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The Congestion Conundrum: sustainable solutions?

(Sustainable infrastructure)

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What is sustainability? Is it merely leaving crumbs on the table or is it leaving a useful inheritance for future generations?

If individuals and society as a whole are being honest with themselves they probably could do more. However, human beings are creatures of habit and feel threatened when their comfortable routines are disturbed or challenged. As a nation the United Kingdom and much of the developed world has come to rely on the private car too much and are prepared to spend greater proportions of their income funding an activity that enables them to do so much. People in the UK make more use of cars, 87% commute by car, than any other European country despite having below average car ownership, 464 cars per 1,000 population, and the inevitable result of this is increasing congestion. *(1)*

Modal Split of Passenger Transport Across the EU
&
Number of passenger cars per 1000 inhabitants

	% Car use for commuting *
UK	**86.8**
France	84.3
Belgium	81.8
Finland	81.6
Netherlands	81.5
Germany	81.4
Ireland	80.3
Sweden	80.2
Luxembourg	79.9
Denmark	79.4
Spain	78.6
Poland	78.1
Italy	76.6
Austria	73.1
Greece	66.7
Total	*81*

(2)

	Cars per 1,000 pop #
Luxembourg	618
Italy	574
Germany	539
Austria	514
France	485
UK	**464**
Belgium	455
Sweden	452
Spain	451
Netherlands	418
Finland	414
Poland	364
Ireland	359
Denmark	350
Greece	322
Total	*488*

(3)

In the UK "*over the period 1970 to 2000, the proportion of households without cars has fallen steadily from 48 per cent in 1970 to 27 per cent in 2000. In 2000, for the first time, the proportion of households with two or more cars (28 per cent) was higher than the proportion without a car (27 per cent).*" *(4)*

As a nation of motorists, the mobility which provides one with the freedom to go wherever one wishes, when one wishes has locked them into the grind of the daily commute, the need to ferry children, to reach the out of town shopping centres, to battle with every other driver delaying their rapid progress.

The motor car has become such an integral part of one's live that it cannot be easily discarded, and the use of the car will therefore feature in all lives for some time to come. As a society, we have become victims of the success of the car, and are suffering more and more congestion. Congestion that is both localised in time and space.

A study by the RAC revealed that "*just to keep traffic congestion at current levels would require a five-fold increase in what we spend now on road building, or a rise in fuel duty to five times the current level……. and that roads are almost the only public utility that is free at the point of use.*" *(1)*

Over the next 20 to 25 years we face dramatic increases in road travel. Left unchecked car traffic could grow by more than a third and van and lorry travel is forecast to grow even faster. *(5)*

As Highway & Transportation engineers it is our job to apply the principles of science to solve practical problems. So what is the problem with urban traffic and congestion, and how do we encourage more people to travel more sustainably'?

The problem with congestion

The problem can be summarised by the principles of logistics: getting the right goods in the right place at the right time in the right quantity and right quality for the right price. Too many people are trying to go to compact concentrated locations for the same time in their own private cars and they are not paying for the usage of the facilities at peak periods. According to the CBI, such congestion costs the UK economy £15-19 billion per year. *(6)*

During the rush hour in GB nearly $^{2}/_{3}$ of cars are single occupancy vehicles and levels of car use for commuting to work is highest in NI, and is increasing year on year. While car journeys increase journeys by public transport decrease year on year.

In a ten year period from 1988 to 1998 road traffic levels rose by more than $^{1}/_{5}$ and left unchecked traffic congestion will curtail our 'freedom' to move even more,

Statistics show that people are using their cars more, replacing walking and cycling trips. For example, a walk to the corner shop has been replaced by a drive to the 24 hour garage or the 'out of town' Shopping Centre, the demand for travel has not increased significantly but how we travel has changed. All this is happening at a time when in real terms, motoring costs have stayed constant for the last 20 years, while bus and rail fares have risen by 80%. *(7)*

So how can the whole of the transportation sphere be made more sustainable?

