

Evaluating an Urban Clear Zone : Case Study Bristol

Jo BAKER

Transport & Travel Research (TTR)

1 - SYNOPSIS

The Clear Zone and Low Emission Zones are new concepts which seek to improve urban areas by reducing the environmental impact of transport. This paper describes each.

2 - ABSTRACT

3 - INTRODUCTION

3.1. Scope of the Paper

This paper describes work which has been undertaken in the UK City of Bristol to develop the Clear Zone concept, which would exploit a variety of transport and land-use measures in order to improve the local environment in the city centre.

The paper goes on to discuss subsequent work which is being undertaken in order to develop a more generic toolkit for the development and evaluation of Low Emission Zones, a specific type of Clear Zone, in UK Cities.

3.2. Context

Historically the control of air pollution in the UK has developed in a reactive fashion, with regulations developed to address specific problems as they became recognised. There has not previously been a strategy or framework to deal with air quality in a holistic sense.

The obvious link between air pollution and transport was in the Royal Commission on Environmental Pollution's 18th Report on "Transport and the Environment" (1), which set out eight key objectives intended to make transport policy more sustainable. The Environment Act 1995 'Air Quality' (2) broke new ground in that it required the Secretary of State to prepare and publish a statement containing policies with respect to the assessment or management of the quality of air. This was duly published as the UK National Air Quality Strategy and outlined a comprehensive approach to control emissions from the main sources and to improve ambient air quality by a nation-wide system of local air quality management as well as by national policy instruments.

More recently the Government has provided further tools for tackling the environmental impacts of transport, with the Road Traffic Reduction Act 1997 (3), and the Integrated Transport White Paper "A New Deal for Transport: Better for Everyone" (4) in the summer of 1998. The Road Traffic Reduction Act places a duty on local traffic authorities to assess traffic levels in their area and provide targets for traffic reduction. The main theme of the white paper is the development of integrated transport solutions that provide for sustainable mobility and encourage the use of alternative modes of transport to the private car.

The Clear Zones and Low Emission Zone concepts (5) have emerged in the context of these changes in thinking. They have been developed as tools to improve local air quality by reducing vehicle emissions and stimulating the use of 'clean-fuelled' vehicles. However, they can also support and be complemented by broader transport and land-use policy objectives aimed at the reduction or moderation of the need to travel.

4 - CLEAR ZONES

4.1. Background

The Clear Zone strategy has been developed in response to a campaign promoted jointly by the UK Departments of Environment, Transport and the Regions (DETR), and Trade and Industry (DTI). Bristol was one of the first cities to consider the role of the Clear Zone in the planning of future transport systems for the city centre. A feasibility study was undertaken under the DANTE project within which Bristol was one of nine case studies. DANTE was a collaborative European research and development project, part-funded by DGVII of the European Commission, to assess strategies designed to reduce the need and level of demand for road travel in European cities and on inter-urban road transport corridors.

The Bristol Clear Zones project built upon, and drew together, many of the different initiatives which were already in place, under development, or proposed for the city. The Clear Zone strategy does not represent one or more particular schemes, but rather an approach to urban planning which is intended to improve the quality of life of everyone who uses the Clear Zone.

At the outset of the Bristol study, there was no definition of a Clear Zone available for guidance. It was suggested by DETR/DTI that Clear Zones would require new technologies to achieve the following:

- Efficient public transport
- Efficient movement of goods
- Land-use measures and technology to minimise the need to travel
- Improved technology to improve access to tourists and leisure travellers
- Design and monitoring to reduce the health impact of travel
- Multi-modal models to enable the design of the Clear Zones

On this basis, it was decided to develop a three-tier definition of the various elements of the Clear Zone concept as follows.

- **Clear Zone:** The “liveable, accessible and lively urban centre where traffic congestion, pollution, noise, stress and other negative impacts of mobility are eliminate or limited” within which the Clear Zone strategy will be applied, and within which Clear Zone measures will be implemented
- **Clear Zone Strategy:** a set of objectives which all Clear Zone measures should comply with, and which should be applied to any new initiatives within the Clear Zone.
- **Clear Zone Measure:** a specific measure, or package of measures which are in accordance with the Clear Zone strategy, and which may be deemed suitable for implementation within the Clear Zone

The Clear Zone was defined as the area within which the Clear Zone strategy is applied. Therefore the first step in the preparation of the Clear Zone is to define this area. For the purposes of the feasibility study, it was decided that the Clear Zone should be defined as the area of central Bristol which is bounded by one option for the City Centre loop which is proposed in the City Centre strategy. This is illustrated in Figure 2.1.

