13th EU Hitachi Science & Technology Forum 2012

Transport & Mobility towards 2050

10th May 2012, London

SUMMARY REPORT

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Contents

Foreword

I am pleased to introduce the summary of the proceedings of the 13th EU Hitachi Science & Technology Forum on 'Transport and Mobility towards 2050' which was held in central London on 10th May 2012. 155 participants from both Europe and Japan attended this year's Forum - the highest ever number of participants.

The objective of the EU Hitachi Science & Technology Forum is to contribute to the public policy debate in Europe by providing a platform for discussing societal issues related to science and technology in the daily life of European citizens.

Despite the uncertain investment climate in Europe at present, it was clear that the issue of Transport and Mobility remains at the top of the policy agenda. The Forum discussed it from the perspectives of cost and financing, energy use and urbanisation. Technological innovations were presented and scenarios for transportation in 2050 were debated.

Dr Keiji Kojima, Vice President and Executive Officer of Hitachi, emphasised how smarter transport relies on the use of ICT to optimise the use of energy in the system as a whole through better use of information. Hitachi's business is no longer simply about products or systems, but about social innovation. Hitachi will continue to innovate for Green and Smart road and rail transport systems to make them more convenient and energy-efficient, and is looking to work with European partners in these efforts.

I would like to thank to all speakers, moderators, Forum members and fellows, and all other participants for their valued contribution to this year's Forum. In addition I do hope that you will find this report interesting and that it will further contribute to the discussion on transport and mobility in Europe.

With my best wishes,

Stephen Gomersall

Sir Stephen Gomersall
Chairman of Hitachi Europe Ltd. and Group Chairman for Europe

The Forum provides a platform to address and discuss societal issues related to science and technology in the daily life of European citizens

The Forum

The EU Hitachi Science & Technology Forum is a platform dedicated to promoting dialogue between European citizens and decision-makers. It brings together professionals from a wide range of sectors and backgrounds to discuss societal issues related to science and technology in the daily life of European citizens.
Since its launch in 1998, annual meetings have been held at locations across Europe on topics relevant to the European policy debate. Participants are European scientists, engineers and business-people who have all participated in long-term internships at Hitachi laboratories or plants in Japan, together with representatives from Hitachi's businesses in Europe and invited guests and experts.
The Forum has two objectives. Firstly, it provides a platform to address and discuss societal issues related to science and technology in the daily life of European citizens. Secondly, it provides a bi-yearly occasion for Forum members and participants to network with friends and colleagues.

Executive summary

Over 150 participants gathered in London on 10th May 2012 for the 13th EU Hitachi Science & Technology Forum. The meeting brought together researchers, business leaders, policy-makers and NGO and media representatives to debate the issue of Transport and Mobility towards 2050.
The Forum discussed sustainable solutions for the mobility sector in response to the energy and environmental challenges and changes in the patterns of consumption and demand, and explored future scenarios in a 2050 timeframe. The Forum also heard about the Hitachi Group's efforts to support social innovation and in particular its research portfolio in the transport and mobility sectors.

The Mobility Challenge
The growing global demand for energy, and the associated implications for our planet through global warming, is one of the defining policy challenges of our age. Transport is intrinsic to this debate.

According to International Energy Agency estimates, global energy demand will increase by one-third in the period from 2010-35, mainly in the new economies such as China and India. Transport is the main driver in oil demand, accounting for almost 90% of the projected increase in global oil use. Worldwide, the number of cars is projected to more than double, from 750 million today to more than 2.2 billion by 2050, again mainly due to soaring ownership in new and developing economies. EU oil imports are rising, while China is set to become the largest importer of oil by 2020. All of this amounts to a shift in the locus of global demand and in oil security concerns.

The heavy reliance on fossil fuels puts transport centre-stage in the fight against climate change. The sector accounts for about one-quarter of global greenhouse gas (GHG) emissions. Existing and current policies will not halt the rise in CO_2 emissions and radical action is needed. In Europe, EU Member States have committed to reducing emissions by 80 to 95% by 2050; analysis suggests that for transport a 60% reduction is the most cost-efficient contribution.

Aside from the direct energy and environmental impacts, ever-growing congestion and rising fuel costs threaten to constrain economic growth and exacerbate regional disparities. Citizens, businesses and governments see transport as essential to economic prosperity and quality of life.

The path to a low-carbon future demands radical deployment of efficiency technologies, rapid and deep decarbonisation of electricity generation, and a move to zero-carbon fuels such as electricity, hydrogen, and biofuels/bioenergy. Transport has its role to play in all of these, but also faces major technological and societal challenges.

Transport Technologies for 2050
The Forum heard of a number of radical transport innovations, as well as some incremental ones. Algal biofuels being demonstrated by companies such as Bio Fuel Systems could offer a new means of producing fossil fuels whilst actually removing CO_2 from the atmosphere. The MyCopter personal aerial vehicle (PAV) concept offers a vision of personalised air travel in order to overcome ground-based traffic congestion. And electronic coupling could completely transform the concept of rail travel, enabling individual railcars to disperse across different routes. Certain radical innovations are sure to break through and could be disruptive.

At the same time, solid and serious engineering is being undertaken, by Hitachi and others, in areas such as high power density inverters for use in electric and hybrid vehicles; high power, high capacity long-life and safe lithium batteries; the design and production of energy-efficient rolling stock for the next generation of railways; and standards and protocols for car-to-car (C2C) and car-to-infrastructure (C2I) communication.

The year 2050 - now just 38 years away - is a visible and viable time-frame in which to plan and to act.

Advanced materials (e.g. composites, superconductors, nanomaterials, etc.) will also be increasingly widely applied. ICT has a key part to play, such as a new generation of driver cooperation systems that fill the gap between passive driver information and active pre-incident intervention. Mechatronics – the redesign of purely mechanical systems to take advantage of electronics, computing and control – will continue to be an important feature across the transport sector (in planes, cars and trains), often in association with more intelligent infrastructure.

The year 2050 – now just 38 years away – is a visible and viable timeframe in which to plan and to act. In particular, the period 2010-2020 will be crucial for many of the low-carbon technologies identified to reach economies of scale and position themselves for full commercialisation later on.
We can and should actively learn from the past. Looking back 38 years, to the mid-1970s, we see a number of developments, some quite minor and mundane, that helped push the transport debate forward. Tilting trains, hatchback cars, construction of the first Space Shuttle, and the Blackbird supersonic plane were all begun or launched during this period. Several of these lacked a business case but have nevertheless been successful; others that were seen as major innovations at the time, such as Concord, are no longer a part of the transport picture. So the lesson is that we cannot plan everything and whilst we should seek out a business case where possible we must also be prepared for the unexpected.
This last point underlines the value of foresight and technology assessment (TA). Such studies will not always be correct, either in their vision or in the detail, but are nevertheless worthwhile. Just the act of making such a study can influence the future.

Transport Policies for Sustainable Mobility
What can be done to make transport more sustainable? As the recent European Commission White Paper points out, "curbing mobility is not an option". Transport drives economic development, as has been seen in London from the late nineteenth century through to the present day. In a globalised world and an integrated Europe, cutting citizens' and businesses' opportunities for travel just will not work.
Rather we have to develop policies that respond to the energy, environmental and social challenges and send the right signals to transport users and operators. As well as technological changes, policies have to take account of changes in society and patterns of demand (e.g. teleworking, long-distance commuting, leisure expectations, etc.). The Forum welcomed the White Paper's intention to pursue an approach to European policies which seeks to balance transport efficiency and technology-oriented measures.

A balanced approach to transport policy means taking into account factors such as:
• Upgrades versus new infrastructure: Upgrades to existing infrastructure are appropriate in some circumstances. New infrastructures will also be needed, especially in the new Member States and to fill gaps in the networks, but we have to look carefully at what types of infrastructure this should be: e.g. high speed vs urban rail; hub vs regional airports; best sites for cross-border links; and how best to safely accommodate walkers and cyclists.
• Ensuring a level-playing field: Market signals in transport are far from transparent: in some areas, such as rail, users pay the full costs whereas in others, such as roads, they do not. Pricing structures need to reflect the true costs and users have to take a greater share of the burden.
• Continuity of policies: Large-scale investments in infrastructure and innovation require continuity and certainty. Long-term planning that transcends the political cycle reduces the risk for both the private sector operators and public sector funders.
None of this is easy, especially in the current climate of austerity. We have to show that transport is a key to, rather than a drain on, economic growth and that it yields real and shared benefits. Yet there is scope for major impact. Europe spends €500 billion per year on cars and fuel; just a 10% saving would yield significant benefits for all.
Discussion at the 2012 EU Hitachi Science & Technology Forum identified four priorities for a successful outcome:
• Involve stakeholders so as to converge on shared visions and views.
• Invest in solutions to realise these visions, through both public and private funding.
• Incentivise stakeholders so as to engage users and consumers in tackling the challenges ahead.
• Inform stakeholders, with scientists, engineers and businesses leading the dialogue.
A competitive transport sector is key for Europe. Technology innovation calls for joint effort, a long-term perspective and action across the full innovation cycle from research to deployment. In particular, deployment – taking innovative technology out of the laboratory and into full scale commercial operation – is a bottleneck requiring concerted action. The Forum recognised the importance of the EU's TransEuropean Networks (Ten-T) and the forthcoming Horizon2020 programmes as support-platforms for research, innovation and deployment but stressed that these could not substitute for companies' own and other public sector efforts.

