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## **Mobility in Times of Climate Change: Technology Fix versus Behaviour Change**

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### **Lecture manuscript**

#### **SLIDE 1**

The lifeblood of societies both economically and socially throughout the ages has been access – the ability for us as human beings to reach people, goods, services and opportunities. Overwhelmingly, achieving access has involved movement – the transcending of distance.

As societies across the world have developed and continue to do so, movement has tended to increase in speed. As we travel faster as societies we seem to spend no less time travelling and consequently we travel further.

There has emerged a perpetuation of motorised mobility dependence – as individuals we buy into such mobility with the promise of the independence and new reach in terms of access that it affords us. Collectively, however this affects other things – patterns of land use change in response to this such that we appear to need to cover greater distances to reach the things we desire or need and thus are dependent upon our cars.

In westernised societies especially, this perpetuation has been permitted and indeed supported. We have been prepared to expand our transport systems to accommodate motorised mobility, affordability of motorised mobility has allowed its growth and there has generally been an abundant supply of energy to fuel the system of motorised mobility and limited cause for concern about its environmental and social externalities.

Things have now changed.

Expanding our transport systems, certainly in terms of roads infrastructure, has increasingly been seen to be both unaffordable and limited in its effectiveness. Climate change and peak oil – the prospect that abundance of energy as we have known it may soon no longer be a given – have come to the fore to question the environmental credentials of motorised mobility and our ability to fuel it.

Tough challenges now lie ahead. So how are we and how should we be rising to them? There are two notable areas of consideration in addressing this: technology fix and behaviour change. I will explore each of these, taking a view that technology fix represents a convenient perpetuation of 'business as usual' and calling for more emphatic attention to be given to the role of behaviour change in addressing our challenges.

#### **SLIDE 2**

This slide depicts a simplified overview of the determinants and consequences of the transport system.

The demand for people to travel (by motorised means) creates an energy requirement before demand can be realised in the form of traffic – the flows of people and more especially vehicles that the

transport system must accommodate. Where and when there is insufficient capacity provided by the system the result is congestion. Traffic itself is a source of vehicle emissions but emissions are increased in congested conditions.

Emissions have implications for health and for climate change and as such themselves have economic consequences. It has been widely accepted that congestion has an adverse impact on economic activity – people stuck in traffic reflect time being wasted that cannot be put to productive use. Economic activity generates a need for travel to achieve access thus feeding once again into travel demand.

The slide also depicts three levers that can exert influence on the system.

*Land use* affects travel demand. Where people are located in relation to the people, goods, services and opportunities they wish to reach has consequences for the distances that must be transcended and in turn influences the frequency and means by which travel is undertaken.

*Technology* or rather technological developments can affect the ease, affordability and volume of energy production to support motorised mobility. Technology is also used within traffic management to try and make the most effective use of available system capacity to accommodate the traffic using the system and thus plays its part in potentially influencing congestion. It can also affect the efficiency of vehicles by reducing energy consumption and emissions per unit of distance travelled.

*Consumer behaviour* has the widest set of potential impacts. Individuals' decisions on where, when, how, how often and whether to travel strongly govern travel demand. Consumers' choices about the vehicles they purchase and use and the ways in which they are driven affect energy demands as well as the composition and distribution of traffic in time and space and thus the congestion that arises and the emissions that are produced.

All three levers are in principle able to be influenced through policy and investment. However, each of them faces differences in the extents of and inter-relations between affordability, effectiveness and acceptability.

With this overview in mind, I will next consider technology fix as the lever of choice. I will then go on to entertain the prospect of the alternative lever of behaviour change including the prospects of behaviour change through technology.

### SLIDE 3

I would suggest that we are attuned to technology fix in terms of the evolution of our modern transport systems. I conceive of three phases that exist in the unfolding of transport systems and their use:

The first phase - *Vehicles and infrastructure* - concerns creating the asset – building infrastructure that facilitates the movement of vehicles and in tandem designing and improving vehicles produced to use the infrastructure. In this phase science, engineering and technology dominate in terms of success and achievement.

