CITY OF YORK COUNCIL

NETWORK MANAGEMENT

Directorate of City Strategy
9 St Leonard's Place
YORK
YO1 2ET

Briefing Note

'Alternative environmentally viable and financially practical methods of transport'

Introduction

The term 'Environmentally Friendly Transport' is much used but little understood. In terms of the movement of people in general it is applied to anything that is not a conventional bus or car as if by so doing it elevates the object to some greater status in terms of its environmental acceptability as a means of transport. There is invariably no scientific justification or comparison given to warrant this. Surprisingly this term is also not normally associated with the movement of goods as if this significant sector of the transport industry has no impact upon the environment at all. This note seeks to put this term into context and to indicate potential responses that may have a measurable impact in respect of the environment.

Clearly the first consideration when attempting to understand this subject and identify options is to define the outcomes required. The 'Environment' is now a well understood concept but for something to be 'environmentally friendly' it is necessary to form a view about just what is intended by such transport. Is it [a] transport, which in terms of its consumption of finite non renewable resources, has the least effect, or [b] transport which in terms of its effect upon air quality and quality of life has the least effect, or [c] both?.

If just [a] then the focus needs to be on the provision of renewable energy sources and the maximisation of the efficiency of the use of both these and non renewable sources.

If just [b] then the focus needs to be on the emission of vehicles, their noise and the amount they are used.
With regard to this latter issue the Sub Committee fundamentally needs to be clear about what they are seeking to achieve. They need to be clear if they are concerned about the impact on local air quality (mainly NO_x and PM_{10} emissions) or the impact on global air quality (CO_2 emissions) or both? – the answer will influence what aspect of a vehicles emissions is scrutinised and clearly this will reflect in any recommendations they make as in general what is 'good' for a local situation is not necessarily 'good' for a global context (and vice versa).

Without any debate of substance there seems to be a growing assumption within the lay community that any true ‘environmentally friendly transport’ must satisfy both criteria. Leaving to one side that this objective is not one that can be delivered by a single nation state acting alone, it follows that any such transport meeting both criteria needs to be radically different to that which are in use today. In other words the solution is not something that can be readily sourced or indeed, rapidly deployed. It is also not something that any individual or organisation within a single nation state can individually expect to influence. The delivery of true ‘environmentally friendly transport’ needs the intervention of national Governments working in concert, a structure of legislation and the support of individuals/organisations. In other words, the solution can be influenced by individuals/organisations but only delivered through national Government actions supported by the world community.

Oil and natural gas are fuels of choice for the majority of combustion engines. They are clearly a finite resource. Vehicles are in general manufactured from steel and plastic. Steel is also a finite resource and plastic, being a derivative of oil, has a finite supply. Both, however, have the advantage that they can be recycled almost indefinitely. This suggests that a core element of any ‘environmentally friendly transport’ is that it is manufactured from recyclable materials and at the end of its service life, is able to be readily reprocessed into raw materials for other purposes. A further core element is clearly that the fuel used is used with the maximum efficiency and is derived from renewable sources.

Whilst there is a great deal of scientific argument concerning the reason for global warming and in particular what the role of vehicle generated CO_2 actually is in that process, there is a consensus concerning the adverse impact of the combustion engine upon local air quality. Equally there is ample evidence that supports the view that the volume of vehicles using our highways is now damaging the local environment enjoyed by local communities, both through their presence and the noise they generate. It therefore seems inescapable that the final core aspects of any ‘environmentally friendly transport’ are that [1] it has a minimal polluting impact, [2] it is quiet and [3] it is only used when and where absolutely necessary.

These considerations therefore provide the ‘shopping list’ for any environmentally friendly transport options. Any such needs to be:

- Manufactured from recyclable materials
- Easily reprocessed at the end of its service life
- Powered by renewable energy in as energy efficient manner as possible
- Produce nil or minimal pollutants
- Inherently quiet when in use
- Operated within a Transport Policy that reduces the need to travel (for people) and minimises movement (for goods)

Discussion

Facts

The transport sector, including aviation, produces about one quarter of the UK's total carbon emissions, with road transport accounting for 85% of this and passenger cars accounting for around one half of all carbon emitted by the transport sector (51%).

