City Blueprints – Pathways to Sustainable Mobility

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Disclaimer

City Blueprints for Sustainable Mobility

- This project was undertaken to identify pathways, plans and actions - potential “Blueprints” for the transport sector particularly in respect of increasing urbanisation, global mobility demand growth and the need to reduce transport sector emissions.
- The project was sponsored by Shell GameChanger with the intention of gaining external perspectives and expert opinion. This report represents these external views and do not necessarily reflect the views of opinions of Shell

Contributors

- TRL:
- LEGO
- Shell: GameChanger, Global Solutions, Retail, Future Fuels, Learning,
- Best Foot Forward

Objectives

City Blueprints for Sustainable Mobility - Background

This project was undertaken to identify pathways, plans and actions - potential “Blueprints” for the transport sector particularly in respect of increasing urbanisation, global mobility demand growth and the need to reduce transport sector emissions.

- The aim of the project was to:
  - Develop a framework for assessing drivers of change regarding sustainable mobility
  - Capture assumptions about each driver
  - Consolidate into potential roadmaps for market adoption and penetration of mobility options
  - Identify key actors and factors including enablers & constraints to market adoption
- The project was undertaken as a series of workshops to address the key pathways associated with sustainable mobility – vehicle technology, intelligent transport systems and alternative transport.
- Whilst drawing on expertise relating mainly to the UK transport sector it is believed that this report has relevance to both other developed markets and to the developing world

City Mobility and emissions

- In most developed/OECD countries, transport usually accounts for around 25% of total Green House Gas (GHG) emissions - 80% of greenhouse gas emissions are from cities, and emissions from the transport sector are a significant contributor to emissions in cities Transport sector emissions have been steadily increasing over the last 25 years, unlike other sectors where emissions have either been stable of slowly decreasing..
- The increase in emissions is due to the rapid increase in the number of journeys by road. Although the fuel efficiency of vehicles has steadily improved (leading to a decrease in carbon emissions per vehicle), this has been more that out-weighed by the increase in the number of journeys. The most inefficient of which are city commutes.
- There are significant difference in transport energy use in cities across the world. In part these reflect the different patterns of car ownership between the developed and the developing world. Car ownership is set to double by 2030 and to quadruple by 2050, with most of the growth from the developing world.

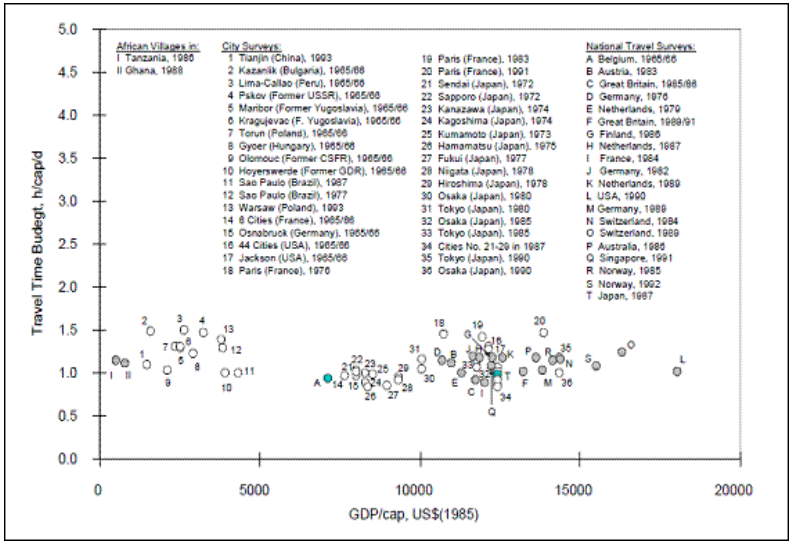
All cities are different ….

