the expected deliveries.

Considering a revenue of 6 € for each delivery (composed of one or more parcels for a total of max 100 kg), representing a price in line with logistics market, a minimum number of deliveries/day is required to achieve a balanced budget (excluding depreciation costs), in particular::

- 8 trips/day x 300 days/year x 6 € = 14.000 €/year; yearly income for 1 delivery of each vehicle
- 200.000 €/year management cost / 14.000 €/year = 15; number of deliveries to be made by each vehicle

*These figures draft a business plan showing that **the Almada UCC is economically sustainable only if an average number of  $15 * 8 = 120$  deliveries/day can be ensured.***

#### 5.1.9.5 Energy and environmental impacts

##### CO<sub>2</sub> emissions reduction

The planned Almada UCC will be located 2,5 km far from the central point of the study area (Praça Movimento das Forças Armadas), thus every electric van will cover around 10 km/delivery trip.

Considering that the UCC electric vehicles have an optimized load (min 90% of full capacity vs 30-40% of freight operator vans), an optimized electric vehicle is equal to around 2,5 current freight vehicles.

The use of optimized electric vehicles is equal to:

- 8 trips \* 10 Km \* 2,5 = 200 Km/day, not covered by conventional diesel vehicles.

As GHG emissions of a light diesel vehicle are around 430 gr/km CO<sub>2</sub>e (equivalent carbon dioxide):

- 200 km/day\*0,43 kg/km\*300 operat. days/year = **25,8 ton/year gross CO<sub>2</sub>e emission reduction.**

To take into account the CO<sub>2</sub> emissions related to the energy consumption of the 2 electric vehicles adopted by the Almada UCC, it is important to consider that in Portugal, production of electricity by renewable sources can reach 60 %, thus CO<sub>2</sub>e emission per produced kWh can be as low as roughly 255 gr.

Considering that the average consumption of one of the electric vehicles taken into account for Almada UCC would be 0,25 KWh/Km, for an overall yearly distance of around 24.000km a consumption of around 6.000 KWh can be calculated. Therefore, 1,53 ton CO<sub>2</sub>e/year would be emitted for producing the kWh/year needed by the electric vehicles of UCC fleet.

Thus, the **net CO<sub>2</sub>e emission reduction** related to the implementation of the Almada UCC and the adoption of commercial electric vehicles would be **of** about  $25,8 - 1,5 = 24,3 \text{ ton/year}$ .

### Energy consumption reduction

#### - Diesel vehicles

Considering that a 3,5ton light diesel vehicle normally consumes 16,6 lt/100 km:

$16,6 * 200/100 * 300 \text{ days} = 9.960 \text{ lt/year diesel} * 0,835 \text{ diesel density} = 8.317 \text{ Kg/year diesel}$

$8.317 \text{ Kg/year} * 10.200 \text{ Kcal/kg} = 84.833.400 \text{ Kcal /year}$

$84.833.400 / 10.000.000.000 = 8,84 \text{ TOE/year}$

#### - Electric vehicles

Consumption = 0,25 kWh/km

$200 \text{ Km/day} * 0,25 * 300 \text{ days} = 15.000 \text{ kWh/year}$

$15.000 * 0,000086 = 1,29 \text{ TOE/year}$

**Net energy consumption reduction =  $8,84 - 1,29 = 7,55 \text{ TOE /year}$**

## 5.1.10 Implementation plan

Several positive European experiences highlight that a reasonably time needed for implementing an UCC, until its full operation phase, amounts to around 3 years.

According to this indication, the following table provides a possible implementation calendar for the Almada UCC case study.

