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## Implementation and impacts of low emission zones on freight activities in Europe: Local schemes versus national schemes

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### Abstract

One of the ways in which air quality in urban areas can be improved is by introducing Low Emission Zones, which are areas to which access by the most polluting vehicles is restricted. The decision to implement such zones may be taken either locally or as part of a national scheme. The research presented in this paper aims to examine the differences of socio-economic impacts between the implementation of each type of scheme, in particular with regard to freight transport. We have taken as examples two cities with Low Emission Zones: London and Berlin.

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*Keywords:* Low Emission Zone, urban freight, freight operators, local authorities

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### 1. Introduction

Human health, as it is affected by the environment, is an important issue for different levels of government, from the European Union to local authorities. In 1993 and 2002 the European Union implemented the fifth and sixth Environmental Action Programmes (EEC, 1993; EU, 2002) which set out to achieve “a high level of protection of ... human health”, “contributing to a high level of quality of life and social well-being for citizens by providing an environment where the level of pollution does not give rise to harmful effects on human health and the environment”

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and setting out environment and sustainability goals to be achieved by 2020 and 2050. In addition, the most recent European Union transport White Paper, which was published in 2011 (EU, 2011), stresses the need to develop new transport systems which consume less energy and therefore produce less pollution. The goal of this White Paper is to achieve transport which is more sustainable, particularly in urban areas. The reason for this is that transport and environmental sustainability issues are more severe in urban areas, in view of the high concentrations of activities and people.

It was in this context that the introduction of Low Emission Zones (LEZ) in Europe was encouraged (EU, 2008). These are zones to which access by the most polluting vehicles is restricted, on the basis of the vehicle pollution criteria laid down in standards according to vehicle age and type. At the beginning of 2015, there are approximately 200 zones of this type in Europe. The implementation mechanisms vary, in some cases involving national plans (as in Germany and the Netherlands), and in others more local arrangements (London, Prague). This has prompted us to ask about the impacts and benefits of each of these scales of action, particularly with regard to freight activities which is the principal target for these policies.

The goal of the paper is to describe the impact of the governance of Low Emission Zones, on the basis of two main examples, London and Berlin. The vast majority of Low Emission Zones restrict freight vehicle access. Freight transport is an important issue in urban areas, but one that is frequently a minor consideration for public policy, in spite of its considerable economic and social importance. In order for the various stakeholders in the freight transport sector to be able to adapt, the public policies that are implemented at local and national level need to be coherent and joined-up, and carriers need to engage in a thorough examination of their business activity and how they can modify their fleet replacement plan.

This paper will examine the case of two major cities in order to compare the types of governance: London in the case of a local plan and Berlin in the case of a national plan. We have characterised London's plan for a Low Emission Zone as local because it was decided within Greater London. Berlin's Low Emission Zone (*Umweltzone*) implements the German Federal government's national plan with some local adaptations.

This paper is structured as follows: it begins with a description of the current state of knowledge and our methodology (section two). In section three, we shall describe the temporal aspects of the implementation of Low Emission Zones and how the two types of governance differ in this regard. In section 4, we shall detail the influence of the selection of one or other type of governance.

## **2. State of Art and Methodology**

### *2.1. Pollution problems in cities: transport is a major contributor*

The public authorities regularly blame road transport during periods of peak pollution, and indeed the sector is responsible for a considerable proportion of Greenhouse Gas Emissions – as much as 20% in the EU in 2010 (EEA, 2012). The amount of pollutant emissions produced by freight vehicles exceeds the proportion of such vehicles in the traffic. This is essentially due to the type of fuel they use: in Europe, with the exception of Austria and France, the majority of cars use petrol, while the majority of HGVs use diesel which generates a large amount of Particulate Matter (PM), which is recognised by the WHO (IARC, 2012) as carcinogenic.

Transport is also a major source of other pollutants such as Oxides of Nitrogen (NO<sub>x</sub>), and the public authorities are therefore trying to reduce the sector's impact from this standpoint. A high proportion of the pollutant emissions in both our study areas are generated by road transport. For example, in Berlin, it is responsible for 36% of the PM and 47% of the NO<sub>x</sub> (Senate of Berlin, 2005). According to a study published by *Transport for London* (2008), Heavy Goods Vehicles (HGV) traffic is responsible for 25% of the London's PM and 57 % of its NO<sub>x</sub>.

There is a need for the public authorities to respond to the environmental issues evidenced by these figures. Low Emission Zones appear to be a possible way of reducing the negative externalities of road transport which is the main mode used to carry freight in urban areas.

## 2.2. Methodology

A number of studies have been conducted in the field of transport socio-economics in order to ascertain the impacts of an LEZ. The literature in question generally highlights a significant reduction in pollutant concentrations (Boogaard et al., 2012; Qadir et al., 2013; Wolff and Perry, 2010) but pays little attention to its effects *ex post*. In the case of London, one study - Browne et al. (2005) – has assessed the impacts on the freight transport sector, but solely on an *ex ante* basis.