The problem can be summarised by the 3 Ps:

1. 'PEOPLE'
2. 'PROPULSION'
3. 'PATHWAY'

1. People

As upwardly individuals in a capitalist first world country we are striving for mobility, freedom, quality transport, comfort and privacy – we want a car, then a newer more upmarket and powerful model, then a second and third car.

Northern Ireland is no exception and in fact has a 'love' for the private car. The growth in car ownership is the fastest in the UK, we have the youngest vehicle age, 4.3 years to GB's 6.5 years. In Northern Ireland we seem to covet luxury cars, as exemplified by the BMW range, and the BMW 3 Series is the 12th most common car in Northern Ireland. *(8)*

The reality is that in the 2000/01 year the "*government spent approximately £47.90 per head on public transport in Great Britain. For Northern Ireland the figure is a third of that, £16.75 per head. By contrast, in December 2001the Irish government announced public transport expenditure of 424m (£263m) for the (future) 2002/03 year, which equates to £73.06 per head, or 4.5 times the level of support paid in Northern Ireland.*" *(9)*

The opinion of the general public is also that public transport is for the less 'well off' people, who cannot afford a car of their own, and that ownership of a car offers status, freedom, convenience and a cocoon from the world.

The key to sustainable transport is not only increasing levels of funding but changing the attitude and perception of car users.

However, for many of us sustainable transport is incompatible with our current lifestyles as it will involve asking ourselves questions such as:

1. Is this trip necessary?
2. Could I walk or cycle instead?
3. Could the need for this journey be satisfied closer to home?
4. Do I need to drive my children to school, or the whole way to the school gates?
5. Do we need a second car?

In Northern Ireland the 'school run' is a particular problem. In GB 1 in 5 children are driven to school but in the 'elite' schools in Northern Ireland over $^4/_5$ of children are driven. This is also mirrored by the statistics that show 80% of the workforce in Northern Ireland use a car, van or minibus to travel to work, in the UK, as a whole, only 71% use these modes. The link is the socio-economic status of parents and how many cars they own. *(8)*

2. Propulsion

How one travels can be altered to improve the environment. Either one uses public transport or travel in more environmentally friendly vehicles – that are electric, hydrogen or gas powered and 100% recyclable. Or one could walk and cycle for shorter journeys.

Research performed by TRAC at the University of Ulster has shown that over half the children in Northern Ireland are driven to school, this is based on the findings of a representative statistical sample. This is equivalent to 100,000 car journeys and if these car journeys could be replaced by buses then the congestion and pollution from 100,000 cars would be replaced by only 2000 buses. Or if the start times of schools are staggered this can be reduced to 1000 buses!

The pollution reducing impact of such a radical solution cannot be underestimated, as air pollution is a major problem for all developed and developing countries. About 100,000 premature adult deaths attributable to air pollution occur each year in Europe, and emissions from road traffic account for a significant share of this burden.

The Expert Panel on Air Quality Standards (EPAQS) established by the UK Environmental Secretary following the 1990 Environmental White Paper, This Common Inheritance, has identified 9 major pollutants and Transport is the main source of eight of these. The Transportation of people and goods is responsible for the consumption of $^1/_3$ of fossil fuels and _ of air pollution. *(10)*

The following chart indicates the energy efficiency of various modes of transport. As expected the sustainable modes of transport are the most pollutant.

Mode	**MJ per pax km**
Personal	
Cycling	*~ 0.05*
Walking	*~ 0.13*
Automobiles	2.38
Personal Trucks	2.96
Motor cycles	1.36
Total Personal	2.55
Bus	
Transit	3.15
Intercity	0.74
Total Bus	1.65
Rail	
Intercity	2.01
Transit	2.08
Commuter	1.92
Total Rail	2.02

(2)

"*Cars take up a third of city space and produce much of its air pollution. In Los Angeles 90 per cent of commuters drive to work, taking up 50 times more road space than if they were travelling by bus. In Athens 80 per cent of air pollution is due to traffic*". *(11)*

3. Pathway

The construction and make-up of the highways and roadways upon which the vehicles travel can make a significant contribution to sustainability, the retardation factor caused by the surfacing in the form of "rolling resistance" can reducing the distance travelled per gallon/litre

of fuel. New developments in the design of thin surfacings with inverted texture (minus-texture) can provide a smoother, quieter, and more economic ride for all roadusers.

