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Country report 6: The UK mobility system

Mike Hodson, Frank Geels, Andy McMeekin

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Executive summary

This report presents an *interpretive* assessment of the feasibility (practicality, achievability) of sustainability transitions *in the present* in the mobility domain in the UK. It asks:

- Do analyses of recent developments in green mobility niche-innovations and regime (in)stability in the UK suggest that a transition is beginning to take place and, if so, does this look like substitution or reconfiguration?

To address this question the report summarises a break through analysis of niche-innovations in the mobility domain in the UK (see Table 1).

Table 1: Breakthrough analysis of niche-innovations in the mobility domain in the UK

Niche-innovation	Internal momentum	Strong or weak alignment with broader regime characteristics and developments	Likelihood of imminent breakthrough (and/or future potential)	Pathway A or B (or mixed)
(Plug-in) Hybrid Electric Vehicles	Moderate	High potential alignment, but: <ul style="list-style-type: none"> - Needs plug-in infra - High battery costs - Hedging by dominant regime interests 	Moderate to high	A
Battery Electric Vehicles	Moderate	Weak to moderate alignment: <ul style="list-style-type: none"> - ‘Greening’ of automobility - Needs plug-in infra - Higher costs than ICE comparators - Absent electricity regime actors - Policy promotion but governance experimentation 	Weak to moderate	A (with some B)
Inter-Modal Ticketing	Low	Unclear which regime might align with <ul style="list-style-type: none"> - Promotes public transport v private car use - Low alignment with automobility regime - Breakthrough in London but weak alignment elsewhere 	Weak to moderate	B
Car-Sharing Clubs	Low	Weak to moderate alignment	Weak to moderate	B

		<ul style="list-style-type: none"> - Aligns but also needs ICT systems - Ltd evidence of significant re-alignment of cultural understandings - Ltd new governance experimentation 		
Biofuels	Low	<p>Weak alignment</p> <ul style="list-style-type: none"> - Potential alignment between biofuels and automobility - Questions of process/source of biofuel generation - UK biofuel policy strongly shaped by shifting wider discourse, pressure from NGOs & Euro legislation 	Weak	A (with some B)
Hydrogen Fuel Cell Vehicles	Low	<ul style="list-style-type: none"> - Fairly significant alignment - fundamental need for new fuel infra - Socio-cognitive alignment - though H2 safety issues - Large-scale infra requires coordinated policy & governance 	Weak	B (and A)
Urban Cycling/Sharing	Very Low	Not intended to align with automobility regime but to provide an alternative to short car and public transport journeys	Moderate	B
Compact Cities	Very Low	<p>Involves fundamental reconfiguration of a city through designing in public transport and designing out car use</p> <ul style="list-style-type: none"> - This has been limited in the UK 	Weak	B

The report also assesses regime trends in the land-based passenger transport system in the UK: Lock-in and stabilising forces; cracks, tensions and problems in the regime; and what this tells us about the orientation towards environmental problems of the regime and the main socio-technical problems the regime faces in this respect (see Table 2).

Table 2: Assessment of regime trends in the mobility domain in the UK

	Lock-in, stabilizing forces	Cracks, tensions, problems in regime	Orientation towards environmental problems	Main socio-technical regime problems
UK auto-mobility regime	Strong	Weak/moderate	Moderate (some incremental change)	Dominance of regime actors - industry and policy Sunk investments Cultural dominance of automobility
UK railway regime	Moderate	Moderate	Limited change	Deeply fragmented rail system Network capacity limits Costs to tax payers and customers
UK bus regime	Moderate	Weak	Slow, incremental change	Fragmented system with no point of control Disproportionate use by the poor, elderly and disadvantaged
UK cycling regime	Weak/moderate	Weak	Incremental but very limited contribution to overall emissions	Unclear whether there is a cycling 'regime' in the UK Cycling remains marginal. Realisation of cycling infrastructure has been limited.

The report suggests that the eight green niche-innovations assessed are *not* about to break through more widely. It provides an assessment of dominant regime trends for land-based passenger mobility in the UK. There is either moderate incremental, slow incremental or limited change in these regimes individually.

Integrating niche and regime analyses, the report suggests that in the land-based passenger mobility domain in the UK, there is a slow and spatially selective reconfiguration rather than a transition beginning to unfold. Such change as it is happening in the UK mobility sector is coming not from privileging green niche innovations but through *multiple* processes that primarily involve dominant regime interests. These are: (a) incremental change within transport regimes, (b) some substitutional changes between niches and regimes, (c) limited change in relationships between transport regimes, and (d) some change to transport regimes from symbiosis with non-transport regimes. Change can be understood as a process that includes gradual, incremental and spatially uneven change producing slow reconfiguration.

The main reason for this is the ongoing dominance of a neoliberal discourse in relation to land-based mobility and a lack of political will amongst dominant regime actors for radical transformation. Many niches have limited internal momentum in the UK. Furthermore, the regime and sub-regimes of the land-based passenger mobility system in the UK are still, generally, locked-in rather than exhibiting significant cracks and tensions. As such, a transition to sustainable mobility is not imminent. Changes in the overall land-based passenger transport system prioritise efficiency and incremental change in existing regimes and systems rather than radical change within and between regimes. While the scale of the required change is significant, existing regime interests often act as a ‘brake’ on more radical reconfiguration.

1. Introduction

This report presents an assessment of the feasibility of different mobility transition pathways in the UK. It provides an *interpretive* assessment of the feasibility (practicality, achievability) of sustainability transitions *in the present* in the mobility domain in the UK. This being the case, the key focus of the assessment is whether a transition is beginning to unfold in the mobility domain in the UK.

The report draws on significant empirical material assessing recent developments in green mobility niches and in regime (in)stability in the land-based passenger transport system in the UK. Data in this report is drawn from two previous reports that were compiled from a mixture of primary and secondary sources, and which were fully referenced in these reports (Hodson et al, 2014; Hodson et al, 2015). The findings from these reports form the basis for an interpretative assessment of the feasibility of mobility transitions in the UK by asking the question:

- Do analyses of recent developments in green mobility niche-innovations and regime (in)stability in the UK suggest that a transition is beginning to take place and, if so, does this look like substitution or reconfiguration?

The report suggests that the green niche-innovations assessed are *not* about to break through more widely. Many niches have limited internal momentum in the UK. It provides an assessment of dominant system/regime trends for land-based passenger mobility in the UK suggesting the regime and sub-regimes of the system in the UK are still, generally, locked-in rather than exhibiting significant cracks and tensions.

The report highlights that in the land-based passenger mobility domain in the UK, rather than a transition beginning to unfold there is a slow and spatially selective reconfiguration of the mobility domain. This is happening not from privileging green niche innovations but through multiple processes that primarily involve dominant regime interests. These multiple processes are: (a) incremental change within transport regimes, (b) substitutional changes between niches and regimes, (c) limited change in relationships between transport regimes, and (d) some change to transport regimes from symbiosis with non-transport regimes. These multiple processes constitute gradual, incremental and spatially selective change that produces slow reconfiguration.

The main reason for this is the ongoing dominance of a neoliberal discourse in relation to land-based mobility in the UK, a lack of political will amongst dominant regime actors for transformation and a political will for continuity.

The structure of the report is as follows: Section 2 assesses the breakthrough feasibility of eight green mobility niche-innovations in the UK. Section 3 assesses regime reorientation in the land-based passenger transport system in the UK, focusing on the automobile, rail, bus and cycling regimes. Section 4 presents conclusions and a wider discussion.

