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Commission on Travel Demand

Approaches to demand futures

Briefing Paper 02

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Executive Summary

This briefing paper introduces different approaches which have been used to understand travel demand futures. These are:

- Forecasting
- Visioning
- Backcasting
- Exploratory Scenarios

Each technique is introduced in brief before examples are given to demonstrate how the technique has been applied. The examples are necessarily brief and the intention is that they are used to reflect on how demand for travel is, has or could be represented in each of the approaches rather than to be a critique of any particular approach.

Some key points for discussion are:

- What are the methods being used for?
- Does this influence why demand futures are conceptualised the way they are?
- What assumptions underlie the construction of a notion of business as usual?
- How is social change and the relationship between changing travel and social change represented?
- What are the critical uncertainties in thinking about demand futures and how well do the different approaches allow them to be considered?

1. Overview of approaches to futures

A range of approaches and methods have been applied to examine future travel demand. They are structured in different ways that vary depending on which ontological approach to the future is taken. As presented in Table 1, distinction can be made forecasting, backcasting/visioning and exploratory approaches (Vergragt and Quist 2011; Timms et al. 2014).

Table 1: Approaches to future (adapted from Timms et al. 2014)

	Forecasting	Visioning/Backcasting	Exploratory Futures
Definition	An extrapolation of current trends to the future. It might take into account the prediction of the implementation of specific policies.	A vision is an 'imagine of a desirable future'. Visioning is the process of constructing that image. Backcasting is the construction of pathways to reach a vision.	Construction of different plausible futures as emerging from the present conditions.
Starting point	Present	Future	Present

Broadly speaking, forecasting approaches aim to answer the question: 'how is the future likely to be?' They assume as a start point the present and recent past and try to extrapolate future trends. Backcasting/visioning approaches aim to answer the questions 'how should the future be?' To do so they start from the future and then consider possible pathways for its realization. Specifically these approaches have a normative approach to futures, setting for it specific policy goals and targets. Finally, exploratory approaches look at 'how could different futures be?' and are instead exercises aimed to consider possible futures and alternative evolutions of present conditions.

Each of these different approaches to anticipating the future would produce and analyse different scenarios for the future of transport[1], where a scenario can be defined as a story about the future or, in the words of Timms et al. (2014) as a as "a 'snapshot of a future state of transport"(79). According with which approach to future is taken (forecasting, backcasting or exploratory), scenarios can be used to anticipate the future, or to explore possible different futures (Tollin and del Castillo 2009). Scenarios can be qualitative or quantitative, participatory or expert based. They can embrace different geographical and spatial scales.

What is of particular relevance to the Commission on Travel Demand is the nature of the assumptions that each method makes about the way in which demand will evolve. This paper explores each method and some of these assumptions through short case study vignettes.

[1] The use of the terms scenario and vision it is not clearly defined in the literature and presents several overlaps. In this document we consider a scenario to simply be a snapshot of the future. A vision is a normative positive scenario of a desirable future. Moreover, given the broad meaning of 'scenario planning', indicating any form of planning that uses future scenarios and often used interchangeably with exploratory approaches, we do not refer to the term but cover examples that use it under the categories proposed by Timms et al. 2014, presented in Table 1.

2. Forecasting

2.1. Introduction

Forecasts are predictions of the future state of a system drawing on previous knowledge of how a system has changed over time and what the key factors associated with change over time have been. The approaches can be very simple extrapolation based tools or can be more complex modelling suites which are re-calibrated and developed over time (consider the continual modification of short, medium and long-term weather forecasts for example).

In the transport sector there has been a long-standing practice of forecasting the future demand for travel (in kilometres or miles travelled) and how that varies spatially (as the network develops), by journey purpose and also by time of day (although this is less common). The models which are used to generate the forecasts are based on estimated changes in land use, demographic data, socio-economic factors (e.g. income and age) and travel pattern changes in the specific location considered. Changes in demand are therefore determined by a series of external 'drivers' (e.g. the more people there are the more travel there will be generated).

Whilst there are different approaches to developing the models which produce the forecasts, much practice within the sector continues to rely on the four stage model approach which is set out in brief below. The four stages are:

1. Trip generation (the number of trips to be made);
2. Trip distribution (where those trips go);
3. Mode choice (how the trips will be divided among the available modes of travel); and
4. Trip assignment (predicting the route trips will take).

In the first stage the number of trips is predicted on the base of land use characteristics that provide data and projections on number and size of households, automobile ownership, types of activities (residential, commercial industrial, etc.), and development. It can be aggregated at the household level or disaggregated at the individual level. Typical variables considered are, for a household level model: number of households and average size, average income and car ownership, working population and number of employees by type of industry.

The model then generates a distribution of trips that are predicted considering the attractiveness of different geographical areas based on the type of activities in it and its distance from other areas. Typical variables are: zone – to –zone travel time (could include peak time data) and activities in each zone.

The choice of modes is assigned considering mode capacity, schedules, and fare levels and on real-world observations of how, when, and where people use transit collected via surveys at present time. Typical variables are: Zone-to-zone travel time and cost by mode, average income and car ownership.