|                                                                                                                                                                          | Months |   |   |   |   |   |   |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|---|---|---|---|---|---|
|                                                                                                                                                                          | 6      | 6 | 6 | 6 | 6 | 4 | 8 |
| Deep analysis of Almada UCC sustainability, including evaluation of existing commercial activities and interviews dealing with the interest in a UCC by the stakeholders | x<br>x |   |   |   |   |   |   |

|                                                                                                                                                                                                                                                                                               |        |        |        |        |        |        |        |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|
| Interviews with the main freight operators for evaluating the possibility to sign commercial agreements allowing the companies to use the UCC                                                                                                                                                 | X<br>X |        |        |        |        |        |        |
| Meetings with interested stakeholders, such as transport operators associations, minor freight operators, shopkeeper associations, citizens association, Chamber of Commerce, Municipality, etc. in order to create the maximum level of consensus regarding UCC implementation and operation |        | X<br>X | X<br>X |        |        |        |        |
| Permits for UCC implementation (Several procedures at Municipal offices, change of “intended use” of the area)                                                                                                                                                                                |        |        |        | X<br>X |        |        |        |
| Emission and adoption by the Municipality of specific normative for city logistics, oriented to push operators to the use of UCC services                                                                                                                                                     |        |        |        | X<br>X | X<br>X |        |        |
| UCC Implementation                                                                                                                                                                                                                                                                            |        |        |        |        | X<br>X |        |        |
| Operations start-up                                                                                                                                                                                                                                                                           |        |        |        |        |        | X<br>X |        |
| Low operation level                                                                                                                                                                                                                                                                           |        |        |        |        |        |        | X<br>X |
| UCC in full operation (target 120 deliveries/day)                                                                                                                                                                                                                                             |        |        |        |        |        |        | X      |

## 5.2 Pick-up Point (PuP)

### 5.2.1 Description of the measure

The planning activities performed for the present study identified, as a possible location for setting up the innovative Almada PuP, the building of Afonso Henriques parking (former Citroen garage), close to the fish market in the central part of the study area, where FLEXIBUS depot and ECALMA call centre are currently located.

As already indicated, FLEXIBUS provides Almada residents and visitors with a flexible transport service from 7:00 am to 7:00 pm in weekdays and from 8 am to 1 pm on Saturdays.

A fenced freight area could be arranged inside the garage and dedicated to the collection and delivery of parcels related to B2C sector, i.e. goods purchased on the web (eCommerce).

As already stressed one of the main limits of eCommerce is that people are frequently (above all in the morning) out of home for several reasons (work, school, shopping, etc.) and thus are not able to collect their parcels/envelopes, which are brought back to the express courier depot, often outside the city, where the user will collect it, wasting time and fuel.

With the Almada PuP set-up at FLEXIBUS depot citizens could indicate this as the final address for delivering purchased goods and require the supplier to inform them by email once the delivery was made. This way the user will have the possibility to go to the PuP and collect his parcel during a long time window (opening hours of FLEXIBUS service or other timing periods defined on the basis of this service and on its success).

The presence of FLEXIBUS service infrastructure represents a particular opportunity to set up an interesting additional service to the "classic" PuP, consisting of the possibility to deliver the goods at a specific point, with a minor increase of the delivery fare. The electric bus driver could deliver parcels by agreeing a delivery time with the customer at one of the existing FLEXIBUS service stops.

### 5.2.2 Main advantages of PuP service in Almada

The introduction of a PuP service for Almada residents is strongly recommended, also considering the very low investments needed and the benefits for users, environment and mobility produced by this light and simple solution, in particular:

- Useless trips in the city centre can be avoided;
- Customers will not need to move by car to the outskirts of the city for collecting their parcels. Afonso Henriques parking (FLEXIBUS service depot) can be easily reached walking from the city centre, by means of FLEXIBUS services, by tram, by BUS and by bicycle;
- Supporting FLEXIBUS funding;
- First step for characterizing FLEXIBUS system as a possible first nucleus of e-urban logistics agency.

A future possible extension of the PuP service could take advantage from the Almada UCC implementation. In this sense the UCC logistics base can also operate, in principle, as an additional PuP located outside of the inner centre of the city.



*Fig. 33 – Afonso Henriques parking location – FLEXIBUS depot*

### 5.2.3 Constraints, costs and revenues

PuP service does not require significant investment costs considering the existing infrastructure (FLEXIBUS depot). Also the possible implementation of parcel delivery service at FLEXIBUS stops does not demand any investment, since this makes use of existing structures and staff.

The only constraint envisaged is that the service must be run by the parking company ECALMA, or an agreement with this institution, already working in the depot, must be reached, for their staff to perform these additional activities.

Costs for setting-up the pick-up point inside the Afonso Henriques parking only consist of the expenditure needed for purchasing some shelves and to rearrange an existing office, for a total of less than 5.000 €.