2. Assessment of breakthrough feasibility of various niche-innovations

This section summarises the internal momentum of eight green mobility niches in the UK context and describes the different elements of internal momentum. These niches, the rationale for selecting them and a detailed assessment of their momentum were set out in report D2.1 (Hodson et al, 2014). Each of these niches can be understood as aiming to contribute to either a form of technological substitution in an incumbent regime (Pathway A) or a broader regime transformation (Pathway B). In this section the alignment of each of these niches with regime and landscape developments is summarised and an assessment of breakthrough feasibility is made. A summary of this can be found in Table 3.

2.1 (plug-in) Hybrid Electric Vehicles

For Hybrid Electric Vehicles there has been ongoing growth in the numbers licensed since the early 2000s and momentum in the UK. The automotive industry is the main actor. In the UK, governance is a response rather than agenda-setting. The aim is to attract the production of new models to safeguard economic activity, to address carbon emissions reduction and to use tax and fiscal measures to stimulate uptake. (P-)HEVs can be used in similar ways to conventional ICE vehicles and therefore require little reconfiguration of infrastructure or user practices. For use in plug-in mode there is an emergent plug-in infrastructure in the UK, where some changes in user practices are needed. Momentum has been moderate generally. Specifically, there is:

- Moderate momentum for market trajectory of (P-)HEVs
- Moderate socio-cognitive momentum
- Moderate governance and policy momentum

Alignment with regime and landscape developments

There is high potential alignment on the techno-economic dimension between (P-)HEVs and the incumbent automobility regime. That said, in plug-in mode there is the need for new plug-in infrastructure and the costs of vehicles remain higher than comparator ICE vehicles, much of this due to battery costs.

(P-)HEVs have high potential alignment with the existing automobility regime. This is the case both in terms of dominant regime actors being centrally involved in the development of P-HEVs and also in users of P-HEVs being similarly conceived of as users of conventional vehicles.

(P-)HEVs are promoted by dominant regime interests and, in governance terms, show a strong alignment with the automobility regime.

Feasibility of breakthrough

(P-)HEVs enjoy moderate momentum in the UK. Though the potential of (P-)HEVs to align with the automobility regime is high, momentum is moderate and, therefore, the breakthrough potential is moderate to high.

2.2 Battery Electric Vehicles

With Battery Electric Vehicles there has been a new cycle of hype in the UK since 2005. Social, organisational and technological networks are being developed. Yet, BEVs remain a highly marginal part of UK mobility. In the production and use of BEVs there are many

similarities with ICE. There are also numerous differences including an emerging, policy-driven plug-in infrastructure and new production and R&D facilities in the North-east of England. There is a key role for incumbent actors. The main inhibitors to greater momentum are issues of vehicle range and costs. UK policy on BEVs aims to address decarbonisation and economic development. Momentum is moderate generally and specifically there is:

- Low momentum in terms of market trajectory
- Moderate socio-cognitive momentum
- Moderate governance and policy momentum

Alignment with regime and landscape developments

There is moderate potential alignment on the techno-economic dimension between BEVs and the incumbent automobility regime, where BEVs can be understood as contributing to a ‘greening’ of automobility. There is the need for new plug-in infrastructure and costs of BEVs remain significantly higher than ICE comparators.

There is a central role for dominant automobile regime actors in BEVs in the UK but where electricity generators and distributors remain outside of the niche. This lack of integration is a fundamental challenge to building socio-cognitive alignment between BEVs and the automobility regime.

There is policy promotion of BEVs but governance is subject to experimentation where the required range of actors are weakly to moderately aligned with the existing regime.

Feasibility of breakthrough

Feasibility of breakthrough for BEVs is weak to moderate based on the assessment of alignment across the three dimensions above.

2.3 Inter-Modal Ticketing

Inter-modal Ticketing (Smart Cards) has seen long-term growth in London and limited development elsewhere in the UK. The challenge of building an interoperable smart card specification was underestimated. The policy narrative is of the ‘inevitability’ of smart cards but this has met the reality of the need for new business processes and commercial agreements. Smart cards aim to integrate sub-regimes of public transport systems; this involves both existing interests and new interests in configuring new business processes and user patterns. Momentum is low, with the exception of London where it is high. Specifically:

- Momentum of market trajectory is high in London and low elsewhere
- Socio-cognitive momentum is low to moderate
- Governance and policy momentum is low to moderate

Alignment with regime and landscape developments

It is unclear which regime inter-modal ticketing might be seen to align with as it seeks to work between and integrate rail, bus, cycling and walking regimes, with the aim of promoting more efficient public transport and providing an attractive alternative to private car use.

So, there is low alignment with the automobility regime but high potential alignment of multiple other regimes.

This involves trying to align existing rail, bus and cycling regimes with new business processes and user practices. There has been a breakthrough in aligning these regimes and this niche in London but weak alignment elsewhere.

There is policy promotion of inter-modal ticketing but, outside of London, the alignment of interests in effective forms of governance is weak.

Feasibility of breakthrough

Inter-modal ticketing enjoys high momentum in London and low momentum elsewhere in the UK. The success of London highlights that breakthrough is possible and the weak momentum elsewhere suggests that there is currently a moderate potential for breakthrough.

2.4 Car-Sharing/Clubs

Car-sharing/Clubs experienced ‘haphazard’ development from 2000, with rapid growth in membership from 2007 (geographically concentrated in London). Car clubs remain highly marginal. The sector has undergone and continues to undergo rapid change. Local authorities are key actors whose role is subject to experimentation. This requires significant reconfiguration in conceptions of users, business models, tracking, monitoring and payment infrastructure and a mix of new and incumbent actors. Momentum is generally low but moderate in London.

- Momentum of market trajectory is moderate in London and low elsewhere.
- On the socio-cognitive dimension there is low to moderate momentum.
- Governance and policy momentum is low.

Alignment with regime and landscape developments

There is low to moderate alignment between car-sharing and the automobility regime.

On a technical dimension car-sharing aligns with the incumbent automobility regime in many ways, in particular through the use of ICE and alternative drivetrain cars and also existing road and fueling infrastructure. The operation of car-sharing does, though, rely on configuring new ICT booking, payments and monitoring systems around the vehicle.

Car-sharing is predicated on a significant re-alignment of socio-cognitive understandings of car use from private ownership and use to access. There is limited evidence of this re-alignment in practice.

There is need for significant reconfiguration in conceptions of users, business model, tracking, monitoring and payment infrastructure and a mix of new and incumbent actors. This requires new forms of governance. There is some experimentation with this but, overall, this is limited and suggests limited actual alignment between the existing regime and car-sharing.

Feasibility of breakthrough

The feasibility of breakthrough for car-sharing in the UK is low to moderate, but with specific breakthroughs more likely in large urban centres, particularly London.

2.5 Biofuels

There has been a shift from optimism around 2003 that biofuels could provide a viable (if partial) substitute for UK liquid transport fuels to a flat-lining of supply towards the end of the decade. Biofuels are currently more expensive than fossil fuels. It is difficult to characterise a UK-specific trajectory of biofuel technology development. The UK governance style at present appears unlikely to provide the required push to reach targets set at the European level. Biofuels can be viewed as substitute for liquid transport fuels, though a wider framing sees the reconfiguration of land-use systems from production for food to production for fuel. Momentum is low. This can be understood in terms of:

- Market trajectory momentum is low to moderate
- Socio-cognitive momentum is low
- Governance and policy momentum is low

Alignment with regime and landscape developments

Questions of alignment or lack of it cover multiple regimes (automobility, food, land-use). On a techno-economic dimension there is potential alignment between biofuels and the incumbent automobility regime. Biofuels become aligned through a ‘greening’ of automobility discourse. Yet, after earlier optimism that biofuels could provide a viable (if partial) substitute for UK liquid transport fuels, supply has flat-lined. Levels are low within the European context and even lower compared to Brazil and the USA.

