INTERNATIONAL ENERGY AGENCY

WORKSHOP REPORT 2016

Transport, Energy Efficiency & Behaviour Workshop

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INTERNATIONAL ENERGY AGENCY

The International Energy Agency (IEA), an autonomous agency, was established in November 1974. Its primary mandate was – and is – two-fold: to promote energy security amongst its member countries through collective response to physical disruptions in oil supply, and provide authoritative research and analysis on ways to ensure reliable, affordable and clean energy for its 29 member countries and beyond. The IEA carries out a comprehensive programme of energy co-operation among its member countries, each of which is obliged to hold oil stocks equivalent to 90 days of its net imports. The Agency's aims include the following objectives:

- Secure member countries' access to reliable and ample supplies of all forms of energy; in particular, through maintaining effective emergency response capabilities in case of oil supply disruptions.
- Promote sustainable energy policies that spur economic growth and environmental protection in a global context – particularly in terms of reducing greenhouse-gas emissions that contribute to climate change.
- Improve transparency of international markets through collection and analysis of energy data.
- Support global collaboration on energy technology to secure future energy supplies and mitigate their environmental impact, including through improved energy efficiency and development and deployment of low-carbon technologies.
- Find solutions to global energy challenges through engagement and dialogue with non-member countries, industry, international organisations and other stakeholders.

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The European Commission also participates in the work of the IEA.

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Background

Global transport demand has been growing steadily by 2% per year since 2000 and accounted for 30% of overall energy demand in 2013. By 2040, transport energy demand is projected to grow by a further 35% despite current policies aimed at improving energy efficiency.

While many transport policies have led to energy efficiency improvements, some have fallen short of achieving expected/technical energy savings – and large energy efficiency potential remains. Increasingly governments and industry are interested in understanding how interventions can be improved to close the gap between expected and achieved policy outcomes. For many technologies and policies, success relies on behavioural factors and thus mechanisms going beyond traditional regulatory, financial and information approaches are being explored to draw on a growing body of research and evidence based on behavioural economics, sociology, psychology, anthropology and other social sciences. These measures take into account the impact of design, culture, geography, socio-economics, values, attitudes, habits, infrastructures, etc. on energy-service demands and behaviours.

To help countries share experiences with the measures mentioned above, the International Energy Agency (IEA) hosted a workshop on Transport, Energy Efficiency & Behaviour 10-11 May 2016 at the IEA headquarters in Paris, France. Workshop presentations can be found here.

Objective

The workshop sought to share experiences from around the world with planning and implementing policies and measures to encourage people to:

- avoid or reduce travel
- shift travel to more energy efficient modes
- improve vehicle energy economy

The workshop offered participants the opportunity to gain valuable insight into ongoing and planned work in the area of transport and behaviour worldwide. Participants shared and discussed research and experience, proposed new approaches and gained insight into the perspectives of other stakeholders and countries.

Participants included policy makers from IEA member countries and key emerging economies interested in learning about and sharing experiences with implementing energy efficiency measures in the transport sector. Private sector experts involved in the logistics and planning of transport systems, the promotion and sale of alternative fuel vehicles and the promotion of public transport also joined the workshop, as did researchers analysing transport, energy efficiency and behaviour.

Outputs

Findings from the workshop will feed into a wider IEA project on strengthening energy efficiency policies by better understanding human and business behaviour. It will also inform IEA work on transport and energy efficiency markets.

Workshop report

Experts from more than a dozen countries, representing national and local governments, research institutions and the private sector presented their analysis of and experiences with implementing measures to improve energy efficiency in transport. The next section provides a summary of ten key findings that emerged from the workshop presentations and is followed by a brief summary of each of the presentations.

Key findings

I. Vehicle fuel economy labels should be visible not only at the point of sale, but also where vehicle purchases are researched.

Vehicle fuel economy labels are one of the most frequently used tools to increase awareness of energy efficiency in the transport sector. Clearly displaying labels not only in vehicle dealerships, but also online can increase effectiveness as people are increasingly researching and purchasing vehicles online. According to one study, 80% of people in the UK researched their car purchase online and 27% of people in New Zealand purchased their vehicle online (Zifei Yang).