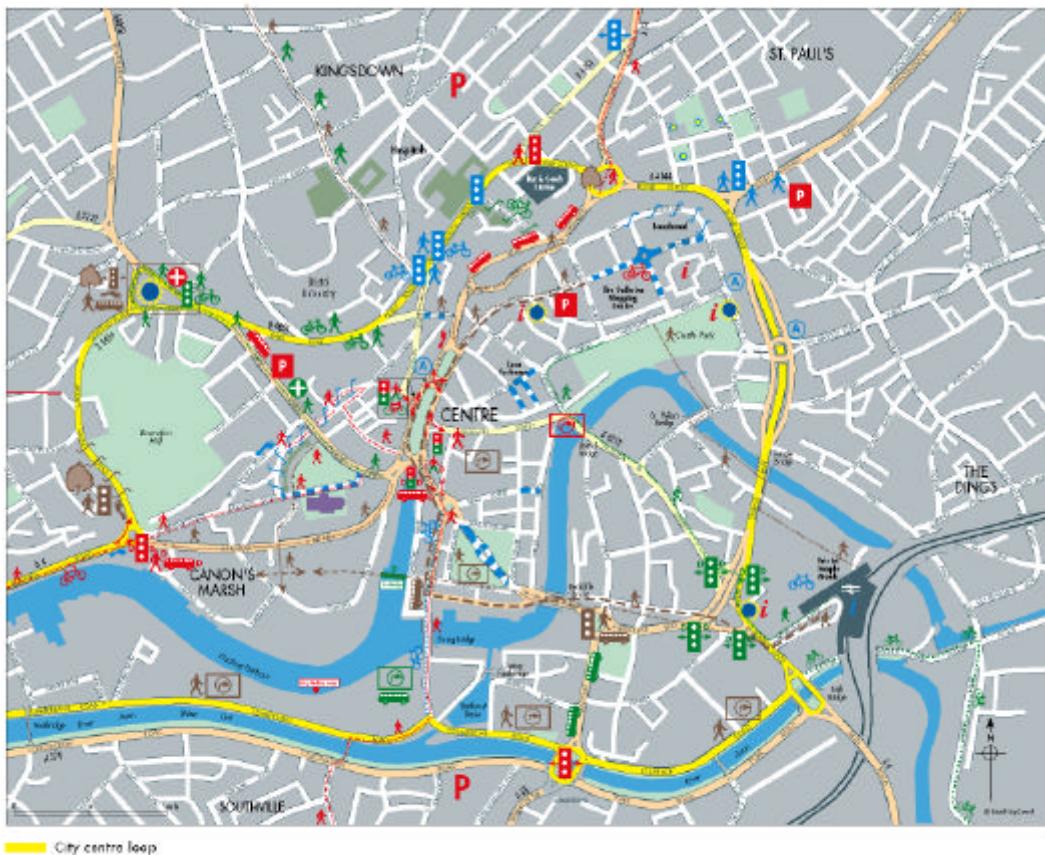


Figure 2.1: Study Area and City Centre Loop

Within this area are a number of sub-areas of varying characteristics defined as District Neighbourhoods in the City Centre strategy. Some of these already offer many of the features of the Clear Zone whilst others clearly require further improvement.

The possibility of the creation of an alternative Clear Zone in a suburban centre of Bristol was considered at an early stage in the study. It was decided, however, that the city centre should be the focal point for the Clear Zone feasibility study.

4.2. Development of the Strategy

The general policy objectives for the Clear Zone provide a very broad basis for the consideration of the way in which the Clear Zone might develop. These do not necessarily specify what will be required, but only the principles to be followed.

Often, however, there will be considerable conflict between the different local policies. This will require a judgement to be made between issues such as economic well-being, accessibility, the environment, and personal freedom of choice. The Clear Zones Strategy must seek to make these decisions in a way which maximises the quality of life of the people who use the Clear Zone.

The balance between these issues can be resolved by establishing a hierarchy of requirements which consider the implementation of the Clear Zone as it would apply to the various sectors of society.