HGV's and Buses between them account for some 42% of the carbon emitted by the transport sector, this despite the fact that there are some 26 million passenger cars but less than a total of 1 million HGV's and Buses. There is thus a clear link between transport and the production of CO_2 but an even clearer link between the polluting impact of HGV's and Buses.

Evidence for the impact of this gas upon the environment is however not as clear cut as many in the media would have it with the connection between it and global warming being far from proved. What is clear is that the gas has an adverse impact upon the local environment in terms of damage to vegetation, bio diversity and the human body. A reduction in the production of this gas for this reason alone is thus highly desirable.

By 2010, transport is in fact expected to be the largest single contributor to E.U. green house gas emissions. This is likely to compromise the Kyoto protocol, and hinder the chances of meeting the E.U's target of reducing greenhouse gas emissions by 8% by 2012. The government has responded to this prediction by granting £16.6 million to the development of greener transport methods, £9.3 million to renewable technology, and £6.1 million to bio-processing.

The Pan-European environmental objectives for the aeronautical industry (through ACARE[1]) seek 50% reductions in CO_2 and noise and 80% reductions in NOx in new products by 2020, whilst requiring lower costs and enhanced safety and security. The European Powering Future Vehicles Strategy also sets a target of 10% of new road vehicles emitting less than 100g/km CO_2 by 2012.

Other pollutants (oxides of nitrogen, particulates, etc) from transport also have a considerable adverse impact on local air quality and public health. Road transport emissions currently make up about 49% of total UK emissions of nitrogen oxides. These pollutants are known to increase the symptoms of respiratory illnesses, mainly amongst the young and very old. PM_{10} concentrations are also linked to the incidence rate of heart attacks.

Due to the adverse impacts on public health national air quality objectives are already in place in the UK for a number of vehicle related pollutants (including nitrogen dioxide and particulates). Where these objective levels are not met local authorities are tasked with declaring Air Quality Management Areas

[1] Advisory Council for Aeronautics Research in Europe

(AQMAs) and drawing up Air Quality Action Plans (AQAPs) for improving air quality. There are currently more than 200 AQMAs in the UK. Mandatory EU limits for nitrogen dioxide (NO_2) and fine particulate matter (PM_{10}) limits are due to come into force in 2010 and will impose a significant driver for the shape of the future transport systems both nationally and locally.

In 1992 the European Commission initiated a tripartite research programme with the European oil and motor industries aimed at identifying technical measures to help improve air quality at least cost to society. The Auto/Oil programme as it known has led to the gradual introduction of vehicle emission standards for all newly manufactured vehicles. These are commonly referred to as ‘Euro emission standards’. The most recent standards are Euro IV with Euro V due to be released in 2008.

The Euro emission standards have reduced the impact of individual vehicles but improvements in air quality are being rapidly outstripped by the continued exponential growth in total vehicle numbers. Another problem is that much of the technology designed to reduce emissions of NO_x and PM_{10} reduces the efficiency of engines and increases the oxidation of CO to CO_2 emissions. The overall result is a reduction of the pollutants of <u>local</u> concern but an increase in those of <u>global</u> concern. In general there is a fine balance to be struck between reducing ‘local pollutants’ and reducing ‘global’ pollutants. For this reason the choice of vehicle should include some consideration of the types of journey being made. For short trips around urban environments improving local air quality (ie reducing nitrogen dioxide (NO_2) and fine particulate matter (PM_{10})) should be the first priority. For long distance trips between urban centres reducing CO_2 emissions should be of greater concern.

<u>Public Transport</u>

The National Environment Technology Centre data shows that an average diesel engined bus emits as much particulate pollution as 128 cars, and as much oxides of nitrogen (NO_x) as 39 cars. The University of Tokyo has found the chemical 3-nitrobenzanthrone in diesel bus exhausts when the engine is under load, e.g. when pulling away from a bus stop. At the time of its identification this chemical was, and probably still is, one of the most carcinogenic chemicals known to science. With one bus transporting some 45 people and the cars transporting some 154 and 47 individuals respectively these figures point to the fallacy in the oft repeated simplistic argument that the solution to air quality problems lies in the significant expansion of the bus fleet.

Studies on the sustainability of public transport versus private transport[2] have also concluded that that buses and their public transport alternatives consume 60% more energy than cars per person transported. Given that diesel fuel used by the bus industry is subsidised by the Government by some £365 million a year the incentive to improve energy efficiency by engine manufacturers is blunted and thus greater use of buses would in effect have a

[2] Automotive Advisers and Associates, Hilden, Germany,

disproportionate adverse impact upon the consumption of non renewable energy.