Label design is important for attracting attention and conveying simple to understand messages about fuel economy. Providing information on fuel-cost savings and fiscal incentives emphasizes the financial benefits of efficient vehicles and makes the fuel efficiency label more relevant to consumers (good examples include UK, Singapore, New Zealand, US, and Canada). Labels can include QR codes and links to apps and websites that provide more detail. New Zealand, Singapore, and the United States' websites offer creative and effective graphics that communicate information about fuel economy (Zifei Yang).

II. Eco-driving programmes are an effective and necessary complement to fuel economy standards

The most effective tool for improving vehicle energy efficiency is the fuel economy standard. Fuel economy standards covered around 70% of new passenger vehicles sold in 2015 and are driving down official estimations of vehicle fuel consumption (IEA, 2016). Official estimations, however, hide the fact that fuel consumption measured under laboratory settings is often much lower than under real-world road conditions due, in part, to inefficient driving behaviour (Patrick Vincent).

Driving style can account for up to a 30% difference in fuel performance (Conor Molloy). Driving habits differ according to gender, age, education, culture and economic class, suggesting social and psychological influences on driving behaviour (Martin Kroom). For example, a UK study showed that educated, affluent women, 25-65 years old, using small, low mileage vehicles were most likely to practice eco-driving (David Pryke).

Drivers training courses offer a good opportunity to introduce energy-efficient driving habits (David Pryke). Training courses can be tailored according to target audiences, from students to public bus drivers.

By complementing fuel economy standards with mandatory eco-driving programmes implemented as part of driver's education courses and fleet management programmes, an average of 5% sustained energy savings can be achieved (Conor Molloy).

Initially much higher energy savings are possible, but research shows these savings decrease over time unless combined with feedback instruments, competitions, prizes and periodic refresher courses (Patrick Vincent). In fact, a study in Ireland found that without feedback instruments, 80% of the eco-driving training benefits are lost within six months of eco-driving courses (Conor Molloy).

III. Information communication technology (ICT) and improved connectivity are predicted to increase the benefits of eco-driving and logistics optimisation in the future

Studies from Renault predict that in the future, improved connectivity will double fuel savings and increase awareness. For example, today navigation systems recommending optimal routes lead to average fuel savings of 1%. This number is expected to increase to 5% with improved technologies in the future. In another example, the eco-mode feature in vehicles currently achieves 2-10% energy savings and will likely reach 4-15% in the future (Patrick Vincent).

ICT has been used in several innovative driver feedback pilots in the UK. For example, in one pilot, sensors were installed on traffic lights that communicate with feedback systems in vehicles. Drivers receive signals to speed up or slowdown in order to smooth traffic flow. During the pilot, drivers experienced decreased congestion, reduced travel time and energy savings (Phil Blythe).

In the freight sector, new ICT solutions and algorithms have the potential to optimize fleet management and increase energy efficiency. Fleet operators using asset optimization tools achieve, on average, CO_2 reductions of 12%. Only 15% of fleet operators are using asset optimization tools. CO_2 emissions could be reduced by an additional 25% if delivery windows were relaxed from one hour (currently) to five hours (proposed) (Martin Rapos).

Also in the freight sector, the UK has conducted research on joining vehicles together so that they follow the speed of the vehicle in front (platooning). Platooning trials have shown fuel reductions from 5-15% (Phil Blythe). Other benefits include improved safety and increased road capacity.

IV. Dynamic pricing for roads and parking can reduce traffic congestion, fuel consumption, CO_2 emissions and air pollution

Demand management measures such as pricing and parking policies can be effective at reducing fuel consumption (Martin Young), and lead to other safety, congestion and environmental benefits. The City of Stockholm implemented a congestion tax that led to significant reductions in traffic (primary routes but also secondary routes), travel time and CO_2 emissions in the city centre. It has also led to increased public transport use. Stockholm found that although the project initially encountered opposition, acceptance grew quickly after a pilot project demonstrated that the differentiated pricing structure financially rewards people who have the flexibility to travel during off-peak times, and decreases the travel time of people willing to pay the peak price (Joel Franklin). Stockholm held a referendum after completion of the pilot project where the once hesitant population agreed to continue with the scheme. For governments considering adoption of a congestion charge, implementing a pilot project first, followed by a referendum, could be an effective way to build support.