Socio-cognitively, the use of biofuels has strong alignment with existing automobility practices and use. Questions remain in terms of the process and source of biofuel generation. The search for advanced biofuels has been spurred by emerging evidence concerning greenhouse gas emissions from biofuels and the effects of energy and food crops competing for land.

UK biofuel policy has been strongly shaped by the shifting wider discourse, high pressure from NGOs and by European legislation. The overall governance orientation for biofuels can be summarised from the early 2000s as a shift from gentle economic incentivising, to strongly interventionist, to the current situation of pulling back and finding ways to circumvent the previously strong commitments. There is weak alignment with the automobility regime.

Feasibility of breakthrough

Current momentum is low and there are weak chances of a breakthrough. Though there is potential for alignment between biofuels and existing automobility practices, there remains weak alignment in relation to legitimacy issues and in between the variety of interests that need to be aligned in the governance domain.

2.6 Hydrogen Fuel Cell Vehicles

Hydrogen Fuel Cell Vehicles were the subject of much hype from the late 1990s, that stalled around 2005 in the face of technical and cost difficulties and the ‘re-emergence’ of BEVs. Since 2012 there have been the beginnings of a much more modest momentum in the UK. In order to be able to support hydrogen fuel cell vehicles, the existing road infrastructure and

some manufacturing capacity can be used. A new hydrogen production, distribution, storage and fuelling infrastructure needs to be configured around the vehicle - elements of which have been the subject of demonstrations in the UK. Momentum is low. Specifically:

- Market trajectory momentum is low
- Socio-cognitive momentum is low to moderate
- Governance and policy momentum is low

Alignment with regime and landscape developments

There is a fairly significant alignment between HFCVs and the existing automobility regime although a fundamental issue is also the need for configuring a new fueling production, transportation, distribution and storage infrastructures.

In socio-cognitive terms, there is significant alignment between HFCVs and the existing automobile regime. That said, there are issues related to the safety and perceived safety of the use of hydrogen.

Policy and governance promoted HFCVs in the early 2000s. This has waned. In the absence of a large-scale development of hydrogen infrastructure, which would require coordinated policy and the development of governance capability, the role of policy and governance has been in the promotion of demonstrations and place-based initiatives. Thus there is weak alignment with the automobility regime.

Feasibility of breakthrough

Momentum for HFCVs is very low and chances of a breakthrough remain low in the short-to-medium term.

2.7 Urban Cycling/Sharing

The UK's largest Urban Cycling/Sharing scheme commenced operation in 2010. There have been limited responses in the rest of the UK. Other interventions alongside bike-sharing may be important in reducing congestion, such as congestion charging. An effective public transport system and governance capacity may be a pre-requisite. Reconfiguration of many elements around the bicycle - requires a new conception of users, new business models, new actors, tracking, monitoring and payments technologies and the strategic development of infrastructure. Momentum is very low, except in London where it is moderate to high. This can be understood as:

- Market trajectory momentum is very low, except in London where it is moderate to high
- Socio-cognitive momentum is low outside of London
- Governance and policy momentum is very low

Alignment with regime and landscape developments

Urban cycle share schemes are intended to provide an alternative to short car and public transport journeys. In doing this they are not intended to align with the automobility regime but to provide an alternative to it. Though there has been significant growth in the numbers of bicycle-sharing schemes the only 'large' scheme in the UK is in Greater London.

On the techno-economic dimension bicycles are configured with GPS capability and other tracking mechanisms, locking technologies, sometimes smartcard payment systems and the location of docking stations at rail and bus stations and other public sites. These configurations are intended to create an alternative to automobility rather than an alignment with it.

Feasibility of breakthrough

Feasibility of breakthrough is moderate. There is nothing in principle stopping the development of bike-sharing schemes. Bike-sharing developments in other parts of the UK aside from Greater London have been rather limited. Greater London has a privileged relationship with national government. It has a large and relatively well integrated public transport system and has political institutions which allow strategic development and relatively greater resources to achieve these than other areas of the UK.

2.8 Compact Cities

The idea of a compact city has been promoted by national and sub-national policymakers and architects. There are many contemporary visions of new and ‘retrofitted’ cities which have seen limited realisation; the most well-developed is in London. In other cities in the UK this is much more piecemeal. This is not surprising given weaker governance powers and capabilities relative to London and less well-developed public transport systems. Momentum is very low. Specifically:

- Market trajectory momentum is very low
- Socio-cognitive momentum is very low
- Governance and policy momentum is low to moderate

Alignment with regime and landscape developments

The compact city involves a fundamental reconfiguration of a city through designing *in* public transport and designing *out* car use. In its ideal forms, it is intended to minimise the automobility regime through configuring multiple public transport regimes together in an integrated way. In the UK, the extent to which this has happened has been limited, with the exception of London where integrated public transport, inter-modal ticketing and congestion charging have all been promoted. The automobility regime at the UK level remains dominant.

Feasibility of breakthrough

Despite there being some policy momentum overall momentum is low and, without purposive political intervention, there is weak to moderate feasibility of a breakthrough.

2.9 Analysis of niche-innovation breakthrough potential

In this section, we provide an overview assessment of the potential for breakthrough for each niche-innovation, based on the internal momentum of the niche and its relationship to the regime, set out above.

Table 3: Breakthrough analysis of niche-innovations in the mobility domain in the UK

Niche-innovation	Internal momentum	Strong or weak alignment with broader regime characteristics and developments	Likelihood of imminent breakthrough (and/or future potential)	Pathway A or B (or mixed)

(Plug-in) Hybrid Electric Vehicles	Moderate	High potential alignment, but: <ul style="list-style-type: none"> - Needs plug-in infra - High battery costs - Hedging by dominant regime interests 	Moderate to high	A
Battery Electric Vehicles	Moderate	Weak to moderate alignment: <ul style="list-style-type: none"> - 'Greening' of automobility - Needs plug-in infra - Higher costs than ICE comparators - Absent electricity regime actors - Policy promotion but governance experimentation 	Weak to moderate	A (with some B)
Inter-Modal Ticketing	Low	Unclear which regime might align with <ul style="list-style-type: none"> - Promotes public transport v private car use - Low alignment with automobility regime - Breakthrough in London but weak alignment elsewhere 	Weak to moderate	B
Car-Sharing Clubs	Low	Weak to moderate alignment <ul style="list-style-type: none"> - Aligns but also needs ICT systems - Ltd evidence of significant re-alignment of cultural understandings - Ltd new governance experimentation 	Weak to moderate	B
Biofuels	Low	Weak alignment <ul style="list-style-type: none"> - Potential alignment between biofuels and automobility - Questions of process/source of biofuel generation - UK biofuel policy strongly shaped by shifting wider discourse, pressure 	Weak	A (with some B)

		from NGOs & Euro legislation		
Hydrogen Fuel Cell Vehicles	Low	<ul style="list-style-type: none"> - Fairly significant alignment - fundamental need for new fuel infra - Socio-cognitive alignment - though H2 safety issues - Large-scale infra requires coordinated policy & governance 	Weak	B (and A)
Urban Cycling/Sharing	Very Low	Not intended to align with automobility regime but to provide an alternative to short car and public transport journeys	Moderate	B
Compact Cities	Very Low	Involves fundamental reconfiguration of a city through designing in public transport and designing out car use <ul style="list-style-type: none"> - This has been limited in the UK 	Weak	B

Generally, these niches have limited (if spatially variable) momentum. There is moderate momentum in relation to (Plug-in-)Hybrid Electric Vehicles and Battery Electric Vehicles and low or very low momentum among the other six niches.. Many of the eight niches involve some substitution and also some reconfiguration of a wider regime. That each niche is attributable to a single pathway is thus not clear cut. With understanding of how these niches might align with regimes, none of these niches suggests that it is about to breakthrough more widely at a general UK level.