Buses in their present guise are thus clearly not any form of environmentally friendly transport other than in their ability to significantly reduce the amount of road space used by transport. The ability of a bus (ie a multi passenger vehicle) to contribute to the delivery of a balanced Transport policy thus rests upon the solving of these motive power issues. In that regard the key to solving the adverse impact of buses is also the same as solving much of the adverse impact of private vehicles – namely the use of Green Transport Fuels.

Freight

Since the early 1950's the proportion of freight transported by rail has been in decline and now almost exclusively this sector is concerned with the movement of bulk goods such as quarry products and coal. Bulk movement of oil, petrol, gas and water is now undertaken by an extensive network of pipelines. With a very limited exception all 'consumer goods' are now transported by road. Clearly these facts are self evident, however what is not so apparent is that since the 1950's there has been an increasing trend towards larger and larger vehicles covering more and more miles so that today, proportionately (based upon the Gross Domestic Product) the transport industry moves by road many times more goods and over longer distances than at any time in the country's history.

Part of the reason for this change is the investment made by successive governments in the national motorway system and key trunk routes. This network makes the use of large vehicles feasible. That in turn means that a single vehicle can move more goods and hence the cost per ton transported drops. This in turn makes goods more affordable and hence more are purchased. The consequence of this approach is, however, that retailers service a series of stores with a single large vehicle carrying out what is known as 'multi-drop' deliveries.

The multi-drop approach has three key impacts:

a. The vehicle is invariably unsuited to the local environment within which the store is situated
   This leads to physical damage to the environment
b. Because of the physical size of the vehicle and the layout of the roads which it needs to use in a town or city centre the vehicle is forced to travel at relatively slow speed and hence in a lower gear than is optimum for engine efficiency.
   This leads to air quality damage to the environment
c. Towards the end of its delivery run the vehicle load inevitably reduces
   This means that a huge vehicle can be delivering a small load to an individual store.

These considerations together with the disproportionate carbon footprint of current HGV's means that an 'environmentally friendly' local freight solution must incorporate the following elements:

The vehicle used to deliver to its destination must be of a physical size appropriate to the local environment at its destination
The vehicle must only transport full loads to its destination and must be powered by a low/nil polluting engine when travelling close to its destination
Legislation must be in place to prevent vehicles failing to meet the above requirements from accessing environmentally sensitive areas
Facilities must be in place to enable the economies of scale provided by the use of the Motorway and Trunk Road network to be fully exploited.

In part these considerations have led to the development – almost exclusively on the continent – of Freight Transhipment Depots and Urban Consolidation Centres where goods brought along the Motorway and Trunk Road network are either broken down into loads for a specific local destination for onward transport by a smaller vehicle or where part loads are consolidated from several vehicles into one which then continues with deliveries either direct or to Transhipment locations.

Green Transport Fuels

The alternatives are:

Bio-diesel

This is a clean-burning bio-fuel. Separating glycerine from natural oils including that of oil seed rape, sunflowers, soybeans and most vegetable oils produces it. This ensures it is an entirely renewable energy source. Bio-diesel is also completely bio. This is already available in the U.K, but as yet is being used in combination with mineral diesel. If a diesel compound is 5% bio-diesel, this increases the fuel economy of the vehicle by 12%, whilst increasing engine life by 40%. Some studies have however shown that bio-diesel (or bio-diesel blends) can give rise to greater emissions of NO_x than conventional mineral diesel.

Liquefied Petroleum Gas (LPG)

LPG is produced from natural gas (usually methane) fields. This is however not a 'renewable' fuel, as obviously eventually the gas fields will run dry. Many vehicle manufacturers have already produced cars that run on LPG and conversions of existing conventional engines are widely available. LPG vehicles have been shown to reduce greenhouse gas emissions by 10% and to give rise to less NO_x and PM_{10} emissions than conventional fossil fuels.

Around 8 years ago LPG was being hailed as the fuel of the future with many local authorities converting their own vehicles to LPG and encouraging others to do the same. In recent years enthusiasm for

LPG has waned. This has been driven by problems with the reliability and efficiency of LPG vehicles (particularly conversions), a reduction in the emission differential between LPG powered vehicles and petrol driven vehicles, and the ceasing of grant assisted conversion programmes across the UK.