The work was conducted in the framework of the RETMIF project (*Reducing freight transport emissions, scenarios for the Greater Paris Region*) funded by the Ministry of Sustainable Development via the French Environment and Energy Management Agency (ADEME). Its purpose is to understand how European Low Emission Zones have evolved, and how they have affected the freight transport sector in order to draw lessons before introducing an LEZ in the Paris region, the first phase of which was implemented on 1<sup>st</sup> July 2015. One of the phases of this project was to interview approximately 70 individuals drawn from the transport sector, public stakeholders and federations in several European cities. The purpose of these semi-directive interviews was to understand the impact of Low Emission Zones on the freight sector. The interviews dealt with the environmental attitudes of the firms or public stakeholders and show how their activities have changed as a result of the Low Emission Zone. Particular attention was given to how the smallest firms see this measure. The rest of this paper will largely be based on the results from these interviews. For reasons of confidentiality no corporate names will be given.

This research has already given rise to one paper (Dablanc and Montenon, 2015) which dealt with the position of goods vehicles in Low Emission Zones and the impacts on affected firms.

One of the aims of this paper is to make an *ex post* assessment of the impacts of the type of scheme (whether local or national) on freight transport companies, particularly the smallest firms. The impacts on such firms have received little attention in the literature in spite of their social and economic importance.

## 3. Setting Up Low Emission Zones: Temporal Aspects and Levels of Decision-Making

### 3.1. Temporal aspects and the organisation of Low Emission Zones

The creation of Low Emission Zones in Europe is partly due to increased environmental awareness and European measures. There are many differences between the different LEZs, in terms of how they operate (times of day, targeted vehicles), the area they cover (which varies between 0.6 km<sup>2</sup> in Lisbon to some 5,700 km<sup>2</sup> in Styria (Austria), and which authority was the driving force behind their introduction.

#### 3.1.1. How does a Low Emission Zone operate?

Low Emission Zones are areas which are closed to the vehicles that pollute the most. They currently number about 200 and are distributed all over Europe, but mostly in Germany and Italy (Fig. 1). We shall discuss the case of Germany in greater detail in this paper.



Fig. 1. LEZs in Europe in 2014. Source: APUR, modified by the authors

The authorities decide which categories of vehicles to ban on the basis of the European Emission Standards (pre-Euro to 6 – 6 being the most recent). These standards have been made gradually more stringent over the years and each number refers to a certain pollutant level, so the more recent the standard, the lower the pollutant emission level.

There are two main ways of monitoring the compliance of the vehicles in the LEZ, by checking the stickers visually in Germany or with automatic cameras as in London.

In Germany, the stickers are issued by the State or official bodies, and their colour indicates the vehicle's Euro Standard (Fig. 2b) and whether or not retrofitting has been performed. Thus, the oldest vehicles, that comply with Euro 1 or do not even achieve that, have no sticker. Euro 2 or Euro 3 vehicles with an approved retrofit system display a red sticker on their windscreen and a green sticker indicates a Euro 4 or Euro 3 vehicle with an approved retrofit system. Municipal employees check the stickers, so the measure's effectiveness varies a great deal depending on the number of municipal employees assigned completely or partially to the task.

a.



b.



Fig. 2. (a) German traffic sign indicating the beginning of an LEZ; (b) German stickers providing access to LEZs.

*Images from Creative Commons*

In London, a system of automatic cameras has been installed to photograph vehicle number plates and check them against the national database of registered vehicles. This system is entirely automatic and managed by *Transport for London* which is the authority responsible for transport in Greater London. It performs a rapid and systematic check

of all the vehicles present in the LEZ. The system is based on a very large network of cameras which represents a very high investment but which is extremely effective as all vehicles are checked.

### 3.1.2. The spread of Low Emission Zones in the years 2000

The years in which LEZs were set up show that consideration of the environment has taken place at different times, but also with different strategies. The pioneering country was Sweden, which in 1996 adopted a long-term (25 years) phased national plan for the environment. It should be noted that a six-year period elapsed between the first discussions and the implementation of this project (Johansson, 2007). Indeed one of the characteristics of LEZ projects in Europe is that they are introduced in several phases in order to make the transition less sudden.

In London, air quality has been of great concern for several decades, as witnessed by the high mean annual concentrations of fine particle levels that were forecast in the feasibility study for the LEZ (Watkiss et al., 2003). The LEZ appeared to be an option among others (like the optimisation of routes) of improving air quality. While the London LEZ, which is one of Europe's largest (1580 km<sup>2</sup>, Fig. 3), was implemented in 2008, discussions about its creation began several years<sup>2</sup> before it was officially announced by the mayor in May 2007.