In the second phase - *Traffic management*, overlapping with the first, there is a need to ensure that use of the asset is as efficient as possible – maximising the throughput of people or, more typically, vehicles and minimising delay. In this phase technology remains dominant in managing the system – optimising the operation of mechanisms governing vehicle movements and conflicts between them.

Success of the first two phases is likely to encourage the use of the transport system. There can then arise a problem in demand exceeding supply even in the face of ongoing expansion of the asset or the management of traffic using it. To address this requires the nature of demand itself to be changed either in terms of an absolute reduction in demand or an influence over how, when and where people are making use of the system.

This third phase of *demand management* can rely upon technology to facilitate but fundamentally it is about influencing the decision making of users of the transport system. This sees a broadening of the expertise required that begins to encompass social science: a need to study factors that give rise to travel demand (lifestyles and social and business practices) and which influence people's decision making.

The first two phases have dominated our thinking with an aim to provide for what society needs: a mindset of *transport is here to serve society*.

With this mindset it is presumed or implied that accommodating demand should take priority over influencing or managing demand. The dominance of the first two phases alongside this mindset has created a transport industry and profession that tends to be or have been dominated by engineers, scientists and technologists alongside mathematicians and economists.

At the same time there are professionals tasked with profiting from the sale of mobility in a privatised market for whom reducing demand is likely to be unattractive unless compensated for by higher prices. The collective voice of transport as an industry or profession can thus have a natural leaning towards technology fix.

#### SLIDE 4

Technology fix is appealing to the public because it holds the promise of maintaining or enhancing 'business as usual' – improving levels of service associated with people's current behaviours or mitigating the problems caused by transport in ways that do not impinge upon their own lifestyles.

*Politicians are here to serve the electorate* and unsurprisingly if the public are supportive of technology fix and the industry or profession offers some promise of being able to deliver then politicians will find technology fix favourable. Investment in technology supports industry and may win votes.

It should come as no surprise then that technology fix finds favour – it can comfort us and inspire us that human inventiveness and ingenuity can exert a mastery over the problems we face. This perspective is perhaps now being accentuated.

For many years the central challenge facing transport was that of congestion and in the face of traffic management being unable to cope, demand management was receiving growing attention. However, the recent emergence of two other prominent concerns may be changing this. Climate change for transport turns the focus from congestion to emissions, allied to the growing attention given to peak oil which brings energy supply to the fore, further overshadowing congestion as an issue. Emissions and energy supply readily lend themselves to science, engineering and technology.

#### SLIDE 5

Reports continue to emerge in the UK reflecting an optimistic and prioritising focus upon technology fix as a response to the challenge of climate change.

The 2008 King Review of low-carbon cars was commissioned to "examine the vehicle and fuel technologies which over the next 25 years could help to 'decarbonise' road transport, particularly cars".

In setting a context the report stated that "[d]emand for motoring is strongly linked to economic growth" and "the global challenge is to enable growth in road transport, in a sustainable, environmentally responsible way". The strong implication here is that we should expect to see a continuation of the current *automobility regime* in which high levels of traffic are inevitable and a necessary accompaniment to economic growth.

The report highlighted the significant potential to reduce CO<sub>2</sub> emissions from road transport "through the development of more efficient vehicles, cleaner fuels and smarter consumer choices".

Acknowledgement was given to the role of behaviour change in terms of people's choices about which cars to buy and how they drive their cars and also to choices about how and when people use their cars. However in considering prospects for alternatives to car use, the report nevertheless concluded that "we must assume that, at least in the medium term, improvements in vehicle fuel or driving efficiency will be required to achieve emissions reductions on the scale required". Underlining the presumed capabilities of technology fix, the report suggested that "in the long term (by 2050 in the developed world), almost complete decarbonisation of road transport is a realistic ambition".

Later in the same year the UK's Committee on Climate Change published its first report '*Building a low-carbon economy – the UK's contribution to tackling climate change*'. This had a strong orientation towards technology fix, underlining the messages of the King Review. It observed that "[d]eep emissions cuts in transport can be achieved through improved fuel efficiency of new cars and vans" and stated that "the good news is that reductions... are possible without sacrificing the benefits of economic growth and rising prosperity".