Finally trips are assigned assuming that individuals will always try to minimise their travel time. Variables are zone-to-zone travel time by route.

Several authors have highlighted its weaknesses in predicting long term futures (Lee 1973; Flyvberg et al. 2006; Welde and Odeck 2011) due to the complex nature of transport systems, in which societal, psychological and environmental elements play together and in which innovation might rapidly interrupt deterministic prediction. Specifically the model used to forecast risk to be a quasi-static representation, that assumes constant patterns of behaviour and change for making predictions (Waddell 2011).

Alternative model formulations exist, some of which draw on the activity based approaches set out in Briefing Paper 01, although these remain limited in number and very resource intensive to develop. Land-use transport interaction (LUTI) models are becoming more widespread, where feedbacks between the accessibility gains achieved through transport investments and the attractiveness of land for development are incorporated. Nonetheless, there is still a requirement to have some notion of demand and demand growth which the model can then allocate. LUTI models do not have a more sophisticated notion of what demand is.

2.2 Examples

National Road Traffic Forecasts

Road traffic forecasts for the UK come from the National Transport Model (NTM), a four-step travel demand model augmented with sub-models for freight (Figure 1). The NTM acts as a giant calculator that translates exogenous forecasts of future population and employment in 2,500 zones into estimates of vehicle ownership as well as trips, trip distances and mode for each of 8 trip purposes. The translation of population and employment into trips is based on previous behaviour as captured in the UK National Travel Survey. DfT is currently updating the models to reflect more behavioural data. While the model produces multi-modal estimates of travel demand, DfT cautions against the reliability of non-road forecasts (DfT 2015b: 30).

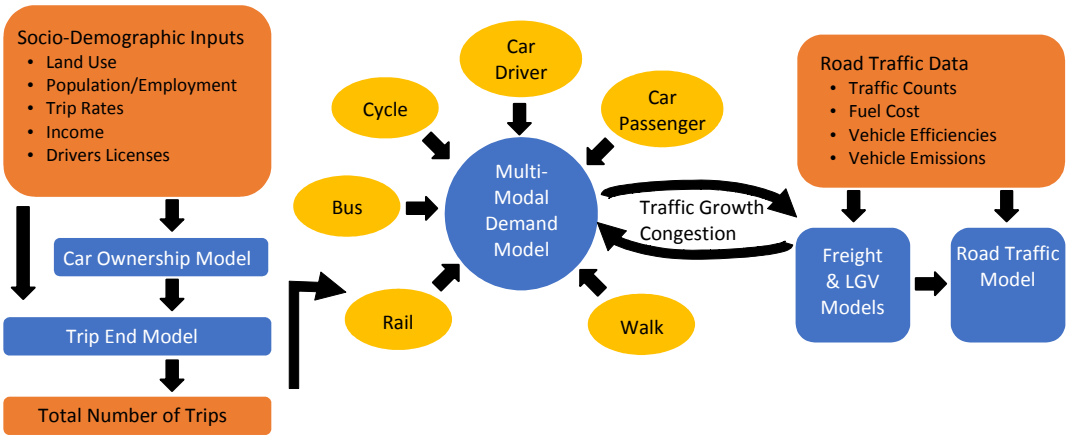
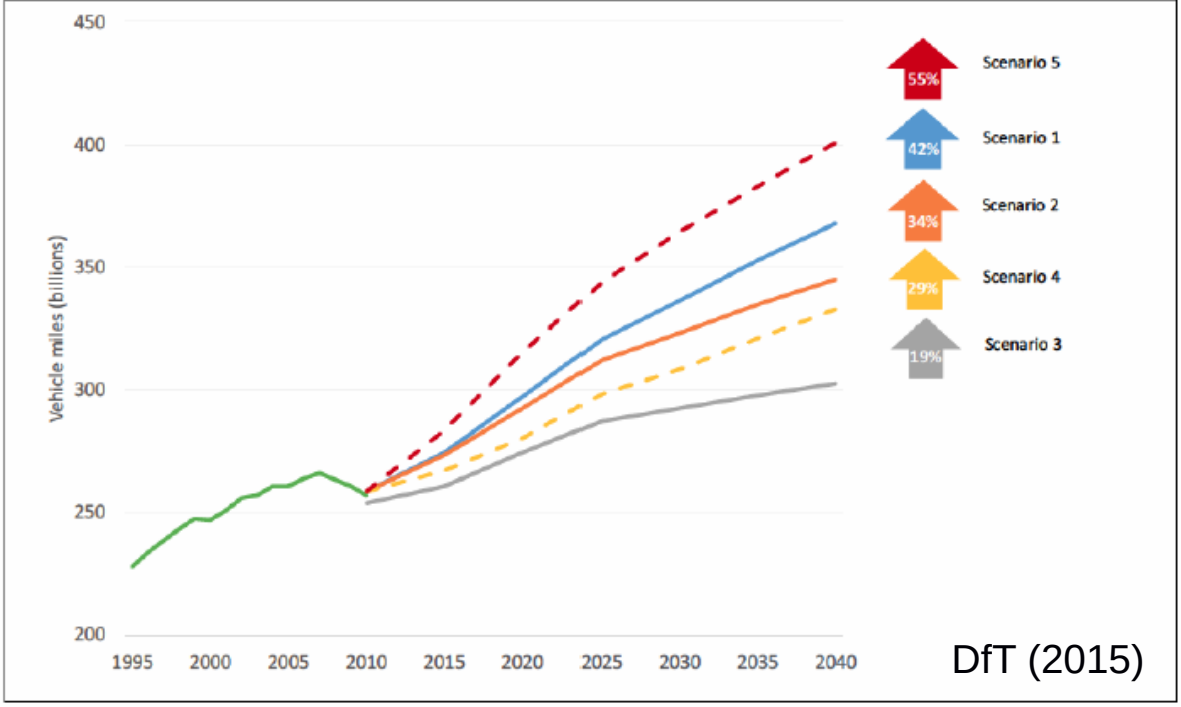