Concerning the revenues of PuP service (and additional agreed freight delivery to a bus stop), fares should be at very low cost (max 1-2 € /parcel) in order to foster its use. In any case, also small revenues could be used to support FLEXIBUS service.

## 5.3 Market area service

### 5.3.1 Description of the measure

As stated at section 4.4, during the morning (from 06h to 14h) the area around the Almada fish and vegetable market, an "hexagonal" building located in Praça do Comércio, in Almada old town (and in particular the related parking lots), is almost entirely occupied by freight vans, owned mainly by market internal shop keepers and working people.

Indeed the market shopkeepers use the van parked in parking lots during the market opening hours as second depot for their needs and activities.

Besides implying significant traffic congestion problems during the day (customers double-park their cars), this strongly affects the walking flow and the possibility for market clients to park near the market, provoking also negative impacts on the overall market business (Fig. 34).



Fig. 34 – Vans traffic congestion in market area (Praça do Comércio)

The solution could be defined around the following possible main elements/rules:

- After 7:00 am parking times for freight vehicles should be limited to 30 minutes (45 minutes for private cars);
- After the 8:00 am freight vehicles will be allowed to park only for 15 minutes, and private cars for 45 minutes maximum;
- After 2:00 pm parking is re-allowed also to vans;
- Market shop keepers can park their vans for free inside the Afonso Henriques parking (former Citroen garage area), around 120 m far away;
- In the Afonso Henriques parking, one or more electric (or manual) trolleys, with a load capacity of 500 Kg, are available to market shopkeepers, for free, so that they can easily transport freights all along the day to and from the market.

The main advantages of these logistics measures are:

- a better and more harmonized atmosphere around the building, that would be visible to people passing by;
- a significant improvement of mobility in the area (also covered by FLEXIBUS service);
- better walkability of the outside area;
- more parking lots available for providers arriving during the morning, thus avoiding waste of time and fuel for searching for free spaces;
- more parking lots available for market customers to park their cars during the whole morning.

From the environmental point of view significant benefits can be identified in terms of lower emissions and energy consumption, leading to an overall improvement of the quality of life in the area.



*Fig. 35 –Market (Praça do Comércio) and Afonso Henriques parking location*



Fig. 36 – Examples of electric trolleys

### 5.3.2 Constraints and costs

Envisaged possible problems can be identified in:

- Overcrowded garage damaging FLEXIBUS service operation;
- Opposition of shopkeepers to accept the new planned measures, although these could lead to an enhancement of sales (higher possibility for customers to park). This aspects should be addressed by a strong involvement activity (meetings with market shopkeepers, transport operator associations, citizens association, Chamber of Commerce, Municipality, etc.) in order to create the maximum level of consensus;
- Investment on the electric trolleys.

This measure benefit of already existing public infrastructures, thus no significant costs are foreseen. The only devices to be purchased are the electric trolleys (n. 2, at the start-up) costing around 1.850 € - 2.500 € each (source: [www.carrelli.eu](http://www.carrelli.eu)).

### 5.4 Extension of the Cacilhas logistics parking regulation and parking lots signalling

In 2014 Almada City Council is going to promote a revision of the parking regulation of the Cacilhas zone, due to the need of including logistics issues, in the scope of ENCLOSE.

A parking regulation for this area already exists but it does not address logistics problems and it does not define loading and unloading areas, time windows nor any other type of logistic related norms.

In order to regulate parking of commercial vehicles, Almada City Council, as ENCLOSE project soft measure, will revise and update the parking regulation of Cacilhas.

Other Almada neighbourhoods have also specific parking regulations, but these have also not considered logistics in the planning phase. These neighbourhoods will benefit from the measures and their regulations will also be revised later on, according to the experience of Cacilhas.

This new regulation, covering the whole study area, foresees:

- Definition of specific time windows for loading/unloading;
- Definition of conditions for commercial vehicles to enter the Cândido dos Reis street, taking advantage of the recently installed access control equipment;
- Signage panels to be put at the beginning of access roads;
- Indication of loading/unloading areas in the official urban parking plan layout;
- Definition of these dedicated parking lots on the ground by using coloured lines or, better, a different coloured asphalt (Fig. 37);
- Signage panels indicating maximum stopping time for commercial vehicles and prohibiting parking to private cars and;
- High level of controls.