Fuel Cell Vehicles

Fuel cells are electro-chemical devices that turn hydrogen to oxygen, and oxygen to water or steam. Electricity is produced in this process, and it is this electricity that provides fuel for the vehicle. The only emission therefore, is water, making this potentially a green fuel. However, the cell needs a supply of the two component gases and the production of Hydrogen involves the consumption of energy and hence, depending upon how it is obtained the overall process may not be as environmentally friendly as would first appear. Fuel cells are nevertheless said to be the most promising development in environmentally friendly transport fuel.

Stored Electricity

Whilst not strictly a ‘fuel’ this is a source of energy and in a suitable vehicle it can be used to provide the motive power to electric motors. The method of storage, however, is inefficient, heavy and has a limited life. Dependant upon the type of battery disposal of exhausted batteries can pose some significant issues and in environmental terms there is a cost to be paid in reclaiming the materials used, some of which are exceptionally toxic.

Compressed Air

Again this is not strictly a ‘fuel’ but is a means of storing energy produced by whatever means so that it can be used in a mobile situation. How environmentally friendly this might be will depend upon the energy source used to compress the air at the point of delivery. (ie the garage forecourt). Invariably this is likely to be from an electrical source and thus whilst the compressed air driven vehicle will produce no pollutants with respect to the local environment, on a global view how that electricity is produced will determine just how ‘green’ the overall impact is.

India’s largest motor vehicle manufacturer, Tata Motors, has recently announced that it will be producing a compressed air driven car – the MiniCAT costing £5,500 within the near future. This vehicle is claimed to be able to operate with a range of up to 124 miles of city driving on a single tank of compressed air costing around £1 to produce. The vehicle is claimed to have a top speed of 68mph.

The likely development of hydrogen supplies for the UK

There are several ways of making hydrogen in the UK. The cheapest is to convert natural gas into hydrogen by a process called reformation. Reforming natural gas into hydrogen produces CO_2 but no more than burning it. However, using the hydrogen in a hydrogen fuel cell or using the natural gas itself in a natural gas fuel cell produces at least twice as much useful energy for a given amount of natural gas than burning it (in a natural gas fuel cell the natural gas is 'reformed' inside the fuel cell).

There are four main alternative methods available at present for producing hydrogen without producing CO_2 or adding more CO_2 to the atmosphere:

1) The electrolysis of water using electricity from renewable resources such as wind power, hydro-power and solar photo-voltaic cells. This method produces no carbon dioxide.

2) The chemical or thermal reformation of biomass feedstocks such as SRC (short rotation coppice) wood chips or methanol manufactured from biomass. This method releases carbon dioxide but it is all recycled by the growth of more biomass.

3) The biological reformation of biomass using micro-organisms. This method releases carbon dioxide but it is all recycled by the growth of more biomass.

4) The direct splitting of water using light with special catalysts or extreme heat, this method produces no carbon dioxide if the heat is produced from a carbon neutral source.

Of these four processes only the production of hydrogen by the electrolysis of water using electricity generated by windpower is financially viable on a large multigigawatt scale in the UK.

The transport of hydrogen

Hydrogen is a gas and as such could be transported over long distances economically via a pipeline to a local distribution point or potentially individual homes. However to be financially viable sales of hydrogen would need to be significant and it is unlikely that this could be expected at least in the short to medium term. This then means that the gas would need to be transported by road and this can be done either by compressing it or by liquefying it. The storage of compressed hydrogen requires heavy and bulky tanks and hence there is a cost in moving these around the country.

Storage of liquid hydrogen requires much lighter tanks thus reducing this cost but some 29% of the energy in hydrogen is required to liquefy it thereby increasing its actual and environmental cost. On the other hand liquid hydrogen is much lighter than diesel or petrol (1/10th the weight of petrol) and is safer and easier to use as a portable fuel for road vehicles than compressed gas.

Cost of hydrogen power

Studies have suggested that the extra cost of using liquid hydrogen to power a bus would be around 2 pence per passenger mile. This represents about an increase of 8%.