The materials used in the production of BSS Hot bituminous mixes are now using more RAP (recycled asphalt planings) up to 30% in certain cases, thus saving the use of valuable virgin aggregates and bitumen.

Research by the Building Research Establishment and TRAC at the University of Ulster has shown that use of waste roofing felt and plastic composites can produce an excellent road surface and thus save disposal costs and the purchase of valuable virgin materials.

For many years it has been considered not only viable but logical to use Construction and Demolition waste in the foundation of many roads, recently this material has progressed to its use in the bituminous layers in the pavement.

Another interesting reuse of waste from the roadway is the recycling of "gully-waste" as a replacement for the fine aggregate in mixes, again reducing the use of new materials and leading to a more sustainable pathway.

So what can one do?

What can one do to address the problem of increasing traffic and the need to be 'sustainable'?

Solutions

The easy option is 'do nothing', just let the situation remain as it is and hope that the natural road capacity limits will force people onto public transport out of necessity or frustration. However, this is neither sustainable nor environmentally friendly.

The second approach is to try and build our way out of congestion. However, the old predict and provide approach is no longer fashionable, sustainable or environmentally friendly. The final option to reduce traffic congestion would appear to be the management of demand through congestion charging.

Managing demand involves (1) discouraging driving as a mode of travelling (2) promoting 'other ' forms of travel, and (3) reallocating space towards facilitating other modes of travel. An example is the reallocation of roadspace "*by people flow rather than the more traditional traffic flow. For example, a bus can carry up to 80 people and takes up less than three cars. On busy roads it might be a better use of road space to give a bus its own lane. In some busy town centre roads you can see cars parked on both sides with one slow-moving traffic lane in between, and pedestrians squeezed on to narrow pavements. Hardly a fair or effective use of road space.*" *(1)*

The best way to use demand management to reduce urban traffic congestion and encourage sustainable transport would appear to be the well-tried and tested 'Carrot and Stick' approach - penalising people who insist on driving and rewarding those people who make an effort to use other modes.

Sticks

The Stick Approach is always controversial and provides plenty of fodder for the media who like to feature stories of less 'well off' people and mothers who are dependent on their cars. We only have to cast our minds back to the weeks before The Mayor of London, Ken Livingston, Congestion Charging scheme began and the images and stories publicised in the papers and on TV.

So what are Sticks supposed to achieve? The aim should be to reduce the number of cars on the road and in so doing lower levels of congestion, pollution and road traffic collisions.

The only real and effective way of achieving this is hitting people where it really has an impact - their bank balances. This can start from when you buy your car. A higher purchase tax based on the value of the car, physical size, engine size and Brake Horse Power would encourage motorists to purchase smaller more fuel-efficient cars.

The Fuel Tax Escalator has proved unpopular because it penalises those people who lived in rural areas and who are socially excluded. The UK Government suffered their most embarrassing challenge 4 years ago, when a blockade of fuel depots in protest of high taxes, nearly brought the country to its knees. It also heralded an end to a real commitment on the part of the Government to prioritising Integrated and Sustainable Transport over car use.