*Fig. 37 – Rendering of a possible layout for l/u parking lots*

### 5.4.1 Impact dimensions

Based on traffic data issuing from December 2012 survey, around 512 heavy commercial vehicles (see par. 4.3) enter daily the study area for freight deliveries (10-25 average deliveries per vehicle).

In the hypothesis that the new implemented system allows to a 50% of commercial vehicles to reduce delivery route of around 10m (or that it improves the mobility of other vehicles for 10 m):

$512 \times 0,5 \times 17$  average deliveries.  $\times 10 \text{ m} = 43,5 \text{ km/day}$  reduction

considering a number of 300 working days/year = 13.056 km/year

According to data indicated at par. 6.1.9.5:

#### CO2 emissions reduction

$13.056 \times 0,73 \text{ Kg CO}_2\text{e /Km} = \mathbf{9,53 \text{ tons CO}_2\text{e / year of emission reductions}}$

#### Energy consumption reduction

$13.056/100 \times 24,0 \text{ lt/100 km} = 3.133 \text{ lt of saved fuel}$

$1.793 \times 0,835 \text{ (sg)} \times 10.200 \text{ (sh)} / 10.000.000 = \mathbf{2,67 \text{ TOE of primary energy saved}}$

If we considered the impact on light commercial vehicles also, the impact would be significantly higher.

## 6. Conclusions

The feasibility study for city logistics in Almada city centre shows that all the analysed measures represent an added value in environmental and energy terms.

In particular, setting-up an UCC along with the utilization of electric vehicles for freight delivery, besides bringing environmental and energy benefits, can also lead to an overall improvement of urban life quality, by reducing traffic and noise pollution.

It is nonetheless important to stress that the economic sustainability of the Almada UCC (breakeven point), in a minimum start-up scenario, can be achieved with a minimum of 120 deliveries/day at a price of € 6 each.

In order to guarantee the economic sustainability of UCC implementation it is strongly recommended to identify, develop and set-up, additional added value services (i.e. third party warehouse, packaging collection, hotel luggage services, elderly and disabled services, etc.), contributing to an enhanced use of logistics infrastructures, not being limited only to last mile/km service.

