Introduction to Panel 4 Mobility, transport, and smart and sustainable cities

Panel Leader: **Neil Wallis**
Low Carbon Vehicle Partnership
United Kingdom
neil.wallis@lowcvp.org.uk

Panel Leader: **Marianne Ryghaug**
Norwegian University of Science and Technology
Norway
marianne.ryghaug@ntnu.no

Introduction

An increasing percentage of the EU population lives in urban areas, using 70 % of our energy. Thus, the sustainable development of urban areas is a key challenge for policymakers. This requires new, efficient, and user-friendly technologies and services and particularly important is how we tackle mobility challenges in future cities. Solutions need integrated approaches, in terms of both the research and development of advanced technological solutions, as well as their deployment. Transport is currently responsible for about a third of energy consumption in Europe. So in both the urban and wider contexts, it's vital that transitions in transport and the mobility services of the future bring about a more efficient and sustainable use of energy, in order to improve resource efficiency, cut greenhouse gas emissions and local pollution and improve energy security.

The Panel 4 submissions were grouped into five themes:

- **From transport to mobility services; optimising the efficiency of movement** – the papers in this section focus on the creation of new 'mobility services' like car sharing and the optimization of modal choice while reflecting on the changing relationship of young people with the private car.
- **Plug-in & hydrogen vehicles: user perceptions and consumer behaviour** – focuses on user experiences of hydrogen and electric vehicles, including interactions with the refuelling infrastructure.
- **Policy making for low carbon transport** – include a variety of approaches to unblock the shift to low carbon, low pollution transport in cities and extra-urban environments.
- **Smart cities: sustainable mobility & the EV demand challenge –** look at the issue from a variety of perspectives, including the value of international cooperation.
- **Smart cities: the built sector and the need for community engagement –** ask how ready Europe is for the 'smart building revolution', focusing on the importance of community engagement.

From transport to mobility services; optimising the efficiency of movement

The revolution in information technology associated with mobile and other hand-held devices has spawned an associated revolution in the way we are looking at moving around in future cities. From Uber and Gett, car clubs to Bolloré Autolib car sharing and vehicles with increasing levels of autonomy, technology is an enabler of extraordinarily rapid changes in mobility behaviour.

Ortar and Vincent-Geslin (4-433-17) look at the idea of 'peak car', particularly in the context of urban areas, focusing in their study with qualitative surveys carried out in Lyon (France) and Montreal (Canada). Their analysis shows how attitudes to mobility are evolving in the case of young adults aged around thirty. Some young adults are choosing to join, or take part in, car clubs and car sharing services which have shown significant growth in recent years in cities around the world. Sprei et al. (4-109-17) look, in particular, at free-floating car sharing services (FFCS) which provide a more flexible option compared to traditional car sharing. FFCS can significantly improve vehicle and fuel infrastructure utilization, so have the

potential to increase the efficiency of the transport sector. The paper looks at FFCS services in 22 cities in Europe and North America, comparing usage patterns and examining similarities and differences in usage of the services.

Meanwhile, Gebhart et al. (4-071-17), studied intermodality – the flexible use and combination of different transport modes. They consider how this is playing an increasing role and how it could be an important key to a more efficient urban transport system. The paper presents data on mono- and intermodal travel modes' performance using accessible locations, based on a survey set in Berlin.

Plug-in & hydrogen vehicles: user perceptions and consumer behaviour

The ascension of the US electric vehicle manufacturer Tesla to the ranks of the world's most valuable (by share price) auto makers provides the strongest evidence that an electric revolution is under way in the transport sector. Papers under this theme focused, in particular, on the important user interface with electric as well as hydrogen vehicles. While manufacturers have been gearing up to make many more and varied electric models, their acceptance by users could stall, or speed, their uptake. Ingeborgrud and Ryghaug (4-325-17) studied user perceptions of different models of EVs. The paper focuses on how different models have been accepted by Norwegian households. The importance of the incentives and policies related to the adoption of EVs are particularly highlighted and discussed in relation to other perceived properties of EV driving, such as comfort and environmental concerns. The paper is based on qualitative interviews with different segments of EV drivers from 2013-2015, as well as a quantitative analysis of 3,654 EV drivers in Norway from 2016. Meanwhile, Taylor and Fujita (4-431-17) conducted a 'research gap analysis' of plug-in vehicle purchase. Despite the benefits and considerable investments by OEMs in plug-in electric vehicles (PEV), plus great interest by US electric utilities, they comment that US market expectations for PEVs are dampened by concerns about low consumer salience, given sustained low oil prices and the improved fuel economy of traditionally-fuelled vehicles, as well as reduced state and federal incentives. The paper reviews existing research using a framework that is well-established in academic marketing circles but is novel in the context of the PEV purchase process.