The two niches with most momentum (HEVs and BEVs) promote continuity with motoring. With the possible exception of biofuels and HFCVs, the other six niches can all be understood as involving often complicated reconfiguration of regimes. These niches generally involve taking a well-established artefact (a car, a bike, a plastic card) and configuring this anew. Car-sharing, for example, involves a car, new forms of service delivery, a shift from ownership to access, new business models, assembling networks of commercial operators, local authorities, employers, new conceptions of users, and mobilising ICT with various reservation and accounting systems and on-board computers for tracking and billing journeys. Similar accounts can be developed for bike sharing. In HFCVs, the car as an artefact is the centre of a configuration of gas production, distribution, storage and use, and links industrial gas regimes and automobility regimes. Inter-modal ticketing is a niche between multiple regimes (Parkhurst et al, 2012) that configures a credit card-sized piece of

plastic with new patterns of use, with ICT monitoring technology and standards. The compact city is a site where many of these regimes and niches are conjointly reconfigured.

It is often not clear which regime's reconfiguration niches contribute to. Is bike-sharing an extension to the rail regime or bus regime, if a focus is taken on the 'last mile' issue? Does it strengthen or alter the cycling regime? There is a blurring of the boundaries of both niches and regimes. The distinct nature of them becomes more permeable. There is also a question about whether some of the eight should be seen as niches; where rather than aiming to overthrow the regime they may offer a defence of the dominant regime rather than potential challenges to it. This may be the case, for example, for HEVs and BEVs. Furthermore, a niche - such as inter-modal ticketing - is not a challenge to a regime and system but an add-on to it in attempts to solve problems (Parkhurst et al, 2012). Yet, not only are these niches being mobilised by regime actors to defend regimes but in doing so they do provide some challenge to the regime, not in the sense of replacing it but in forcing it to change through symbiotic relationships with complicated multiplicities of other regimes and niches. Perhaps the issue here is that the notion of 'breakthrough' and 'radical overthrow' are themselves problematic and that we need a much more nuanced, multi-pathway understanding of change where we address pathways through the relationship of *multiple* regimes and niches and their complex configurations in pursuing sustainable mobility in particular places.

3. Assessment of regime reorientation

In this section we assess the dominant regime trends in the land-based passenger transport system in the UK. This means summarising the automobility, rail, bus and cycling regimes in the UK. We highlight the lock-in and stabilising forces and the cracks, tensions and problems for each regime, their orientation towards environmental problems and the main socio-technical regime problems. We do this to assess the extent to which regime actors are contributing to Business as Usual or incremental change. A summary can be found in Table 4.

Automobility

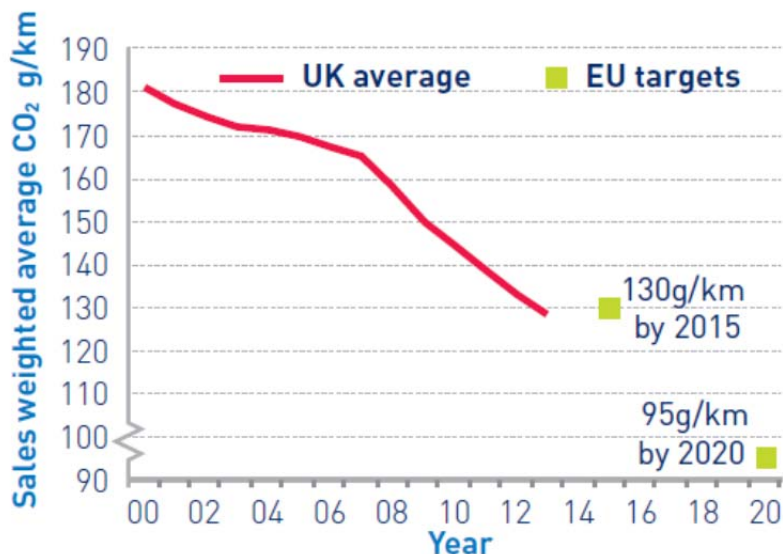
Overall, the automobility regime remains fairly strongly locked-in (although perhaps less so than 20 years ago) with weak to moderate cracks and tensions. Lock-in remains strong in the automobile industry with its sunk investments in machines, people, factories and knowledge, and its continued commitment to the internal combustion engine (ICE). There are some weak cracks and tensions that include cut throat competition, recovering levels of post-financial crisis sales, awareness of the long-term pressures of climate change and peak oil and the development of radical alternatives to the ICE, but as a hedging strategy not as a full reorientation strategy. The car remains strongly embedded in lifestyles and mobility patterns. There are weak to moderate cracks and tensions that include depressed car sales after the crisis, with some recent signs of picking up; some dissatisfaction about fuel prices, congestion and parking problems; and the emergence of debates around ‘peak car’ and possibilities of less desire for cars amongst younger people (Kuhnimhof et al, 2013; Goodwin and Van Dender, 2013). Policy is supportive of cars, although less so than 20 years ago. There is some climate change pressure from EU policymakers (CO2 regulations are not yet technology-forcing, but could get stronger), limited climate change pressure from national policymakers (no targets, regulations, etc.), but support for green technology development/deployment and some pressure from local policymakers, who introduce some car-restraining measures and stimulate alternatives (bus, cycling).

In public opinion and debate, many positive cultural associations with cars remain (freedom, individuality, excitement, success, power) and there are powerful pro-car lobby groups. There are weak cracks and tensions with the long-standing presence of an anti-car discourse. There is a moderate role in stabilising the automobile regime for - often industry-linked - pro-car lobby groups and where road and car safety groups contribute to incremental improvements in automobility. There are weak cracks and tensions that NGOs and social movements can create and exploit. Anti-roads protesters had success in curtailing road-building programmes in the 1990s. This was arguably weakened by fuel protests in the 2000s and the announcement of a new road building programme in 2013.

Orientation towards environmental problems: Automobile firms believe that the ICE still has substantial technical development potential for incremental improvement in green directions. CO2 emissions have fallen annually in new vehicles since the late 1990s and there has been a 30% fuel efficiency improvement in new petrol vehicles 2000-2013 (Department for Transport, 2014) (see Figure 1).

Figure 1: UK new car CO2 emissions and EU targets

Chart 1 UK new car CO₂ emissions and EU targets



Source: SSMT, 2014

Main socio-technical regime problems: The sunk investments, dominant regime interests and ongoing cultural dominance of automobility provide a context to understand the focus on incremental change. More radical change would require changes in these fundamental and deep rooted issues.