There also appears to be a evidence that Congestion Charging may have a negative long-term economic impact on commercial centres bounded by such zones. A study by London's chamber of commerce has reported that _ of business in the congestion zone has been forced to lay off staff. The fear is now that people will shop and use services that are not inside the congestion zone but at dispersed location outside urban areas. The irony of this is that people may then become even more car-dependent as public transport cannot provide the network density required to compete with the private car. *(12)*

The Commission For Integrated Transport (CfIT) has suggested linking a form of congestion charging with an abolition of VED. In order to be fair all drivers should pay for every journey based on traffic levels, journey times and length. They suggested fitting all cars with GPS receivers and a black box that would work like most 'pay as you go' mobile phone deals. If you drive during off-peak periods on relatively un-congested roads you would pay a minimal charge, whereas the drivers who insist in driving in peak periods on roads operating at peak capacity will pay significantly more for the privilege. This will make drivers think about the necessity of each journey they make. While it may be some time before GPS Tracking & Charging becomes a reality, the potential benefits to be derived from such a system are immense, and it would also mean that heavy levies could be imposed on drivers who make very short journeys that could easily be made on foot. *(13)*

Road Safety would be transformed by the use of such technology to monitor driver behaviour and actions before an accident. There is even the potential to issue penalty points without the need for Speed/Safety Cameras or even Traffic Police.

A levy could be placed on Car Parking whether at the workplace or at commercial carparks. Workplace parking levy work by companies and organisations being charged for each parking space at their premises. "*Currently, up to 90% of people driving to work park freely when they get there. As a result there is no incentive to consider alternative forms of travel.*" This could be combined with park & ride schemes to keep cars away from congested areas. *(1)*

To ensure that cars are not as polluting as earlier models the annual MOT vehicle test is one way of ensuring standards are maintained. However, stricter standards will ensure that cars are either well maintained or else they are taken off the road.

However, before motorists are even able to drive cars there is something that can be done. By raising the driving age and making the initial test harder not only would the numbers of new drivers be reduced but they would be more highly trained with a lower accident risk. Regular driver retesting would also weed out those people who are a higher threat to other road users, cyclists and pedestrians.

Perhaps the most controversial 'stick', after the satellite tracking and charging, would be a higher tax on the 2nd or additional cars per household. This would have the added benefit of reducing 'school run' traffic as research, again by TRAC, has shown that it is the second car in the family that makes the difference in how children travel to school and decreasing levels of walking.

In a local town with staggered school start times, only 21% of children in households with only 1 car are driven to school but 44% of children in households with 2, or more, cars are driven to school.

In a neighbouring town, where the secondary schools are not staggered, 45% of children in households with only 1 car are driven to school but 55% of children in households with 2, or more, cars are driven to school.

Carrots

So what can be done to alter how people travel without over-using the big stick?

Two approaches could be used: firstly car users should be encouraged to use cleaner less-polluting vehicles and fuels, eg the Toyota Prius, or they should be encourages to walk and cycle.

In order to encourage more people to use cleaner NRG such as natural gas, hydrogen and electric propulsion the government should lower or waive tax on these energy types for a set period.

Another innovation, from Los Angeles, would be the introduction of High Occupancy Vehicle lanes, or lanes exclusively for cars that have more than three people in them. These lanes could be combined with bus lanes and would ideally involve a reallocation of road space. This would inconvenience solo drivers but would hopefully encourage them to car-share in order to speed up their journey.

At present Public transport does not offer a suitable alternative and the only solution would appear to be a substantial injection of public money to (1) boost the number of buses and trains, (2) improve existing routes as well as (3) the introduction of more routes that would previously have been unforeseeable or underused.

Cheaper fares would make it easier for people to use public transport and children who have cheaper fares/free fares for their school journey are less likely to be driven. The legislation

regarding Transportation Assistance for pupils needs to be revised because very few parents are willing to let their children walk 2 or 3 miles to school. By reducing this to 1 miles from school the 'school run' would be virtually eliminated.

How can more children be encouraged to walk or cycle? As with the stick approach the best way to achieve this modal shift is to effectively pay people to use these modes as well as promoting the health benefits of using of such exercise. Green travel plans encourage aim to encourage employers and staff to come to work by other forms of transport. "*This might mean extra money for people who car share, negotiating bulk discounts with transport operators for season tickets, or providing special facilities like showers and secure bike parking for cyclists. The incentive for companies is that it can reduce their need for parking spaces, which can reduce their costs and the space which then be put to better use.*" *(1)*

However, it is an admirable aim to encourage people to walk and cycle, but if the infrastructure is inadequate or if it has not been upgraded then the efforts of the Government's various Transport bodies will be in vain.