In April 2009 the UK Government published its strategy '*Ultra-Low Carbon Vehicles in the UK*' highlighting its intention "to help put electric cars into the reach of ordinary motorists by providing help worth £2000 - £5000 towards buying the first electric and plug in hybrid cars when they hit the showrooms - which we expect from 2011 onwards

Technology fix also features in aviation as something seen to be able to overcome the apparent policy conflict between tackling climate change and increasing economic competitiveness.

In 2009 the UK's Climate Change Committee looked at "the potential to reduce the carbon intensity of air travel through technological improvements in airframe and engine design, through operational efficiency improvements and through the use of sustainable biofuels". While noting that unconstrained demand would be far higher, it concluded that "there is potential for aviation demand to increase while still meeting the Government's target – in the most likely scenario, a 60% increase in demand is allowed".

A defining characteristic of technology fix, whether in terms of tackling climate change, energy or congestion, is that it seeks to improve the efficiency of movement rather than the absolute amount of movement. We can of course reduce congestion, energy consumption and emissions by travelling less. Technology fix, on the other hand, seeks to allow us to travel as much or even more while aiming to diminish the negative consequences. It can seem alluring.

In relation to the current preoccupation with climate change and energy it seems we find ourselves in a rather deluded state of mind that if we can create a zero emissions perpetual motion transport system then our troubles will be over. The reality is that energy supply and climate change are indeed very serious issues that need attention. If, however, these are 'solved' through technology fix then society will still be faced with its 'old' problem of congestion and its social and economic implications. Greening motorised mobility cannot be the only answer. Indeed pursuit of 'greening' could merely be putting off the longer-term challenge of whether societies can sustain such high dependencies on motorised mobility.

## **SLIDE 6**

I have made reference to the automobility regime. By this I mean the factors that characterise the way our current transport system – dominated by the car – is perceived and developed. Such factors include the centrality of motorised mobility to connectivity and economic growth, the pursuit of faster journeys and freedom of movement as an apparent human right. The reports referred to above and indeed technology fix in general largely espouse this regime rather than questioning it. The implicit intention is to sustain the regime rather than to entertain any transition to a new regime in which our transport system is reframed.

Sustaining the existing regime tends to find support from the public whose lives are entwined with the regime and have a (perceived) dependence upon it. People do not generally like the prospect of change so regime preserving measures are appealing. Messages conveyed to the public in the reports I've mentioned are (implicitly) that technology is fixing 'the problem' and that its business as usual for the regime of automobility.

It is notable that the regime is prone to be not only preserved but perpetuated with the assistance of technology fix. Aviation is evolving with alarming parallels with the car. Notions of the 'right to fly' have emerged analogous to the 'freedom to drive' entitlement for the motorist.

Perhaps at the heart of any debate about the virtues of technology fix (or behaviour change) is whether or not as a society we believe the current regime of automobility to be healthy and desirable in terms of pursuing improvements to quality of life. Technology fix will prolong and intensify motorised

mobility dependence, it will sustain the industries that rely upon it and it will put off the comparatively difficult political prospects of bringing about fundamental change.

But what if technology fix fails to deliver? It may fail for two reasons:

- firstly it may prove insufficient in being able to improve energy efficiency, reduce emissions per unit of travel or improve vehicle throughput for a given capacity;
- secondly it may succeed in this only to encourage even higher levels of mobility that ultimately cannot be sustained and will be even more difficult to migrate away from.

It might be said that technology fix addresses the symptoms of the problem but not the underlying cause.

Let us now turn to an alternative approach to preserving or adapting the current regime of automobility – behaviour change.

## SLIDE 7

Behaviour change essentially refers to an influence on decisions made by individuals and/or firms that serve to affect the nature and extent of travel demand and resulting traffic.

These decisions can be strategic or tactical.

Strategic decisions such as where to live or work have implications over a time frame of many months or years.

Tactical decisions meanwhile – such as whether, when and how to travel for a particular purpose – can, in principle, be subject to change in response to circumstances on a more regular basis.