- Whilst there are large variations in energy intensity, vehicle ownership, use of alternative modes of transport, road infrastructure

All cities are the same …

- There is a remarkable degree of similarity in the time people spend on travel per day - travel time budget (about an hour)

Transport parameter	Asian Cities	European Cities	US Cities
Car ownership (passenger cars per 1000 persons)	109	392	608
Specific road length (metres per capita)	1	2	7
Road density (metres of road per urban ha)	122	115	89
Walking+cycling+pedicab (% of work trips)	19	18	5
Role of public transport (% of all passenger km)	48	23	3
Car use per person (km per capita per yr)	1,397	4,519	11,155
Energy use per person (private passenger transport per capita, MJ)	6,969	17,218	55,807



Conclusions

- Improvements in passenger vehicles arising from vehicle, drive train and fuel technologies will not deliver sufficient emission reductions by 2030 and make no significant contribution to improving safety or reducing congestion.
- However, when combined with demand side measures to improve the efficiency of use of vehicles & the use of alternative travel choices 2030 and 2050 emission targets ***can*** be met whilst satisfying increasing demand for mobility in the developed and developing world.
- Vehicle and fuel technologies take time to achieve mass impact
- Potentially 75% lower road transport emissions (compared to 1990 baseline) can be achieved from a mix of different demand choices and deployment of new vehicle/fuel technologies
- There is likely to be a high level of interdependencies between different measures - interventions in support of specific measures can counter act the potential benefits of other actions leading to lower overall emission reductions. We have developed a modelling framework for illustrating these dependencies.
- Currently there lack of alignment in policy making at the national and international level.
- In the developed world the challenge is to change existing habits and behaviours
- In the developing world the challenge is make different choices that still allow access to opportunity
- There is an opportunity for Shell, TRL, and LEGO to work with others to disseminate information and knowledge in support of policy development and to undertake further technology development and deployment.

A reduction of c80% in road transport emissions is possible by 2030* - equivalent to >60% below 1990 levels

It is not just about fuel and drive train technology

Vehicle and Fuel technologies are important but will only start to impact post 2020

Significant reductions can be achieved sooner through different demand choices and behaviours

There is high uncertainty about whether these reductions will be delivered - without them emissions targets will not be achieved

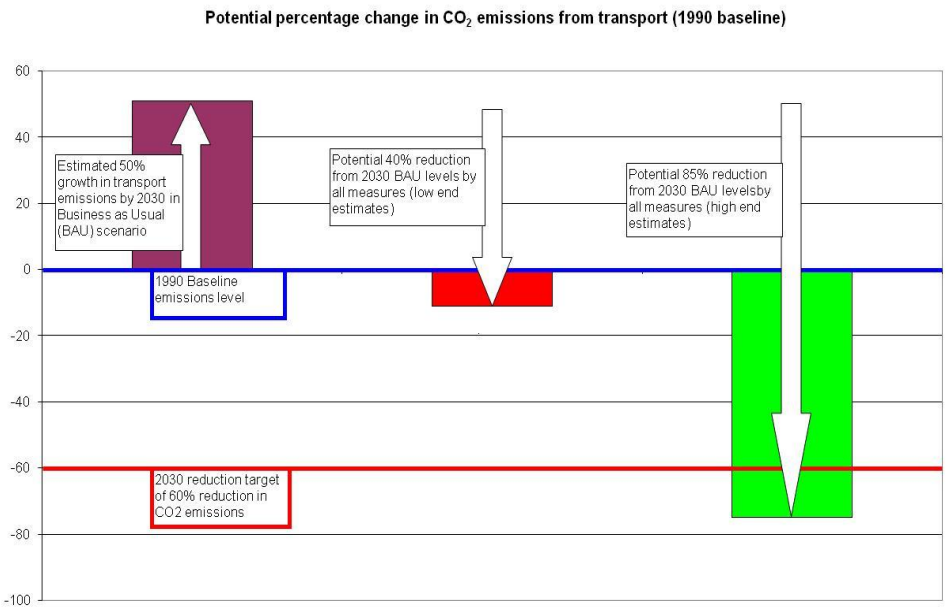
Integrated actions are required by policy makers, opinion formers and business to deliver the potential reduction

Whilst the developing world may leapfrog to new technologies they also need to make the right demand side choices and develop “good” travel habits

It is not about stopping people using cars but providing viable alternatives and improving efficiency of car usage.