Like with Stockholm's congestion tax, San Francisco was able to reduce congestion, lost time and air pollution through a dynamic pricing system. The SfPark pilot provided real-time parking information, real-time pricing (higher costs for streets with fewer spaces available) and easy-to pay meters. Results showed higher parking payment rates, more parking availability (easier to find parking), 30% fewer vehicle miles travelled looking for parking, a 20% reduction in GHG emissions, a 2.3% increase in transit speed and lower average hourly parking rates than before (Wei-Shiuen Ng).

V. Urban planning tools are successfully being used to change consumer preferences and reduce vehicle travel demand

Evidence from pilots around the world shows that reducing road space for cars by increasing pedestrian walkways, adding bus and cycle lanes, closing roads, etc. leads to a median overall traffic reduction of 14-16%. Trials in the UK to encourage bus use, walking and cycling for local journeys have led to car trips falling by 9% and car trip distance decreasing 5-7% (Sally Cairns).

In Vancouver Canada, the following tools have decreased vehicle demand: reallocation of space from cars to people, strict parking laws, densification of housing and a policy to provide frequent, reliable transit where people work and live. Policies have led to changing local preferences – interest in car ownership is decreasing, fewer people are getting drivers licenses and the number of vehicle kilometres travelled is declining. In parallel, people are increasingly interested in living near work and school and there is a rise in commutes by public transport, walking and cycling (Holly Foxcroft).

VI. Policy makers can increase public transport demand by improving convenience and comfort

The Delhi Metro Rail Corporation has been able to increase passenger ridership by 122% over the past five years by not only putting in place new infrastructure, but also by requiring quality and safety standards to improve rider experience. ICT has also helped increase ridership by providing real time information on arrival times and seat availability, and allowing mobile-based payments (Sandeep Garg).

To improve convenience, Bangkok is developing an integrated ticketing system that allows easy transfers between public transport modes. Bangkok is also changing building codes to encourage development of parking spaces within 500 metres of metro and train stations to encourage 'park and ride' (Asawin Asawutmangkul).

VII. Perception is still a barrier to widespread electric vehicle adoption and dealerships are not helping

Mainstream car buyers have very low awareness about electric vehicles (and their differences) (Jonn Axsen). One barrier to purchasing electric vehicles is range anxiety (Jonn Axsen, Jo Bacon), despite the range of most electric vehicles being sufficient for most trips. Concerns about the availability of recharging points is also a barrier, although studies in the UK and Germany show people are less concerned about this than they used to be due to easy residential recharging at the domestic plug (which is by far most frequently used) (Patrick Jochem) and widespread investments in charging infrastructure in the UK (Jo Bacon).

Most car dealers are not helping to alleviate mainstream car buyers' concerns about electric vehicles. A study from the United States shows that dealers steer buyers away from electric cars for several reasons. First, many dealers do not have a good

understanding of electric-vehicle technology. Second, in general, it takes longer to sell an electric car than a conventional vehicle and third, the dealership earns less on maintenance contracts with electric vehicles (Eric Cahill).

Tesla is the exception. It sells a lifestyle – and cultivates its brand. Its dealerships are designed to convey convenience, luxury and design. Tesla's staff are highly trained and informed and they only sell Teslas (no competition with non-electric vehicles). Tesla offers packages that include high-power charging stations and remote trouble shooting that address many consumers concerns (Eric Cahill).

If government, but more importantly industry, wants to push a transition to electric cars, they will need to overhaul their communications and sales strategies. This is the case in the United States and Canada, but also in Eastern Europe where the level of electric mobility is very low, but the car fleet is relatively old (eight years) and a fleet changeover would have a large impact on emissions (Janos Ungar).