Rail

Alternatives to the automobility regime in the UK remain marginal. Overall, both lock-in and cracks and tensions in the rail regime are moderate. There is no great challenge to the privatised rail system. It is expensive, congested but also heavily used by passengers. The UK train system has been privatised and fragmented since 1994. Infrastructure, train operations and rolling stock separated into multiple units with no system controller. There are also moderate cracks and tensions with political rows since 2011 over whether the state should prioritise the last remaining UK train manufacturer in awarding contracts, with mixed results.

The long-term decline in rail use in the UK has been reversed in the last two decades with an approximate doubling of passenger KMs travelled but where rail's contribution to overall transport share remains small. Yet, post-privatisation (between 1997 and 2014) fares increased on average by 102%, a 23% increase in real terms. The majority (62%) of all rail journeys started or ended in London with implications for system investment (Rail Trends Great Britain, 2013/14); and capacity is a serious issue (including sharing of lines between local /inter-city trains). Numerous government reviews have not fundamentally rejected the post-privatisation organisation of the railway system (See Eddington Review (2006); McNulty review (2011), Brown review (2013), House of Commons Transport Committee (2013)). There are also moderate cracks and tensions in the role of policy in the regime, where though passenger numbers have increased, public subsidy has risen sharply, counter to

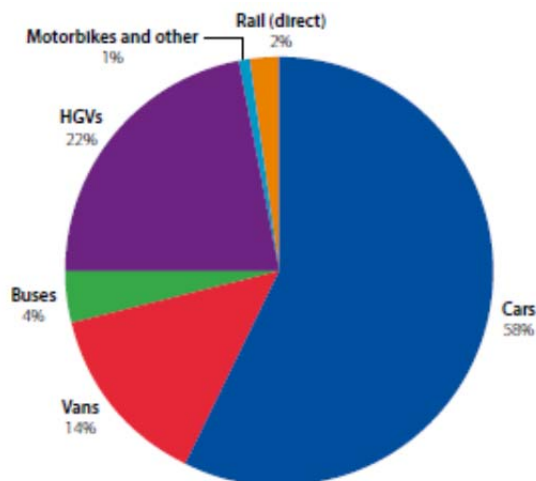
a key objective of privatisation (Office of Rail Regulation)¹; assessments of privatisation as policy response suggest a mixed record of success; and policy is selectively prioritising parts of the rail system, primarily into and through London.

Public debate and opinion acts as a moderate lock-in force in stabilising the regime through representations of significant increases in post-privatisation rail use. This meets moderate to strong cracks and tensions where there are increasing debates about the cost of rail to the public purse and passengers; the growth of rail use has emphasised capacity and congestion issues; the development of high-speed lines and their costs, a focus on London and the local effects of new lines has become and is likely to increase as an issue. There is some debate about whether rail should be in private or public hands. Pressure from social movements and NGOs has been moderate in stabilising the regime. A mix of insider and outsider groups exist to champion passengers, to campaign on fares and to oppose privatisation.

Orientation towards environmental problems: Rail accounted for around 8% of land-based passenger KMs in the UK in 2012. Relative to other modes of surface transport, carbon emissions directly attributable to rail accounted for around 2% of emissions in 2011 (see Figure 2). This was up on the previous year by 4.6% largely due to passenger km increasing by 5.3%. Furthermore, indirect emissions from transport, primarily through electricity use from rail, rose by 5% over the same period (Committee on Climate Change, 2013a). This suggests that the contribution of rail to carbon emissions is relatively small, but stable. A programme of rail electrification raises challenges for how this electricity will be generated and how more integrated relationships between rail and electricity regimes will take place.

Main socio-technical regime problems: The main regime problems relate to the deeply fragmented nature of the rail system, post-privatisation, capacity limits on the rail network, where passenger numbers have more than doubled in the two decades since privatisation, and the costs to the tax payer and customers of the rail system have risen.

Figure 2: Breakdown of surface transport CO2 emissions by mode in 2012



Source: Committee on Climate Change, 2014, p.246

¹ Government support to the rail industry - Table 1.6, 1985-86 to 2013-14 Great Britain (£ million) at <https://dataportal.orr.gov.uk/displayreport/report/html/0913a84d-b740-4111-b6f8-bf6470e2d7b7> [accessed 15/01/2015]

Bus

Overall, there is moderate lock-in in the bus regime. The organisation of the bus system remains shaped by the privatisation and deregulation of the 1980s, but there have been incremental changes in ownership of operators since then and a period of relative stabilisation of operating companies, passenger numbers and fleets. There is a complicated landscape of bus operators across the UK, with local variety. Three operators - through mergers - together account for almost half of market share (DfT Statistics, BUS1001b). There are nine bus and coach manufacturers in the UK and the number of buses/coaches in Britain has stayed reasonably steady over the decade to 2014 at around 52,000 vehicles (DfT Statistics, BUS0601). There are weak cracks and tensions with a relatively settled operator landscape after a series of mergers in the 1990s (Cowie, 2002; Langridge and Sealey, 2000) but with incremental moves to bring more control over the bus operating companies through local authorities.

Bus use remains significant at around 30 billion passenger KM a year and remains used for a wide range of purposes from commuting, to shopping, education and leisure activities (Department for Transport, 2014). There are weak to moderate cracks and tensions. Bus use has been in long-term decline outside of London but this has levelled off. There is though geographical variation to bus use with London seeing significant growth in passengers but rural areas showing significant reductions (National Travel Survey: 2013 England). Buses are disproportionately used by the poor, the young and elderly and bus fares have increased faster than inflation. Deregulation and privatisation since 1985 have shifted ownership and operation of the buses from public to private bodies and enshrined the general principles of competition law in the operation of the bus system (White, 2010). There are weak to moderate cracks in relation to policy where the tension between competition law and a greater role for local policymakers in the governance of the bus system has incrementally increased in the 2000s (White, 2010).

Public debate and opinion creates moderate pressures for lock-in where the overarching narrative of the bus system in the UK remains wedded to the effects of deregulation, almost three decades on. There are weak cracks and tensions, including that bus use suffers some negative perceptions that can be traced to the binary debate of the 1980s between the desirability of automobile ownership and use and the perceived personal economic 'failures' associated with bus use. Pressure from social movements and NGOs in either stabilising the regime or creating cracks and tensions is weak.

Orientation towards environmental problems: CO₂ emissions from buses accounted for 4% of surface transport emissions in 2011 (see Figure 2). As a category, public transport emissions decreased in 2011 and the fall in bus emissions - estimated at a 7.1% decrease from 2010 - more than offset a rise in emissions from rail (Committee on Climate Change, 2013a). The assumption of those advising national government is that progress to decarbonisation of buses assumes that 50% of new buses are hydrogen fuelled by 2030 (Committee on Climate Change, 2013b). So, there is some incremental decrease in emissions but this is within a context of buses contributing a small amount to overall CO₂ emissions and where radical decarbonisation of buses is predicated on half of the bus fleet operating as HFCVs in less than 15 years' time.

Main socio-technical regime problems: The main problems of the bus regime relate to its fragmentation largely as a result of deregulation and privatisation since 1985 which shifted ownership and operation of the buses from public to private bodies. This enshrined the general principles of competition law in the operation of the bus system. Buses are disproportionately used by the poor, the young and elderly and bus fares have increased faster than inflation. Furthermore, significant usage by pensioners is through concessionary travel which may come under threat in times of austerity.