To generate the electricity to produce the hydrogen would need a 2 MW offshore wind turbine for every 18 large buses or 864 cars operating under city driving conditions. Each such unit would cost in the region of £3 million. Given that there are some 90,000 buses and some 25 million cars this would therefore require the provision of some 34,000 2 MW generating units at a cost of some £10.2 billion.

The location of such a large volume of turbines around our coasts would be problematic and studies have indicated that in any significant number the actual units would themselves have a detrimental impact upon marine life, and hence the environment.

Electric Vehicles - The alternative to Hydrogen?

At present, battery electric vehicles (EVs) are the most common zero emission vehicle (ZEV). ZEVs produce no vehicle tailpipe emissions in the course of their operation and EVs, which are recharged using energy sourced from renewable energy technologies are as close to being zero emission as possible (there are emissions associated with their manufacture). Even when EVs are charged using standard grid electricity, they are still cleaner than all other cars on the road.

EVs consist simply of a large rechargeable battery which stores electrical energy and this coupled to an electric motor which drives the wheels. This combination is far more efficient than internal combustion engine powered cars and is the reason for their very low emissions. The wheels are either powered by an electric motor in each of the wheels themselves or, more commonly, a single central electric motor is connected to the wheels through a transmission. Unlike a conventional engine, an electric motor works efficiently at a wide range of speeds, so an electric car does not need a gearbox. Also electric motors may be used to slow the vehicle and pass the energy back to the battery. When an EV has its motors in the wheels there is no need for a transmission. This makes more space available and reduces the weight of the car. A lighter car is more fuel efficient and less dangerous when impacting a pedestrian.

Because their power source is currently much heavier than the power source of a conventional car, the fuel tank, EV's are more limited in their range (the distance they can travel between recharges of the battery). For example, it takes about one ton of batteries to store as much energy as seven kilos of petrol. Many of the smaller commuter EVs have ranges of around 30 to 60 miles (50 to 100 km), while some higher performance examples have ranges of 150 miles (240 km).

The reason for their short range is the state of battery technology today. A variety of battery types are used in EVs with three main types: lead-acid, nickel metal hydride (NiMH) and lithium-ion. Lead-acid batteries are the same as conventional car batteries and have the lowest energy density (resulting in a low energy to weight ratio). Nickel metal hydride batteries have a higher energy density and are similar to the more familiar nickel-cadmium (NiCad) batteries but do not contain the expensive and environmentally damaging metal cadmium. The use of cadmium in batteries has been banned by the European Union. Lithium-ion batteries (as used in mobile telephones and laptops) have the highest energy density and a slow loss of charge when not in use.

While fast recharge times are very useful (enabling recharge stops of a similar duration to refuelling stops for internal combustion engine vehicles), the most important breakthrough will be in the battery's energy to weight ratio. A high energy density will enable EVs to have a range comparable to internal combustion engines and will increase their marketability.

EV's generally have a low top speed (although electric cars have surprisingly quick acceleration, so they can keep up with city traffic without any difficulty).

One of the EVs great assets could also be one of its weaknesses. Electric vehicles are almost completely silent and in cities it has been found that this can create a safety problem as pedestrians and cyclists do not hear them coming. Solutions such as artificial engine noise or some other form of audio or visual alert have been proposed. EVs quiet operations make them an attractive option as delivery vehicles, especially in cities.

The environmental benefits of EVs are dependent on the energy source. It is often forgotten that while EVs produce no tailpipe emissions, they can cause emissions indirectly because the electricity needed to power them is often generated from fossil fuels. However, it is possible to purchase electricity from suppliers who only use renewable sources. In this case, the vehicle can be considered to be more or less completely free of carbon and particulate emissions in operation.

EV's use energy far more efficiently than internal combustion engine vehicles so even if the electricity is sourced from fossil fuel power stations, the carbon and particulate emissions remain significantly less than internal combustion engines.

However an EVs battery is not cheap and after a while, its capacity to hold its charge reduces until it becomes unusable and needs replacing. The time this takes depends on the battery technology, how often it is used and how deeply it is charged and discharged.

Electric vehicles can be recharged simply by plugging them into an existing conventional electrical socket however this can take some time. A number of city councils are installing electric recharging points in car parks and the first on-street recharging points have been installed in London.