Figure 1: Summary of National Transport Model Structure. Adapted from DfT (2015b: 32).

Recent reports from DfT have acknowledged the multiple sources of uncertainty around future travel demand including demographics, spatial, autonomous vehicles, and trip patterns (DfT 2015a, 2015b, 2015c).

The latest round of forecasts ran five different 'scenarios' for the future development of demand. These scenarios can be seen as sensitivity tests more than exploratory scenarios as described below. They look at the potential implications of different levels of economic growth (and therefore income growth) and oil price. In addition, one scenario included the continuation of a trend of falling trip rates leading to a very substantial divergence in potential travel demand outcomes.

Figure 3.4: Traffic growth by scenario (bn miles, all vehicles)



Summary

Forecasting approaches are developed based on an understanding of associative factors which have been found to be statistically significant in explaining demand changes in the recent past. The models can be recalibrated periodically to understand which factors may have changing importance. The approach adopted takes demand futures to be a function of a series of largely exogenous 'drivers' of demand which may be moderated by different types of policy or investment. Policies are not part of the making of demand, the demand is seen to be latent and policies are layered on after the projections are made. There is an acknowledgement that the drivers are subject to uncertainty. The modelling approaches taken are based on trip rates which have been observed in travel diary surveys but do not explain why these trip rates might be changing over time.

One of the functions of forecasts is to provide a base case or Business as Usual position which

suggests what demand would be if existing plans are put in place and demand grows according to some specified trajectory. This forms the reference against which the worth of interventions are assessed in transport appraisals.

3. Visioning

3.1. Introduction

The literature uses the terms 'vision' and 'visioning' in different ways. For clarity in this document we consider a vision to be a normative scenario for the future. It has the specific characteristic of being defining as a hypothetical but desirable future, often in medium long-term time frame, "with a great anticipatory and inspirational potential for radical changes, and very suitable for participatory processes" (Tollin and del Castillo 2009: np). Visions can cover a range of transport related issues and can be as narrow as designing a single road layout, looking at the possible settings of urban infrastructures and their influence on travel behaviours (Timms et al. 2013) or as broad as considering entire regional transport development plans and at fundamental changes in travel demand.

Visioning is a method to produce and evaluate different visions, e.g. different desirable futures. Different visions are evaluated following a set of guiding principles and are used to generate overarching policies and implementation strategies.

The majority of the visioning exercises in transport studies consider, implicitly or explicitly, the background social/political conditions as a continuation of those recognisable today, whilst changes are envisioned in the "transport system, transport behaviour and related sectors such as the land use system, rather than whole-scale changes throughout society" (Timms et al. 2013: 2).

With these characteristics, for certain authors, distinct from forecasting approaches, visioning is less concentrated in predicting the development of current trends in the future and more based on taking into account community needs and aspirations to design possible future scenarios and planning goals (Lemp et al. 2008; Timms et al. 2014). Visions have been used especially when there has been the need to explore a variety of possible future scenarios and assist decision making in context of high complexity and indeterminacy.

3.2. Examples

Visioning Great Manchester 2040

Transport for Great Manchester (2017) has developed a vision for the region in 2040. In the vision, travel demand evolves shaped by a series of factors, grouped in the categories of economy and employment, technology and innovation, society and community, urban development, environment and resources and policy and governance.

Demand Assumptions

The main driver for mobility is employment. The predicted economic growth in the region would correspond into at least 30,000 more trips towards the CBD in peak time. More trips would also be generated towards new work places outside the CBD. Economic growth would also result in an increased movement of goods in the area.

In the vision, "ongoing social change" (Transport for Great Manchester 2017: 8) would also importantly affect demand. For example travel demand would be reduced as effect of growing use of social media and spreading of community-focused activities and services, generated by a response to local public sector funding cuts. As a result of the introduction of new technologies and social changes, there will be less demand for car-based mobility by young people that would instead rely more on virtual interaction and more flexible types of mobility "on the go"(ibid). Similarly ageing of population would correspond to increasing demand for transportation solution towards healthcare also via special modes.