## SLIDE 8

This overview comparison of behaviour change and technology fix highlights that both can, in different ways, improve the efficiency of consumption – for example technology can ensure a vehicle achieves more miles per gallon and produces less emissions; meanwhile different driving styles and sharing cars with others can also achieve, per person, more miles per gallon and less emissions per person.

Technology fix has a tendency to maintain or even encourage consumption of motorised mobility while behaviour change has more evident prospect of reducing motorised mobility consumption.

As noted already, technology fix supports the substantial transport industry and the jobs it provides for through investment in research and development and in the production and maintenance of vehicles and the infrastructure and fuel sources they rely upon. Behaviour change could adversely affect some parts of the industry if it resulted in less motorised mobility.

However, behaviour change may be able to yield a healthier society in the sense that a move away from the sedentary lifestyle associated with the car to more walking and cycling would increase exercise and could improve mental alertness and hence productivity. Less motorised mobility may enhance social cohesion both in a reduced presence of the motorcar in the physical landscape but also through greater interaction between people who are less commonly 'carcooned'.

Perhaps one of the most significant contrasts between behaviour change and technology fix is the extent to which they can be readily supported politically. Technology fix allows a political message that says "*we are doing something positive to tackle the problem while you get on with your lives*". Meanwhile, behaviour change comes with a political message that may read, or be read as "*in order to do something positive to tackle the problem we require you to make some changes in your lives*". It begins to suggest that transport should be doing something other than serving us and that interference in our freedoms is mooted.

Lastly, technology fix tends to have the effect of preserving the automobility regime whilst behaviour change represents challenge to it. There is a comfortable familiarity with the regime and its norms and

keeping things 'as they are' is welcome as opposed to opening up all the uncertainties that change may have in store.

## SLIDE 9

Changing behaviour requires that individuals have available to them viable alternatives and that they are minded to consider those alternatives. The viability of alternatives is determined by the factors individuals deem important when making comparisons across their options. Whether they are minded to consider alternatives rather depends upon how comfortable they are with their current behaviours. A number of challenges relate to pursuit of behaviour change, including: acknowledgement of a 'problem', social norms, social dilemmas and decision mechanisms. These are now considered in turn.

## SLIDE 10

UK data provides us with a robust finding over time that while a very large majority of the public asserts the seriousness of congestion for the country, a large proportion of the population do not find congestion as a serious problem for themselves. We are told by politicians and the media that congestion is problematic and costly to the economy and seem to subscribe to the view that it is a problem for the country. However, in our daily lives we are either accustomed to congestion (especially predictable congestion), have mechanisms to cope with it (such as listening to the radio when we sit in traffic) or we are able to take our own steps to avoid it in terms of how and where we travel.

## SLIDE 11

This familiarity with and conditioning to congestion relates also to the power of social norms. Social norms reflect what, within peer groups or more widely, is seen to be acceptable or normal in terms of behaviours and attitudes.

For many people aligning with the norm is important in engendering a sense of belonging and conformity. Individuals who act or think outside of the norm may be frowned upon by their peers or fear this being the case. Social norms relate in turn to notions of *social imitation* – copying what others do can be both easier in terms of ease of decision making and also assist in ensuring one is 'in' rather than 'out'.

Norms are not universal and importantly they change and therefore can be changed. Nevertheless some norms can be powerful barriers to entertaining behaviour change, for example it is or has been normal to drive by oneself to and from work each day, it is or has been normal to judge public transport (especially the bus) as being second rate to the car and so on.

At the same time some norms can be seen to change – for example it has become normal to engage with household recycling; and in some circles normal to view sports utility vehicles (4x4s) with disdain. If social norms can be influenced in favour of the sorts of behaviour changes sought then there is a greater likelihood that behaviour change momentum can be built up.

## SLIDE 12

Social dilemmas intriguingly reflect how as individuals we can all lose out through selfish behaviour when changing our behaviour to be more co-operative could benefit us all. They also reflect the potential importance of sticks as well as carrots to change behaviour.