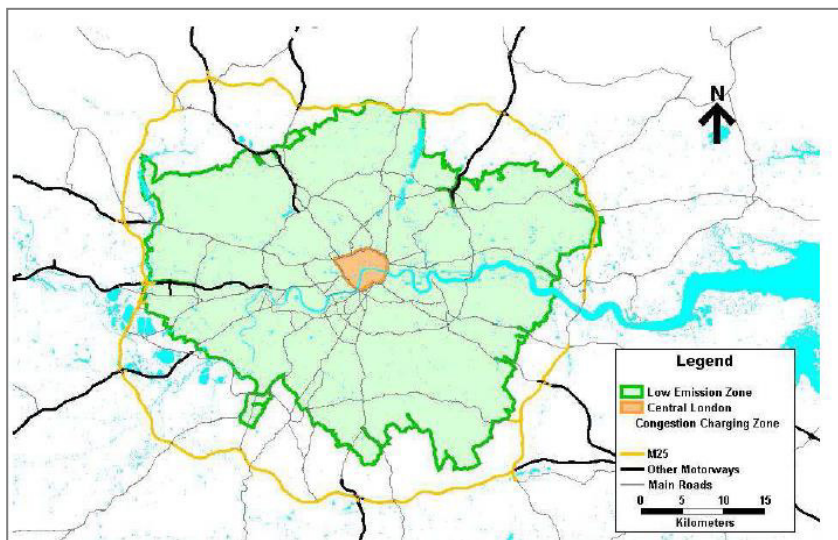


Fig. 3. The London LEZ. Source: Ellison et al., 2013

Traffic restrictions in London were introduced in phases. Thus, in February 2008 only diesel vehicles with a permissible maximum weight of 12 tonnes which complied with the Euro III standard for particulate matter were allowed to enter the zone. It should be pointed out that buses were exempted, as were emergency vehicles of all types. Then the restrictions were gradually extended to apply to smaller vehicles (vans) by phase 3 in 2012 (Table 1). It should nevertheless be noted that passenger cars are not affected by any restrictions, freight transport being singled out for the measures, which freight carriers may consider to be unfair. Some discussions with the public authorities revealed that it is mainly for political reasons passenger cars are not covered by the measure.

<sup>2</sup> In 2005, the LEZ is mentioned as an action in the Air Quality Plan Action.

Table 1. The London LEZ: entry conditions from 2008 and the present

Phase	LEZ entry conditions
Phase 1 : Feb 4, 2008	Diesel vehicles with a permissible maximum weight of 12 tonnes must comply with Euro III PM. Exceptions : Buses and emergency vehicles
Phase 2 : July 1, 2008	All vehicles with a permissible maximum weight of over 3.5 tonnes must comply with Euro III PM.
Phase 3 : Mar 1, 2012	Goods vehicles with an unladen weight of over 1,205 kg and a permissible maximum weight of under 3.5 tonnes, ambulances and motor caravans with a permissible maximum weight of between 2.5 and 3.5 tonnes, as well as minibuses with more than 8 seats with a permissible maximum weight of under 5 tonnes must comply with Euro 3 PM.
Phase 4 : Mar 1, 2012	HGVs of over 3.5 tonnes and buses and coaches of over 5 tonnes must comply with Euro IV PM.

In addition, a phasing system that is planned several years in advance may be disrupted by external factors. For example, the introduction of phase 3 which targeted vans and minibuses, should have begun in 2010, but, because of the financial crisis it was delayed by the authorities until 2012 to give firms more time to adapt to the new requirements. Thus, although pollution problems have not disappeared and are still very important, the economic importance of these sectors is such that the authorities postpone the dates at which a new phase comes into force in order to achieve a better compromise between economic activities and public health.

In Germany, the LEZs, which are known as *Umweltzonen*, have been introduced in the framework of a national plan adopted by the federal government in 2006. We shall return to this aspect in the following sub-section. In Berlin, this zone covers an area of 88 km<sup>2</sup> (Fig. 4). In contrast with the situation in London, the access restriction conditions apply to all types of vehicle – passenger cars, vans and HGVs. A few vehicles, for example vehicles for disabled drivers, are excluded. This inclusion of all types of vehicles is not confined to the city of Berlin, it is shared by all German Low Emission Zones. It is nevertheless the case that the entry conditions for light vehicles are less strict because a Euro 1 petrol vehicle can obtain a green sticker while diesel vehicles need to comply at least with Euro 4 PM Diesel or Euro 3 PM Diesel if they have a retrofit system.

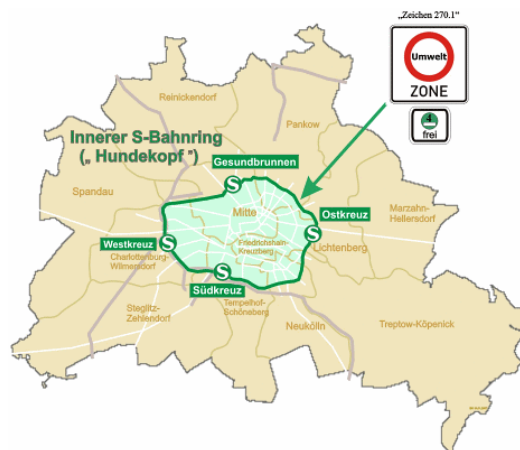


Fig. 4. The Berlin LEZ. Source: Senate of Berlin

As in the case of London, the system was introduced in Berlin in several phases which gradually restricted entry to the least polluting vehicles of all types (Table 2). These phases were spread over several years, but from the outset the measure included vehicles of all types (HGVs, vans, passenger cars) without any permissible maximum weight criteria. As in London, the applicable Euro standards became increasingly strict in each new phase, with the last phase demanding the tightest European standard.