Housing location is also considered an important factor in shaping the demand for travel. Investments towards high quality housing in right locations near to business would facilitate local work places, reducing the need for travelling.

Finally transport demand would be impacted by governance structures and wider policy decision-making as they will shape the ability of local authorities to "deliver a customer-focused transport system"(ibid: 15). The devolution of resources and autonomy in decision making and funding would positively impact on local economy. This would then directly impact on demand.

Transport Modes

Increasing flexibility in employment times, location and types would require increasingly flexible and adaptable transport solutions, including services outside traditional peak times.

Increasing integration, resilience and consistency in public transport system resulting in more seamless journeys across all forms of transport would also provide more alternatives to private car, encouraging use of more sustainable modes. Use of low-carbon solutions is also influenced by the urban environment: attractive streets and public spaces, with suitable walking and cycling facilities and affordable public transport, are assumed to increase demand for sustainable transport solutions.

Overall, the choice of sustainable transport modes is seen as connected to land use patterns that can support low-carbon lifestyles. This can be done by developing areas that can be easily served by public transport by locating and ensuring that key local facilities are positioned within walking and cycling distance from where people live. In the areas where this is not possible there is a need to maximise the use of existing public transport or ensure that new services can be provided.

Technological advancement would also affect the choice of travel modes, with increasing availability of electric cars and bicycles. Technology would also allow a better demand management via smart data management. It is anticipated that apps will increase the responsiveness of the public transport network. Coach travel and taxis especially are seen as supporting a growing "visitor economy" and also reducing the demand for cars.

Summary

The vision exercise contains a mix of approaches identified in Briefing Paper 01. The vision talks in terms of choice, drivers of demand and the relationships between supply and demand. It makes strong connection between distance, quality of provision and modal choice drawing on the economics and activity perspectives. The potential for co-location of activities or more community based patterns of living bring a clear spatial dimension (particularly inner and outer).

Whilst the vision unsurprisingly places changes in transport options and preferences to the fore in discussing demand change, it also addresses some broader issues of the interplay between social change, technologies and travel. It anticipates changes to how some activities will be undertaken (for example in the flexibility of employment) and it imagines how changes to different cohorts might relate to the future transport system (particularly looking at the younger and older traveller).

It suggests that some systems there today will not be there in the future and other new options might emerge. It recognises that there are interactions between these different elements.

VISION2030

This visioning exercise, funded by the EPSRC and which ran from 2008 until 2011 was concerned with the uptake of walking and cycling in UK by 2030. It involved the generation of 3 generic visions for urban landscape in UK and the discussion of them with different stakeholders (Timms et al. 2013). The exercise aimed to understand how different groups will react to these futures and provide a means by which those groups can explore their own futures.

Approaches to Demand

The visions produced as part of this project are visualised trough 3D images that show different urban landscapes at the street level. These are generated via adaptation and extrapolation of real-life street scenes from different locations. The different urban environment visualise changes considered in terms of modal split, as presented in the following table, adapted from Timms et al. (2013: 5):

	Vision One (V1)	Vision Two (V2)	Vision Three (V3)
Summary of vision	Step change: universal (or near) application of current European best practice in relation to walking/cycling in UK urban areas	Step change – major reduction in car use in urban areas, large increase in walking and cycling, enhanced public transport	Step change – walking and cycling technology significantly enhanced, walking and cycling fulfil most transport requirements in urban areas
Exogenous scenario	'Business as usual'	Major social change in society	Extreme shortage of fuel in UK
Governance	Similar to today, though with heightened focus on need for planning (in all sectors)	More decentralised governance at national level than at present though with strong coordination of policies at the urban level	Strong government at national level (to cope with fuel shortages) but more decentralised governance at local level than at present
City population (within city boundary)	Same as today	Same as today	Many people have moved from the city to its hinterland
% urban walking (by trip stage)	32 (Compare: 2006 urban average for Great Britain: 28%)	37	40
% urban cycling (by trip stage)	13 (cf. 2006: 1%)	23	40
% urban public transport (by trip stage)	25 (cf. 2006: 12%)	35	15
% urban car (by trip stage)	30 (cf. 2006: 59%)	5	5

Changes in demand are mostly considered as effects of the general political settings (that are called 'macro-story lines') and of the implementation of specifically designed policies and infrastructural investments. These are presented in the following table (adapted from Timms et al. 2013 : 6):

1A	Current economic crisis lasts until around 2020, after which there is a recovery. Increase in walking and cycling due to perceived high cost of alternative modes

	(both car and public transport).
1B	Fast recovery from current economic crisis, but a further economic crisis around 2020 (since lessons from current crisis were not learnt). Government support (including funding) for walking and cycling similar to before current crisis.
1C	Fast recovery from current economic crisis, with no more crises before 2030 (since lessons from current crisis were learnt). High government support (including funding) for walking and cycling.

Transport Modes

Variation in demand for walking and cycling depends on the macro-story line chosen (as presented in the table). It is affected by the implementation of policies, the provision of infrastructures, the perceived cost and general attractiveness of the mode.