VIII. Free parking and access to express lanes are powerful incentives for encouraging the purchase of electric vehicles

Norway achieved average new car emissions of 96 gCO_2/km, the best in Europe, by implementing policies to encourage the purchase of electric vehicles. Incentives for electric vehicles include free parking in public spots, access to public transport lanes and free use of state ferries and toll roads. Electric vehicles are also exempt from sales tax/VAT and benefit from reduced annual taxes. Surveys show that the added convenience of free bus lanes and parking played a significant role in many owners' decision to buy electric vehicles (Konrad Putz).

IX. In some markets, transport systems may be transformed by 'mobility as a service' (including uber, car sharing, autonomous vehicles and integrated transport systems)

More research and different tools are needed to understand, measure and model mobility as a service and its potential impact (Sonia Yeh).

It is known, however, that culture plays a role regarding mobility preferences. In a study of Chinese versus American attitudes towards car ownership, the researcher found that 48% of Chinese survey respondents would consider delaying or forgoing car purchase plans if carpooling were conveniently available. This is in stark contrast with respondents in California who were overwhelmingly opposed to the idea of carpooling (Wei Shiuen Ng).

In the UK, carpooling is keeping cars off of the street. 63% of customers surveyed using a car pooling (lift share) programme said that if the programme were not there, they would own a car and drive alone (Sally Cairns).

X. Electric car owners are willing to postpone charging in order to integrate more electricity generation by renewable energy resources

Whatever the average electricity mix is for charging electric vehicles, they emit significantly less CO_2 emissions than conventional cars. For some countries even 6 gr per kilometer is achieved today. In the future, the time of charging becomes more and more important in order to not negatively influence the electricity system. In a field-test in

Germany many users already agree to postpone their charging if it helps to integrate more electricity generation by renewable energy resources (Patrick Jochem).

Workshop presentations

This section summarises and presents the key messages from each of the workshop presentations.

Welcome and introduction

Keisuke Sadamori, IEA Director of Energy Markets and Security, kicked off the workshop by highlighting global trends in transport. He said increased transport energy use translates directly into higher GHG emissions and more air pollution because of the sector's continued dependence on oil. This poses a big challenge for policymakers and he argued that aggressive policies are required across all modes of transport to meet countries' climate, energy security and health objectives.

Brian Motherway, IEA Head of Energy Efficiency Division, presented an overview of the workshop objectives and touched upon the agenda topics (Annex 1) that would be discussed during the two days. These included:

Demand management
Congestion charges and dynamic parking pricing
Intelligent transport systems
Demand management measures

Fuel switching and promoting electric vehicles
Vehicle choice
Promoting electric vehicles
Charging infrastructure for electric vehicles
Promoting hydrogen vehicles

Driving more energy efficiently
Encouraging eco-driving
Driver feedback systems

Attitudes towards car ownership and public transport
Attitudes towards transport
Promotion of public transport

Real versus Modelled Behaviour
Accounting for behaviour in transport models

Demand management

The sessions on demand management explored a variety of tools that can be implemented to change transport behaviour – these tools include dynamic pricing for roads and parking, policies to promote transport as a service (as opposed to personal vehicle ownership), techniques for reducing transport quickly- such as odd/even license plates or no car days and information communication technology (ICT) to improve traffic management and freight logistics.

Mobility as a service ('MaaS') – Business models and consumer attitudes
Sonia Yeh, University of California, Davis & Chalmers University of Technology, Sweden

Main messages:

- 'Mobility as a service' (Maas), including uber, car sharing, integrated public transport systems, smart payments and tickets, ICT, autonomous vehicles, etc., may become a disruptive innovation in the transport system and an alternative/competitor to personal vehicle ownership.

- More research and different/new tools are needed to understand measure and model MaaS and its potential impact on the transport system.

Intelligent transport systems for reducing energy demand in road transport
Phil Blythe, Department for Transport, UK

Main messages: New technology is able to decrease energy consumption and lower congestion.