Table 2. The Berlin LEZ: entry conditions from 2008 and the present

Phase	LEZ entry conditions
Phase 1 : Feb 2, 2008	All vehicles must have a red sticker (Euro 2 or Euro 1 + retrofit for Diesel vehicles), a yellow sticker (Euro 3 or Euro 2+ retrofit for Diesel vehicles) or a green sticker (Euro 4 Diesel, Euro 3 Diesel+ retrofit or Euro 1 for petrol vehicles).
Phase 2 : Jan 1, 2010	All German registered vehicles must display a green sticker, unless granted exemption. Foreign registered vehicles and coaches must display a yellow or green sticker. Vehicles with a yellow sticker are allowed to enter the zone if they have a retrofit system.
Phase 3 : Jan 1, 2012	Vehicles from abroad and coaches must display a green sticker.
Phase 4 : Jan 1, 2015	All vehicles must display a green sticker. Derogations will only be possible in exceptional conditions.

In both the cases we are studying, the low emission zones were introduced in the same year, 2008. Rather than indicating coordination between the cities, this shows that the public authorities have wished to become active in this area and implement solutions since the beginning of the years 2000.

Both our cases studied exhibit the same desire to introduce measures gradually, and this was confirmed by the interviews. The first phase often imposes few restrictions and is used by the stakeholders to prepare for what follows. Phasing allows carriers, and the owners of private cars in the case of Berlin, to adapt by investing in more recent vehicles which pollute less. We shall see in the last section of this paper that transport companies have not always decided to follow this path. So, with regard to the phasing system no significant differences are apparent between the national plan applied in Berlin and the local plan applied in London. On the contrary, similarities are more apparent, as the introduction of phases which are increasingly constraining for the transport sector are always decided on during the creation of the zone and this is done at the local level.

Thus, as far as the system of phasing is concerned, we observe no significant difference between the national plan implemented in Berlin and the local plan implemented in London. On the contrary, it is the similarities that are more striking, as the decision to implement the phases, which impose stricter and stricter constraints on the transport sector, is always taken during the process when the zone is being created and locally.

### 3.2. Local Scheme vs. National Scheme

#### 3.2.1. London's local scheme vs Germany's national scheme

The project for the London LEZ received its political backing from the Greater London Authority and Transport for London was responsible for technical and practical aspects. The plan was adopted in 2001, giving those affected a period of approximately 6 years to adapt to the new system. The Low Emission Zone is one of the measures backed by Greater London Authority Air Quality Department and then implemented by modifying the Mayor's Transport and Air Quality Strategy, in 2006 (GLA, 2006). The LEZ isn't considered as the only one measure to reduce air pollution in Air Quality Strategy, others tools are mentioned like the optimisation of trips or the technologies considered as more sustainable.

In the United Kingdom, although there has been some debate about the principle of introducing a national plan (for example at the ClientEarth conference on 1<sup>st</sup> May 2014), it is not currently on the agenda. Each local authority makes its own environmental decisions. Each municipality wishes to conserve flexibility in its measures in order to take account of local conditions as fully as possible. Introduction of the zone involved coordination between the five major themes of Communication, Information, Management, Feedback and Policy.

The Berlin *Umweltzone*, which along with those of Cologne and Hanover was among the country's first LEZ, is the outcome of a national plan for *Umweltzonen* adopted by the German federal government, with assistance from the City of Berlin. The working groups started to meet at the beginning of the years 2000, and the principle was officially adopted in a legal document in 2006 (BRD, 2006). This allows each local authority (the *Land* and the City) to include the possibility of implementing an *Umweltzone* in its air quality plan. This must be done in accordance with predefined national rules, for example coloured stickers to classify vehicles, signage, phased introduction,

exceptions for certain types of vehicle (vehicles for disabled drivers, farm vehicles, etc.). Thus, although the plan is national, each local authority (*Land* and City) decides on the nature of the system it will ultimately put in place.

### 3.2.2. Linkage between the measure and local characteristics.

In 2014, 76 municipalities in Germany had an *Umweltzone*. Twenty-five of these were in the *Land* of Nordrhein-Westfalen and 38 in the *Land* of Baden-Württemberg (Fig. 5). The kind of links between the *Land* and the City may differ from case to case. For example, the City-Land of Berlin decided to put in place a system of annual derogations which, on payment of a certain sum, gave firms who could not afford to purchase several new vehicles more time to adapt, on condition they ensured that at least part of their vehicle fleet was compliant. The *Land* of Baden-Württemberg decided to make the green sticker compulsory in all its *Umweltzonen* from 1<sup>st</sup> January 2013, and that all the derogations granted by one municipality are to be valid in all the other *Umweltzonen* in the *Land*. On the other hand, the *Land* of Nordrhein-Westfalen has not unified the measure in this way.