Cycling

Whether we can talk of a cycling regime as such is questionable. Overall, 'regime' lock-in remains weak to moderate. Cycling remains marginal in a UK context, despite small increases in distance travelled by cycling in recent years. The vast majority of bicycles bought in the UK are manufactured outside of the UK and bicycle manufacture has become specialised and niche. There has been the growth of a wider cycling industry of associated products (clothing, accessories) (Grous, 2011). Cracks and tensions create moderate regime pressures. The UK has no mass producer of cycles and though there has been a growing cycling economy there is a view that this growth may have peaked.

The long-term trend of cycle usage in Britain is one of decline since the Second World War, but with an increase in cycling KM of around 20% between 1998 and 2013 (CTC Cycling Statistics). Cycling is seen as an 'abnormal' activity in the UK (Pooley et al, 2011) and low by comparative EU standards (ECF, 2011). There are some weak to moderate pressures including that there is a poor understanding of the cultural dimensions of cycling and hence limited congruence between cycling and some practices, such as travelling to school for example. There are also huge variations in use by age and gender and notably by geography (Department for Transport, 2014; DfT Statistics Table CW0111). There was no real national cycling policy prior to the 1990s. A National cycling strategy in 1996 placed a renewed policy emphasis on cycling but subsequent targets to triple cycling trips in a decade failed (Aldred and Jungnickel, 2014). There are weak cracks and tensions in relation to policy and its role in the regime where cycling policy emerged in a neo-liberal state that means capacity is outsourced and fragmented and policy is difficult to realise locally (Aldred, 2012).

Views that people hold of cycling are often ambiguous, sometimes contradictory and cycling remains a marginal activity (Pooley et al, 2013). There are weak to moderate cracks and tensions. There is significant geographical variety in use with Greater London, for example, seeing relatively large growth since 2000. There is a moderate role for social movements and NGOs in contributing to regime lock-in with a variety of NGOs working to promote different elements of a cycling agenda but with ad hoc connections between them. There are weak to moderate cracks and tensions where cycling at local authority level requires a statutory response but there is limited in-house capacity.

Orientation towards environmental problems: It has been claimed that, although it does not represent a carbon free mode of transportation, the bicycle's greenhouse gas emissions are more than 10 times lower than those attributed to 'individual motorized transport' (ECF, 2011). The same report suggested that if cycling levels across the EU were equivalent to those of Denmark that this would contribute between 12% and 26% of the EU's 2050 greenhouse gas emissions target reductions for transport (ECF, 2011). As a contributor to emissions reduction in the UK this raises questions about the current role of cycling where the average person cycles almost 600 miles in Denmark annually, around 120 miles at the

level of EU average per person per year and only 46 miles in Britain². This suggests that the role of cycling in contributing to CO emissions reduction in the UK is marginal. That said, though cycle use in the UK is low by comparative EU standards, the distance that those cycling travel is up 20% between 1998 and 2013 from 4 billion km to 5.1 billion km (CTC Cycling Statistics) and thus there is incremental, if limited, contribution to CO2 emissions reduction.

Main socio-technical regime problems: It is unclear whether there is a cycling ‘regime’ in the UK. Cycling remains marginal in a UK context, despite small increases in distance travelled by cycling in recent years. The realisation of cycling infrastructure has been limited and cycling is still seen as an ‘abnormal’ activity.

3.1 Integrating niche analysis and regime orientation: limited or incremental changes by regime actors?

In this section, we use the material above to summarise regime trends in the UK and what this tells us about their orientation towards environmental problems and the main socio-technical problems faced (see Table 4) to then assess what an integrated analysis of niche momentum and regime orientation in the land-based passenger mobility system in the UK reveals.

Table 4: Assessment of regime trends in the mobility domain in the UK

	Lock-in, stabilizing forces	Cracks, tensions, problems in regime	Orientation towards environmental problems	Main socio-technical regime problems
UK auto-mobility regime	Strong	Weak/moderate	Moderate (some incremental change)	Dominance of regime actors - industry and policy Sunk investments Cultural dominance of automobility
UK railway regime	Moderate	Moderate	Limited change	Deeply fragmented rail system Network capacity limits Costs to tax payers and customers
UK bus	Moderate	Weak	Slow, incremental	Fragmented system with no

² <https://www.eta.co.uk/2011/12/13/co2-emissions-from-cycling-revealed/> [accessed 09/02/2015]

regime			change	point of control
				Disproportionate use by the poor, elderly and disadvantaged
UK cycling regime	Weak/moderate	Weak	Incremental but very limited contribution to overall emissions	Unclear whether there is a cycling 'regime' in the UK Cycling remains marginal. Realisation of cycling infrastructure has been limited.

There is strong stability in the land-based passenger transport system in the UK. Although it faces several problems, automobility as a mode of travel is still dominant and stable, although less so than twenty years ago. Alternative modes to automobility in the UK remain marginal. This is the case even with rail, where passenger journeys have more than doubled since 1994/5, where rail passenger miles have increased 51% since 2001, but which still accounted for only around 3% mode share of surface transport trips in 2013 and just over 8% of 'total inland passenger km' in 2012 (DfT Statistics, TSGB0601; Transport Statistics Great Britain 2014)³. Similarly, passenger kilometres and trips by bus remain marginal relative to automobility, as part of a long-term trend of decline that has levelled off and in some cases begun to reverse over the last decade. Cycling, likewise, remains marginal in a UK context, despite small increases in distance travelled by cycling in recent years. Rather than radical reconfiguration or transition, the land-based passenger transport system is being slowly and spatially selectively reconfigured. This involves the following elements:

Incremental changes within regimes: The overall land-based passenger transport system remains generally stable with a lot of incremental change taking place in individual regimes. In particular, the dominance of the automobility regime remains intact where dominant regime interests have promoted incremental changes in fuel efficiency and carbon emissions reduction through regulatory measures, involving incremental technological improvements requiring little reconfiguration of existing regime or system elements. Alongside incremental change there is some hedging with alternative drivetrain technologies and niches. Likewise, change in the rail and bus regimes has been incremental. There were ideological transitions in the rail and bus regimes in the 1990s and 1980s respectively. The role of dominant regime interests in the rail regime and bus regime has been in maintaining these forms of competitive market-based public transport, but alongside which there are incremental forms of change.

Substitutional change between niches and regimes: There is a wide variety of niche activity with relevance to the land-based passenger transport system. Generally, across a range of niches that include P-HEVs, BEVs, HFCVs, urban bike sharing, car clubs, biofuels and inter-modal ticketing, these niches have gained very little momentum, which has contributed to

³ <http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&plugin=1&pcode=tsdtr210&language=en>
[accessed 12/05/2015]

limited regime change. Where niche activity has gained some momentum, for example in the case of P-HEV, this has involved the strong involvement of dominant regime interests, strategies of hedging, and processes of substitution. In many cases these niches fundamentally suggest relationships with regimes that are based on reconfiguration rather than being based on substitution. This requires the relationship of niche to regime being one of transforming or reconfiguring the regime rather than being niches that conform to it (Smith and Raven, 2012). There is much uncertainty as to how to go about reconfiguring. This requires forms of experimentation in reconfiguration where there is often spatial variation and selectivity in the levels of success with this, with Greater London at the forefront of this kind of activity in the UK.

Limited change in relationships between transport regimes: There has been limited reconfiguration of relationships between transport regimes to facilitate modal shift or reducing trip lengths. This is despite strategies for modal shift and distance reduction in particular requiring these relationships to be radically reconfigured. Inter-modal ticketing, car-sharing and urban bike-sharing schemes in many ways are niches that sit at the interface of multiple transport regimes and can be understood as mediating or bridging niches that aim to reconfigure relationships between transport regimes. Despite this being so, these niches have very low momentum when assessed at an aggregate UK level, though there is geographical variation where many niches have significant momentum in London.