Let me run through an example to illustrate the point. Commuters to an urban centre have a choice of travelling by car or by public transport. <CLICK>

With all or most of the commuters travelling by car they all face (collectively self-inflicted) congestion. <CLICK>

If an individual chooses to switch from car to public transport (s)he will remove a car from the road and thereby marginally reduce the traffic level and improve the journey for all other car users and

public transport users. This may well, however, be at a greater personal 'cost' to the individual concerned than the benefit they receive from the switch. <CLICK>

If all or most car users switch to public transport then all commuters would benefit more than they would if no-one switched. <CLICK>

In this situation the rational car user will remain in their car.

This is explained as follows. If the individual is the only one to switch then they will lose while all others will gain. If the individual switches and sufficient others do likewise then the individual will gain. If others switch and the individual does not (i.e. the individual is a freerider) then (s)he will gain. Such rational behaviour regrettably results in all commuters being (or remaining) disadvantaged.

Such social dilemmas require an intervention for them to be broken – this is what a measure such as London's congestion charge achieves. The individual is effectively penalised for selfish behaviour and everyone receives collective reward through those choosing not to use their car making traffic less congested and journeys easier.

### SLIDE 13

Returning to the individual then there is a need to better understand decision mechanisms that individuals employ in order to appreciate the challenges of changing behaviour.

Notable in these is the distinction between *utility maximising* behaviour and *satisficing* behaviour. In the case of the former an individual wishes ideally to be in possession of all of the facts and aware of all their travel options in order to be able to compare them and identify the preferred option that maximises utility ('attractiveness') or conversely minimises disutility – a Mr Spock approach.

In the case of the latter an individual has a threshold of acceptable 'attractiveness' which once exceeded renders the travel option 'good enough' or satisfactory – a Homer Simpson approach. Either through repeated assessment of available options for a given journey (such as the daily commute) or through an immediate tendency towards satisficing behaviour, an individual can move into habitual behaviour whereby the options are no longer considered and the behaviour is an 'automatic' response to the need to travel confronted.

Technological developments in the provision of travel information services have implicitly if not explicitly been founded upon assumptions of utility maximising behaviour – individuals wishing to use information once made available. What tends to transpire instead is that individuals are unlikely to seek information for journeys that are sufficiently familiar and/or predictable (which constitute the majority of journeys).

### SLIDE 14

Before turning from challenges to opportunities for behaviour change we must raise the matter of *which behaviour changes* can substantially tackle the problems of energy, emissions and congestion. A simple assessment of the facts highlights the need for behaviour change to be much more than just about public transport as the alternative to the car.

In 2008 the average number of car trips per person per year in the UK (as a driver or passenger) was 637 (64% of all trips). The figures for surface rail/underground and local bus were 27 (3%) and 65 (7%) respectively. If a 10% reduction in car trips were to be achieved by mode shift (or a suppression of a 10% increase in car trips) then this would amount to either a 236% increase in rail trips or a 98% increase in bus trips. This would have major implications for the capacity of these modes.

This highlights the need to turn attention to a wider set of behaviour changes that notable include cycling and walking or a decision not make certain journeys.

## SLIDE 15

It will be apparent from the above that there is much to suggest that behaviour change is challenging, not least politically, because people are in general wedded to the current regime. However, behaviour change potential remains substantial, whether or not it can be realised.

While people can be vocal in their resistance to change as a collective, behaviour change is in fact a characteristic of all our lives in terms of changing circumstances and strategic decisions. As we move through our life course we change where we live, we acquire and change jobs, we form and reform households and so on. As these changes occur our travel behaviours can be subject to reassessment and we may actively seek to change them.

For example, in a study into residential relocation it was found that over a quarter of respondents had changed their main mode of travel for commuting since relocating.

Aggregate statistics on travel can imply that little overall change is occurring while in fact change at the level of the individual can be appreciable. An example of this has been highlighted in relation to car ownership. A very small net increase in car ownership at the aggregate level between two consecutive years (0.2%) was shown to have resulted from nearly 16% of households changing car ownership overall: 8.2% increasing car ownership and 7.6% reducing car ownership.