Finally, the Forum called on researchers, businesses and policy-makers to consider the human aspect in future transport and mobility. To be sustainable, there must be public acceptance not only of new technologies (e.g. biofuels, fully automated flying, electronically coupled trains, etc.) but also of related policies (e.g. safety, road pricing, congestion charging, etc.).

Welcoming remarks

Masahide Tanigaki, Representative Executive Officer, Senior Vice President and Executive Officer, Hitachi Ltd.

Transport and mobility is very topical at the moment, said Mr Tanigaki. Over the last several years the energy impact of human activities has been at the forefront of the global agenda. For industrial and residential applications solutions have been developed and are being deployed in many areas. In the transportation sector, so far technological advances have been offset by the increase in mobility and global exchanges.

However, energy is not the only challenge facing the transport sector. Globalisation will continue to drive demand for mobility, road congestion will require investment in new infrastructure, and growing cities will have to integrate the mobility dimension in their urban planning. Financing, energy and environmental aspects would all be discussed within this EU Hitachi Science & Technology Forum, Mr Tanigaki explained. The morning session would look at sustainable solutions for the mobility sector. Later, Dr Kojima would discuss Hitachi Group's efforts to support social innovation, in particular the transport and mobility sectors, and the afternoon sessions would explore scenarios for the future.

The Forum was pleased to come to London in this key year of the 2012 Olympics, said Mr Tanigaki. Hitachi has long associations with the UK and in 2009 introduced the country's fastest domestic trains. Hitachi is proud to have introduced this new generation of trains and is committed to bringing the latest mobility solutions to the European market.

The EU Hitachi Science & Technology Forum exists as a forum for researchers, business leaders, policymakers and NGOs to discuss important policy issues and to contribute to European public policy. Mr Tanigaki extended a warm welcome to all speakers, moderators and attendees and wished them a pleasant and fruitful debate. Particular thanks were due to Mr Alex MacGillivray, Executive Director of Climate Business, an NGO that works with businesses to unlock environmental solutions, who had agreed to act as the Forum's General Moderator.

Forum General Moderator:
Alex MacGillivray, Executive Director, Climate Business

Mr MacGillivray thanked Mr Tanigaki for his introduction and Hitachi for the invitation to act as moderator for this important event.

He invited the audience – those who were old enough – to cast their minds back to 1974. This was the year in which Philip Bagwell published his classic book Transport Revolution from 1770 looking at the growth of transport systems; the iconic cyclist Eddy Merckx won the Tour de France for the fifth time; NASA began construction on the first Space Shuttle; the Blackbird plane flew from New York to London in under two hours; and Volkswagen launched the legendary Golf 'hatchback'. Each of these in their different ways represented a revolution in transport, even though some might be considered mundane now.

The reason for focusing on 1974, Mr MacGillivray explained, was that this was 38 years ago; and from 2012 we must look forward another 38 years to 2050. There is no doubt that over this period we will see "some inspirational stuff". New things will emerge and some of the things that are part of the transport picture now will no longer be around. The Concord of the 1970s is one such example.

Successful innovation is about deployment as well as invention, and this depends as much on social and psychological factors as technical ones. There is a constant tension between innovation and inspiration. We have to allow for the inertia in the system, sometimes people just do not want things even though they are technically possible. There is no doubt that this will be an exciting journey, but we have to keep well grounded as well. Providing this grounding was a key aim of the Forum debates.

Keynote

Setting the Scene - Overview of Transport Sector in Europe

Marcel Rommerts, DG Mobility & Transport, European Commission

Mr Rommerts offered a vision of the transport system of 2050 and the related policy challenges and implementation actions. The recent European Commission White Paper on Transport identified three main challenges for the transport sector. Firstly, there is the high oil price and persistent oil dependency. Transport depends on oil for about 96% of its energy needs, while the transport sector accounts for almost 90% of the projected increase in global oil use. Worldwide, the number of cars is projected to increase from around 750 million today to more than 2.2 billion by 2050. The depletion of reserves and growing global demand would lead to ever higher and volatile oil prices.

Secondly, there is pollution and greenhouse gas (GHG) emissions, with the transport sector facing an increasingly tight carbon budget. Transport accounts for about one quarter of GHG emissions. In Europe, Member States have committed to reducing EU emissions by 80 to 95% by 2050 compared to 1990 levels. Commission modelling suggests a 60% reduction is the most cost-efficient contribution from transport. Thirdly, ever-growing congestion is an issue. Fuel costs and congestion levels are expected to rise significantly by 2030, leading to further divergence in accessibility and exacerbating regional disparities. These challenges must be addressed in ways that improve mobility and support growth. This requires action across many levels, from long-distance and international travel to regional transport, and urban transport and commuting.

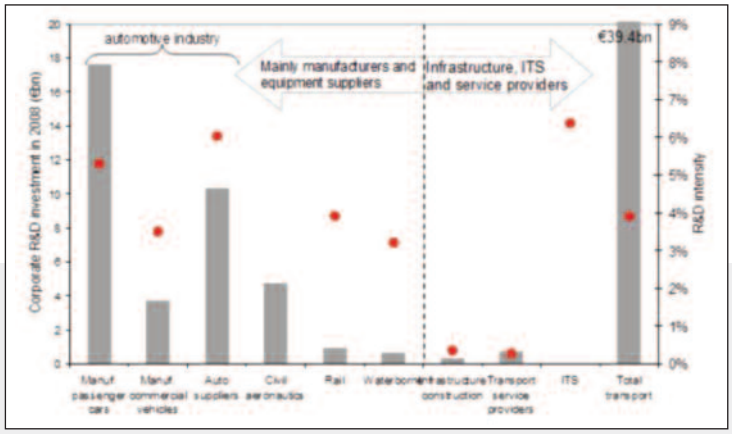


Figure 1: EU R&D Investment Across Transport Subsectors
Source: European Commission, DG JRC

The White Paper proposes around 40 actions that can be summarised as the four 'i's:

- Internal market: Create a genuine Single European Transport Area by eliminating all residual barriers between modes and national systems.
- Innovation: EU research needs to address the full cycle of research, innovation and deployment in an integrated way.
- Infrastructure: EU transport infrastructure policy needs a common vision and sufficient resources. The costs of transport should be reflected in its price in an undistorted way.
- International: Opening up third country markets in transport services, products and investments continues to have high priority.

Focusing on the role of technology and innovation in achieving these goals, Mr Rommerts noted that a competitive transport sector is key. The transport industry is an important part of the European economy: in the EU, transport services employ around 10 million people (4.5%) and account for about 5% of value added. Manufacturing of transportation equipment accounts for another 3% of value added and 8 million jobs (3.5%). Several European companies are world leaders in areas such as infrastructure, manufacturing of transport means, logistics and traffic management systems. EU-based companies invest around €39 billion per year in transport R&D plus public investment accounts for a further €4 billion (in 2008). In fact, transport is the largest R&D-investing industrial sector in the EU. European companies account for more than 40% of worldwide industrial R&D investments related to transport, compared to around 25% each for Japanese and US-based companies. However, investment intensity varies significantly between subsectors, with automotive and intelligent transport systems (ITS) having the highest rates at around 6% (compared to an average across all sectors of 4%) (Figure 1). This variability in innovation performance impacts on uptake and deployment, and highlights the need for tailor-made approaches. There is a trade-off between a modally organised transport sector versus the need to optimise the transport system as a whole.

The White Paper recognises that the goals will not be met without innovative 'technology', seen in a holistic sense. Developing the necessary technology agenda requires a joint effort, a long term perspective, and to look across the full innovation cycle from research to deployment. The Commission is developing a Strategic Transport Technology Plan to take this agenda forward. It will better specify transport research and innovation needs based on jointly agreed roadmaps. Given the current economic climate, it will also propose measures to focus transport research and innovation towards policy and deployment; and improve coordination and cooperation. Initial research and innovation areas are likely to include: clean, efficient, safe and smart transport road vehicles, aircraft, vessels, and railways; infrastructure and smart systems that make better use of ICT; and better transport services and operations for passengers and freight.

Session I: Issues and Challenges - Case Studies

Can We Afford the Transport Infrastructure We Need, and How Do We Justify It?