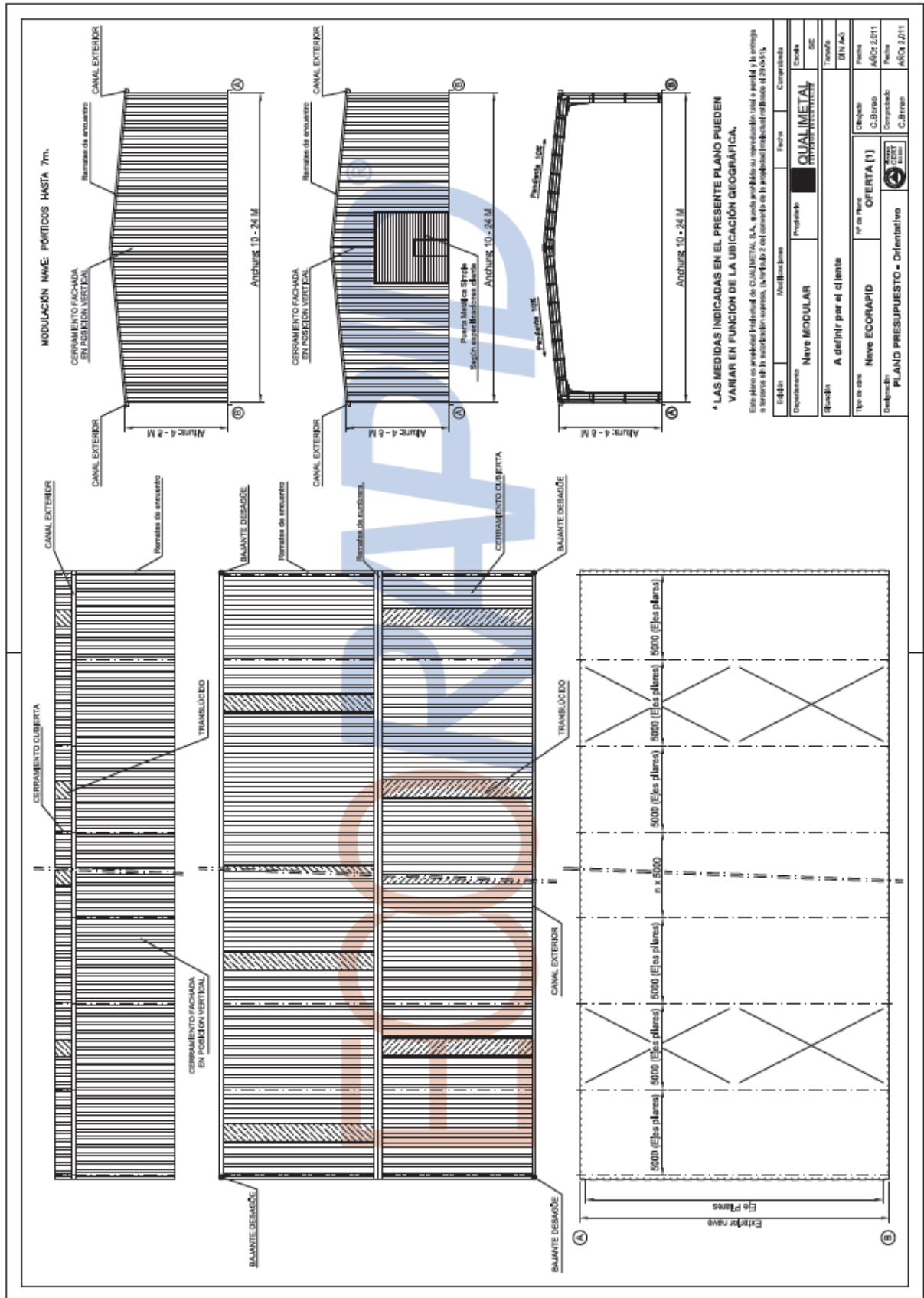
The planned logistics measure dedicated to the delivery of freight related to B2C processes (i.e. goods purchased on the internet), based on setting-up a pick-up point and related services, may provide citizens with a high value service, also considering the possibility of use FLEXIBUS in this useful service.

In what regards the new Cacilhas logistics parking regulation and it's possible extension to the whole Almada urban area, and also the planned support measures and the new parking rules (and services) in the fish and vegetables market area, it is important to highlight that they will bring important benefits are gained (in terms of mobility, environment and energy), resulting in an overall improvement of life quality in the city centre, with very low investments required.