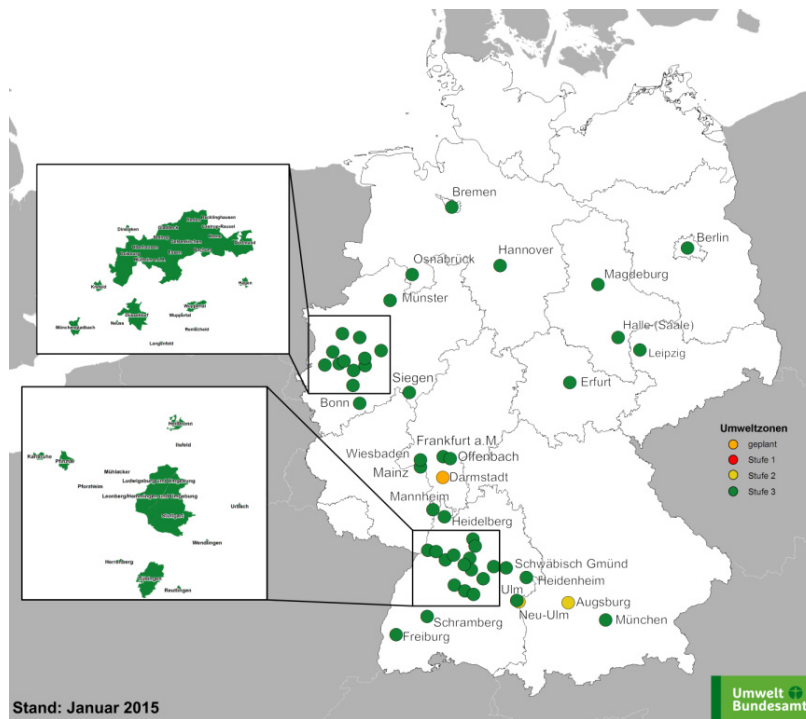


Fig.5. The LEZs in Germany. Source: Umweltbundesamt, 2015

This illustrates the importance of local characteristics, and it is a factor that is present in the case of all the Low Emission Zones. With local plans, the characteristics of the city are obviously taken into account, but the same principle applies with national plans. These local characteristics are all the characteristics which make it possible to differentiate the local zone from a larger one. For example, in the case of issues relating to transport and the environment they include the local legislative system, the population's commitment to environmental action, the age of the population, the composition of traffic on the basis of vehicle type, the road and transport system, the economic specialisation of the areas in question, the presence of cameras, etc.

### 3.2.3. The political aspect, flexibility and communication

Our interviews with the public authorities in the two zones and major transport firms and federations who worked with them have shown that the consideration of three factors helps understand the choice between a harmonised



national and a local. The first is the political aspect. In each country and city, environmental and transport issues may be dealt with at local and/or national level. In national plans, the introduction of Low Emission Zones remains a political decision which is applied locally and which has local impacts. The local goal takes precedence over the regional and national goals. Thus, each local authority makes its own political decision about whether or not to harmonize its measures with those of its neighbouring municipalities and to comply with regional and national plans. What it decides will depend in particular on its commitment to the environmental cause and its desire to be independent from competing cities. A good example is the Ruhr region in Germany. Some of this area's chief cities (Essen, Duisburg, Dortmund, etc.) introduced an LEZ in 2008 with their own organization. The less powerful municipalities of Castrop-Rauxel, Gladbeck and Herne waited for four years before deciding to join the movement, which made it possible to harmonise the measure throughout the conurbation. The second factor is communication. Our interviews show that a measure which is implemented by different levels of government has a greater communicative force because it is comprehensive. This leads to wider public acceptance, in particular due to the principle that part of the population is not excluded. At the same time, each local authority loses a certain amount of freedom with regard to the application of a local law within its jurisdiction, which brings us to the last area: flexibility. The example of London, and the interviews we conducted there, shows that the London plan could not be adapted to suit other areas of the country because of the city's colossal budget. For example, unlike Greater London, a small municipality cannot afford to use a system of cameras or pay for access to the records of the Driver and Vehicle Licensing Agency. In order to provide an example of environmental excellence and effectiveness for other cities in the world, Greater London had to put in place a scheme which was not only wide-ranging, but also, above all, effectively monitored. As these local characteristics are not shared by other authorities, the flexibility of the measure assumed greater importance than comprehensive harmonization.

#### **4. The Impact on Road Freight Carriers – A Group That is at the Centre of the Regulations**

We have compared the two types of plan (local and national) for implementing Low Emission Zones, and started to describe how they may affect the application of the measure. We shall now use our interviews in firms in the zones in question to examine more closely the difference between the two by studying a section of society, the road freight transport sector that is strongly impacted by this measure.