Non powered solutions

York has a high level of short commuting trips (56% of commuting trips by York residents were less than 5km in 2001). This suggests that walking and cycling could be important in providing an alternative mode of transport for commuters and therefore particularly effective at helping to reduce traffic at peak times. Clearly much has been done in the recent past to encourage cycling but this approach has now faltered and the increase in cycling's share of the travel market has remained largely static for a few years. Equally walking has been encouraged but also seems to have reached a point where additional trips are not being made.

Whilst it is clear that there are a number of measures that could be introduced to increase the share of cycling and walking (and the now adopted Local Transport Plan has a range of initiatives targeted at this objective), it needs to be recognised that these modes will always be in the minority. The young, the elderly and those with young children are target groups that through their special circumstances are just three examples of those for whom it would not be reasonable to anticipate high levels of use. Equally it must be recognised that the modern lifestyle and the layout of the city are constraints that will always result in a demand for vehicle based travel.

To a degree these vehicle trips can be accommodated by the use of vehicles provided by Car Clubs. Equally public transport, be it by multi passenger type vehicles or taxis/private hire will provide a solution. These 'shared' vehicles can be of an environmentally friendly type and thus provide transport at a reduced cost to the environment. However, what is very clear from all the studies that have been done around the world on this topic is that given the option, individuals will generally opt for the use of their own private transport in preference to the use of shared transport.

The key to reducing the environmental footprint of transport thus lies in having a properly balanced Transport Strategy that provides transport options that are genuinely environmentally friendly, significantly support the use of non vehicle based travel and actively reduces the use of private transport. This latter could be achieved by a simple reduction in the need to travel or by preventing use through regulation or fiscal means.

As the development of such a Strategy is outside the scope of this note, no further discussion of this matter takes place here. However, it is important to recognise the potential role of Freight Transhipment Depots and Urban Consolidation Centres in managing the core environmental problems of HGV's.

Urban Consolidation Centres (UCC)

In a major study by the Transport Studies Group of the University of Westminster for the Department of Transport (November 2005), it was concluded that UCCs have the greatest prospect for success if they meet one or more of the following criteria:

- Availability of Capital and on going Revenue funding
  There is no strong evidence that any truly self-financing schemes yet exist
- Strong public sector involvement in encouraging their use through the regulatory framework
- Significant existing congestion / pollution problems within the area to be served
- Bottom-up pressure from local interests (e.g. retailers in a Street Association)
- Locations with a single manager/landlord

From the evidence available, UCCs are most likely to be successful in situations similar to those detailed below:

- Specific and clearly defined geographical areas where there are delivery-related problems
- Town centres that are undergoing a “retailing renaissance”
- Historic town centres and districts that are suffering from delivery traffic congestion
- New and large retail or commercial developments (both in and out of town)
- Major construction sites

The study further suggests that, from a logistics perspective, the major potential beneficiaries from the establishment of UCCs would be:

- Transport operators making small, multi-drop deliveries
- Shared-user distribution operations

- Businesses located in an environment where there are particular constraints on delivery operations (e.g. limited access conditions – physical or time related)
- Independent and smaller retail companies

Interestingly the study also concluded that the traditional concept of a transhipment centre, with loads transferred into smaller vehicles, has generally not succeeded. Recent developments, with the main focus on improving vehicle utilisation and integrating the operation into the supply chain, seem to offer more potential.

<u>Transhipment Centres</u>

A Transhipment Centre is a physical location where goods transported in bulk may be broken down into smaller loads for onward delivery to a specific location. In the early days of the railway system such an arrangement was a common feature of most towns, cities and indeed quite small habitations. Virtually everything required by a particular community was brought in by rail and them off loaded into first horse and carts and latterly small lorries for delivery to shops, etc.

This railway system worked [a] because it was under the control of a single operator, [b] because that operator was contracted to deliver the goods 'to the door' and [c] labour costs were cheap. Today none of these apply and indeed the delivery of goods is a highly competitive £billion industry with costs cut to the bone. The industry is thus institutionally disinclined to share facilities or to use any arrangement which would add to its costs – unless required to do so by legislation. This latter effectively 'levels the playing field' and means that all operators are incurring the same costs (and of course delays since Transhipment clearly adds time to the delivery process).

Successful Transhipment centres do exist (Stockholm, Sweden; Lille, France for example) – but exclusively on the continent where there are some 68 sites in use. However they work only within the context of two particular sets of circumstances:

a. The geographical isolation of the centre served from other alternative shopping centres
b. The presence of a strong regulatory framework that effectively prohibits the use of HGV's within the town/city centre

There is a significant amount of evidence that even with these conditions such centres are not self financing and require subsidy from the local authority within which they are situated.