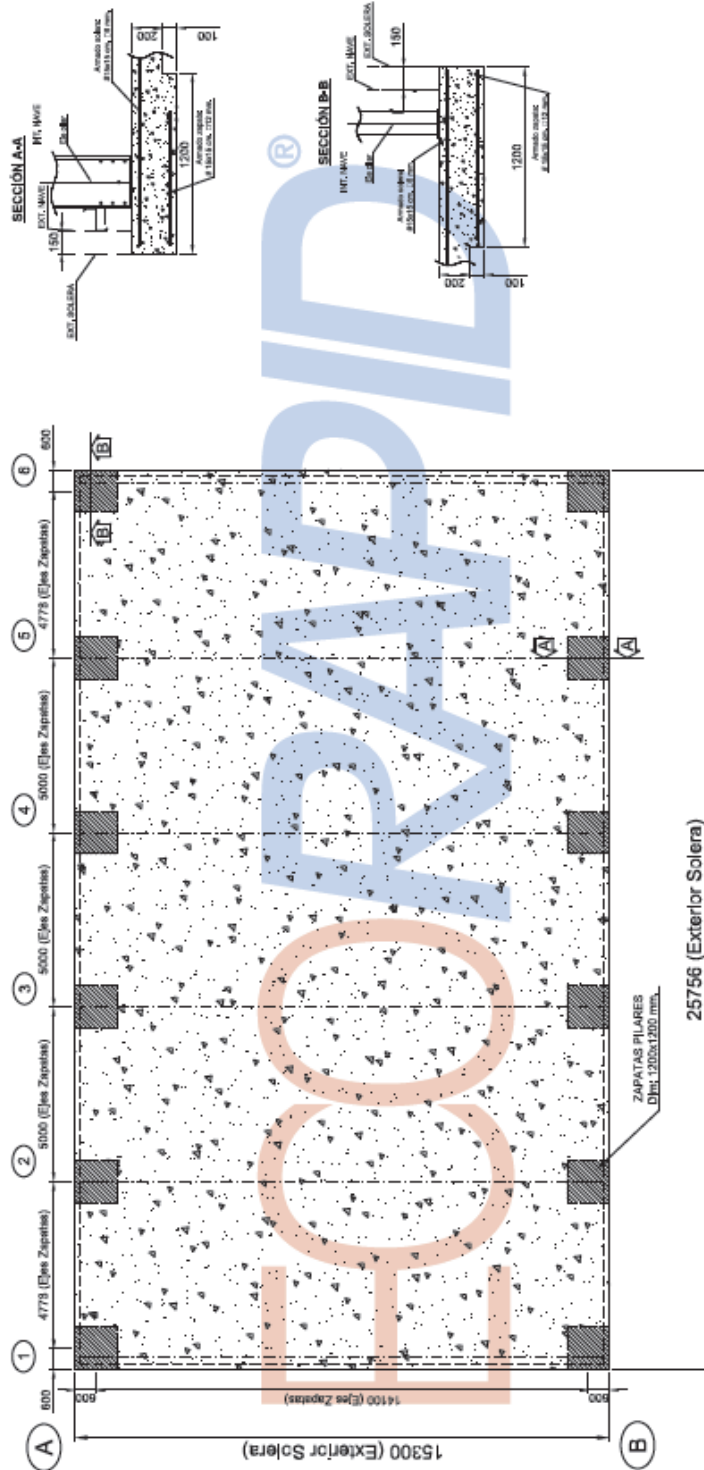
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# Annexes

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## CIMENTACIÓN - Plano orientativo



Nota:  
El presente plano de cimentación y solera se elige y recomienda por QUALMETAL, S.A., en virtud de su experiencia y conocimiento de las condiciones de terreno y de las cargas que se aplicarán en el edificio, así como de la normativa de aplicación.

Tensión máxima del terreno  
 $\sigma = 2 \text{ Kg/cm}^2$

**LEYENDA**

- Exterior zapatas 20 cm.
- Exterior solera 20 cm.
- Linea exterior solera
- Linea exterior pilares
- Linea solera para

Las modificaciones realizadas por el cliente en el presente plano de cimentación y solera se eligen y recomienda por QUALMETAL, S.A., en virtud de su experiencia y conocimiento de las condiciones de terreno y de las cargas que se aplicarán en el edificio, así como de la normativa de aplicación.

Proyecto de cimentación y solera para el edificio de logística y almacenamiento de mercancías, situado en el terreno de 15300x25756 mm, en el municipio de Almada, Portugal.

Proyecto de cimentación y solera para el edificio de logística y almacenamiento de mercancías, situado en el terreno de 15300x25756 mm, en el municipio de Almada, Portugal.

Proyecto de cimentación y solera para el edificio de logística y almacenamiento de mercancías, situado en el terreno de 15300x25756 mm, en el municipio de Almada, Portugal.

| EDICIÓN | MODIFICACIONES | FECHA | COMPROBADO |
|---------|----------------|-------|------------|
| 1       |                |       |            |
| 2       |                |       |            |

|                         |              |             |                |
|-------------------------|--------------|-------------|----------------|
| PROYECTO                | DIR. TÉCNICA | CONTRATISTA | RESP. MONITALE |
| ALMADA LOGISTICS CENTER | QUALMETAL    | QUALMETAL   | QUALMETAL      |

|          |  |          |  |
|----------|--|----------|--|
| Nombre   |  | Fecha    |  |
| Apellido |  | Revisión |  |

|          |          |          |          |
|----------|----------|----------|----------|
| Proyecto | Proyecto | Proyecto | Proyecto |
| Proyecto | Proyecto | Proyecto | Proyecto |
| Proyecto | Proyecto | Proyecto | Proyecto |