##### *4.1. Taking account of road freight carriers in political decisions*

Freight transport is frequently perceived as a neglected part of transport, in spite of its fundamental importance for an area's economy (Dablanç, 2008, 2013, Lindholm, 2010). Freight transport accounts for between 20 and 30% of the vehicle-kilometres covered in urban areas (Dablanç, 2007). In Europe, in the official working documents and regulations produced by local authorities, freight transport has only started to be considered in the last few years, and doing so is rarely compulsory. It should nevertheless be noted that in France freight transport must be covered in some compulsory transport planning documents. In addition, since 2014, the urban transport authorities are now responsible for urban logistics. The difficulty is that the general public is less aware of freight transport than of public transport.

This state of affairs applies in all of Europe's main cities. In London, the transport authority has a team that deals specifically with freight. This team was consulted with regard to the creation of the Low Emission Zone, in connection with training and notification issues. However, the main player and the instigator of the measure was the Air Quality Department not the freight team which did not deal with the nature of the measure, but merely its effective implementation. Work on specifying the zone either ignored or paid little attention to its impact on freight activities, which was dealt with in a number of expert reports at a later stage (Watkiss et al., 2003; TfL, 2008). Some of the persons we interviewed confirmed that there was a genuine separation and a lack of consultation between the various departments that were called on in connection with the Low Emission Zone. The implementation of the zone and the related measures were not the outcome of a dialogue that set out to develop a comprehensive plan for transport and air quality, but that air quality was given primacy while transport was expected to adapt.

In Berlin and Germany in general, the problem of the Low Emission Zone took a very different form due to the existence of the national plan. In 2005, the federal government introduced a mileage tax known as the *LKW-Maut*.

This was payable by all vehicles with a permissible maximum weight of 12 tonnes and was applied at a lower rate the higher the Euro standard of the vehicle. The *LKW-Maut* project was designed and implemented in collaboration with several federations representing road freight carriers, such as the BGL (*Bundesverband Güterkraftverkehr Logistik und Entsorgung*), which we interviewed. This measure encouraged freight carriers using motorways to reconsider their investment and their organisation. As a result, the road haulage sector was consulted less for the drawing up of the plan for the Low Emission Zone, in spite of the considerable difference between the two types of measure. This feeling was shared by the majority of the professionals we interviewed, particularly those working in small firms.

In some areas, the introduction of the zone was accompanied by additional measures to assist carriers. In London, the Freight Operator Recognition Scheme (FORS) allows the carriers with the best practices to present a more attractive image to potential clients. In Berlin, we have already mentioned the example of the derogation that allows transport companies to adapt to the new situation, but these measures are fairly rare. The case of Nordrhein-Westfalen, with its large number of closely spaced *Umweltzonen*, shows that the difficulties experienced by carriers who have to make deliveries in a number of cities and therefore take advantage of a number of derogations if their vehicles are non-compliant has not been taken into account. The *LKW-Maut* does not apply to vehicles with a total permissible weight of under 12 tonnes<sup>3</sup>. Thus, little assistance has been given to firms that use vehicles that are under this size, which is most of them, particularly the smallest firms which are in the greatest difficulties. In what follows we shall now consider how the measure has affected these carriers.

#### 4.2. A strategy of adaptation or replacement of the fleet

Road freight carriers attempt to reduce the impact of the Low Emission Zone on their activities. In the two cases studied, the interviews shows that freight operators are aware of having to play a role in the improvement of air quality even economic strategy stays more important. Thus, the strategies that freight operators implement differ depending on whether the scheme is a national or a local one, but one common feature is that freight operators must to change their fleet because the two cities have an important role in the economy, mostly for London.

##### 4.2.1. London, a local scheme confronted by redeployment of the fleet

In London the fact that several months' notice was given prior to the introduction of the Low Emission Zone gave the transport sector time to reorganise itself. London's local Low Emission Zone prompted the largest road haulage firms to conduct an in-depth analysis of how they organised their transport activities. They attempted to minimise the financial impact of the measure. Thus, those which operate in all parts of the country redeployed their fleet so that their cleanest vehicles operated in the Greater London region while their older vehicles operated in zones where no restrictions applied, namely the rest of the United Kingdom<sup>4</sup>. Consequently, the scheme had little impact on fleet replacement as far as these firms were concerned. The financial stakes are such that carriers attempt to minimise the number of new vehicles they purchase. It should, however, be noted that the large transport companies are also those with the most recent vehicle fleets.

London will implement an Ultra Low Emission Zone (ULEZ) in 2020, we assume that the phenomenon of redeployment shown with the LEZ would be noted another time, because no other city except London has implemented or intends to implement a LEZ with freight vehicles restrictions. Nevertheless, it could be in smaller proportions, because the area of the ULEZ will match with the area of the congestion charging zone (Fig. 3).

Small transport companies, which are the most sensitive to change, had to "put money aside" before the introduction of the Low Emission Zone, as one industry federation pointed out. However, these small firms cannot always afford to purchase new vehicles when a new phase of restrictions comes into force. For example, it was difficult for a small firm to purchase a Euro IV in 2008 in order to be ready for the corresponding phase of

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<sup>3</sup> On 1<sup>st</sup> October 2015, this limit will be reduced to a total permissible weight of 7.5 tonnes.