Clearly transhipment is an added expense to the delivery of goods and one that is passed on to the eventual consumer. This simple fact has a range of significant implications for the transport network, and in particular for road travel, the key ones being:

- Where reasonably convenient alternatives exist for shoppers to travel to and where they will be able to offset their travel costs by the purchase of cheaper goods, the town/city centre will decline.
  This effect can be seen close at hand where the Meadowhall shopping centre has significantly affected Sheffield city centre and virtually eliminated many suburban shopping centres within a relatively short distance of the centre. Regrettably this is not an isolated example but universal experience around the UK.
- The travel generated by the movement of people to such alternative centres adds to the use of congested highways and of course adds to the impact of vehicles upon the environment.

Without a regulatory framework there is no ‘level playing field’ for delivery operators and hence in such a cut throat business the use of a transhipment centre becomes financial suicide for an operator.

The implications of these considerations for York are significant – and because of the way the city has developed far higher than for most. Control of the city centre will:

- Increase the use of the Monks Cross, Designer Outlet and Clifton Moor shopping centres.
- Increase the use of the Acomb shopping centre
- Potentially result in alterative shopping being undertaken in Leeds, Beverly, Hull and Malton and thus lower the retail spend overall within the city.

The outcome will thus be:

- Greater use of the A1237
- Greater use of the A64
- Increased congestion at the Hopgrove junction and the A19 south/A64 junction
- Increased pressure upon on street parking around the Acomb centre
- Potentially a loss of jobs within the city centre (an possibly elsewhere in the city bearing in mind that 1 person employed generates sufficient wealth to employ roughly 1.5 others).

It can therefore be seen that the simplistic concept of solving York’s HGV issues by the construction of a Transhipment centre is in fact far from simple and indeed requires the concept to be:

Fully embedded within a holistic transport policy that fundamentally addresses the travel transfer issues
Structured such that there is an effective regulatory framework in place
Organised in such a way that on going revenue finance is available

These conditions clearly rule out any early introduction of a centre and indeed point to the conclusion that this is one of the last elements to be put into place within a holistic transport structure rather than one of the first.

Options

The preceding will have identified that there is currently no such thing as a truly environmentally friendly powered vehicle. It should also have shown that there is a long way to go before there is such a vehicle (or vehicles) and that the infrastructure required to support those vehicles is significant. It would therefore be natural to assume that there is nothing that could be done here in York on a local scale that would make any difference.

Whilst perhaps this is all too true with respect to measures that would impact upon the mass travel market there are options that could make a difference (albeit small) and which might be practical in the medium term.

The key to taking such action lies in dealing with those activities over which the City Council can have a direct influence, either because it owns the vehicles concerned or can, through contracts or legislation, exert direct control. This also limits the number of vehicles involved and can therefore be more readily adapted to the use of alternative fuels. Although the number of vehicles may be small they have the potential to move large numbers of people and hence in terms of travel movement, the potential for a disproportionate air quality impact.

The areas that the council could exert an influence are:

1. Stage carriage services (currently bus operated)
2. Park and Ride operations
3. School Transport
4. Dial a Ride
5. Social services transport
6. Taxi's and Private hire operations
7. Fleet services (ie the council's own vehicles)
8. The movement of freight – and the types of motive power used by freight providers

Looking at these, four vehicle groups emerge:

a. For operations 1 and 2 these are mass people movers working to fixed routes predominantly within the Outer Ring Road

b. For operations 3, 4 and 5 these are mass people movers working on flexible routes both in and outside the Outer Ring Road

c. For operations 6 and 7 these are effectively conventional vehicles that reflect the general availability of such in the marketplace

d. HGV's

Vehicle group [a]

Working fixed routes lends itself to the development of Conventional Light Rail (CLR), Ultra Light Rail (ULR) or guided solutions. The first two make use of the friction reducing characteristics of operating on steel rails. This ability means that they are at least three times as fuel efficient as buses operating on a tarmac road. In addition the vehicles experience less wear and tear and therefore can be amortised over a period of up to 30 years compared to 8 – 12 for a bus. Both mean that the cost per passenger mile of running the vehicle is significantly lower than a bus and hence, all other things being equal, lower fares can be offered.