Thereafter, the priorities can be further disaggregated by considering how they would apply in different parts of the Clear Zone. Table 2.1 establishes a basic hierarchy of users which might be used to define the functions of the Clear Zone.

Table 2.1 Possible Model for a User Hierarchy

| |
|--|
| <p>The following should be eliminated within the Clear Zone Long-Stay Parking Through traffic Commercial vehicles, except for access</p> |
| <p>The following should be deterred Internal combustion engine private vehicles Heavy commercial vehicles</p> |
| <p>The following should be permitted, but alternatives promoted Private vehicles for disabled people Conventional public service vehicles Conventional light commercial vehicles Heavy commercial vehicles where these represent the most efficient means of delivery</p> |
| <p>The following should be promoted Alternative fuel and electric vehicles Accessible Public Transport Cycles and Pedestrians Efficient goods handling</p> |

This hierarchy of users identifies a need to deter certain modes of transport, but to encourage others. The Clear Zone will, therefore, be based upon a combination of “carrot” and “stick” measures. The balance between the two must ensure that local businesses are able to benefit from an improved environment, whilst economic viability is not challenged by restricted access. Table 2.2 sets out the range of measures which might be introduced.

Table 2.2: Possible Clear Zone Measures

| Vehicle Technology | Physical Measures | Telematics |
|---------------------------------|----------------------------------|-----------------------------------|
| <i>Clean Diesel Buses</i> | Road closures | Smart Cards |
| <i>Alternative Fuel Buses</i> | One-way traffic circulation | Variable Car Park Signs |
| <i>Shared Taxis</i> | | Tele-working/shopping |
| <i>Electric Buses</i> | Bus lanes and gates | Urban traffic control (UTC) |
| <i>Alternative Fuel Cars</i> | Weight/height restrictions | <i>Public Transport RTI</i> |
| <i>Electric Cars & vans</i> | Townscape improvements | <i>Road pricing</i> |
| <i>Community Transport</i> | | <i>Environmental Monitoring</i> |
| Light Rapid Transit (LRT) | Pedestrian / Cycle facilities | <i>Mobility Management Centre</i> |
| <i>Low-floor Vehicles</i> | Pedestrian accessibility | <i>On-bus information</i> |
| <i>Electric bus</i> | Traffic calming | |
| <i>Ultra-light-transit</i> | Parking restrictions | Other Measures |
| <i>Cycle hire</i> | | <i>Planning Control</i> |
| | Freight Handling | <i>Green Commuter Plans</i> |
| | <i>Urban distribution centre</i> | <i>Car Sharing</i> |
| | <i>Multi-modal transshipment</i> | <i>Waste minimisation</i> |
| | <i>Quiet Vehicles</i> | <i>Travel Awareness</i> |
| | <i>Goods home delivery</i> | |

4.3. Implementation Of The Clear Zone

The successful implementation of the Clear Zone requires the ongoing implementation of a wide variety of complementary measures. The achievement of these will, of course, depend on the availability of suitable funding. It is not, however, clear that central government funding will be made available for the funding of Clear Zones in their own right, and at present, component schemes are to be funded on a more ad-hoc basis as part of Local Transport Plans.

In addition to the issue of availability of funding, the development of a Clear Zone is likely to be impeded by a variety of other barriers. The majority of urban demand management schemes meet with a degree of opposition. The use of a wide variety of new technologies to ensure that any adverse operational impacts are minimised should help to reduce this opposition. Nevertheless, many people do not recognise the fundamental need to curb vehicle emissions and usage. Some of these concerns are very real, and may require innovative solutions if they are not to constrain the development of the Clear Zone. Others reflect the personal values which may place self-interest over the well-being of society as a whole: such attitudes must be overcome by increasing public awareness, or by new incentives to achieve changes in behaviour.

The range of barriers encountered may include the following types of issues:

- Physical
- Public opinion
- Legislation
- Financial
- Enforcement
- Accessibility
- Institutional
- Operational

4.3.1. Physical Barriers

The Clear Zone must fit within, and complement the existing City Centre. Certain measures, such as a proposed LRT system will be restricted by existing physical constraints. Whilst these constraints might be overcome using at some expense, it is undesirable to pursue a transport policy at the expense of the historic urban fabric.