<sup>4</sup> In United Kingdom, except London, only few cities have implemented a LEZ but only with restrictions concerning the buses.

implementation. They therefore need to take the cheaper option of purchasing a Euro III vehicle second-hand or renting one rather than purchasing a new vehicle. The firm in question will therefore have to invest in two vehicles: the first before 2008 and the second before 2012, unlike large firms which have the financial capacity to make the necessary investment from the first phase. Due to important part of Greater London in the economy, small companies have no options of operating in contiguous areas, they must to comply with LEZ or if they don't comply, they could disappear for lack of sufficient freight to survive. The survival rates in freight activities are less than all activities. In 2008, 3 250 new freight companies were created in United Kingdom, but five years later, only 37.7% already work whereas the survival rate is 41.3% for all activities. This shows the fragility of the freight transport.

In spite of difficulties of adaptation for freight sector, the LEZ allowed an accelerated modernisation of the fleet in the zone due to an efficient system of control.

#### *4.2.2. Berlin, the need to adapt*

In Germany, the national plan has led to the introduction of access restrictions in a great many cities, which means that it is not possible for road freight carriers to redeploy their fleets as was the case in London. To overcome these difficulties, the companies sold their vehicles in countries where there weren't restrictions especially in Poland that is around 80 km from the centre of Berlin. Thus, road hauliers found where sold their vehicles without a lot of constraints or costs. As we said before, the *LKW-Maut* has already encouraged freight operators to invest in new vehicles which are less pollutant. The LEZ boosts the process of modernisation of the fleet that was already begun.

Although there is a national scheme, road hauliers would like there to be more harmonization between cities. One federation informed us that "Municipalities do not communicate with each other, so harmonisation is therefore unlikely to take place". Individual cities decide on the derogations for non-compliant vehicles. These derogations take different forms in different cities, which means that the industry is somewhat unsure of their exact nature in a certain city as it is difficult for them to be aware of all the regulations in force in all the cities they deliver to, and freight carriers take advantage of the failure of the authorities to carry out effective checks. The current tendency is for a green sticker to be required to access all Low Emission Zones.

Another difficulty that has been highlighted during the creation of Low Emission Zones in Germany is the short amount of time that elapsed between notification of the measure and its application. If we take the case of Hanover, as one federation of road hauliers has stated: "Three months to adapt is a very short time". This very limited time frame generates additional difficulties, for example, that of finding a sufficient number of vehicles for every transport company.

#### *4.2.3. Vehicle rental companies, an essential stakeholder in Low Emission Zones*

During preparation of the introduction of the Low Emission Zone, federations of road freight carriers are frequently invited to the preliminary discussions, and this applied in both London and Berlin. However, one group of stakeholders in the road freight transport sector which takes little part in these discussions although they may play a central role in the transition is vehicle rental companies. These are important because many transport companies, particularly the largest ones, lease their fleet which allows them to replace it on a regular basis. This system enables many large transport companies to have a fleet that meets the latest pollution requirements, in particular by being ready for new LEZ phases in advance. Indeed, vehicle rental companies have recent fleet due to agreements with vehicles manufacturers that allow them to renew very often their fleet.

Moreover, vehicle rental companies could be an opportunity for small companies to comply with the LEZ if they can't afford to buy new vehicles. It would be more expensive than the purchase of old vehicles, so only a few of them could choose this option.

The problem faced by vehicle rental companies is what to do with the old vehicles. These will no longer be of interest to road hauliers if a large number of Low Emission Zones are created in the country, as is the case in Germany. What to do with the older vehicles is less of a problem if there is no national plan as the vehicle rental companies have a sufficiently large market outside the zone in the state. In the case of Berlin, the freight operators could sold their vehicles in Poland, but if there is a generalisation of LEZ in Europe, the problem of resale could increase.

## 5. Conclusion

Low Emission Zones have been introduced in the framework of national or local plans. Whether chosen locally or “imposed” nationally, the LEZ is one solution among others to improve air quality. Every scheme has its advantages and disadvantages. If a system is developed locally, it is able to take the specific characteristics of the area better into account, while the national system provides a way of giving a unity to local measures which improves clarity and knowledge about the criteria to be met.

Public policy rarely considers freight transport, although there has been some improvement in recent years. At the same time, the sector is a priority target for environmental policies because of its major contribution to air pollution. Low Emission Zones are the outcome of a combination of two types of policy, those that relate to the environment and those that relate to transport, and these are managed differently depending on whether they are implemented by a national or a local authority. In spite of their economic importance, this situation has an impact on road freight carriers, and it would be better if more account was taken of the situation in which they find themselves.

Whether an LEZ is part of a national or local plan has many impacts, on, for example, air pollution, the replacement of vehicle fleets and economic factors. What has emerged from this research is that local plans may tend to encourage vehicle replacement in the zone in question less than national plans. But at the same time, they are more likely to consider the most economically vulnerable firms.