Prof Roger Vickerman, Dean, University of Kent, Brussels

Prof Vickerman thanked Hitachi for the invitation to present at the Forum and for the excellent train that had brought him from Canterbury! As something we experience every day, it seems everyone is an expert on transport, or thinks they are. The issue, said Prof Vickerman, was how to make improvements in this 'age of austerity'. The key, he argued, was recognising the relationship between transport and economic growth.

Much of our transport infrastructure is running beyond its design life and urgently needs updating. Such updating has to reflect changes across the board, not just in technology. Demand for transport has been changing, with more long-distance travel, changing journey purposes, and increasing journey lengths. Critics say we should look to ICT as a substitute; this is true in certain cases but in some circumstances travel is inevitable, especially when face-to-face meeting holds a certain value, such as for a business meeting or even for the networking within this Hitachi Forum. Societal changes, such as increased dispersion of families and more long-distance commuting, and changes in patterns of consumption, such as holiday and leisure expectations, teleworking and the growth of internet shopping, all have implications for mobility.

But infrastructure is costly. Capital projects are expensive to build, face supply constraints and have to address environmental concerns. Maintenance is also costly, especially for infrastructure near or beyond its design life. Interoperability - getting existing systems to work together - is also an issue. And all of this is being addressed within a context of tightening public sector budgets.

Yet transport is key to competitiveness. Ease of accessibility and quality of transport infrastructure are seen as important to agglomeration/cluster effects and to economic productivity. Cities and regions grow because they can keep costs down, but poor transport links increase costs. So a balance has to be struck between growth and congestion. We have to recognise that this is a two-way road: while better links enable those at the periphery to reach the core, they also enable those at the core to connect better with the periphery, bringing benefits for both.

What sort of capacity is needed?, asked Prof Vickerman. There are various – mutually compatible – solutions, each with some unanswered questions. Is rail the best basis for commuter networks in and around major cities? Where and how should national and international road and rail networks be built so as to avoid duplication and promote cross-border links? Are hub airports critical to economic performance? Does every region need a smaller regional airport?

Another question that arises is how to pay for it all? Public-private partnerships are seen as part of the solution but in Prof Vickerman's view "most have been a complete failure". This is partly because it can be very difficult to establish a relationship that delivers cost savings for the operator while avoiding risks falling back on the public sector.

Infrastructure should remain a public sector responsibility, but there is scope for users to bear a greater share of the burden. Above all, we need a level playing field for all modes – why should users pay the full cost of rail when not paying the full cost of road? This raises the spectre of measures such as road charging, which are unpopular and so politicians shy away from them.

Finally, we have to identify the wider impacts of transport, those beyond the direct user benefits and costs. There are four elements here: agglomeration impacts; changes in output due to imperfectly competitive markets; labour supply impacts; and the move to more or less productive jobs. We need to analyse these and attribute the impacts to specific sectors or groups in the population, possibly as a pre-cursor to recouping through specific charges or taxes.

Concluding, Prof Vickerman posed a series of questions which could frame the debate:

- Do we have the tools to predict future demand and infrastructure needs?
- Who pays – is transport a public good?
- Does better transport provide better economic performance?
- Can we afford (not to have) better transport?
- Where should the priorities lie?

Session I: Issues and Challenges - Case Studies

Energy Challenges and Costs for Transport & Mobility

Dr Lewis Fulton, Head of Energy Technology Policy Division, International Energy Agency

Dr Fulton outlined trends and targets within the energy/ transport challenge, focusing in particular on four key components: fuel economy, electric vehicles, biofuels, and costs and benefits.

Emerging economies continue to drive global energy demand. According to the IEA's World Energy Outlook 2011, global energy demand will increase by one-third from 2010 to 2035, with China and India accounting for 50% of the growth (Figure 2). Most new oil production capacity over this period is needed to offset decline. Decline at existing conventional fields will amount to 47 million barrels per day (mb/d), twice current OPEC Middle East production; the largest production increases come from Iraq, Saudi Arabia and Brazil.

As Mr Rommerts had noted, transport is the main driver in oil demand. According to IEA projections, transport net demand will expand by 14 mb/d between 2010 & 2035, outweighing a net fall in demand of more than 1 mb/d in other sectors. Oil demand is driven higher by soaring car ownership. Over the period to 2035, the passenger vehicle fleet will double to 1.7 billion; by 2020 most cars will be sold outside the OECD but markets are far from saturated, making non-OECD policies key to global oil demand.
Changing oil import needs are set to shift concerns about oil security. US oil imports will drop due to rising domestic output and improved transport efficiency; EU imports will overtake those of the US around 2015; China is predicted to become the largest importer around 2020.
Existing and announced policies will not halt the rise in CO_2 emissions, however. Global emissions will slow but still rise by 18% between 2009 & 2035, a trend consistent with a rise in global temperature of around 3.5°C. Efficiency gains can contribute most to emissions reductions. Energy efficiency measures – driven by strong policy action across all sectors – account for 50% of the cumulative CO_2 abatement over the period to 2035 (under a scenario consistent with 2.0°C temperature rise).

Turning to policies, Dr Fulton saw three key steps to a low-carbon future.
- Firstly, we have to *deploy efficiency technologies as rapidly as possible, using strong policies.* Nearly all efficiency technologies pay for themselves fairly quickly, particularly with rising energy prices (since they save fuel).
- Secondly, we should promote *rapid, deep decarbonisation of electricity generation around the world.* This will require a high percentage of renewables, energy storage, extensive deployment of CCS, much smarter grid management and end use signals.
- Thirdly, there should be *substantial increased use of the three main potential zero-carbon fuels (and energy carriers): electricity, hydrogen, and bioenergy/biofuels.* For transport, these all face major challenges.

In terms of fuel economy, a study by the Global Fuel Economy Initiative (GFEI) , a joint initiative between the IEA and other agencies, for the first time compares the average fuel economy of new vehicles around the world. Initial results show major differences between the 22 countries studied, even for vehicles within the same class. The global average was about 8 l/100km in 2005. It improved to about 7.7 in 2008, but the rate of change was well below that needed to hit GFEI targets.

Electric vehicles have a major role to play in reaching low CO_2 levels, especially after 2020. The 2010-2020 period is critical to reach scale economies, cut costs, and be ready for full commercialization in the decades that follow. Thereafter adoption rates would need to increase rapidly. By 2030, CO_2 intensity of electricity generation must be much lower in all countries, so as to make electric vehicles a sustainable alternative. Issues remain however, such as the costs and characteristics of batteries, and the type of recharging infrastructure needed and how this will work for consumers.

For biofuels, the key question is: how much will be needed? Even in a two degree scenario, electricity and hydrogen will have limited transport application in the absence of technology breakthroughs. An energy demand of up to 2000 MTOE will have to be found. IEA estimates that biofuel production would need to provide around 700 MTOE in 2050, compared to 70 MTOE today; can we do this?
Dr Fulton's contribution on the fourth issue, costs and benefits, was presented in the afternoon session.

[1] See: www.globalfueleconomy.org/Pages/Homepage.aspx

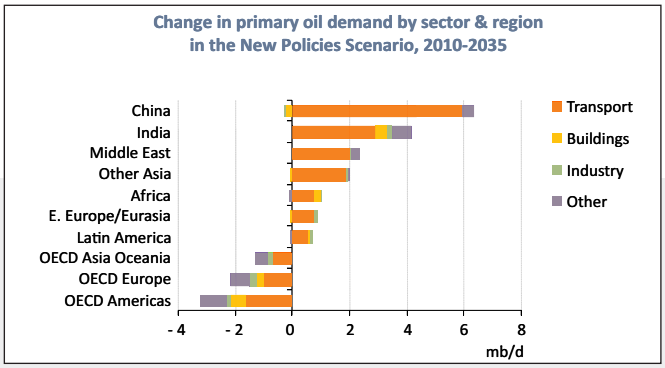


Figure 2: Transport Driving Future Oil Demand. *Source: IEA*

Building a Sustainable World City: The Role of Transport and Land Use in London

Peter Wright Policy Manager, Strategy & Planning, Transport For London

Mr Wright focused on London's relationship with transport past, current and future. As a city, London has changed substantially over the last 200 years. During the Victorian period much of this expansion was driven by the railway network, with a series of lines spreading out from termini around the central area. Cheap fares and housing improved quality of life for the ordinary worker considerably. Later the Underground spurred the development of suburbs not touched by the main commuter lines, which became known as 'Metro-land'. The Underground station at Golders Green, for example, was opened in 1904 and within a few years the area was transformed from a rural idyll to a town within the city. The convenience of the Underground connections and the proximity to central London featured heavily in advertisements for the new housing built in the suburbs during the 1920-30s. Familiar features of those early days – the topographical tube map and the Undergound logo – remain and are largely unchanged.