Specifically in the best case scenario, 1C, the use of walking and cycling increases as effect of construction of high standard and segregated infrastructures, with high level of connectivity and integration also with the public transport network. Moreover, the media present positively walking and cycling. Car use decreases as effect of measures such as parking restrictions, parking charges,

road pricing, street bans etc. and increased attractiveness of public transport and other modes.

Figure 2: Selected images from Visions 2030 (http://www.visions2030.org.uk)

Summary

There is an emphasis on the use of visioning itself as a mean to influence stakeholders' perceptions of different urban futures and to influence political choices that would affect infrastructure investment pathways. The visioning centres on how people might experience the transport network in twenty years time. As such, it engages very little with what people are travelling for and how the activities themselves are evolving. The exercises consider variation in demand to be reflected of modal split as affected by the adoption of different policies and measures at local and national level.

4. Backcasting

4.1. Introduction

Backcasting it is a specific planning technique based on the use of visions that has been also defined as 'backcasting scenario'. Formally it can be considered the opposite of forecasting. Backcasting starts from a defined and normative future vision/scenario and analyses and determines the policy measures required to reaching this particular future working backwards from such future scenario to the targeted present (Robinson 1982). Quist et al. (2006) summarise the main steps of a backcasting exercise as: strategic problem orientation; specification of external variables; construction of future visions or scenarios; backward looking analyses; action agenda.

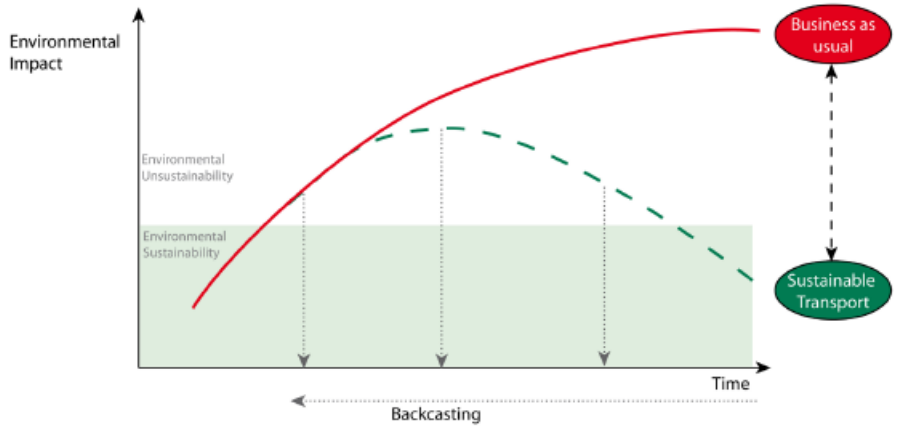


Figure 3: The backcasting approach (Hickman et al. 2009: 4)

Backcasting has been established as planning technique in the 1970s to develop and compare different future policy options. After the 'Our Common future' commission in 1987 has become widely used in sustainability studies (Vergragt and Quist 2011). Subsequently the approach has been used by various actors in a variety of contexts concentrated on sustainable development as final goal of the exercise, often represented by the reduction of certain factors or emissions. In these studies the business as usual scenario is often taken as upper limit for emissions in the future, as presented in Figure 1.

This BAU scenario, often used also in exploratory futures studies, is normally generated projecting forward current trends utilising population forecasts (e.g. provided by Office for National Statistics) and projections for emissions (e.g. provided by Department of Energy and Climate Change (DECC) with different scenarios), as for example in the study of emission in the Low Carbon Bristol Initiative (Millward-Hopkins et al. 2017). Other factors such as GDP forecasts and data on Kms travelled can also be included as in the Future Demand project in New Zealand (see later). Specifically the emissions projections provided by DECC (2015) are based on assumptions on future economic growth, fossil fuels prices and fuel regulations, changes in type of fuel and fuel efficiency, other

policies and regulations. As noted earlier in the forecasting section, the assumptions within BAU are themselves open to debate and appear to assume a fossilisation of social change.

Whilst the BAU scenario attempts to predict the development of current trends, the goal vision is anticipatory and normative, with specific target that are achieved. The most common target is expressed in % of emissions reduced against the BAU scenario by a certain time period (e.g. 2050). Once the target vision is set up the backcasting exercise investigates possible measures to reach it. These are normally considered in terms of policy packages that overlap to the one already included in the BAU scenario.

Hickman and Banister (2014) suggest that the advantage of backcasting is its ability to perform planning irrespectively of current trends and open up for completely different futures. It can be used to explore and reveal the feasibility of different future targets and to fruitfully consider the effects and need for certain actions to be taken in order to reach future goals (Jackson 2011). The actions are deemed as those necessary to achieve change relative to the BAU.

4.2. Examples

VIBAT (Visioning and Backcasting for UK Transport Policy)

This is a leading backcasting project originally promoted by DfT to examine the possibilities of reducing transport carbon dioxide emissions in the UK by 60% by 2030 (Hickman and Banister 2006, 2014). The project has been extended to single cities such as London and Dehli.

