Introduction to Panel 6 Transport and mobility

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Introduction

Mobility and transport are one of the key sectors to address if we want to reach our climate goals. Transportation accounts for approximately 15 % of global greenhouse gas emissions. Addressing transportation energy use will require transitioning to advanced vehicle technologies in addition to creating sustainable transport systems by getting people out of single occupancy cars and into more efficient forms of transportation. This panel will tackle key issues related to emerging and efficient mobility options that will help create sustainable transportation systems of the future.

As the need to reduce greenhouse gas emissions from the transportation sector grows more urgent, cities have taken the lead in creating innovative policies and programs that will shape smart, efficient transportation systems. Cities are increasingly also serving as the testing ground for new technologies and technology-enabled applications that could help reduce energy consumption in the transportation sector. This panel will highlight some of the ways that cities are playing a role in the transition to clean and efficient mobility through promotion of sustainable transportation. On the vehicle technology side, it is apparent that electric vehicles will play a critical role in achieving decarbonisation of the sector as long as infrastructure can keep up. Thus, we look at how to motivate purchase of these cars while avoiding pitfalls like the rebound effects and increased energy use. Electric mobility will also create significant additional electric energy demand. This demand competes with other sectors but can also serve as a balancing factor for peak demand. What needs to be done to ensure that we see a net energy benefit across the transportation and utility sectors?

But even though the long-term objective for mobility and transport is clear, there are a wide variety of policy and technology levers that can be used to achieve a sustainable transport system. Questions of "best" technologies (battery or catenary electric, hybrid solutions, decarbonised fuels etc.) and "best" policy options (incentives, taxes, regulations etc.) are still at large. We will look both at specific and large-scale policies to better understand the path forward. Additionally, what are the impacts for users? How can we communicate the benefits of the mobility transition in terms of health benefits, cost reductions and transport quality despite fears of an uncertain future? How can we nudge travellers to support this transition while still catering to their needs? Many papers focus on the needs of individuals and how they will react to different policies.

The mobility panel has become increasingly interwoven with the topics discussed in other panels. Many of the panel's papers take a broader approach to policies, energy demand or users and provide us with an invigorating view on the complexity of making our cities even more liveable in the decades to come and achieve our obligation to future generations.

How do people profit from sustainable passenger mobility?

One of the most efficient options to reduce both emissions and energy demand in the transport sector is by replacing motorised trips by walking or cycling. Philips et al. (6-233-19) look at the capability of individuals to do so and what that would mean for energy demand. By analysing spatial travel patterns on a micro-scale they can provide useful insights for policy makers to steer efforts for modal shift to locations most promising from an energy saving point of view.

Chatterton et al. (6-019-19) address equity issues based on social and behavioural aspects and the energy demand resulting from transport and home energy use. Based on the concept that every person in a country has only a limited carbon budget, it raises the question of why some people require (or ask for) a larger budget than others. The preliminary results show surprising correlations between different determinants (income, education, home location etc.) and transport/home energy use.

Many people fear the mobility transition and are afraid of losing their freedom. These fears are communicated quite often also by policy makers, particularly in countries with a dominant car industry. But this transition will lead to better health and a longer life in the end due to better air and less negative climate impacts, which is stressed by Kubes & Hayes (6-126-19). They offer insights that are useful for communicating sustainable mobility in a positive manner. How the integration of psychological factors into demand models can improve our understanding of consumer decisions and provide better scenario analyses is shown by Brunsting et al. (6-063-19) for the case of hybrid electric and fuel cell vehicles and solar panels.

Electric vehicles – usage and users

"Who is willing to buy an electric vehicle in France?" ask Pernollet et al. (6-103-19). They answer this question by looking into different segments in terms of travel distances and socio-economic indicators. Discrete choice experiments fed into a total cost of ownership model lead to EV shares by vehicle types (ICE, BEV, PHEV etc.). Mattioli et al. (6-272-19) take a different perspective by putting the electric vehicle in the centre and observe its daily activities – and more importantly the "recreational" periods when its thirst for power can be satisfied. This perspective highlights the caveats when looking at individual mobility patterns and concluding needs for charging infrastructure and power supply. Vehicles are grouped into different clusters based on their typical use. Only the minority of vehicles in England follow a typical regular commuting pattern, though employment status still appears to be the key determinant of vehicle use pattern. The good news is that most vehicles might be able to be charged flexibly at off-peak times.

Craglia & Cullen (6-205-19) put another pitfall of efficient vehicles to our attention: the urge to buy larger vehicles when energy consumption, and thus operating costs of vehicles, go down, what he calls "quality rebound effect". Based on vehicle sales and efficiency improvement data the authors show an impressive quality rebound effect, particularly for diesel engines, i.e. a large share of the (huge) technological efficiency gains were eaten up by people buying larger vehicles. They also highlight that people stick to these vehicles even if fuel prices increase. The consequence is that taxation or effective regulation must be put in place to counter the rebound effect.

Getting to below 2 degrees – policies to reduce transport energy use

Schramm & Roiy (6-281-19) analyse data from cities in the U.S., Europe and China to identify possible contributions of these cities to climate goals. Based on a 1.5 °C pathway the available technology options are scrutinised for different types of cities based on region, population and ports.

Rottoli et al. (6-260-19) look at different scenarios for decarbonisation for multiple energy sectors and their share in overall decarbonisation of our society. Combined transport and energy models show the interaction between the two sectors and open up the discussion on the impact that fuel/energy prices have on consumer choices and, thus, decarbonisation efforts.