This research will continue with a quantitative analysis of the position of road freight carriers before and after the introduction of an LEZ in order to provide a better understanding of the economic impacts in the areas in question.

Likewise, particular attention will be given to the situation in Paris where an LEZ was set up on 1<sup>st</sup> July 2015 within the city limits of Paris. In this case the scale at which decisions are made is of interest, as the first national plan for LEZs that was introduced in 2008 was not followed by the local authorities. Today, it is the city of Paris which is instigating the future LEZ. Last, the creation of the new metropolis (Grand Paris) in 2016 will now doubt affect how this zone is managed and how it evolves.

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## References

- Boogaard H. Janssen, N., Fischer, P., Kos, G., Weijers, E., Cassee, F., Van Der Zee, S., Hartog, J., Meliefste, K., Wang, M., Brunekreef, B., Hoek, G. 2012. Impact of low emission zones and local traffic policies on ambient air pollution concentrations. *The Science of the total environment*, 435-436,132–140.
- Bundesrepublik Deutschland 2006. Fünfunddreißigste Verordnung zur Durchführung des Bundes-Immissionsschutzgesetzes.
- Browne, M., Allen, J., Anderson, S. 2005. Low emission zones: the likely effects on the freight transport sector. *International Journal of Logistics Research and Applications*, 8, 4, 269-281.
- Dablanc, L. 2007. Goods transport in large European cities: Difficult to organize, difficult to modernize. *Transportation Research Part A: Policy and Practice*, 41, 3, 280-286.
- Dablanc, L. 2008. Urban goods movement and air quality policy and regulation issues in European cities. *Journal of Environmental Law*, 20, 2, 245-266.
- Dablanc, L. 2013. Une grande oubliée, la logistique. In: SEURA (Eds), *Les rendez-vous de la métropole*. Paris, pp. 13-31.
- EEA (European Environment Agency) 2012. Sectoral GHG emissions by IPCC sector [online] <http://www.eea.europa.eu/data-and-maps/indicators/greenhouse-gas-emission-trends-5/assessment>. Last access on 28 Jan 2015.
- EEC 1993. Council Directive 93/59/EEC of 28 June 1993 amending Directive 70/220/EEC on the approximation of the laws of the Member States relating to measures to be taken against air pollution by emissions from motor vehicles. 31993L0059. Brussels.
- EU 2002. Directive 2002/51/EC of the European Parliament and of the Council of 19 July 2002 on the reduction of the level of pollutant emissions from two- and three-wheel motor vehicles and amending Directive 97/24/EC (Text with EEA relevance). 32002L0051. Brussels.
- EU 2008. Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe. 32008L0050. Brussels.

- EU 2011. White paper 2011. Roadmap to a Single European Transport Area - Towards a competitive and resource efficient transport system. Brussels.
- Greater London Authority 2006. Greater London Authority Act 1999 - Transport Act 2000 - Greater London Low Emission Zone Charging Order 2006.
- IARC 2012. Press release n° 213. Diesel engine exhaust carcinogenic.
- Johansson, H. 2007. The environmental zone a world first in Göteborg – a world first from Göteborg. An evaluation of the work with environmental zone.
- Lindholm, M. 2010. A sustainable perspective on urban freight transport: Factors affecting local authorities in the planning procedures. *Procedia Social and Behavioral Sciences*, 2, 6205–6216.
- Ministerium für Verkehr und Infrastruktur Baden-Württemberg 2014. <http://mvi.baden-wuerttemberg.de/de/mensch-umwelt/luftreinhaltung/umweltzonen-und-lkw-durchfahrtsverbote/> Accessed on 22 Jan 2014.
- Qadir, R.M., Abbaszadeb, G., Schnelle-Kreisb, J., Chowc, J.C., Zimmermann, R. 2013. Concentrations and source contributions of particulate organic matter before and after implementation of a low emission zone in Munich, Germany. *Environmental Pollution*, 175, 158–167.
- Senat Berlin 2005. Luftreinhalteplan und Aktionsplan für Berlin 2005 – 2010 – Anhang Anlass und rechtliche Rahmenbedingungen Die Luftqualität in Berlin — Situation, Probleme, Ursachen — Maßnahmen zur Verbesserung der Luftqualität.
- Transport for London 2008. London Low Emission Zone Impacts Monitoring – Baseline Report.
- Watkins, P., Allen, J., Anderson, S., Beevers, S., Browne, M., Carslaw, D., Emerson, P., Fairclough, P., Franciscs, J., Freeman, D., Haydock, H., Hidri, S., Hitchcock, G., Parker, T., Pye, S., Smith, A., Ye, R., Young, T. 2003. London Low Emission Zone Feasibility Study. Phase II. Final Report to the London Low Emission Zone Steering Group. AEA Technology Environment.
- Wolff, H., Perry, L. 2010. Trends in clean air legislation in Europe: particulate matter and low emission zones. *Review of Environmental Economics and Policy*, 4, 293-308.