- Pilot studies in the UK are showing how energy consumption and traffic congestion can be decreased as a result of the 'Energy Efficient Intersection Service' programme. In this pilot, sensors on lights communicate with ICT in cars to tell drivers to speed up or slowdown in order to safely and smoothly pass on green. The pilot evaluation showed decreased energy consumption on all trips during all times of the day. It also showed reduced travel times for most trips.
- The UK is rolling out trials and demonstrations of autonomous vehicles as well as researching the impact of 'platooning', e.g. joining vehicles together so that they all follow the speed of the vehicle in front. The goals of platooning are to i) improve safety (can therefore reduce vehicle weight needed for safety and thus reduce fuel consumption), ii) increase road capacity, iii) set optimum driving speed to reduce fuel use and associated emissions. Results of platooning trials have shown fuel reductions ranging from 5-15%.

Optimised (collaborative) logistics drive operational and CO_2 efficiencies
Martin Rapos, Routemonkey, Netherlands

Main messages:
New ICT solutions and algorithms have the potential to optimize fleet management revealing a big potential to increase energy efficiency.

- Fleet operators using asset optimization tools achieve, on average, CO_2 reductions of 12%. Only 15% fleet operators are using asset optimization tools.
- CO_2 emissions could be reduced by an additional 25% if delivery windows were relaxed from one hour (currently) to five hours (proposed).
- Cooperation between fleet operators could lead to further optimisation

More pilot programs are needed to generate data on the saving potential of new ICT (and other aspects including acceptance).

Stockholm's congestion tax: Implementation, acceptance, and environmental consequences
Joel Franklin, Royal Institute of Technology, Sweden

Main message: Congestion charging can change mobility behaviour patterns. A sound strategy, accompanying policy and communication can turn initial opposition into support. Congestion charging in Stockholm has:

- Led to significant reduction in traffic (primary routes but also secondary routes), travel time and CO_2 emissions in the city centre. It has also led to increased public transport use.
- Experienced a surge in support: Before the pilot period, people were strongly opposed; after the pilot, government held a referendum where people voted to keep congestion charging. Voters found that differentiated pricing structure financially awards people

who have the flexibility to travel during off peak times, and decreases the travel time of people willing to pay the peak price.

- For other countries wanting to replicate congestion pricing, there are many different policy designs and incentives that can be considered according to city context.

Dynamic parking pricing: Experiences in California
Wei-Shiuen Ng, International Transport Forum, France

Main messages:
Dynamic pricing for parking can be a powerful transport demand management tool that i) reduces congestion, lost time and air pollution, ii) improves parking availability and iii) creates revenue for operators. ITC can facilitate dynamic pricing, but lower-cost options can also lead to results.

- SfPark, a pilot in California, provided real-time parking information, real-time pricing (higher costs for streets with fewer spaces available) and easy-to-pay meters. Results were promising and showed higher parking payment rates, more parking availability (easier to find parking), less vehicle miles travelled (-30% miles travelled), decreased GHG emissions (-20%), improved transit speed (+2.3%) and lower average hourly parking rates than before.
- GoBerkley was a lower-tech parking pilot in California that led to an overall reduction in automobile use, including an increase in bicycle use (+5%), increase in walking and increase in carpool (5-12%).

Saving oil in a hurry: Demand management measures
Martin Young, Head of Emergency Policy Division, IEA

Main messages: Demand management measures (car and ride sharing, driving restrictions – including speed limits, driving bans, pricing and parking policies, eco-driving, etc.) can be effective at reducing fuel consumption when short-term energy disruptions occur. Most of these measures require advanced planning and should be considered by policy makers before a disruption occurs.

Driving more energy efficiently

This session explored measures and policies to promote more energy efficient driving. Presentations examined how to strengthen eco-driving programmes, considered the psychology of driving and explored how gains in passenger light duty vehicle efficiency have been undermined to some extent by a growing gap between tested and real-world fuel economy.