4.3.2. Public opinion

The Clear Zone must be designed to enhance the quality of life in the City. A balanced assessment of public opinion must be made to ensure that measures meet local approval, whilst not being obstructed by a short-termist

and unsustainable preference for the use of the private car. Education and incentives must be employed to ensure that public opinion increasingly reflects the needs of society rather than self-interest. Fiscal measures such as road-pricing and taxation on various aspects of car usage may be essential if a lasting change is to be achieved.

4.3.3. *Legislation*

Certain elements of the Clear Zone approach, such as road pricing, are not permissible under existing UK legislation, whilst others, such as co-ordinated transport planning are virtually impossible in the current deregulatory environment. Some of these issues may need to be the focus of future lobbying campaigns either in the European or National dimension. Such barriers must not be allowed to prevent the successful application of new initiatives.

4.3.4. *Financial*

Clearly the Clear Zone must be financed if the project is to proceed. Financial constraints may allow the project to proceed, but the identifiable concept of a Clear Zone will only become apparent once a critical mass has been achieved. There is no simple means by which this barrier can be resolved, other than comprehensive exploration of all available funding sources. The use of private finance to implement schemes which are beyond the limitations of public investment must always be considered, although a robust payment mechanism must ensure that potential profits are only permissible if accompanied by a genuine transfer of risk.

4.3.5. *Enforcement*

The enforcement of the Clear Zone is essential if its integrity is to be maintained. Key areas of enforcement are city centre access and parking control. The responsibility for parking control is being taken over by the local authority, ensuring that local enforcement can be managed in such a way to enforce planning objectives. City Centre access control is more complex because of the need to allow exemptions to essential users. The technology exists to develop a comprehensive system, but the effective enforcement is essential for success.

4.3.6. *Accessibility*

If the Clear Zone is to be successful then overall accessibility should always be increased by measures which are introduced. Individual car drivers may feel that their personal accessibility is constrained by traffic restraint, but measures which promote walking, cycling and public transport will increase accessibility for the majority of travellers. It should always be remembered that many people in urban areas do not own a car. Whilst a large proportion have access to a car, many of the journeys made each day will not be made by car. Moreover, levels of urban congestion hamper accessibility for essential travellers.

4.3.7. *Institutional*

Bristol City Council does not have control over all aspects of transport and land-use planning in the City. As a Unitary Authority, it is fortunate in being able to integrate the main functions of land-use and transport, but transport operators, and the control of private land are beyond its direct influence. Many other cities have even more complex institutional arrangements which preclude a co-ordinated approach to the development of a Clear Zone.

There is a need for a partnership approach to overcome this barrier and allow a combined team to develop the major multi-organisational structures which are required if major projects are to be tackled successfully.

4.3.8. *Operational*

The final barrier to implementation is, of course, the ability of identified technology to fulfil the operational requirements of the Clear Zone. In some ways, this can be considered to be an adjunct of the financial barrier: technology can usually be developed to fulfil any objectives, but the costs of success may be prohibitive. Robust assessment of implementation trials is required to ensure that any major investment programme can proceed on a sound basis.

Clearly innovation can only succeed through a degree of investment risk. The local Council, however, may wish to ensure that such risk, where possible, is transferred to the private sector.

4.4. The Way Forward

At present, Bristol City Council has not adopted the Clear Zone approach, but has chosen to develop the Clear Zones measures on an individual basis, reflecting the difficulty in obtaining funding or approval for a more comprehensive implementation programme. The various proposals are contained within the Bristol Transport Plan (6), which pre-empt the requirement in the UK for the development of Local Transport Plans. Whilst this does not enable the evaluation of the impact of a widespread implementation, it represents a more pragmatic and realistic approach which may be of more relevance to other local authorities. Measures to be investigated include the following:

- Traffic management
- Traffic restrictions
- Road pricing
- Rapid Transit
- Ultra-light rapid transit
- CNG Buses
- Electric buses
- Park and Ride

This balanced approach of land-use and technology measures will be used to achieve a more liveable city centre.

5 - DEVELOPMENT OF A LOW EMISSION ZONE TOOLKIT

5.1. Introduction

Subsequent to the end of the DANTE project, TTR, in association with the University of West England was commissioned by the National Clean Air Society to develop a toolkit to support local authorities who wish to develop Low Emission Zones (LEZ) similar to the Bristol Clear Zone.