Emissions reduction come from:

- **Greater use of alternatives to the car**
- **More effective use of the car**
- **Lower emissions from cars**



***dependent on effectiveness of combined measures (based on UK data)**

To achieve emission reductions of c80%*, different demand choices AND new vehicle/fuel technologies are required

Sources of Emissions Reductions*

Alternatives to the car - 20%

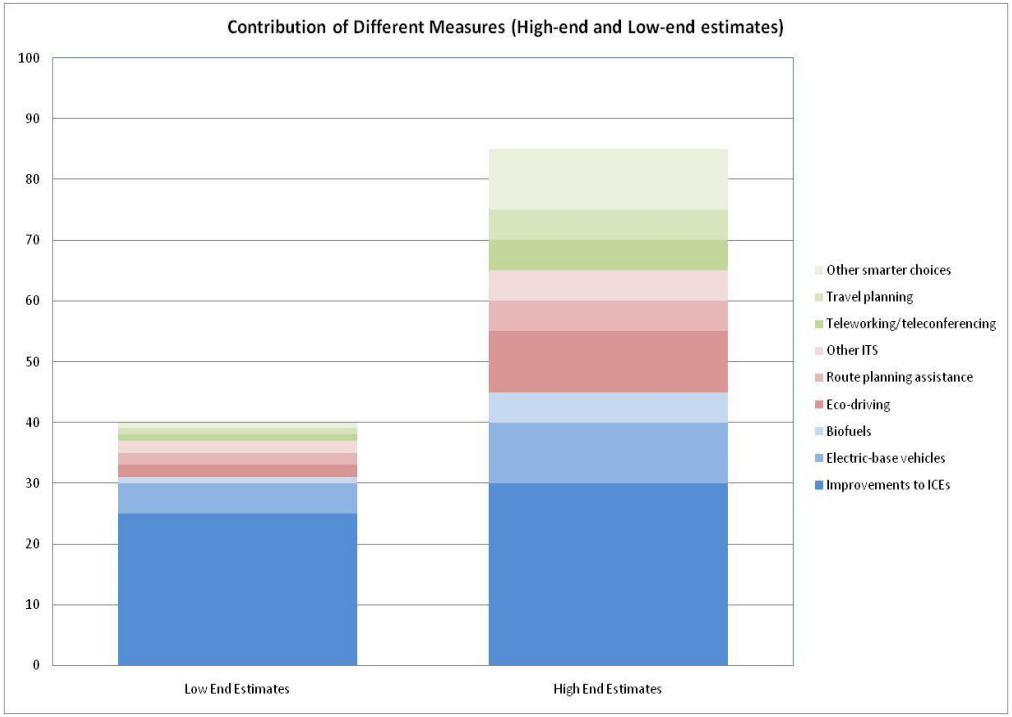
- Teleworking/teleconferencing - 5%
- Travel planning - 5%
- Other smarter choices - 10%

Better use of the car - 20%

- Eco-driving - 10%
- Route planning assistance - 5%
- Other ITS - 5%

Lower emissions from cars - 45%

- Improvements to ICEs - 30%
- Electric-based vehicles - 10%
- Biofuels - 5%



There is a high level of interdependency between different measures

Poorly defined interventions can encourage some measures but reduce the effectiveness of others

***dependent on effectiveness of combined measures (based on UK data)**

Different demand choices can make a faster impact

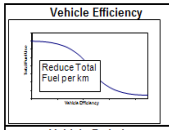
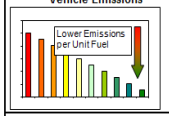
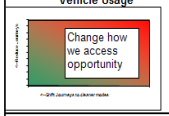
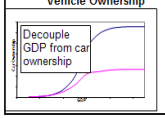
New vehicle and fuel technologies take longer to achieve mass impact due to time to mass market penetration

2010-2030 – demand choices

- Driving behaviour
- Traffic demand management
- Vehicle usage
- Vehicle ownership