Some change to transport regimes from non-transport regimes: Whether reducing the need is to travel is happening or not is difficult to say with certainty. But the processes through which we think it may happen, through new forms of work organisation and shopping and consumption patterns, are happening incrementally outside of the land-based passenger transport system. This is happening through landscape changes in the world of work and shopping. There are some changes to transport regimes, as part of this, through forms of symbiosis with the ICT regime. The ICT regime is also engaged in numerous forms of symbiosis with transport regimes to develop more 'smart' (often efficient) forms of transport and mobility. In other cases, relationships between the transport regime and regimes outside of the transport regime do not see such symbiosis despite niche efforts to promote such relationships (e.g. automobility and electricity regimes in BEVs and automobility and industrial gas regimes in HFCVs).

4. Conclusions and wider discussion

4.1 Which niches are about to break through (if any)? Does this suggest a transition is imminent or presently unfolding? If not, are regime developments moving in the direction of the sustainability goals?

None of the eight green mobility niches assessed are about to break through. All eight have either moderate, very low, or no momentum at all. There is, though, spatial variation with a number of these niches demonstrating momentum specifically in Greater London.

A transition is not unfolding. What is happening cannot be solely understood as being about business as usual and substitution (Pathway A) or reconfiguration (Pathway B). Rather, this is about multiple processes (between niches and regimes but also within regimes and between transport regimes and between non-transport regimes and transport regimes) that collectively constitute a slow reconfiguration of the land-based passenger transport system.

In terms of sustainability, this slow incremental reconfiguration is based more on principles of efficiency rather than modal shift, dealing with distance reduction or reducing the need to travel. Dominant regime interests are fundamental to this, whether in the automobility, rail or bus regimes. Common across all these regimes is the role of policymakers and political interests and manufacturers (in the automobile regimes) or operating companies (in the rail and bus regimes). These interests often prioritise incrementalism, efficiency and hedging over more radical forms of reconfiguration. Yet, travelling less, promoting modal change and redesigning cities requires more than substitution and promoting efficiency, it requires more radical forms of reconfiguration to address overlap and ‘hybridisation’ between modes of transport, where, for example ‘at the boundaries, defining transport modes is becoming more complex, as different kinds of hybrid modes such as trams-trains, taxi-buses and shared vehicles emerge’ (Parkhurst et al, 2012, p.309). Conventional boundaries of automobile, rail, bus and cycling regimes and systems are symbolically challenged by sustainable mobility, envisaging hybridisation, new regime interrelationships and multiple niches, but there is limited tangible momentum for these niches, as we saw above. Furthermore, there remain significant lock-in mechanisms for each of the regimes and fairly modest cracks and tensions.

That reconfiguration is incremental, spatially selective and based on principles of efficiency is an issue of (a lack of) political will to change the landscape that has shaped transport regimes (through ideologies of competition, liberalisation, individualisation and market-based responses) and which continues to do so. That said, since the early 2000s the neoliberal approach to transport in the UK, while remaining strong, has seen increasing state intervention in the automobility system to re-establish competitiveness in the face of a global economic recession, peak car debates and pressures from climate change. Competition and liberalisation remain the dominant organising principles of the rail and bus regimes but with efforts to build develop more local coordination in rail, bus and cycling systems. This tension between competition and the search for more efficiency on the one hand and intervention and coordination of new elements of these systems on the other hand persists and it is important in understanding slow processes of reconfiguration.

There is a generalisable aggregate representation of processes of slow reconfiguration at the national scale in the UK. Within this, though, there are examples of places where there are attempts to be more radical in promoting elements of sustainable mobility beyond efficiency and elite regime interests. We illustrated how there was momentum around urban bike hire schemes, inter-modal ticketing and car sharing in Greater London that was much greater than

in other places in the UK. There are various other examples of efforts at mobility experiments in London – congestion charging scheme, low emissions zone, policy promotion of it as an electric vehicle capital for Europe - which collectively contribute to more radical efforts to reconfigure mobility there. Other places in the UK, notably Greater Manchester, Oxford and Brighton (Schwanen, 2015) are experimenting with new forms of urban mobility. What is needed is a way of understanding these different processes and how these processes of reconfiguration at city-scale inform wider processes of reconfiguration at a UK level.

4.2 What is the scale of the transition challenge?

Regime changes are slowly moving in the direction of some sustainability goals but not others. There are incremental improvements in carbon emissions reduction and engine efficiency in the automobility regime. There are slow and incremental changes in rail, bus and cycling regimes. These are, though, marginal in terms of contributions to CO2 emissions reductions. So, while changes in the automobility regime may be fundamental to questions of CO2 emissions reduction, rail, bus and cycling are more marginal and can often be understood in relation to wider sustainability goals such as efforts to promote modal shift, less travel or distance reduction.

Increasing Efficiency in Transport Systems

Increasing efficiency in the dominant automobility regime has been through incremental change, through CO2 emissions reduction and improved new car fuel consumption, rather than through regime reconfiguration or niche breakthrough. Overall CO2 emissions from vehicles in the UK have been in decline over the last decade and more, as have emissions per km. Efficiency improvements are primarily enacted through dominant regime interests (automobile producers and EU policy) and regulatory measures, involving incremental technological improvements (lighter chassis, stop-start technology) requiring little reconfiguration of existing regime or system elements.

There have also been hedging strategies where various alternative drivetrain niches - (plug-in) hybrid electric vehicles (P-HEV), battery electric vehicles (BEV) and hydrogen fuel cell vehicles (HFCV) - have been promoted by dominant regime actors (automobile producers and government). Hitherto the market share and momentum of each of these niches is limited in the UK. P-HEVs have a greater market share than BEVs and HFCVs, but in 2011 still only accounted for 1.2% of UK cars sold (Kay et al, 2013). Though we appear to be in a period of renewed enthusiasm, 'BEVs may only provide a niche market over the next 20 years' (Tran et al, 2012, p.332). Even more so, HFCVs remain largely in a demonstration phase where it is 'not possible to extrapolate diffusion patterns on this basis' (Zubaryeva and Thiel, 2013).

There are various niche possibilities, such as BEVs, HFCVs and biofuels which suggest regime change beyond incremental change, a need for reconfiguration within the automobility regime and the building of relationships of symbiosis or integration with other regimes. To take one example, BEVs, there are technological and cost challenges as well as issues with configuring users, developing a network of plug-in infrastructures and, crucially, in building relationships with other regimes, particularly electricity. Uncertainties of levels of diffusion of BEVs, with estimates of future market shares ranging from 20% to 70% between 2030 and 2050, means that potentially between 2GW and 18GW of installed capacity may be required (Tran et al, 2012). There is a need to bring electricity generators and distributors into the emergent BEV niche. But a business model that works between these sectors has yet to be effectively developed; including mechanisms and levels of payments between electricity

suppliers and vehicle operators (Steinhilber et al, 2013). Electric mobility requires a fundamental shift in the supply of energy, local distribution to users and the provision of charging infrastructure networks (Leurent and Windisch, 2011). Yet, neither BEVs nor HFCVs have gained any real momentum in the UK.