Today transport is seen as central to London's growth and economic prosperity. The region can be considered as a series of concentric zones. Central London comprises 4% of all residents but 25% of all jobs and is an area of intense economic activity. Inner London comprises 36% of all residents, 35% of all jobs and is characterised by high density development. Outer London has 60% of all residents and around 40% of all jobs and is dominated by low density housing. In addition, there are 12 "Metropolitan Town centres", significant centres of retail, employment and public transport provision spread across the Greater London area. Travel patterns within and between these zones differ greatly (Figure 3). For instance, although journeys from Inner and Outer London to the Central zone account for around 10% of all trips, a significant majority is by public transport. Journeys within the Inner zone (21%) and Outer zone (39%) account for a greater proportion of overall travel, much of which is by car.

Since 2000, when the Mayoral system was introduced, there has been a modal shift from car to public transport, walking and cycling of 7 percentage points. Bus usage has increased by 60%, cycling by 90%, while traffic in the Central area has reduced by 19% since 2009. Underground usage is the highest ever and there have been service improvements such as Oyster smartcard ticketing. Specific investments have been made ahead of the 2012 Olympics. One emphasis has been on providing people with better information, such as through smartphone apps, information displays at bus stops, and on-street maps.

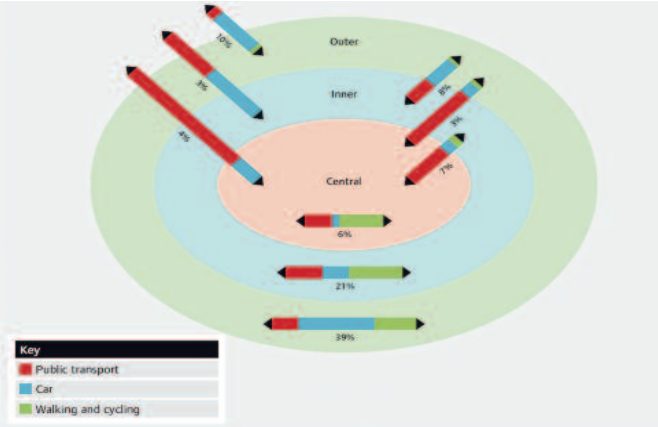


Figure 3: Travel Patterns Within Greater London
Source: Transport for London

Transport developments have to keep pace with economic development, but also help drive it. Canary Wharf, for example, has seen successive waves of infrastructure, each of which has improved the area's connectivity and increased its attractiveness. The first phase was the Docklands Light Railway, opened in 1987, which by 1995 supported a working population of approximately 13,000. The opening of the Jubilee Line Extension to the tube in 1999 led to the working population reaching 93,000 by 2006. The latest development, Crossrail (a new 118km east-west rail link set to open in 2018) will enable further schemes such as Wood Wharf and push the working population close to 200,000.

Future planning for transport is addressed within the Mayor's Transport Strategy, developed alongside plans for economic development and spatial planning. By 2031, London's population is forecast to grow by 1.3 million; employment is forecast to increase by 750,000 jobs; and the number of trips is set to increase by 30% for public transport and 15% overall (from 2008 base). In light of this, the Strategy aims to support economic development and population growth; enhance the quality of life and transport opportunities for all Londoners while improving safety and security. At the same time, policy will aim to reduce transport's environmental impact, while also supporting delivery of the London 2012 Olympic and Paralympic Games and its legacy.

This will be a policy-led approach to sustainable mobility. Integration of land use development and transport, efficiency improvements, and managing demand are all key elements. Capital investments will focus on Tube upgrades, Crossrail, the London Overground, buses and cycling. Looking to the longer term, TfL will also be seeking to get the most for London out of the proposed High Speed Train Two (HST2) network, if and when this is built.

Session I: Issues and Challenges - Case Studies

Discussion

Mr Mike Parr asked why alternatives to the proposed HST2 were not being considered. Prof Vickerman replied that the UK had made huge investment in rail, including the upgrade of the West Coast mainline. Such upgrades to operational networks were highly disruptive. There comes a point where the only way to increase capacity is to go for a new system. The proposed HST2 network would free up capacity within the existing network for intermediate stations to grow. Furthermore, upgrades do not deliver value for money versus a completely new line.

Mr Carsten Hess of Deutsche Post DHL asked why transport R&D is still focused on the automotive sector. Why do logistics and other sectors not increase their research? Mr Rommerts said he felt inclined to throw the question back to the questioner: why does DHL not invest more in R&D? The figures shown in Mr Rommerts' presentation related to EU-based companies, so may not capture the full picture in Europe but were accurate overall. In any case, further impetus will be provided for European players under the forthcoming Horizon2020 programme which has a proposed budget of €6.8billion for transport-related research.

Mr MacGillivray asked whether there was a desirable rate for R&D. Mr Rommerts said the European Commission had set a general target of 3% for R&D in the EU, although few Member States attained that level. Transport certainly needs new user-friendly and environmentally-friendly solutions. In the current climate of austerity, the issue is deployment, which goes back to Prof Vickerman's question: who will pay?
A participant asked why cycling's share was so low in London. Mr Wright acknowledged that cycling and walking had declined in the past. In the central area the modal share is now around 20%, whereas 15-20% of car journeys are less than 500m, so changing behaviour is a real challenge.
If the choice in this age of austerity is between hardening existing infrastructure and developing new schemes such as HS2, where should our priorities lie? Mr Rommerts thought that it was not a question of either/or. We need a balanced approach between the different priorities. Dr Fulton agreed there was a need to balance the future versus how things run right now. "This requires that we appeal to the public and give them a vision of the transport system of the future". We spend a lot of money on personal transport, in Europe about €500 billion on cars and fuel per year. In developing countries the situation is different: people are forced to spend on cars because the state cannot provide basic mobility. Mr Rommerts added that an efficiency saving of 5% per annum could save

€25 billion. A 10% saving – equivalent to €50 billion – would be even better. This money could then be reinvested in innovation and deployment.

Mr Wright emphasised the importance of investment commitments spanning beyond the political cycle, as had been the case in London. Having that security gave much greater certainty in planning for the medium term, while also allowing new initiatives on cycling, etc.

Prof Vickerman reiterated that investment in transport is a long-term undertaking; we cannot afford to wait around to see what happens, as has been the approach in the UK regarding airports. Also, it is essential to get the pricing structure right, so we can see where demand is and get signals for planning. Again, this has not been done in the UK.

Session II : Innovative Answers

The Third CO_2 Cycle

Bernard Stroiazzo-Mougin, President, Bio Fuel Systems

Bio Fuel Systems (BFS) is pioneering a new approach to producing biofuels based on the photosynthetic properties of algal. This approach not only produces a high-grade fuel that can substitute for gasoline, but also – and most importantly – reduces CO_2 emissions as well. It represented, said Mr Stroiazzo-Mougin, a new and additional CO_2 cycle to sit alongside those observed in nature.

Petroleum has proven its worth as a dense practical trans-portable storable chemical energy. This 'black gold' is the pillar of the economy in the industrialised world but its economic and environmental viability oblige us to search for other alternative resources.
BFS's technology can help meet these challenges in a variety of ways. Firstly, the energy challenge, by absorbing and quickly turning industrial CO_2 into fuels similar to fossil fuels that are compatible with current transport and electrical production structures. Secondly, the environmental challenge: creating an artificial anthropomorphic CO_2 cycle to avoid the saturation of the natural cycle due to industrial emissions and thus reduce the greenhouse effect. Thirdly, as a source of food: working on this organic chain, the mineral chain of CO_2 transformation to separate protein elements and essential fatty acids for a healthier nutrition of the population.

BFS's technology is based on physical processes observed in nature. It uses solar energy as the main source of energy and CO_2 from industrial emissions as the raw material. Phytoplanktons are used as a simple primary efficient exchanger, using photosynthesis enhanced with catalysers to transform the CO_2 into a high quality hydrocarbon. Around 2168 kg of CO_2 is required to produce one barrel of biofuel oil. The end result is a high quality fuel with a calorific value of around 9,700 kcal/kg.

The technology runs on a pilot plant near Alicante in Spain, taking CO_2 from a nearby cement factory. This plant has the potential to process around 450k tonnes of CO_2 per annum, producing 35k tonnes of biofuel and 3k tonnes of highly nutritious secondary products. Around 200k tonnes of CO_2 emissions would be eliminated from the atmosphere.

Figure 4: BFS's Demonstration Plant, near Alicante

Session II : Innovative Answers

ICT for Safe, Eco-Friendly and Efficient Mobility

Dr Ilja Radusch, head of Automotive Services & Communication Technologies department, Fraunhofer Fokus

The concept of 'smart mobility' presents many challenges: how to achieve greater safety for all road users; how to achieve more efficient use of existing infrastructure; and how to achieve less consumption and pollution. Communication is central to all of these issues and was the main focus of Dr Radusch's presentation.

Driver assistance systems – an application of communications to improve safety – is the subject of extensive research and certain systems are already being deployed in commercial vehicles. They include systems to warn the driver about a vehicle in their blind spot while manoeuvring, to warn about black ice, and to warn about traffic jams ahead.