Schneider (4-289-17), meanwhile, looks at the other automotive fuel which is challenging for supremacy in the transport markets of the future. Her paper presents the objectives, methodology and findings of an integrated qualitative and quantitative study of user perceptions of using the hydrogen refuelling infrastructure in Germany. The work was part of comprehensive research activities accompanying the 50 Hydrogen Refuelling Stations Programme.

Policy making for low carbon transport

Building on the plug-in vehicle theme, Plötz et al. (4-188-17) look at how Governments around the world have introduced monetary and non-monetary incentives to accelerate PEV market diffusion. They note that empirical evidence assessing the effectiveness of the incentives is limited. PEV sales from 30 European countries is analysed, looking at direct subsidies, tax rebates, and other incentives. Their model finds that income, diesel prices and both direct and indirect subsidies positively influence PEV adoption. Also looking at policy as it relates to EVs, Karlsson (4-286-17) focuses on how the limited range of current plug-in models is hampering their deployment. His results, based on 64 two-car Swedish households, show that a flexible vehicle use strategy, fully utilising both vehicles available, can considerably increase PEV driving.

Zimmer et al. (4-110-17) take a 'big picture' approach to the transport sector. They report on the project "Renewbility" which includes several climate protection scenarios for the transport sector in Germany. The work models transport demand, energy consumption, CO_2-emissions and economic effects. The common objective of all the scenarios was the full decarbonisation of the transport sector by 2050. The authors say that the results show the need for clear and future-oriented political action: electric vehicles need to be an essential pillar of an overall strategy against climate change up to 2050 and that effective policy measures include the phase-out of the internal combustion engine.

In another paper under the policy making theme Gnann et al. (4-346-17) focus on the hard-to-decarbonise heavy road transport or commercial vehicles sector. They look at potential technical options including the direct electrification of trucks via batteries, over-head power lines, hydrogen and fuels derived from renewable electricity. The options are compared with respect to their degree of technological readiness, economy, infrastructure costs and CO_2 reduction potential.

Joining up policy making across sectors surely makes sense but can it improve the energy efficiency of the transport system? Using two qualitative case studies of the largest urban regions in Sweden: Stockholm and Gothenburg, Eriksson (4-217-17) aims to tackle this big question. Her results, disappointingly, show that cross-sectoral collaboration does not necessarily lead to cross-sectoral policymaking, which will not necessarily result in a more energy-efficient transport system. She says that this is due to the level within which the collaboration takes place (at goal or action level), the territoriality of the collaboration, sectoral power structures and the participants' 'spatial embeddedness'.

The challenge of air pollution has risen rapidly up the political agenda in Europe but especially in the UK where the Government has been challenged in the courts and found to be breaching mandatory European air quality goals. Brand et al. (4-365-17) have sought to build a model of future transport that can incorporate technical efficiency and the carbon/pollutant content of energy, as well as 'lifestyles' and socio-cultural factors which can 'operationalise' insights into models of future transport energy demand or even scenario analysis. Their paper, exploring four contrasting futures for Scotland, finds that radical demand and supply strategies can have important synergies (and potential trade-offs) between reducing life cycle greenhouse gas and air quality emissions.

Smart cities: sustainable mobility, balancing power demand

The rapid uptake of plug-in vehicles will create particular challenges for the power grid, particularly in cities where demand is already high for other uses. Subkhankulova et al. (4-291-17), look at the UK electricity system, which is undergoing a sig-

nificant transformation. On the supply side, the increasing penetration of renewable energy resources raises concerns for grid stability due to their intermittency, while on the demand side, transportation and heating electrification, as well as small scale electricity generators, are adding to the unpredictability. Demand-side management (DSM), they say, can help by coordinating electricity consumption with variable supply. However, considering the number of autonomous stakeholders involved, each with their different objectives, there is much work to be done to effectively coordinate these interactions while maximizing efficiency and minimizing cost.