This work built upon many of the ideas developed during DANTE, but introduced a closer relationship between proposed transport and land-use measures and their impact on the local environment.

In order to develop a generic toolkit for the preparation of Low Emission Zones, three basic approaches have been defined. These are defined as air quality based, technology based or transport based and are shown schematically in figure 2.1 below. Depending on which approach is taken a specific set of criteria can be determined to define the LEZ.

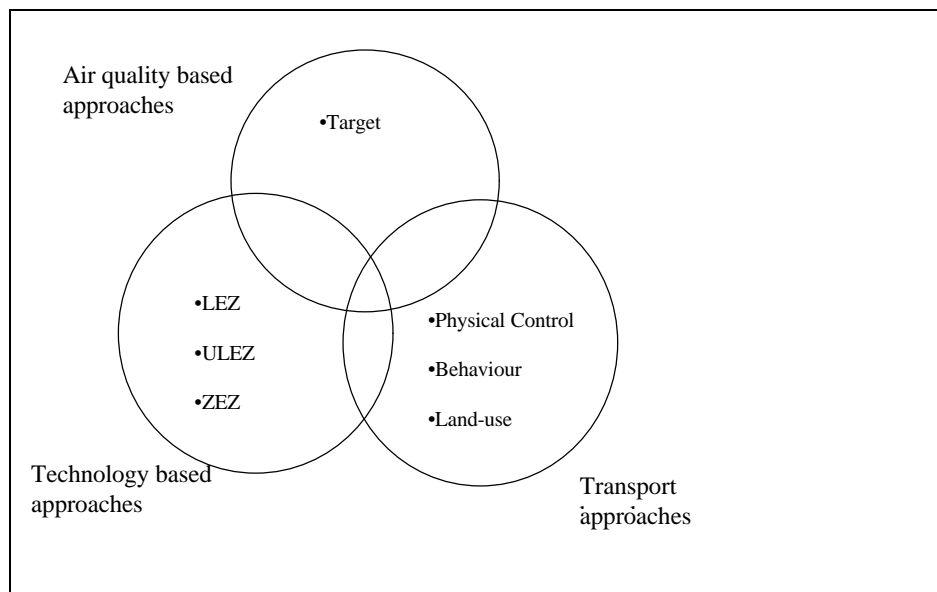


Figure 5.1 Approaches to Defining the Low Emission Zone

The LEZ may be defined in terms of the air quality targets which it must meet. This is an approach which is of great relevance to the current trend to set targets within a political agenda, and then to identify solutions which enable these targets to be met. Following the Kyoto commitments, such an approach is applicable throughout the EC.

Alternatively one can start by considering that the objective of the LEZ is to reduce vehicle emissions and this can be done in two basic ways:

- changing vehicle technology – engine type and fuel, vehicle size and design, etc;
- changing traffic activity and composition within the zone – number of vehicles, type of vehicles entering the zone, vehicle speed and so on.

5.2. Air quality based zones

Since the objective of the LEZ is to reduce vehicle emissions and improve air quality, it is clear that such a zone could be defined in terms of air quality standards and/or emission levels. So for example the zone may be defined in terms of measured or forecast air pollution concentrations, or in terms of certain levels of emissions for traffic in the LEZ.

In the case of an air quality based zone the definition can be considered objective driven rather than action or measure driven. In other words the LEZ is defined in terms of the desired air quality for the zone, rather than by the route to achieving this air quality objective.

The targets for air quality might be set at an arbitrary level in response to a wider agreement. Such targets are an excellent way to focus the political agenda on the air quality issue, but offer no real way in which to meet objectives. Two more practical approaches are as follows:

The emissions bubble. This approach assumes that the maximum emissions level within a particular zone can be estimated on the basis of the number of vehicles operational within that zone. Once the total number of vehicles exceeds the theoretical environmental capacity, entry to the zone is restricted to essential visitors and to non-polluting vehicles. This approach is attractive in that it is a way to ensure that local emissions are capped at an identified level. Many operational difficulties are, however, likely to be identified, particularly in relation to the issue of vehicle circulating whilst they seek entry to the city centre.

The pollution-related traffic ban. A number of cities have already identified the need to control city centre access at times of high pollution. Such an approach can help to reduce local emissions and enable smog to disperse. In practise, it is unlikely that such bans can be implemented immediately, and the introduction of a ban one day later may not be necessary if climatic conditions have changed in the meantime.