VIBAT London proposes two goal scenarios: a 60% reduction in transport CO2 emissions by 2025, and an 80% reduction by 2050, on 1990 levels.

Demand Assumptions

In the study demand is assumed to change in response to a number of social and political factors. Namely: “changing demographic and household structures, including an ageing, yet more active population (greater demand for mobility - passengers and goods); increasing world trade and globalisation, emergence of networked organisations, clusters and supply chains, yet the rising importance of local provision (complex flows); rapid technological developments and the emergence of ‘digital natives’ (the new generation growing up accustomed to technology); taxation increasingly based on resource consumption rather than income; yet decline in the power of national governments and distrust in institutions (ability to influence change); increasing awareness of sustainability issues and demand for change; and the gradual emergence of radical solutions to climate change” (Hickman et al. 2009: 10). Moreover, oil price volatility is considered having an important impact on travel demand.

On the base of the effects of these factors two different scenarios are then developed for London as goal scenario in which different policy options are better implemented. The backcasting exercise is then performed starting from these scenarios. In the first, ‘perpetual motion’, technology has a primary role in shaping the future of transport and emission reduction. However, air travel and car travel in the suburbs, continues to grow. Emission reduction is achieved with increasing use of hybrid technologies and alternative fuels.

In the second one, called 'good intentions', there is a strong political emphasis on sustainability goals that are achieved with a combination of technological improvements, land use measures and increased environmental awareness. Specifically there is a reduction in trip length with people preferring local trips and public transport as effect of growing environmental awareness. New taxation measures and policy incentives also positively affect the demand for clean technologies and sharing schemes.

From a policy level, 12 measures are proposed in the backcasting exercise as instruments to produce the desired demand levels and meet the emission reduction targets. Specifically they are:

PP1: Low emission vehicles; PP2: Alternative fuels; PP3: Pricing regimes; PP4: Public transport; PP5: Walking and cycling; PP6: Strategic and local urban planning; PP7: ICT; PP8: 'Smarter choice' soft measures; PP9: Ecological driving and slower speeds; PP10: Long distance travel substitution; PP11: Freight transport; PP12: International air travel.

The VIBAT approach does not assume that the whole population responds in an equal way to the policies and adopts a segmentation approach drawing on social psychological theory (Shiftan et al. 2008; Anable. 2005). The population is segmented between "Free rider"; "Complacent car addict"; "Techno optimist" – ambitious and realistic; "Enviro-optimist" – ambitious and realistic; "Concerned realist"; "Optimised balance".

Travel modes

In all the scenarios there is increasing use of hybrid and electric cars. Demand is considered to increase continuously for air travel and only politically controversial measures (such as pricing, regulation and rationing) are thought to be able to reduce the trend.

The backcasting exercise, in which the effects of different policy packages are evaluated, show that "low emission vehicles and alternative fuel penetration are likely to remain the most important policy levers, as they tackle carbon efficiency in the dominant mode of travel (the private car)"(ibid: 27). These need implementation also through mandatory targets to manufactures. Investments on public transport and walking and cycling infrastructures are also considered crucial and more likely to impact demand than ICT, 'smarter choices' measures.

As societal awareness is a big component, the study recommends that measures such as "knowledge dissemination, communication, participation in decision-making and marketing of policy options and futures" (ibid: 29) could potentially also impact demand for car travel.

Summary

The backcasting approach focuses on achieving a specific emissions reduction target. Whilst it includes a range of factors which might shape future demand and an acknowledgement that the population will not all behave in the same way in response to them, the approach uses a range of assumptions about policy implementation-travel demand response to determine whether or not the policy pathway is sufficiently ambitious. Demand features as an important variable in the approach (e.g. increased globalisation) but it does not seek to provide an explanation of how demand changes other than through the application of policies.

5. Exploratory Futures

5.1. Introduction

Exploratory futures exercises might be carried out in preparation for a backcasting exercise or to facilitate strategic thinking by organizations (Timms et al. 2014). As such they differ from visioning, that focus only on desirable futures. They concentrate on producing pictures of possible futures, desirable, undesirable or mixed. Hunt et al. (2012), having analysed the different published exploratory futures in sustainability studies divide them in typologies that differ for the vision of the world situation (that can unfold as BAU, Barbarization and Great Transition) and the type of intervention (Policy Reform, Market Forces, Breakdown, Fortress World, Eco-Communalism and New Sustainability Paradigm). The pictures given in each of these exercises concentrate on key drivers of change such as technological, social, economic, political or environmental changes (Hunt et al. 2012) and for each of those give both qualitative and quantitative information.

5.2. Examples

Future Demand

This project aims to take into account of uncertainty and explore possible future development of the current travel scenario in New Zealand (Lyons et al. 2014). The future timeframe is 2042.