Promoting modal shift

In many ways, modal shift is an ongoing incremental process within the automobile, rail, bus and cycling regimes. Cars have incrementally become (by far) the dominant transport mode since the Second World War, accounting for 83% of all distance travelled (including vans and taxis) in 2013. Interestingly, however, car travel seems to have peaked by 2005 and declined since, a development that has given rise to the 'peak car' debate (Kuhnimhof et al, 2013; Goodwin and Van Dender, 2013). It is arguably long-term issues that have led to incremental, rather than radical modal shift in the UK (e.g. the promotion of automobility from the late 1950s onwards, the development of a privatisation agenda for rail in the 1990s, the development of a cycling policy agenda in the 1990s). These have not necessarily been primarily concerned with modal shift and have often been developed from within a regime (e.g. rail and privatisation, buses and deregulation). This has involved either the internal reconfiguration of a regime (rail in the 1990s and buses in the 1980s) or the developmental building of a regime where there previously wasn't one (automobility in the 1950s, cycling in the 1990s) rather than purposive attempts to re-work regime-regime relationships.

There are, though, also more purposive attempts to promote modal shift through niches such as car sharing clubs, urban bike hire schemes and inter-modal ticketing. Since the 1990s the integration of an existing artefact (the car) with various reservation and accounting systems, onboard computers for tracking and billing journeys (Truffer, 2010) have been part of the ongoing development of car clubs. The difference between the conventional automobility paradigm and car clubs is a shift from ownership to access (Katzev, 2003). Though car club membership in the UK rose from 32,000 in 2007 to almost 160,000 in December 2013, participation remains significantly under 1% of the UK population. Around 75% of 3,000 car club vehicles were in London (Carplus, 2014). The UK's largest bike-sharing scheme commenced operation in 2010 in Greater London with around 8,000 bikes and 500 docking stations by 2014 with plans for further expansion. Bike-sharing developments in other parts of the UK aside from Greater London have been rather limited. Large-scale, corporate-sponsored Third Generation schemes involve bicycles that have been designed for frequent use in a variety of conditions, are standardised and identifiable and difficult to vandalise or steal. Most bicycles have a GPS capability and other tracking mechanisms (Midgley, 2011; Boullier and Crepel, 2014). There is evidence that suggests that there is some limited effect from bike-sharing on reducing car use (between 2% and 10% of trips) with the shift being mainly from other forms of public transport to bike sharing (Midgley, 2011) where bikes may increase trips on other modes of public transport and where users may use schemes as part of longer trips (Wang et al, 2010). Bike-sharing requires both an effective public transport system and also forms of demand management policy (Midgley, 2011), the development by cities of comprehensive bike-sharing strategies (Shaheen and Guzman, 2011) and wider sustainable urban transport strategies.

Niche interventions, such as car sharing, urban bike hire schemes and inter-modal ticketing each build new configurations involving surveillance, monitoring and billing technologies being configured around an existing artefact (a car, a bike, a plastic card) as a form of service. As niches, they aim to reconfigure one or more of automobile, rail, bus or cycling regimes through symbiosis or integration between regimes. So, for example, car sharing mediates

symbiosis between the automobility regime and the ICT regime. Inter-modal ticketing aims to integrate a plastic card, with ICTs and multiple transport regimes from rail to bus and light rail. Yet, what is notable is the limited and spatially selective actual processes of developing these niches and then, subsequently, re-working relationships between regimes.

Dealing with Distance Reduction

Dealing with distance reduction through designing more compact cities is a landscape change in that it deals with the long-term change in the organisation of cities. Though there is no accepted definition (Neuman, 2005; OECD, 2012), the idea of a compact city involves a fundamental reconfiguration of a city through designing in public transport and designing out car use. The idea has achieved momentum amongst policymakers at national and sub-national levels (Howley, 2009) and amongst architects and has become something of a ‘conventional wisdom’ of urban futures (Breheny, 1997). Academic work underpins the relationship between compaction and transport, demonstrating that with higher population density per capita petrol consumption falls significantly (Newman and Kenworthy, 1989). Although this fundamental premise has been questioned and empirical evidence is mixed and sometimes contradictory (Breheny, 1995), the literature generally provides enough evidence to suggest that land use influences travel behaviour (Howley, 2009). There are numerous indicators for assessing this relationship, including: passenger kilometres travelled; percentage of commuters using public transport; percentage of commuters walking to work; and others (OECD, 2012). These kinds of indicators don’t effectively capture patterns of and motivations for urban mobility.

Fundamentally, visions of the compact city are about reconfiguration of relationships between regimes and multiple niches at the city scale. This involves integrating multiple transport (rail, bus, cycling, light rail) regimes and employment and leisure practices in new configurations. The power of compact cities is in visions which present the city as a product but realisation is limited. There is, though, significant but variable experimentation with multiple elements of a compact city in urban settings across the UK. By far the most well-developed is in London. London has a spatial plan where the concept of sustainable development ‘runs through it’ providing ‘an integrated economic, environmental, transport and social framework for the development of London over the next 20–25 years’ (Mayor of London, 2011a, p.10). Relatedly there is also a suite of strategies for transport, climate change and energy (Mayor of London, 2010a, 2011b, 2011c). In other cities in the UK this is much more piecemeal. This is not surprising given weaker governance powers and capability relative to London and less well-developed public transport systems.

Assembling and experimenting with a compact city involves multiple niches. In the example of London, there has been the implementation of a Congestion Charging scheme in 2003, the establishment of an urban cycling hire scheme that began operation in 2010, the development of a multi-modal Oyster card system that commenced in 2003 and numerous other initiatives such as car-sharing schemes and efforts to promote BEVs in London. The city becomes a test-bed for experimenting with multiple niches in a real-world context, where reconfiguration rather than substitution at the city scale is the aim. This requires forms of experimentation and learning (Evans and Karvonen, 2011) where niches bring together unconventional regime relationships - between land-use, bus, automobile, electricity – in a multi-regime configuration. There are new model cities but trying to do this in an existing city is very difficult. Hence in practice, we often see substitution through cycle or bus lanes or through BEVs, etc. but no systemic joining up with questions of overall design of the city.

4.3 Are important actors gearing up to address this challenge or is there little sense of urgency?

Multiple processes are contributing to the slow, incremental and spatially selective reconfiguration of the land-based passenger transport system in the UK as a response to pressures for more sustainable mobility.

In applying niche and regime concepts to sustainable mobility in the UK what is apparent is the selective appropriation of the efficiency aspects of a sustainable mobility approach by dominant regime interests rather than a broader sustainability agenda. This conditions the organisation of different transport systems on principles of efficiency, incrementalism, substitution and defence of the status quo. Change is either largely incremental and from regime interests or is through processes of symbiosis with regimes 'external' to transport, such as ICT. Where there are efforts at more radical transformation this is evident in place-based responses, particularly Greater London. Here, there are forms of experimentation with multiple transport niches that is either often not the case, or is much less ambitious, in other UK cities.

The boundaries we put around researching system change and processes of system change (or continuity) are important here. If we focused solely on the rail system, for example, the huge growth in rail use in the last two decades would suggest radical change. Yet, if we frame this within the wider land-based passenger transport system this change is 'small'. Furthermore, when we assess changes at an aggregate UK level this tells us a very different story than if we focused on, for example, Greater London. A focus on reconfiguration rather than change as a sweeping wave of destruction and reconstruction allows us to articulate these struggles and tensions between continuity and change, the multiple processes and social interests involved and its spatial variety.

Understanding reconfiguration processes in relation to land-based passenger transport in the UK has allowed us to illustrate how vested regime interests act as a 'brake' on radical reconfiguration processes but where selectively urban contexts are used to experiment with more radical forms of reconfiguration.

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