Guided solutions do not have the cost advantage of rail but do have the ability to operate 'off route' and thus have a degree of flexibility to cope with road works and obstructions. Conventional guided solutions, however require significant dedicated infrastructure making this unsuited for narrow urban highways. CLR also suffers from the same problem in that the infrastructure can itself obstruct the free movement of other vehicles.

ULR uses a much lighter infrastructure which is considerably cheaper than CLR or conventional guided solutions (around £1 million per km compared to a guided bus-way at between £3 and 4 million and a CLR at £10 million a km). A ULR vehicle is powered by fuel cell technology which, due to the friction reducing characteristics of the steel rail arrangement is sufficient to provide power for a reasonably sized passenger carrying body comparable to that of present buses.

There are guided solutions which do not have any above ground infrastructure and which if the need arises can operate remote from the guideway. Based around the concept of detecting low frequency signals generated through underground cables, the vehicle follows a predetermined route and is based upon a rubber tyre solution. The guidance system can ensure precise steering along narrow transit corridors. This is especially relevant in situations where conventional bus lanes or tram lines would be impractical. This solution employs a fuel cell vehicle powered by hydrogen and the infrastructure costs compare with that for ULR. Because the power of fuel cells is limited at the present stage of development the vehicle is relatively small (in the order of 20 passengers).

Clearly conventional vehicles could continue to operate but using bio fuel rather than diesel. In the longer term hybrid buses might be specified which could run on bio-diesel outside the Air Quality Management Area (AQMA) and switch across to electric for the period they are in the AQMA. Whilst such vehicles are just emerging onto the market they are as yet underpowered and therefore not suited to the mass movement of the sorts of volumes now moved by the conventional Park and Ride fleet.

Vehicle group [b]

This vehicle group is essentially a conventional multi seat vehicle powered by fuel cell technology, stored electricity or bio fuel Essentially they operate within a limited daily range, not at night or weekends. This makes them suitable for overnight recharging but the vehicle loading is at present unsuited to stored electricity for anything over around 12 seats. The use of a fuel cell powered vehicle would allow the capacity to be increased perhaps to 16 seats at the present state of technology.

The use of bio fuel is currently the only option for powering a conventionally sized vehicle.

Vehicle group [c]

Here the options are very limited since the reality is that technology has yet to catch up with the power requirements of the majority of vehicles now in use and manufacturers are not yet providing new vehicles with truly environmentally friendly power sources.

The range demanded by taxis and private hire vehicles also rules out the use of stored electricity solutions.

For this group the most practical option would be to use replacement bio fuel at least until such time that more powerful alternative power sources became available.

Delivery options

For group [a] the council owns the Park and Ride service and 'owns' a significant proportion of the stage carriage network as a consequence of its role in providing socially necessary services. With limited exceptions the majority of services operated after 6pm and at week ends are controlled by the council. Given the finance to fund the necessary infrastructure it would therefore be open to the council to require the operators of both services to deliver their services by the use of a vehicle solution identified by the council.

The cost of this would be significant (approximately £120 million for the Park and Ride service alone) and realistically therefore whilst there may be vehicle solutions that might be useable the reality is that a requirement that vehicles operating these services do so only if using bio fuel is the only practical response.

Given that this is also the same solution that at least in the medium term will limit the environmental impact of the other three groups the council's key contribution could thus realistically be to:

a. specify the use of bio fuel powered engines in all those vehicles which it contracts, or liciences

b. facilitates the use of such fuels by providing a refuelling source at convenient locations that it owns around the city

c. incorporates measures in regulations as appropriate as part of the emerging Air Quality Emissions work

The impact of NO_x emissions would however need to be looked at much more closely in relation to the use of bio-diesel as some studies have shown it increases NO_x emissions – clearly not the answer for a city with an NO_2 problem.

HGV's

The council would have within its legal power the opening up of Bus Lanes for use by 'cleaner' vehicles as is being looked at in Norwich – the idea being to encourage the use of cleaner delivery vehicles. This concept however needs to be treated with caution until the considerable difficulties surrounding its enforcement can be resolved. Clearly there is also the issue of the degree of interference that such use would have upon public transport movements and hence the consequence for the delivery of the councils' overall Transport objectives.