5.3. Technology based zones

Since the objective of the zone is to reduce vehicle emissions, then any technology based criteria can be defined in terms of vehicle emission limits. In this way any technological approach can be considered, from new fuels to new vehicle designs, which will reduce vehicle emissions. For the purposes of the zone one could consider a range of emissions standards from low emission vehicle standards (perhaps the current state-of-the-art) to zero emission vehicles such as electric buses or trams.

5.4. Transport based zones

This is another action based approach for defining the LEZ. This approach aims to alter the amount and nature of traffic entering the zone. These types of zone definitions may include local measures to deter traffic, or a combination of more complex measures to influence travel behaviour or even avoid the need to travel.

The range of measures which can be addressed may encompass any of those identified for the Clear Zone. The accuracy, however, of such a toolkit approach will depend on the ability of a generic case study to act as a proxy

for a specific proposal. Clearly, the developers of a Low Emission Zone will need to have a clear understanding of the wider impacts of their proposal, and to be able to develop a realistic picture of the likely outcomes.

5.5. Evaluation of Impacts of Low Emission Zone

In order to enable local authorities to develop the low emission zone concept themselves, a toolkit is now under development. This comprises the following three sequential elements:

Stage 1: Guide to good practise: example of measures which can be implemented in the urban context, together with background data, and case studies

Stage 2: Transport Impacts: approach to assessment of the impacts of these measures on transport patterns within the urban area; this work would normally be undertaken by the local authority, using a suitable land-use, or transport model

Stage 3: Emissions model: spreadsheet model, based upon work undertaken by ETSU under T131 Open Action (7). An example of the format for data input is indicated in Figure 3.2 below.

Data for measure

Measure name
 Measure number
 Applicability (route or city)

Route Characteristics

Population in catchment
 Households in catchment
 Area of catchment km²
 Population density pop/km²
 Household density htv/km²
 Length of route km
 Public transport share %
 Public transport fare ECU

Description of measures:

Traffic data

| Data category | Sub category | Before | After | Units | Description |
|-------------------------|--------------|--------|-------|-----------------|---|
| Vehicle speeds | Car | | | kph | Average vehicle speed on route |
| | Two wheeler | | | kph | |
| | Bus | | | kph | |
| | Tram/trolley | | | kph | |
| | Van | | | kph | |
| | HGV | | | kph | |
| Vehicle kms traveled | Car | | | 1000 vkm | Total vehicle kms on route per day |
| | Two wheeler | | | 1000 vkm | |
| | Bus | | | 1000 vkm | |
| | Tram/trolley | | | 1000 vkm | |
| | Van | | | 1000 vkm | |
| | HGV | | | 1000 vkm | |
| Vehicle load factors | Car | | | persons/vehicle | Estimate of average car occupancy |
| | Bus | | | persons/vehicle | Estimate of load factor from pkm/vkm |
| | Tram | | | persons/vehicle | |
| Average car trip length | | | | km | Average length of a car trip in the city |
| Total cost of measure | | | | Million ECU | Total cost of implementing measure (without supply station) |

Bus Technology Data

| Technology name | Number of buses | | % of total fleet | | Scale factor change (relative to diesel) | | | | | | |
|------------------|-----------------|-------|------------------|---------|--|-----------------|-----|-----|-----------------|-----------------|-----|
| | Mid | Large | Mid | Large | Energy | CO ₂ | CO | HC | NO _x | SO _x | PM |
| Existing Diesel | 0 | | #DIV/0! | #DIV/0! | | | | | | | |
| CNG | | | #DIV/0! | #DIV/0! | 1.1 | 1.1 | 0.9 | 0.8 | 0.1 | 0.1 | 0.1 |
| LPG | | | #DIV/0! | #DIV/0! | | | | | | | |
| | | | #DIV/0! | #DIV/0! | | | | | | | |
| check | | | #DIV/0! | #DIV/0! | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Additional stock | | | | | | | | | | | |

Note: new technology is assumed to replace old. If the new technology will be additional stock, show in additional stock row above.

Figure 5.2: Extract from T131 Model

5.6. The Way Forward

This latest piece of work will develop a tool which will enable local authorities who wish to develop a Low Emission Zone to determine broad predictions of scheme impact in order to aid the planning process well in advance of the need for detailed, and costly scheme evaluation.