Encouraging eco-driving
Conor Molloy, AEMS, Ireland

Main messages:

- There are five golden rules for eco-driving. These are: 1) Anticipate traffic flow, 2) Maintain a steady speed at low rpm, 3) Shift up early (between 1,500 – diesel and 2,000 (petrol/gas) revolutions, 4) Check tyre pressure frequently and 5) Consider any extra energy (take off roof racks/boxes).
- When performance is measured, performance improves. When performance is measured and reported back, the rate of improvement accelerates (Pearson's law) – Without feedback instruments, 80% of the training benefits, e.g. the fuel savings, are lost within six months of eco-driving courses.

- On average, eco-driving programmes can achieve 5% sustained energy savings.

Reducing CO_2 emissions from vehicles by encouraging lower carbon car choices and fuel - efficient driving techniques (eco-driving)
David Pryke, Department for Transport, UK

Main messages:

- The biggest barrier to changing driver behaviour is that driving is habitual – people do not think about it, it's subconscious. But even if people are aware, most think they are already good drivers. UK drivers scored an average 6 out of 10 on an efficient driving scale. Well educated, affluent women aged 25-65, with low annual mileage using a small vehicle most likely to practise efficient driving.
- The main motivation for improving driving practices is saving money. Safety is also a factor, and environmental concerns are a more limited motivation.
- Driver's training courses are a good opportunity to teach eco-driving; need to look at ways of embedding efficient driving techniques better into training of new drivers – so they form more energy efficient habits. Also good to target fleet drivers – potentially easier to sustain change via employers who are implementing competitions and incentives for energy efficient driving.

Eco-driving is a well-known topic for fuel reduction but what is really behind It?
Patrick Vincent, RENAULT Environmental Strategy Planning, France
Main messages:

- There is a gap between real and announced fuel economy. Renault is seeking to close the gap between certified and real fuel economy by supporting the driver with a set of tools that give the driver information at the right moment through real-time information, including advice on when to shift gears, eco-monitoring that provides indicators on driving style, eco-mode button that automatically optimizes fuel savings depending on engine, driving style and air conditioning, navigation that suggests the most energy efficient route, eco-challenges that allow you to compete with other drivers to have the best eco-driving scores, etc. (this has proven to be very effective!)
- Connectivity and improved ICT will also increase the benefits of eco-driving – Renault expects that in the future, connectivity will double fuel savings and increase awareness; today navigation systems that suggest the best routes improve fuel savings by 1% (5% in the future); assistance scoring coaching 2-10% (6-20% in the future); eco-mode 2-10% now (4-15% in the future).

Car psychology and barriers to sustainable mobility behaviour
Martin Kroon, Netherlands

Main messages:

- For some people, driving is a way to express themselves, their independence, status, culture, aggression, risk-taking, etc. Cars and driving mean a lot of different things to different people in different societies and within societies. Gender, socio-economics, education and other factors can influence driving behaviour and attitudes towards eco-driving and more efficient technologies. It is important to take this into account when formulating policies.
- Up to 30% of fuel can be saved through advanced eco-driving; up to 40% fewer accidents can also be achieved by: keeping engine speeds between 1200 – 3000 RPM; changing

gears (up) at 2000 – 2500 RPM; avoiding strong accelerations, full throttling and long idling; using the RPM meter / board computer / cruise control; adding 10% to standard tyre pressure & checking it!; using less air conditioning [= >10% f.c.] or set >21°C.

- Eco-driving must be part of road safety and driving license policies.
- car manufacturers and retailers, logistics companies, fleet owners, local governments, insurance companies, NGO's, road safety lobbies, consumer organisations should all partner with the national government to roll out eco-driving.

How governments promote efficient vehicles through labeling programmes
Zifei Yang, International Council on Clean Transportation, USA

Main messages:

- Vehicle fuel economy labeling (VFEL) has many benefits. Labeling can raise consumer awareness, enable other policies (fuel economy standards and fiscal incentives) and promote fuel efficient vehicles.
- It is important to provide information on fuel economy online- in the UK, 80% of people making car purchases researched cars online; in New Zealand, 27% of car purchases were made online.
- Creative graphics can be an effective way of demonstrating fuel economy (example from New Zealand energywise website).