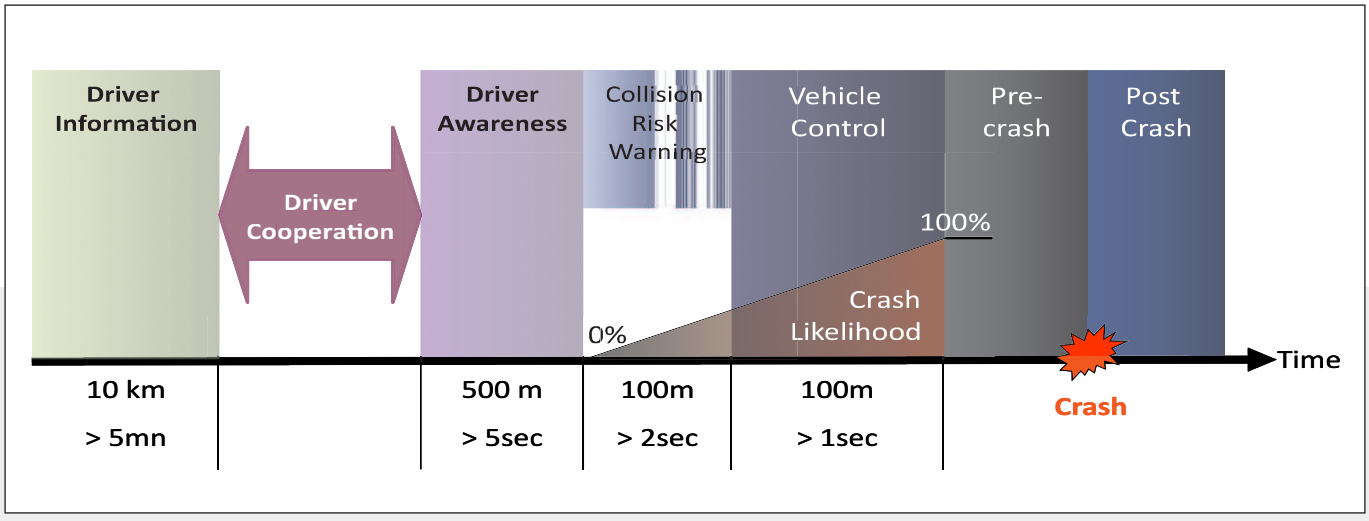
Fraunhofer Fokus and Hitachi are both partners in a European project called DRIVE C2X which aims to establish a European standard and protocol for vehicle-to-vehicle communications. The project will verify proper functioning under real life conditions, prove European-wide interoperability, assess the impact of the various use cases and agree certain use cases for early deployment. Development of the reference system is spread across seven test sites and builds on an earlier project, Pre-Drive 2.

Advanced traffic information systems and recommended itineraries can contribute to greater efficiency. In urban scenarios, tests show that not only vehicles equipped with the system benefit from reduced travel time but 'classic' non-equipped vehicles do too, due to reduced congestion.

Turning to environmental considerations, emissions per vehicle have been decreasing over recent years but this effect is masked by the rapid increase in vehicles overall, so that total emissions continue to rise. Within an urban setting, co-operative eco-friendly navigation can be used to even out emissions, directing traffic onto less pollution-affected routes and so avoiding pollution 'hotspots'. Such an approach leverages the willingness of drivers to cooperate and work as a team. Various traffic and pollution data sources are aggregated and combined based on vehicle-2-x communication and smartphone technology.

In conclusion, Dr Radusch foresaw a new era of in-vehicle communication systems based on driver cooperation (Figure 5). These would fill the gap between the passive driver information systems that act over relatively large distances and timescales and the active driver awareness/ warning systems that act over very short distances and timescales in the seconds leading up to a crash. Such cooperative systems could also increase traffic densities and reduce pollution.

Figure 5: Opportunities for Driver Cooperation



Train Technologies for 2050

Prof Roger Goodall, Professor of Control Systems Engineering, Loughborough University

Forty years is a long time in technological terms. A look back to the train technology of the 1970s shows how significant developments can be. Over this period, we have seen the introduction of trains with tilting technology, with distributed lightweight AC traction (so removing the need for a big locomotive), and intra-train communications via built-in bus systems. None of these had business cases in the 1970s, observed Prof Goodall, which should give pause for reflection: "Business cases may kill off potentially important developments".

The next forty years will see a series of demanding trends and targets in terms of cost-reduction, reduced carbon emissions, and increases in network capacity and customer numbers. This will require a combination of emerging technologies and other, as yet unknown, technologies not even on the horizon.

Advanced electric traction systems are expected to make a key contribution. The efficiency of current systems can be further improved by exploiting the potential to store energy from braking by introducing a storage device such as a battery, supercapacitor or flywheel. At present this is not possible because of space and weight constraints, but new compact, lightweight energy storage solutions promise to bring advances.

Mechatronics is also on the horizon. The redesign of purely mechanical systems to take advantage of electronics, computing and control has happened in aircraft (fly-by-wire), is happening in cars (electronic stability control, drive-by-wire, etc.) and is now starting to happen in trains as well. This could be applied, for example, in the active control of a train's running gear (bogies), with potentially important benefits such as better performance, track-friendly trains, and simpler mechanical configurations.

Other emerging technologies include advanced materials, e.g. composites (already available but benefit/cost ratio too low), advanced condition monitoring, and all-electric trains (i.e. with no pneumatic systems). The science and technology of superconductors is advancing rapidly and could open the way to motors with much higher current densities, which would potentially be a disruptive technology.

So the vision for future rail is of a lightweight vehicle facilitated by advanced mechatronics. If we combine such vehicles with the system itself, we could envision vehicle-based track switching so that the vehicle is actively guided. And taking one step further, why not remove the mechanical coupling between vehicles so that they are electronically coupled only? Thus, there could be highly dispersed rail vehicles which each start from separate locations and come together in the centre of cities or on high traffic routes (Figure 6).

So, trains in 2050 will not be the same as they are now, noted Prof Goodall. This vision will not be correct, but elements of it may be. A number of emerging technologies are likely to become important future train technologies, but what else is out there that we do not yet know about?

The next forty years will see a series of demanding trends and targets in terms of cost-reduction, reduced carbon emissions, and increases in network capacity and customer numbers.

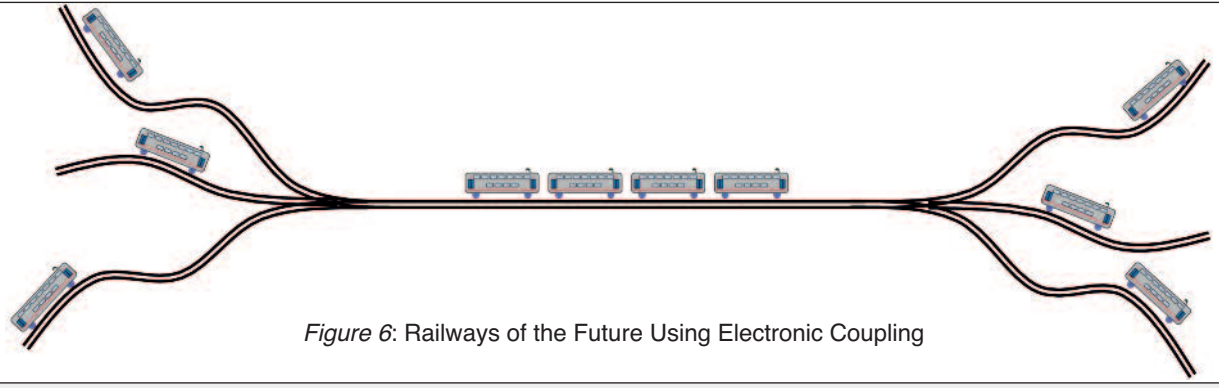


Figure 6: Railways of the Future Using Electronic Coupling

Session II : Innovative Answers

Discussion

Mr Stroiazzo-Mougin's presentation aroused significant interest. Several questioners wanted to know the cost per barrel of the biofuel product. Was it really cheaper to produce than a conventional barrel of oil, as stated in the presentation and accompanying literature?

Mr Stroiazzo-Mougin said present technology allowed the production of 3-5 barrels per hectare per day, so for 1 million barrels per day would require ~5000 sq kms. The pilot plant is in Spain so as to take advantage of the hot climate. It takes CO_2 from an Endesa power plant, separates the CO_2 and then processes it. The cost is $20 per barrel because the biofuel is a secondary product. Capital costs are amortised over two-four years. BFS aims to produce 1 million barrels per day within 4-5 years. Mr Stroiazzo-Mougin reminded the audience that conventional crude oil contains long-chain mineral oils which require refining. Only around 10% goes for high value products such as gasoline, whereas the remaining 90% goes for other uses. Dr Fulton noted that the costs of algal biofuels were generally quoted as around $2 per litre, compared to the $0.30 claimed here.