Table 3.1 provides examples of some of the items that the toolkit will contain as it is developed.

Table 3.1: Example of “Toolkit” Measures

| Approach | Measure | Effects within local area. | Implications of applying measure. |
|---------------------------------|--|---|---|
| Restraint and priority measures | Pedestrianisation | Reduction in emissions in proportion to vehicles banned | May be increases outside area effected by restrictions |
| | Entry restrictions and access control | Reduction in emissions in proportion to vehicles banned. | May be increases outside area effected by restrictions |
| | Central area traffic ban | Reduction in emission in proportion to vehicles banned | May be increases outside area effected by restrictions |
| | Public transport priority | Bus emission reduced by up to 60% on routes applied. May increase emissions from other vehicles. | Little impact on modal split without car restraint |
| | HOV lanes | Can increase average car occupancy. | Often applied to main routes though may reduce circulating traffic in destination zone. Needs car restraint to be effective. May take passengers from public transport. |
| | Promotion of cycling and walking | Has potential and important in ensuring access. | Requires car restraint to be effective. |
| Optimising traffic behaviour | Speed limits | Lower exhaust and noise emissions. | Speeds in urban areas may already be low. |
| | Traffic calming | Typical schemes reduce No _x with HC, CO and fuel consumption showing no change or increases. Noise reductions from light vehicles. | Potential for optimising measure specifically to reduce emissions. |
| | Parking control on major roads | Reduction in vehicles emissions of 1 to 16% on routes effected. | May be most effective on arterial routes not part of LEZ. |
| | Halving number of parking places in central area | Reduced modal share of cars from 56% to 20%. | --- |
| | UTC for central areas | Reduction in fuel consumption typically 5 – 15% but up to 30% has been achieved for systems specifically tuned to achieve more. | Many urban areas already have UTC systems. Further fine-tuning may be possible for LEZ objectives. |
| Supporting and planning | Road pricing/ tolling | Reduced modal share of cars from 56% to 35% | --- |
| | Parking charges (2x increase in central area). | Reduced modal share of cars from 56% to 43% with associated reduced emissions from cars | Does not refer to a levy on workplace parking. May increase share of cars outside effected area. |

The toolkit will also provide a concise introduction to the alternative approaches to the development of a Low Emission Zone. Most importantly, it will reflect the alternative policy approaches which might be adopted in order to achieve the objectives of cleaner air in the urban area.

As with the potential Clear Zone in Bristol, the Low Emission Zone approach may require a combination of land-use based restrictions on access to urban areas, vehicle technology based restrictions, and a package of transport schemes which encompass land-use and transport issues.

6 - CONCLUSIONS

This paper has examined two of the ways in which the need to improve air quality in the UK is leading to the development of practical tools.

The Clear Zone represents a transport policy led initiative which will exploit technologies to minimise emissions and achieve an improvement in quality of life.

The Low Emissions Zone is focused more closely on air quality objectives, which can be approached either as targets to be achieved by restricting urban access to vehicles which comply to designated standards, or by the transport-orientated methods which the Clear Zone would require.

In both cases, a broad package of measures will be required, which incorporate a combination of sound planning techniques, together with the use of innovative vehicle technologies, in order to achieve the desired objectives.

In the Case Study of Bristol, work is proceeding in many of these areas, but the development of a true Clear Zone has been impeded by a variety of identifiable barriers. Nevertheless, it is clear that such an approach is essential if commitments to improve air quality are to be achieved.

7 - ACKNOWLEDGEMENTS

Richard Rawlinson and Paul Cook, Bristol City Council, Dr Guy Hitchcock and Tom Parker, TTR.

8 - REFERENCES

- 1 Royal Commission on Environmental Pollution 18th Report: Transport and the Environment; HMSO; 1994
- 2 Environment Act; HMG; 1995
- 3 Road Traffic Reduction Act; HMG; 1997
- 4 A New Deal for Transport; DETR; 1998
- 5 Winning Through Foresight; Office of Science and Technology, DTI; 1997
- 6 Bristol Transport Plan; Bristol City Council; 1999
- 7 THERMIE Programme Action T131: Energy and Emissions Evaluation of Urban Transport Measures; ETSU; 1995