Adopting a comparative approach, Vaidyanathan and Ribeiro (4-022-17) look at the important role local government has to play when it comes to maximizing energy efficiency of their transport systems. They note that cities increasingly serve as incubators for forward thinking policies and practices and that creating smart cities with sustainable transport systems involves a combination of policies that target vehicle efficiency, expand mobility options, and integrate transportation and land use planning. Their paper discusses the approach taken in ACEEE's City Energy Efficiency Scorecard for evaluating local governments on their actions to improve transport energy efficiency.

Completing this theme, Carlén et al. (4-231-17) provide a retrospective analysis of the challenges and lessons learned from attempts to utilize international collaborative networks to promote urban innovation with the aim of increasing environmental and social sustainability of the participating cities. The paper is based on the Swedish experience with the Global Sustainable Cities Network (2011–2015) and the Alliance for Urban Sustainability (2015–2016). The paper aims to draw conclusions in terms of what is required for successful international collaboration of this kind.

Smart cities: The built sector and the need for community engagement

The final theme of Panel 4 brings together papers that are focused primarily on the built (rather than transport) sector, some of which have as their central area of inquiry the need for people and communities to engage with innovative technologies and practices. Korsnes (4-226-17) brings the experience of the Trondheim Living Lab to his paper, exploring the relationships between radical technological change, domestic life and energy use. As energy systems shift from central to distributed production, the lines between the traditional supply and demand sides become increasingly blurred. Passive consumers are expected to become active, providing flexibility to the system, and eventually morphing into 'prosumers', producing and consuming energy. The paper provides lessons on how co-production and engagement can be achieved successfully.

Mazhar et al. (4-198-17) tackle a closely related theme. Their paper, adopting a case study strategy and qualitative research methods, aims to explore community engagement in Nottingham to help deliver smart city innovation. It evaluates the way Nottingham City Council is engaging local communities in its 'smart projects'. The main drivers and barriers to effective community engagement are identified in the smart city context.

Strasser et al. (4-382-17) focus on the implementation of energy strategies in communities within the IEA. Their paper analyses existing processes, legal frameworks and case studies within urban and energy planning in communities. It aims to provide recommendations for decision makers and others interested in the field of urban energy planning

Extending the central theme of this section, Le Truong and Gustavsson (4-358-17) analyse the potential production of electricity, heat or transport fuel when using one kWh of woody biomass in a fossil energy system designed to provide the same service to society as the most energy efficient bioenergy systems.

One effective approach to increase energy efficiency and energy flexibility is to connect independent production and local supply systems to energy networks. Reisinger and Sauer (4-313-17) focus on one specific technology that can be adopted and placed on urban factories: 'smart rooftop greenhouses'.

Lomax and Barrett (4-274-17) introduce a city energy modelling tool: SiCEDS – the 'Stakeholder interactive City Energy Demand Simulator'. The model allows city stakeholders to produce, share and understand the impact of decisions on a variety of outputs. The model includes the energy consumed and generated by domestic and commercial buildings in a city. The initial model has been piloted in the UK cities, Birmingham and Exeter.

In a paper focused on the interventions possible through energy managers at a large organization level, Stuart et al. (4-421-17) present 'smart' software, enabling a more innovative approach to energy management. The software can maintain detailed consumption patterns across a whole portfolio of buildings, communicating energy performance in a user friendly way. Reports can be designed for energy experts or for other professionals (e.g. finance managers and decision makers) enabling better communication across an organisation, resulting in more effective energy management.

At a more individual level, in an approach linked to the psychological/behavioural aspects of energy efficiency, Löfström and Svanæs (4-406-17) in their paper on 'eco-visualization' explore how persuasive technologies have the potential to change users' attitudes and behaviours towards more sustainable resource use. They use the example of the Power Aware Cord which is a transparent electrical cord with electroluminescent wires molded into it, indicating to consumers how power is consumed by appliances even in standby mode.

Completing the panel, De Groote and Volt (4-161-17) ask how ready is Europe for the smart building revolution? With an appropriate framework, they say, buildings could play a central role in transforming the EU energy system, improving efficiency and cutting carbon emissions. As buildings enter a 'transition phase', they are changing into highly efficient micro energy-hubs consuming, producing, storing and supplying energy, making the system more flexible and efficient enabling a rapid uptake of renewable energy and electric vehicles. The purpose of the paper, say its authors, is to inspire policy-makers in terms of how to foster the potential of buildings as "all-in-one" entities that could benefit the energy system and empower end-users.