Mr Parr asked whether the communication vision produced a tendency for people to over-rely on sensors, as was the case at present with satellite navigation. Dr Radusch acknowledged this was a risk but increases in traffic volumes demand new technologies. Manufacturers do not expect sensors to replace other channels and although there is a risk of over-confidence it will be worth it in the long run. Asked about nausea induced by tilting trains, such as the Pendolino, Prof Goodall said a significant minority of rail passengers were initially affected. Modifications had improved the experience for many passengers and now only a minority of them are affected. In any case, train operators are revisiting the business case for such technology. Although tilting allows the train to take curves faster, the total reduction in journey time is only around 4-5%. So without track upgrades the gains are marginal.

Mr MacGillivray asked whether the distributed coupling vision could also be applied to cars? Prof Goodall replied that demonstrations had already taken place but had been stopped, largely due to concerns over safety litigation. In railways, which have centralised command and control structures, this is less of an issue.

Hitachi will continue to innovate for a Green and Smart transport system to reduce traffic energy consumption and is looking to work with European partners in these efforts.

Keynote

Hitachi's R&D Activity Towards Transport Innovation

Dr Keiji Kojima, Vice President and Executive Officer, Hitachi, Ltd.

The Great East Japan Earthquake of March 2011 emphasised the need for a safe, reliable and energy-efficient transport system. In Tokyo, many miles from the epicentre, thousands of commuters were stranded due to power failures as a result of the disaster.

As other speakers had noted, energy consumption is increasing globally and mobility accounts for a significant proportion of this mega-trend. We need Green and Smart transport technologies to reduce traffic energy consumption. Hence, Hitachi's activities in transport innovation drive in the direction of i) Green technologies and ii) Smart technologies. Electrification is one contribution to greener mobility, decreasing the energy per passenger kilometre. Smarter transport relies on the use of ICT to optimise use of energy in the system as a whole, for instance through better use of information. Hitachi's business is no longer simply about products or systems but about social innovation.

Hitachi's Research & Development Group comprises around 3,500 people. These are mainly in Japan but with facilities worldwide, including London, Cambridge, Munich, Singapore, Shanghai and Santa Clara. The Transportation, Energy & Environment Research Laboratory (TEEL) was set up in April 2011 to bring together related business units in Europe. It comprises facilities in London (for railway systems), Munich (automotive systems) and Paris (for energy systems and power electronics) and works closely with Hitachi's Information & Communication Technologies Laboratory (ICTL) based in Sophia Antipolis.

TEEL collaborates with many universities, such as Technische Universität München (TUM) in simulation of global engine emission regulations. Other examples of research for green transport systems include: rare-earth free motors for industrial use; high power density inverters for use in electric and hybrid-electric vehicles; high power, high capacity longlife and safe lithium batteries; and the design and production of energy-efficient rolling stock for the next generation of railways. An important innovation is a new generation of power converters for railways based on silicon carbide (SiC), which achieve substantial reductions in size and weight.

Research for Smart transport systems includes: advanced robotics for use in automotive, railway and power systems; sensors able to detect objects (such as pedestrians) around a vehicle and so enhance safety; and an 'all-in-one system' proposal for railways. As noted by Dr Radusch, Hitachi is also a partner in DRIVE C2X, a major European project to establish a European standard for car-to-car (C2C) communication systems. Hitachi is also developing wireless communication middleware for C2C and car-to-infrastructure (C2I) based on European specifications. A major Smart Grid demonstration project in Hawaii, partly funded by Japan's New Energy and Industrial Technology Development Organisation (NEDO), aims to assess the stabilisation of grids connected with wind generation by controlling demand-side equipment.

Hitachi will continue to innovate for a Green and Smart transport system to reduce traffic energy consumption and is looking to work with European partners in these efforts.

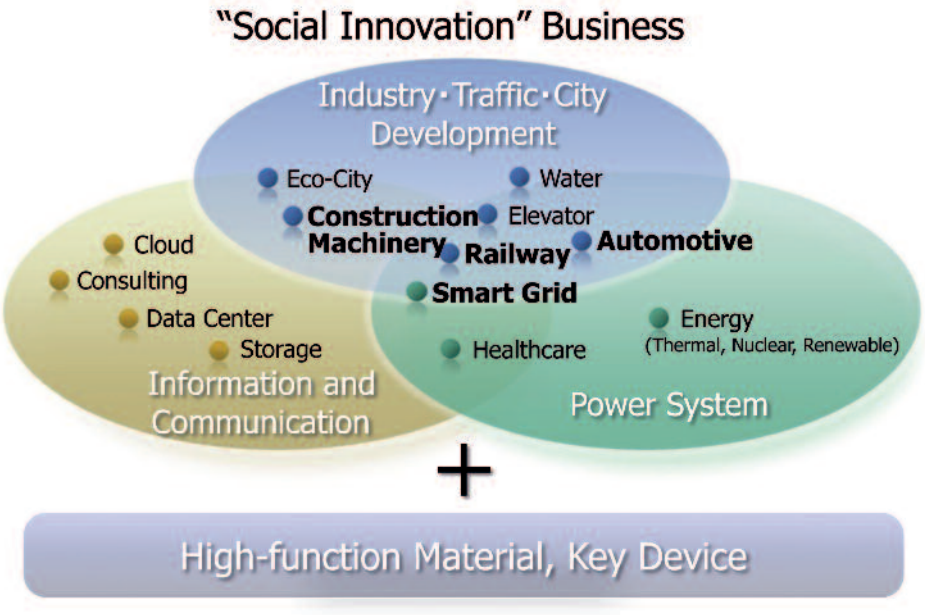


Figure 7: Hitachi in the Business of 'Social Innovation'

Scenarios for 2050

Moderation: Christophe Leclerq, Founder & Publisher, **Ian Hall**, UK Public Affairs Director, Euractiv

Flying to work? Take a MyCopter!

Prof Michael Decker, Institute for Technology Assessment and System Analysis, Karlsruhe Institute for Technology

As the economist Joseph Schumpeter famously noted, innovation is a process of 'creative destruction', that incessantly revolutionises the economic structure from within. Technology assessment – the focus of Prof Decker's Institute at ITAS – is about analysing the balance of winners and losers in such innovation processes: un-/intended effects, un-/desired consequences, main/side effects, positive/negative impacts, chances and risks. Inevitably, the visions that flow from TA are probably wrong from an ex post perspective (taken in future), but this does not matter so long as they are justifiable at present.

MyCopter is a European R&D project into personal aerial transportation. The costs of congestion are well known and have been elaborated by other speakers. A personal aerial transportation system (PATS) is one potential solution. The vision is of a personal aerial vehicle (PAV) – an airplane or helicopter – as a form of transportation that would combine the advantages of ground-based and air-based transportation systems. This vision is nothing new and has been the subject of science fiction – and some science fact – for at least the last 50 years.

The MyCopter project is looking at enabling technologies and focuses on a concrete context (commuting) with either a low or high skilled passenger/driver/pilot. The TA has two main aspects: the balance between automation and autonomy; and how such a system could be implemented into the current transportation infrastructure. So far the project has undertaken a screening of the issues, developed a series of travel scenarios, and set out a series of physical and performance specifications.

Door-to-door time is seen as one of the most important attributes. Distance and accessibility to the departing airfield and availability when needed (e.g. regarding weather and traffic) are also significant. Although there are technical and operational challenges (e.g. the parking and storage of

PACT Locus of Authority	Computer Autonomy	PACT Level	Level of HMI
Computer monitored by pilot	full	5a	Computer does everything autonomously
		5b	Computer chooses action, performs it & informs human
Computer backed up by pilot	Action unless revoked	4a	Computer chooses action & performs it unless human disapproves
		4b	Computer chooses action & performs it if human approves
Pilot backed up by computer	Advice, action if authorised	3	Computer suggests options and proposes one of them
Pilot assisted by computer	Advice	2	Computer suggests options to human
Pilot assisted by computer on request	Advice only if requested	1	Human asks computer to suggest options and human selects
Pilot	None	0	Whole task done by human except for actual operation

Figure 8: Autonomy versus Automation in PAVs

PAVs), many of the issues identified relate to safety, legal and other aspects. The issue of autonomy versus automation is key. Various levels of pilot-computer interaction can be envisaged, from one where the pilot has full authority and there is no computer intervention, through to one where the computer does everything autonomously and is simply monitored by the pilot (Figure 8). The further up this 'locus of authority' spectrum one moves, the greater become the barriers both in terms of public acceptance and regulatory approval.

Asked whether a prototype had been produced, Prof Decker stressed that this was not an aim: rather the focus was on the enabling technologies and how to scale into a mass market solution in order to get a positive effect on congestion at ground. Initial investigations suggest the battery weight/energy density for an electrically-power PAV seems to be practical. There are no requirements on costs at present, but it is estimated that PAVs would cost the equivalent of a middle class family car.