Nadel (6-023-19) presents the efforts for efficiency gains due to electrification in the U.S. and Europe, dominantly in transport and the building sector. While transport shows the largest opportunity for potential, so does the building sector as it shifts away from oil and propane based heating. This might lead to new power demand peaks in the evening (home use, charging of EVs) and morning (heat pumps).

Integrating EVs into the electrical grid: competition or symbiosis

Another block of papers takes a closer look at the interface between vehicles and the energy grid (sector coupling). Whether or not we will reach our climate and efficiency goals will also be determined by the competing use of regenerative energy in different sectors. Transport can reduce peak energy demand and store excess energy from fluctuating sources. It will also be at least one of the largest energy consumers. The extent to which the connection between energy and transport will yield net positive or net negative energy and emissions results will depend on electric vehicle penetration and charging regimes.

Moura et al. (6-089-19) evaluate the role that EVs play as consumers of electricity (grid to vehicle) and as providers feeding stored energy back when demand from other sectors is high (vehicle to grid). Taking the Portuguese market as an example (with high share of wind power) they show that with a grid-to-vehicle system EVs can already balance energy surplus to some extent, but a vehicle-to-grid system (which puts additional requirements on charging technology also in the vehicles) would be needed to achieve a maximum effect and save users even more money. The degradation of batteries, however, makes this system only economically viable for the users in high surplus seasons (in Portugal during winter).

A growing share of energy users in transport are heavy duty vehicles. Due to their long travel distances they are particularly challenging to decarbonise. Two main options are currently discussed not only in Germany: hybrid or battery electric vehicles using overhead lines on motorways, and fuel cell electric vehicles (FC-HDV). Kluschke et al. (6-046-19) analyse the distribution of FC production facilities and their impact on the energy grid in different regions. Up to nearly ten percent of total energy demand in Germany in 2050 might result from these facilities, in some regions they might be the main energy consumers. They can, however, also be a balancing factor in areas with low population but high wind power density.

Taxation and regulation for more efficient vehicles

We know that more efficient vehicles, particularly electric vehicles, will need to be deployed aggressively to reach climate goals. We also know that electrification needs to be promoted to get into the market in the required time frame. But should "promotion" be limited to information and incentives? What are the roles of regulations and taxes?

Seifried & Albert-Seifried (6-127-19) jump right into this discussion by impressively outlining the adverse effects of misguided policies. Plug-in hybrid vehicles are considered zero-emission vehicles in Europe and even receive a temporary bonus when calculating fleet emissions of manufacturers. In consequence, these manufacturers are incentivised to integrate an electric drive into combustion engine vehicles, which has low impact on real emissions (as vehicles most of the time will use the conventional drive due to high speeds and small batteries) but significantly reduces nominal fleet emissions, removing the need to build truly low-emission vehicles.

Petrov et al. (6-166-19) provide a positive example by showing the effectiveness of a CO_2 based vehicle tax in reducing emissions. With their quasi-experimental design, they shed light on the impact of a tax regime change on consumer choice in Ireland. Their contribution also features an outlook on adverse effects of the tax on other pollutants like NO_x due to a shift to diesel.

Brand & Anable (6-309-19) look at the extent to which policies that reduce climate emissions, improve air quality and improve public health, need to be or are disruptive. The currently announced ban of internal combustion vehicles in the UK by 2040 (which is not particularly ambitious as compared to other countries) does not require any disruption, but also misses climate goals. However, the combination of a disruption and continuity framework with the Transport Energy and Air Pollution Model (TEAM-UK) reveals that more ambitious targets are feasible without disruption to the socio-economic system. Only very ambitious bans of all vehicles involving combustion engines (e.g. ICE, HEV, PHEV ban by 2030) will lead to disruptions for the vehicle manufacturers and the government, and to some extent also the general public.

The role of cities for transport efficiency

Much of the mobility transition towards more efficient transport has to take place on city level. Smart cities require smart mobility solutions. And local authorities have a wealth of policy measures that influence mobility behaviour and travel choices.

Nolden (6-005-19) analyses different policy approaches to more sustainable cities in several European cities taking mobility, buildings and energy systems into account. He highlights a broad range of strategies, from far reaching involvement of various actors (the general public, communities and academia), to outsourcing of processes to enterprises, and hierarchical "in-house" processes of authorities. The research underlines the strong influence of national policies on city level policies and business models. It also cautions against unchecked outsourcing of action to entrepreneurs, which might undermine democratic legitimacy, though it can also circumvent bureaucratic deadlock. And finally, Nolden provides evidence for the reluctance to involve all necessary actors in democratic processes due to the effort required (and not backed by required resources), but instead focus on "smart" optimisation solutions that promise (rightly or not) big change with minimal disruption.

Burghard et al. (6-348-19) conduct a survey among German municipalities to analyse their involvement in fostering the diffusion of electric vehicles. Though most cities are already active, they are categorised as having an intermediate or low level of activity in this field. Structural factors underlying stronger involvement like population growth and density are identified. Only few municipalities provide information services for citizens, foster the electrification of commercial fleets or sharing concepts with EVs. Some take legislative measures to advance electric mobility.

Sprei et al. (6-201-19) put minimum parking requirements (MPR) imposed by municipalities into their focus. Projects from Sweden, Germany, Austria and Switzerland are analysed by literature review and expert interviews. MPR has to be put into a wider context, combining public transport access, clear contractual responsibilities between municipalities, developers, mobility service providers and residents, and also conditions in a larger area. There is still room for further research on the impacts, but projects to this end are underway in Sweden.