2020-2050 – vehicle/fuel technology

- Mass market penetration of new vehicle and fuel technologies

	Key Facts	Pathways	Potential	Timing	Levers	Constraints	Actors	Unintended Consequences
Vehicle Efficiency 	• over the last ten years, fuel efficiency of the vehicle fleet has only shown marginal improvements	• improvements in petrol/diesel engines	10 - 20 %	2010 - 2020	• EU Directives • increase in fuel costs • emission reduction policies	• limited capital expenditure for OEMs • inherent conservatism of consumers	• vehicle manufacturers • oil companies • policy makers	• improvements in fuel efficiency make travel cheaper, so people travel more frequently or make longer journeys
		• petrol hybrids	15 - 25%	2010 - 2025				
		• eco-driving	5 - 10%	now				
		• route planning	2 - 5%	2010 - 2015				
		• traffic management	2 - 5%	2010 - 2020				
Vehicle Emissions 	• by 2020, carbon emissions from vehicles will need to decrease from current 160 g/km to about 90 g/km	• pluggable hybrid vehicle	20 - 40%	2015 - 2030	• EU Directives • emission reduction policies	• limited capital expenditure for OEMs • unresolved technological issues • inherent conservatism of consumers	• vehicle manufacturers • oil companies • policy makers • innovators	• improvements in fuel efficiency may lead to cars with higher performance specification, rather than being converted into fuel efficiency
		• battery electric vehicle	30 - 90%	2025 - 2040				
		• fuel cell vehicle	30 - 90%	2020 - 2035				
		• 2nd/3rd generation biofuels	10 -30%	2015 - 2030				
Vehicle Usage 	• emissions by journey purpose are: - commuting (25%) - personal business (17%) - business (14%) - shopping (13%) - visiting friends (12%)	• demand management	5 - 10%	now - 2020	• improving traffic flows in cities • reducing business costs and improving productivity	• limited capital expenditure of LAs • opposition from voters	• Local Authorities • ICT companies • campaign groups	• improving information about route planning may encourage the use of cars
		•congestion charging	5 - 10%	now - 2015				
		• travel plans	2 - 5%	now				
		• car sharing	2 - 5%	now				
		• tele-working & teleconferencing	2 - 5%	now				
Vehicle Ownership 	• world vehicle fleet is set to quadruple by 2050	• improved public transport	5 - 20%	now - 2020	• improving traffic flows in cities • reducing business costs and improving productivity	• reluctance of consumers to give up flexibility of car ownership	• Local Authorities	
		• land-use planning	5 - 20%	now - 2020				
		• mobility services	5 - 20%	now - 2020				

***dependent on effectiveness of combined measures (based on UK data)**

But different demand choices have higher uncertainty and need to be encouraged – “choice architecture”

Choice Architecture

- influencing choices
- providing alternatives
- changing perceptions
- changing habits

Modal choice:

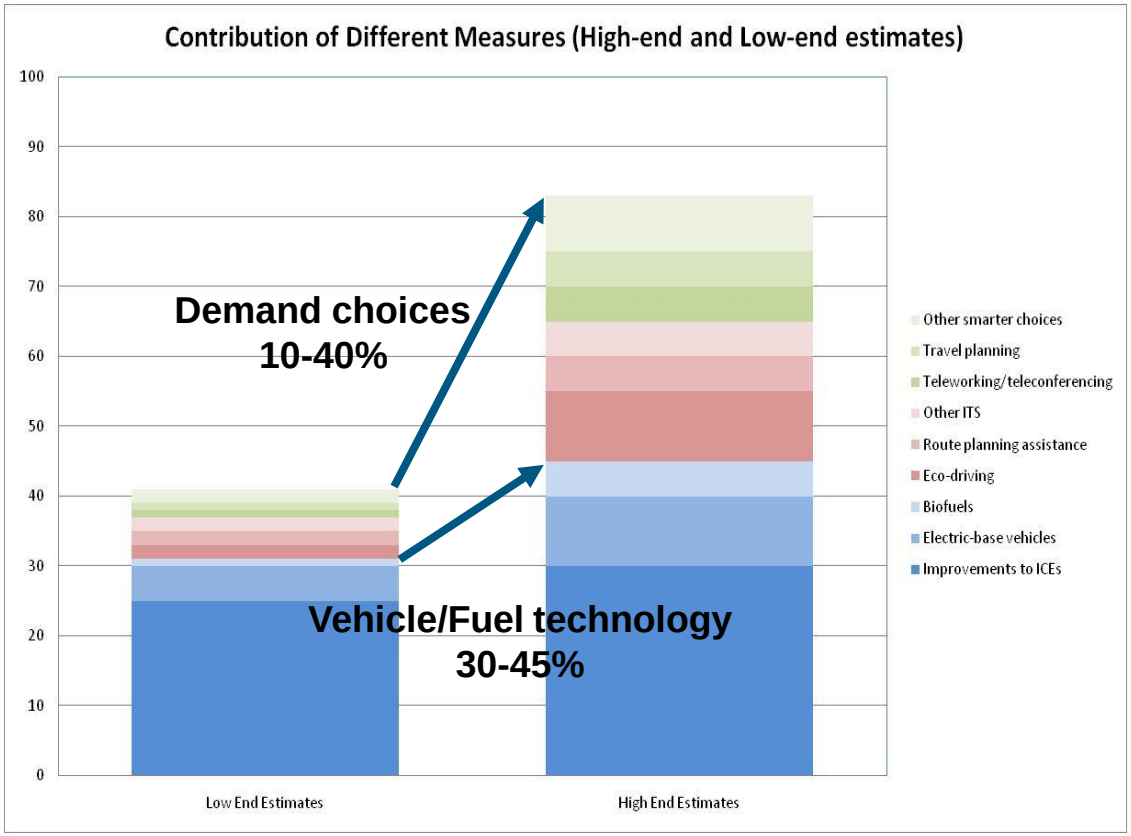
- Land planning
- Travel plannng
- Information
- Media
- Social norms
- Infrastructure investment