Hence behaviour changes are occurring all the time but in different directions in relation to greater or lesser car use. The challenge is how to encourage, facilitate and 'lock-in' the desirable behaviour changes and discourage those changes that are contributing to the overall problems facing transport.

As noted earlier, to create an environment for behaviour change requires both carrots and sticks. It is recognised that while positive enticements to change behaviour (e.g. improved public transport) may be appealing as propositions to the public, their effectiveness relies also upon other measures to 'push' them to change (e.g. parking restrictions or road pricing). The latter are not as popular with the public. However, the public are more supportive of sticks or rather combinations of carrots and sticks when they can see that the approaches are effective.

There is thus a longstanding need for political courage to introduce packages of measures that truly incentivise and achieve behaviour change. Pricing and restraint measures are unavoidable in this and political courage must come from a realisation that effectiveness when demonstrated can improve public acceptability.

## SLIDE 16

In the earlier examination of technology fix, the focus was upon technologies within the 'transport is here to serve' context. However, information and communications technologies (ICTs) are now offering a substantial opportunity to influence travel behaviour. They are making it possible for people to access goods, services, people and opportunities *without* the need for them to travel.

Most notable in this regard has been the arrival of the Internet in society and the invention of the Web. Perhaps only a coincidence but since the early 1990s (when the Web was invented) the road transport intensity of economic activity has been decreasing at least in the UK.

In our own work we have found that ICTs can *supplement* travel (increasing levels of access and social participation without increasing levels of travel – that is, ICTs can substitute for an increase in travel).

However, ICTs can also stimulate more travel through encouraging people to interact. Accordingly there is a need to return to the importance of carrots and sticks. ICTs make possible less reliance on motorised mobility to achieve access but in a regime setting where motorised mobility use is supported rather than restrained, rationed or more highly priced the impact may be limited.

## **SLIDE 17**

Intriguingly different parts of the 'technology industry' can be seen to be in conflict in terms of their implications for motorised mobility (intended or otherwise). Technologies under the umbrella term 'Intelligent Transport Systems' seek to tackle congestion. Meanwhile mobile ICTs that enable remote communication, mobile working, mobile entertainment and relaxation are effectively exploiting congestion.

## **SLIDE 18**

I've made little reference to land use changes further to the mention near the beginning. However, land use patterns play an important part in defining opportunities for different travel behaviours and shaping norms in travel. A partnership between land use planning and exploitation of ICTs could hold the prospect of 'acting globally, living locally' allied to greater interest in walking and cycling.

## **SLIDE 19**

So – to the way ahead.

The mindset of the current automobility regime is such that technology fix is seen to be the primary opportunity and that deserving of most immediate intense attention and investment while behaviour change is a 'nice to have' bonus but an opportunity bestowed with low expectations and consequently much less attention and resource.

The way ahead may well be characterised by technology fix because it suits the status quo. Yet proceeding in this fashion could expose us as a society that has been subject to the frogboiler phenomenon.

A frog put in a pan of hot water will jump out immediately, recognising the threat to its safety; a frog put in a pan of cool water that is gradually warmed up to become hot will adjust its body temperature and will not detect the gravity of the threat to its safety until it is too late.

In transport terms we have been adjusting to mounting traffic and growing dependency on motorised mobility in a way that is gradual such that we do not sense the cumulative effect of the automobility regime. We are doing our best to adjust our body temperature through technology fix and upholding an expectation of further growth in travel demand. We may discover that our dependency eventually reaches a critical point where serious system instability results. Would we not be wise to more seriously contemplate significant adjustment to the regime?

Most evidently the way ahead should be marked by a marriage between technology fix and behaviour change: the answer is to pursue both rather than one or the other. However, for the marriage to work requires a sufficiently meaningful input from both sides. At present we are at risk of saying we are doing both while in practice giving too much attention to technology fix such that it overshadows and diminishes the role of behaviour change.

Rather than allowing the mindset of 'transport is here to serve' to persist, the way ahead requires us to recognise that transport shapes society and should be developed in such a way so as to support society.