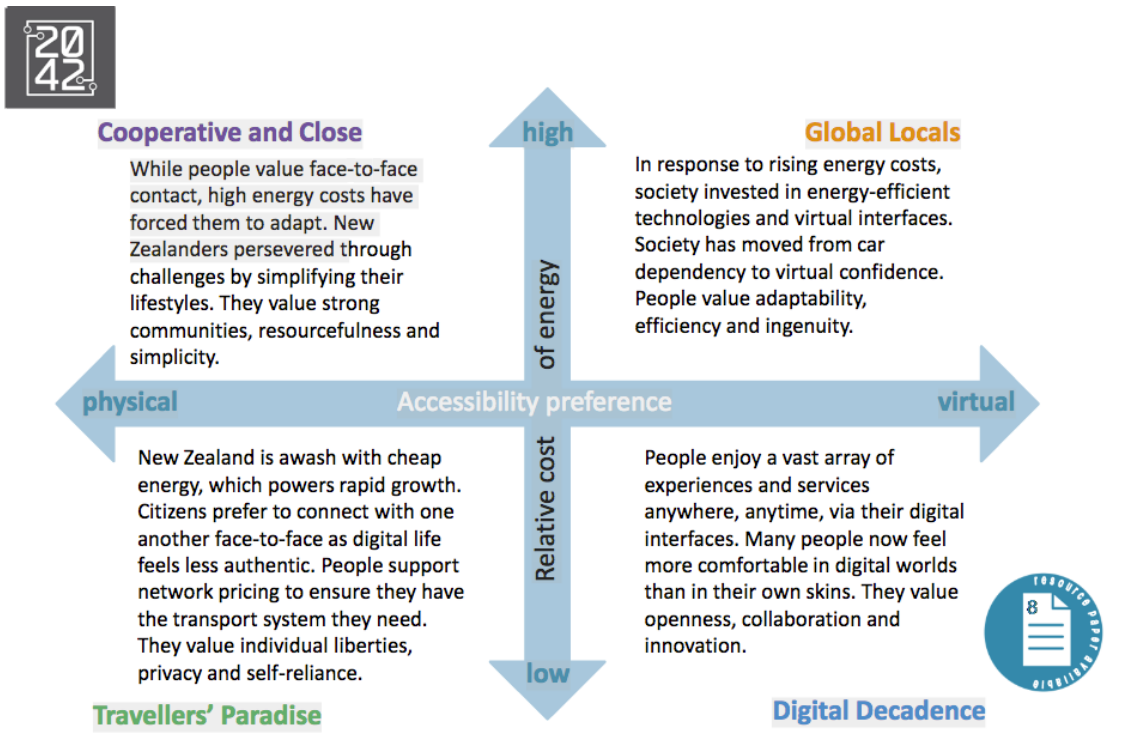
Demand Assumptions

Using a participatory exercise the study has proposed several factors inclined to affect travel demand, presented in the table below (Adapted from Lyons et al. 2014: 13). They have been grouped according with what is believed to be the degree of impact and type of effect. As visible, demand is shaped by both social and economic factors as well as the effects of past policies and investments.

The project then formulated 4 exploratory futures. This has been done starting from the assumption that there is deep uncertainty on the future of car travel, given the fact that demand has been slightly declining and young people are developing new travel attitudes, that there is a general

decreasing propensity to drive and a move to urban areas, whilst diving has increased in rural areas.

The exploratory futures are mainly influenced by the attitude towards technology and energy prices. Different attitudes towards these two domains can generate 4 different futures, as visible in the diagram (Adapted from Lyons et al. 2014: 18):



The exploratory futures focus mainly on people's attitudes towards technological innovations and their availability and costs. This is done with the idea that in considering future demand, for the project, it is crucial to account for which are people's needs, what they want, what they can afford, how they adapt.

Once the exploratory futures were developed, they were evaluated against the BAU scenario in terms of their ability to reduce vehicle kilometres travelled. It is not a necessary feature of exploratory scenarios to quantify the different scenarios. Specifically, to evaluate these scenarios, compared to the BAU, where varied Fuel prices; Percent of urbanisation; Average vehicle fuel efficiency; Estimate of the impact of digitisation on reduction in VKT; Population (for the Digital Decadence scenario).

Summary

The study acknowledges the broad effects that a variety of social and political factors have on demand and their perceived likelihood. The focus of demand variation across the scenarios is in the extent to which society will value face to face interaction over virtual (or vice versa). The extent to which proximity matters is steered to some degree by future energy costs.

Megacities on the Move

Megacities on the Move presents 4 different exploratory futures that respond in different ways to the challenges posed by climate change and, at the same time, the increasing global demand for mobility. The futures are described and explored and included as part of a practical toolkit to help public bodies, companies and civil society organisations understand and plan for the mobility challenges of the future.