Vehicle usage

- Traffic management systems
- Road Pricing/Car & Fuel Tax
- Vehicle ownership/usage models

Driver behaviour

- Feedback systems
- Education



Choice

Changing behaviours and influencing choices is complex

- research shows that policy makers and car users see things differently and so interventions are not always effective
- People develop habits that avoid making conscious choices
- The degree to which consumers choose to use alternatives is determined by individual habits and choices as well as many external factors (media, social norms, ease of access, …)
- Social norms and transport infrastructure have developed to support the use of the motor car – perceptions are that alternatives are not as “good”
- People find it harder to give up something they already have than it is to adopt something new (Prospect theory)
- In the developed world people need to make different choices and develop different habits
- In the developing world the opportunity exists to “nudge” people to make the “right” choices for sustainable mobility that allow them to meet their needs without producing “western” levels of emissions

More work is needed to understand how best to influence choices

Alternative Transport and Alternatives to Transport

Potential 20% emissions reduction

- The main alternatives to the private motor vehicle are walking, cycling, public transport and home working/telecommuting/shopping. Mobility management and land-use planning are essential in promoting the uptake of alternatives to the motor car.
- Mobility management and smarter choices have the potential to achieve reductions in car use of about 10-20%, resulting in similar reductions in carbon emissions. These measures are relatively cheap to implement which can be done *"now".*
- The degree to which consumers choose to use alternatives is determined by individual habits and choices and highly influenced by a number of external factors

These measures can be taken quite quickly: 1 - 5 years

Intelligent Transport Systems

Potential 20% emissions reduction

- Intelligent transport systems provide information to support the driver both before and during the journey and enable the transport network to operate efficiently by maximising capacity
- There are two areas where ITS can make an immediate impact. The first is in supporting eco-driving by providing real-time displays of relevant data and providing on-line coaching. The second is in developing traffic management systems so that they give greater focus to optimising fuel efficiency
- For the longer term, ITS can provide the basis for “mobility services” by promoting and facilitating different models of mobility and vehicle ownership. In this way, ITS will enable greater mobility (ie greater access to opportunity) without increasing the number of journeys
- Accordingly, there is substantial potential for ITS to reduce carbon emissions from road transport. If realised, this potential could lead to a 20% reduction in carbon emissions. ITS measures complement improvements in vehicle technology and are largely additive with them.

Implementation requires collaboration between road network managers, automobile manufacturers and IT/equipment suppliers

Vehicle & Fuel Technologies

Potential 45% emissions reduction

- Whilst there are still specific technological barriers to overcome the main uncertainty regarding vehicle and fuel technologies is the timing of large scale deployment
- Emissions from motor vehicles have shown only very modest decreases over the last twenty years. These incremental improvements fall way short of what is required to meet the emission reduction targets that are now required.
- However, a range of technologies based around improvements to the internal combustion engine already exist. In particular, petrol hybrid vehicles have the potential to reduce emissions below 100 g CO_2/km. Accordingly, these technologies can play a major role in reducing emissions – and do so within the timeframe that is required for meeting climate change targets.
- Other technologies, such as battery electric vehicles, fuel cell vehicles and sustainable biofuels, offer the potential for further reductions in emissions. However, given the long lead times for ensuring significant market penetration, we doubt whether these technologies will be able to make a significant impact before 2030. Pluggable hybrids may be a transitional technology between petrol hybrids and the newer technologies.

The fleet turnover time (5-10 years) means the improvements in vehicle technology take time to make their full impact.