Actions for Low Carbon and Climate Resilient Transport

Françoise Nemry, Economics of Climate Change, Energy and Transport Unit, Institute for Prospective Technological Studies, DG Joint Research Centre, European Commission

Reiterating the presentation of Mr Rommerts, Ms Nemry noted that the European Transport White Paper asserts "curbing mobility is not an option". Rather, this important policy paper sets 10 goals for a competitive and resource efficient transport system (benchmarks for achieving the 60% GHG emission reduction target), and proposes 40 initiatives for which implementation measures are to be developed, assessed, and presented. The Commission Staff Working Paper – on which Ms Nemry's presentation was based – contains supporting analysis based on a series of models and academic research.

The Paper contains four scenarios, the first of which, the Reference Scenario, assumes more or less a continuation of current trends and policies. Compared to this:

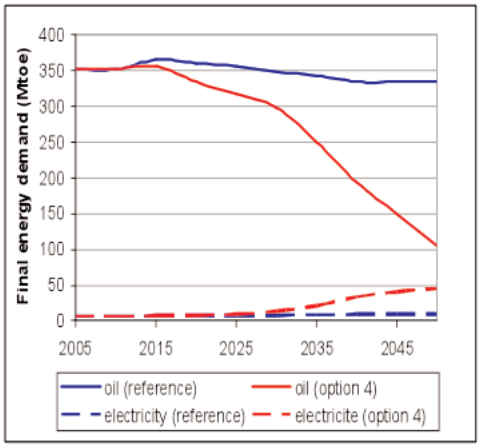
- Policy Option 2: Stronger focus on transport efficiency measures: completion of the internal market, infrastructure development, pricing and taxation.
- Policy Option 3: Stronger focus on technologies: developing and deploying technologies through the introduction of rigorous standards for all vehicles; promotion of R&D policies into the development and subsequent deployment of alternative fuel use.
- Policy Option 4: Balanced contribution of transport efficiency measures (option 2) and technology oriented measures (option 3).

The assessment shows Policy Option 4 to be the most preferable. While achieving the CO_2 target (Figure 9) at higher costs than Policy Option 3, it has lower congestion costs and the overall benefits of a less distorted pricing system. Similarly, Option 4 is also the most advantageous in terms of social impact, affecting lifestyles less drastically than Option 2 but with a greater choice of benefits than Option 3. Policy Option 2 is the most ambitious in environmental terms since it covers the broadest range of environmental impacts. Detailed figures were presented to illustrate these results.

In conclusion, the 60% GHG emission reduction by 2050 is shown to be feasible for EU transport, and to be compatible with other overarching goals (economic progress, enhanced competitiveness and high quality mobility services). None of the categories of instruments alone would be capable of tackling at the same time and in a satisfactory way all of the various problem drivers and all the elements of the specific policy objective. A mix of actions would be needed. The challenge now is to translate these into implementing measures towards a comprehensive and strategically coordinated EU action.

Appropriate legislative proposals with key initiatives will be put forward, preceded by a thorough impact assessment.

Ms Nemry was asked whether any risk assessment had been undertaken on the cost of not taking internal market measures. She replied that the assessment was not made on each individual measure but that such costs are taken into account in the comparison of the policy strategy with baseline scenario in which no internal market measure is assumed. Overall the costs of the policy strategy have been assessed against a baseline scenario (around 0.2-0.4% of GDP compared with baseline by 2050). In response to a question on infrastructures, Mr Rommerts said that the TransEuropean Networks (TEN-T) are an important implementation instrument for transport policy. In the Commission's proposals, future implementation may become more holistic, addressing accompanying ICT infrastructure (e.g. traffic management) and fuelling infrastructure besides the transport infrastructure itself.



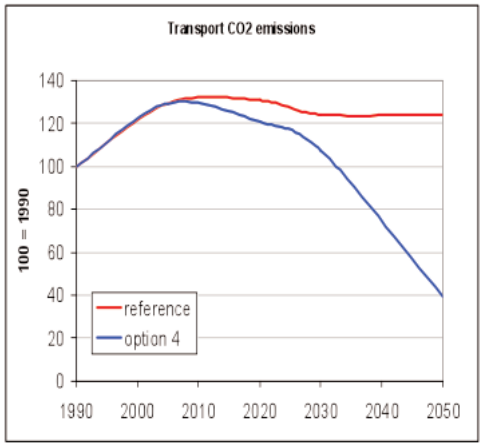


Figure 9: Energy Use and CO2 Emissions from Transport under Policy Option 4

2050 Energy Scenarios for Transport and Mobility

Dr Lewis Fulton, Head of Energy Technology Policy Division, International Energy Agency

Dr Fulton noted that a key message from the presentations thus far was that we have to address societal costs and benefits and unintended consequences. The European Commission's projections seemed to be comparable with those of the IEA, but we need to aim for even greater modal shifts away from car and road transport. Standards alone are not enough, we have to really invest in the infrastructure and provide incentives and direct investment.

What will it all cost?, Dr Fulton asked. Continuing from the morning presentation, he compared cumulative transport costs by scenario for the period 2010-50. The IEA's Improve case (i.e. where the focus is on improving existing technologies) greatly reduces the expenditures on fuels, whereas the Avoid/Shift case (i.e. where the emphasis is on shifting or reducing demand) cuts down infrastructure and vehicle costs. The costs of these low-carbon futures (together part of a two degree scenario) are actually below the estimated cost of a baseline (four degree) future, perhaps tens of trillions of dollars less compared to over $500 trillion spent on vehicles, fuels and infrastructure in the baseline, cumulative from 2010 to 2050. The Improve scenario achieves greater CO_2 reductions than the Avoid/Shift scenario but both provide significant impacts. These results will be explained in greater detail in a forthcoming paper to be published in IEA's Energy Technology Perspectives series.

> Standards alone are not enough, we have to really invest in the infrastructure and provide incentives and direct investment.

Group Discussions

Participants separated into discussion groups representing one of five stakeholder communities: scientists & researchers, companies, citizens & NGOs, the media, and policy-makers/governments. They were then invited to address the following questions:
1) Provide one key recommendation to policymakers to promote transport & mobility in 2050;
2) Provide one suggestion to encourage take-up of sustainable solutions by society;
3) Provide one action the relevant stakeholder group could take now to promote more sustainable solutions.

A wide range of ideas were obtained and are presented in the Table in Annex 1.

Wrapping up the discussion exercise, Mr Christophe Leclerq, Founder & Publisher, Euractiv, said the comments could be summarised in four words: Involve, Invest, Incentives, and Information.

Many of the contributions emphasised collaboration and cooperation. It is essential to involve stakeholders so as to converge on shared visions and views. The EU Hitachi Science & Technology Forum had been one contribution in this respect and Hitachi was to be congratulated on the achievement. Clearly, investment will be necessary to realise these visions. This means not just public funding, but also the private sector and cost savings. Incentives were mentioned frequently in the group responses. We have to find ways of engaging users and consumers in tackling the challenges ahead.

Finally, it is essential to inform. Scientists and engineers are not natural communicators but they accept it needs to be done. Non-European companies, such as Hitachi, can help in this dialogue, starting with taking the arguments to policy-makers in governments and EU circles.

Closing Session

Mr Alex MacGillivray, Forum General Moderator, thanked Mr Leclerq for his summary and did not wish to add to it. He noted that the Hitachi presentation by Dr Kojima had shown that very serious technical issues were being addressed at a technological level. Hence, it is not all down to citizens. Hitachi's key phrase 'Inspiration' should perhaps be added as the fifth 'i'. A lasting impression was that the implementation of existing technologies is not enough. We have to push the boundaries, as with Blue Petroleum and the MyCopter, as well as following existing paths.

Closing the Forum, Mr Hans Daems, Group Public Affairs Officer, Hitachi Europe Ltd. said the event had shown that transport is linked with experience, quality of life and security. It had set the scene, looking at what lies ahead, improving mobility while reducing impact. The conference had also talked about the constraints: how to revive exhausted infrastructure; how to pay for new infrastructure in times of austerity. And the conference had looked at recipes for public-private partnerships which were clearly a must for the future.

What are the solutions? While it was not possible to comment on what is feasible or realistic, the presentations had shown looking backwards to be very valuable. The need to set a business case was emphasised, but this is not always necessary or sufficient; we have to take account of possible future developments as well. Thus, it is necessary to differentiate between short, medium and long timescales and to seek new solutions through the integration of existing technologies. The Forum had also addressed the human aspect: for example, the need to leverage road participants to collaborate as a team, the reaction of the public to new prices and public acceptance of fully automated flying. Such questions must remain at the fore as we tackle the challenges ahead.

The next EU Hitachi Science & Technology Forum would be in 2014 and suggestions for themes, topics and speakers were invited. In the meantime, the participants were encouraged to continue discussions from the present event using social media.

Finally, on behalf of Hitachi, Mr Daems thanked all speakers, moderators, Forum Fellows and guests and wished everyone a safe trip home.

"Transport is linked with experience, quality of life and security."