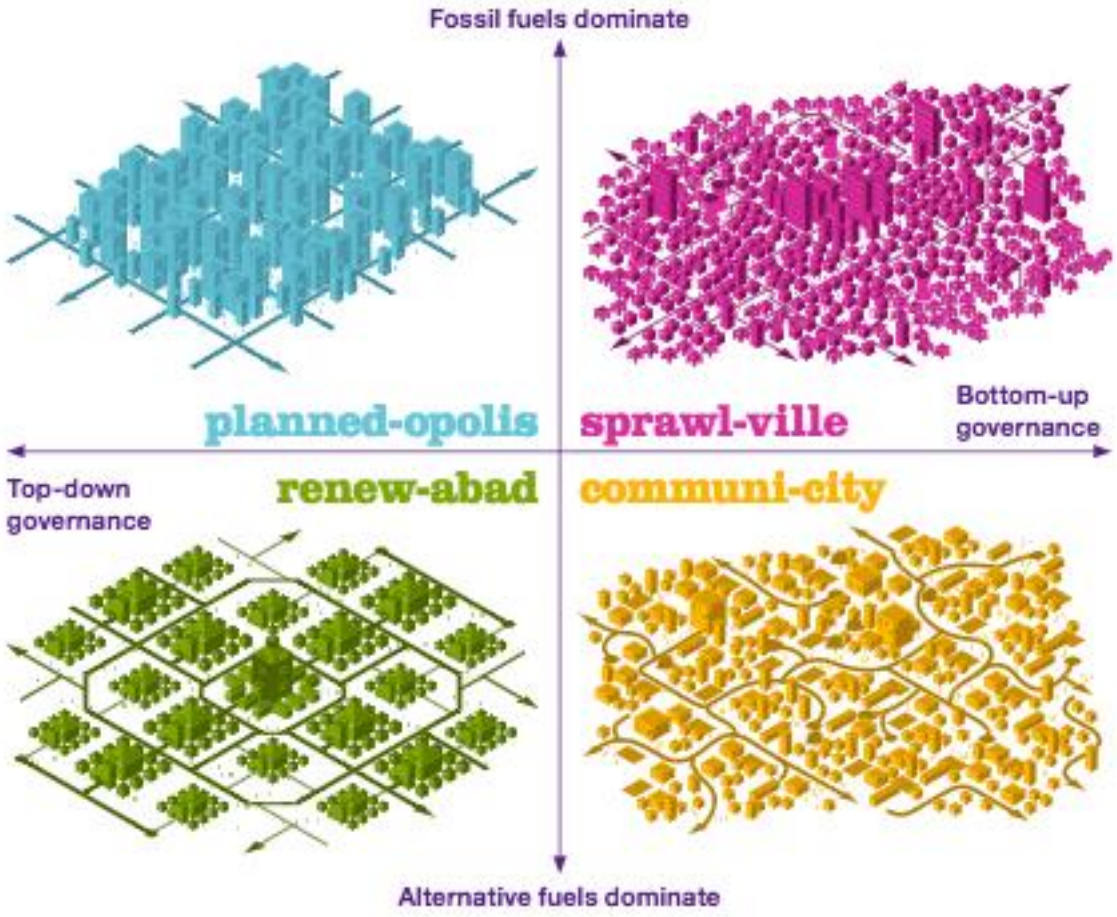
Demand Assumptions

Climate change is considered to deeply affect lifestyles and urban environments and potentially challenge the paradigm of urban growth. The study asks: "We have come to take growth for granted, but could resource limitations or climate change bring the seemingly endless expansion cycle to an end? Or, might lifestyle changes alter how we think about growth and wellbeing, affecting everything from consumption patterns to modal choices?" At the same time the study acknowledges the challenges to mobility posed by the increasingly aging population, the effects of increasing global demand for goods on prices and affordability, and resulting varying patterns of energy supply and demand. Similarly, changes in social structures are likely to affect demand: the atomization of the family structure as well as the emergence of new community structures that are more flexible and mobile.

The different exploratory futures produced consider changes in mobility needs and aspirations, the effects of resource constraints, climate change impacts and social (in)equality on mobility and how ways other than transport (such as virtual services) can met mobility needs. They specifically consider the evolution of the urban form, from compact city to urban sprawl.

They are designed as variation of two main factors: the role of fossil fuels and the type of governance, as visible in the diagram below. Specifically governance is considered to affect the type of mobility at any level of its scale, local to global.

They result in 4 options: planned-polis (mobility choices are constrained and IT plays a big role, cars are banned in central areas and used only by better-off), sprawl-ville (urban sprawl increases as well as the use of EV; there is a process of ghettoization), renew-adab (technology based solutions and increasing use of clean energy, reduced travel demand), commune-city (High use of alternative energy forms, transport is highly personalised and different modes compete)



For each of the scenarios mobility and travel demand have different structures resulting from the influence of various factors at various scales: energy, availability or rationing of resources, regulation of the economy, type of climate change responses implemented, type of governance, social structures, human values, business landscapes, and role of technologies.

Summary

The study looks at how cities will evolve in response to global changes such as population growth, climate change and changes in governance structures and how this will impact on mobility. As in the previous New Zealand study, changes in demand are affected by exogenous factors and by societal attitudes, norms and responses. Societal attitudes and norms appears to draw on the individual social psychological approach and the relationship between energy sources, governance and land-use centres around existing understood land-use planning and transport relationships drawing from the geographic and economic approaches.

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