The improvement of walking and cycling facilities will mean:

1 Reprogramming junction signals to give priority to pedestrians and cyclists
2 Reallocating road space back to pedestrians and cyclists
3 Pedestrianising streets, and
4 Providing cycle shelters and secure storage.

As congestion is localised in TIME and SPACE and it isn't feasible to keep adding more space to our road network, then maybe we need to have a look at 'time'.

The majority of commuters start work between 0830 and 0900 and this obviously means that the congestion is worst in a very short period in the morning. Add a couple of prangs and road works and serious congestion is guaranteed. A possible solution would be to stagger the start times of schools and businesses and thereby reduce the peak traffic flows. Flexible working, and even home-working, would not only improve staff morale but reduce stress from spending less time in stationary traffic.

Conclusions

The future for UK Congestion busting will most probably lie with GPS Tracking & Charging, however, it may not be 100% effective in Northern Ireland given our low population density and the 'need' that we have for the car.

The car has been given a stay of execution but the writing is on the wall for the car as we know it. The greatest irony is that in the long term we may lose the standard of lifestyle that we are used to because oil reserves are predicted to peak between 2015 and 2020. After that supplies are expected to decline significantly. *(14)*

We are living in the age of the car and mass mobility, but will the next age be the Stone Age Part II and the re-emergence of the horse and cart?

References

1. Congestion Charging: The need to tackle congestion, Commission for Integrated Transport. Updated: 29 March 2004
   http://www.cfit.gov.uk/congestioncharging/factsheets/need/index.htm

2. Energy use and Sustainability of Transport Systems, Lowson, M,
   Advanced Transport Group, University of Bristol 12 November 2002
   http://www.cybercars.org/docs/Energy%20report1.doc

3. EU Energy & Transport : Figures and Main Facts
   http://europa.eu.int/comm/dgs/energy_transport/figures/pocketbook/doc/etif_2003_down3.xls

4. Focus on Personal Travel, DTLR, December 2001
   http://www.dft.gov.uk/stellent/groups/dft_transstats/documents/page/dft_transstats_505809.pdf

5. Moving Forward - Northern Ireland Transport Policy Statement
   http://www.nics.gov.uk/transport/itp/chapter1.htm

6. BBC News: Prescott promises to tackle road jams
   http://news.bbc.co.uk/1/hi/uk/50598.stm

7. Congestion Charging: Motoring facts, figures and travel trends, Commission for Integrated Transport, Updated: 01 April 2004
   http://www.cfit.gov.uk/congestioncharging/factsheets/facts/index.htm

8. Northern Ireland Transport Statistics 2002-2003, Department for Regional Development Northern Ireland.
   http://csrb.drdni.gov.uk/statistics/details.asp?publication_id=92

9. A New Start for Public Transport in Northern Ireland, The NITHC/Translink Response to the DRD Consultation Paper, 31 October 2002
   http://www.translink.co.uk/resources/pdfs/NewStartResonseScreenIND.pdf

10. Vital Travel Statistics, 1997, Stephen Potter & Transport 2000

11. David Sattethwaite ed., *Sustainable Cities: An Earthscan Reader* (Earthscan, London 1999)

12. C-charge 'leads to layoffs', Andrew Clark, Tuesday, 25/11/2003, The Guardian
    http://www.guardian.co.uk/print/0,3858,4804608-103630,00.html)

13. Fact Sheets No.8: A new concept for paying for road use, Commission for Integrated Transport. Published 25 February 2002
    http://www.cfit.gov.uk/factsheets/08/index.htm

14. Call out the Reserves, chembytes ezine August 1999, The Royal Society of Chemistry – Chemical Societies' Electronic Network
    http://www.chemsoc.org/chembytes/ezine/1999/evans_aug99.htm