Annex 1: Ideas from Brainstorming

1 Provide one key recommendation to policymakers to promote transport & mobility in 2050

- Better co-ordinate and integrate studies and findings, e.g. bringing together the many good studies on future of transport and of work.
- Commit governments to reduce complexities in existing transport systems (incl. in R&D setting).
- Consistent policy - should change gradually, not step change otherwise impossible for companies to plan.
- Evolutionary policy framework, which supports demos and innovation.
- Include better risk management in transport assessments.
- Innovate by challenging existing assumptions - e.g. Why work Mon-Fri?
- Invest more in R&D; optimise current transport infrastructure; link technology discussions with job creation; take better account of cost issues.
- Personal mobility management system - credits on public transport.
- Place emphasis on translation from research to implementation so as to help new technologies into the market.
- Policymakers should take a wider global view - these are worldwide not just EU problems. Issues of today can have undesired outcomes, e.g. Go green but export jobs.
- Provide stable, strong, predictable long-term funding with emphasis on projects integrating all groups (end-user, industry and academia).
- Start public-private partnerships earlier, at the beginning of the policy process rather than at implementation.
- Take a long-term perspective but taking account that they (policymakers) would still be responsible in 40 years time.
- Take a more holistic view - look at the broader picture. Expect policymakers to take the lead.
- Take responsibility and tell the truth - be real decision makers!

2 Provide one suggestion to encourage take-up of sustainable solutions by society

- Communications/awareness-raising towards all citizens, including schools focusing on both positive and negative aspects.
- Companies leading the demonstrations - experimental learning with real technologies.
- Educate us every age and everywhere - +ve and -ve but noting long term advantages.
- Emphasise win-win approaches.
- Enhance the transparency of benefits but also costs of mobility.
- Incentives to change behaviour e.g. Car scrappage in UK, DE etc was successful. Not enough focus on existing car fleet - retrofit technology.
- Incentivise and marketing campaign for personal mobility.
- Look at the social incentives, e.g. Carbon-neutral transportation ticket.
- Make children and young people understand the impact of transport on energy saving & environment and the benefits of walking/cycling.
- Media can be part of the solution - helping society to change habits.
- More awareness initiatives.
- More transparent information disclosure. Introduce Swiss referendum system. Opportunity to be involved in European Citizen Initiative with a business focus.
- Organise open forums to explain innovation in a simplified way and how it can change everyday life and engage society.
- Promote what products can do and the benefits they could bring - honestly.
- Provide long-term incentives - end the contradictory signals for different behaviours. Use social media to change norms.

3 Provide one action we could take now to promote more sustainable solutions.

- Ad-based tools for citizens and businesses. And a standardised pan-European information/recording tool on CO_2 emissions.
- Ask every few months, do we have to do this? i.e. more self examination, so as to encourage us to change habits.
- Free bikes for everyone! Will generate business for manufacturers.
- Give people an immersive game to get them familiar before they see the real thing.
- Government as a role model, practising what it preaches.
- Improve cycling lanes.
- Introduce flexible working hours.
- Introduce one day without travelling.
- Media campaign focusing on R&D for transport, promoting greater efficiency, lower cost.
- Remove parking places, introduce congestion charging, rationing.
- Stop thinking in conventional terms. A 21st century Wuppertal. Turn personal cars into informal taxis through use of ICT.
- Studies of smart ticketing and other mobility management systems.
- 'Travel-free Friday', to reduce travel on one day a week.

Annex 2: Agenda

09:00 – 09:05 **Welcome remarks**
Masahide Tanigaki, Representative Executive Officer, Senior Vice President and Executive Officer, Hitachi Ltd.

09:15 – 09:35 **Keynote**: Setting the scene: overview of Transport sector in Europe,
Marcel Rommerts, DG Mobility & Transport, European Commission

09:35 – 10:35 **Session I: Issues and Challenges: Case studies**

- Can we afford the transport infrastructure we need, and how do we justify it?
  Prof. Roger Vickerman, Dean, University of Kent, Brussels
- Energy Challenges and Costs for Transport & Mobility
  Dr. Lew Fulton, Head of Energy Technology Policy Division, IEA
- Building a sustainable world city: the role of transport and land use in London
  Peter Wright, Policy Manager, Strategy & Planning, Transport For London
- Q&A

11:00 – 12:20 **Session II : Innovative answers**
- The third cycle CO 2 BFS
  Bernard Stroiazzo-Mougin, President, Bio Fuel System
- ICT for safe, eco-friendly and efficient mobility
  Dr. Ilja Radusch, head of Automotive Services and Communication Technologies department, Fraunhofer Fokus
- Train technologies for 2050
  Prof. Roger Goodall, Professor of Control Systems Engineering, Department of Electronic & Electrical Engineering, Loughborough University
- Q&A

13:00 – 13:20 **Keynote**:
Hitachi's R&D activity towards transport innovation
Dr. Keiji Kojima, Vice President and Executive Officer, Hitachi, Ltd.

13:20 – 16:00 **Scenarios for 2050**
Moderation: Christophe Leclerq, Founder & Publisher, EurActiv
Ian Hall, UK Public Affairs Director, EurActiv

- Flying to work? Take a MyCopter!
  Prof. Michael Decker, Institute for Technology Assessment and System Analysis, Karlsruhe Institute for Technology
- Actions for low carbon and climate resilient transport
  Françoise Nemry, Economics of Climate Change, Energy and Transport Unit, Institute for Prospective Technological Studies, DG JRC, European Commission
- 2050 Energy Scenarios for Transport and Mobility
  Dr. Lew Fulton, Head of Energy Technology Policy Division, IEA

16:00 – 16:15 **Conclusion:**
Forum General Moderator, **Alex MacGillivray**, Executive Director, Climate Business

Closing Remarks:
Hans Daems, Group Public Affairs Officer, Hitachi Europe Ltd.

Forum General Moderator: Alex MacGillivray, Executive Director, Climate Business

Acknowledgments

First of all it gives me great pleasure to extend my thanks to the distinguished speakers and moderators who contributed to this year's Forum. During a full day, participants to the Forum could enjoy high level presentations and very open Q&A sessions. Their professionalism and ability to share their expertise with the audience greatly contributed to the success of this year's event. I would also like to thank all of this year's Forum attendees whose active participation led to extremely vibrant and constructive discussions. Interaction and lively debate on the given topic area between all participants are two of the main aims of this Forum and my thanks go to all speakers, moderators and participants for helping to achieve this goal.

I would like to express my heartfelt thanks to Mr. Alex MacGillivray who kindly accepted to be the Forum general moderator and who performed his task with the utmost professionalism throughout the day. The smooth running of the sessions owes Mr. MacGillivray a deep debt of gratitude.

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As a last word of acknowledgment, allow me to mention the efforts of Mr. Teruya Suzuki, the previous General Manager of Hitachi Corporate Office, Europe who has now returned to Japan. For two years, Mr. Suzuki diligently supervised the organisation of this Forum and much of its success in this period is due to his vision and commitment to contribute to European society through this gathering. We wish him to be as successful in his new assignment as he was while in Europe.

Masayoshi Takidera
General Manager
Hitachi Corporate Office, Europe

Speakers & moderators

Mr. Hans Daems	Group Public Affairs Officer, Hitachi Europe Ltd.
Prof. Michael Decker	Institute for Technology Assessment and System Analysis, Karlsruhe Institute for Technology
Dr. Lew Fulton	Head of Energy Technology Policy Division, International Energy Agency
Prof. Roger Goodall	Professor of Control Systems Engineering, Department of Electronic & Electrical Engineering, Loughborough University
Mr. Ian Hall	UK Public Affairs Director, Euractiv
Dr. Keiji Kojima	Vice President and Executive Officer, Hitachi, Ltd.
Mr. Christophe Leclerq	Founder & Publisher, Euractiv
Ms. Françoise Nemry	Economics of Climate Change, Energy and Transport Unit, Institute for Prospective Technological Studies, DG JRC, European Commission
Dr. Ilja Radusch	Head of Automotive Services and Communication Technologies department, Fraunhofer Fokus
Mr. Marcel Rommerts	Policy Officer, Directorate General Mobility & Transport, European Commission
Mr. Bernard Stroiazzo-Mougin	President, Bio Fuel System
Mr. Masahide Tanigaki	Representative Executive Officer, Senior Vice President and Executive Officer, Hitachi Ltd.
Prof. Roger Vickerman	Dean, University of Kent, Brussels
Mr. Peter Wright	Policy Manager, Strategy & Planning, Transport For London

Forum General Moderator	
Alex MacGillivray	Executive Director, Climate Business

Forum Fellows	
Dr. Jean F. Freymond	President & Director, Geneva Dialogues (D@G)
Prof. M. Muraszkiewicz	Director, Institute for Computer Science, Warsaw University of Technology
Mr. Antoine Ripoll	Senior Administrator, European Parliament
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