Encouraging direct reductions in car use
Sally Cairns, University College London, UK

Main messages:

- It is possible to get people to modify their transport behaviour. Evidence from pilots around the world shows that reducing road space for cars by increasing pedestrian walks, adding bus and cycle lanes, closing roads, etc. leads to a median overall traffic reduction of 14-16%.
- Three trials around the UK to encourage bus use, walking and cycling for local journeys has led to car driver trips falling by 9% and car driver distance decreasing 5-7%.
- Experience from 20UK organisations implementing 'best practice' workplace travel plans led to an average decrease of 14 commuter cars per 100 staff (equivalent to an 18% reduction in the share of staff driving to work). Plans addressing parking more than doubled the reduction in car use than those that did not.
- 30 English schools implemented 'best practice' travel plans (17,800 pupils). The weighted average reduction in car use was 23% (two schools had more than 70% of the kids walking, two schools had over 60% of the kids arriving by bus, one school had nearly 40% cycling to school!)
- The UK is also looking at car sharing – 63% of lift share customers surveyed in the UK said they would otherwise have driven alone. Proportion of car club members owning a car drops from 48% to 20% after joining, 23% of rental customers say having access to rental cars has made them less likely to buy a vehicle.

Driver feedback theory vs. practice in the United States
Tai Stillwater, Zendrive, United States

Main message: Behaviour change theory is mainly concerned with the information content of data to be presented to drivers, yet the success of real-world implementations in a commercial environment may often be due to totally different dimensions. This presentation compared the author's experience with theoretical feedback models to experience implementing feedback in two pilots, a driver efficiency App implemented with the Bay Area Metropolitan Transportation Commission, and a commercial driver safety feedback system for fleets.

Fuel Switching: Promoting Electric Vehicles

In this session, participants shared and discussed research on how to encourage the purchase of electric vehicles (EVs). Participants explored the motivations for vehicle purchases and the barriers to widespread adoption of electric vehicles.

Understanding current and future potential PEV buyers: Implications for policy
Jonn Axsen, Simon Fraser University, Canada

Main messages: There is currently an electric vehicle 'hype' – similar to ones seen in the past for plug-in electric, hybrid, and hydrogen-fuelled vehicles.

- Barriers to widespread adoption of electric vehicles (according to a Canadian study with 1674 participants) include: i) lack of awareness of electric-vehicle technology and 2) range anxiety.
- Pioneer purchasers of electric vehicles tend to have a higher level of education, with higher income, and live a greener lifestyle than that of those who are in the mainstream market. They 'love' their elective vehicle.
- The mainstream has very low awareness about the differences between different kinds of electric vehicles, but seem to be more attracted to plug-in hybrid electric vehicles.
- Research on how to increase demand of electric vehicles suggests that there is a need to focus on supply-side options – e.g. policies that increase electric vehicle supply.

Growing the UK ULEV market: Understanding people's motivations and barriers
Jo Bacon and Andrew Scott, Department for Transport, UK

Main messages: The UK government has set a series of ambitious targets for long-term decarbonisation in transport – namely that nearly every car and van should be a zero emission by 2050. This presentation highlights the attitudes of people in the UK when it comes to going electric.

- At present about half of the EVs bought are for private purposes, while the other are for fleets. The past year has seen record sales of EVs – accounting for 1.4% of new car sales. Of UK car owners, 59% park overnight on private property, 25% on the street, and 16% in a garage – suggesting that a large proportion have the ability to charge at home with relative ease
- Range anxiety and concern about the lack of recharging points come in at the top of issues preventing people from buying EVs in the UK, while cost comes in as the next concern. A lot of people are very concerned about the number of recharging points, although this has fallen in the past year (56% down from 69%) highlighting the on-going investment of the UK government into recharging stations. The difficulty stands at reducing range anxiety.
- Ultra-low electric vehicles (ULEV) are the main car in 9 out of 10 households with a ULEV. Range may be a concern, although there are high levels of satisfaction with EVs in

general. Long journeys are given a high level of importance in purchase considerations even though they are very rare (94% of journeys are under 25 miles). There is a need for government and industries to work with these behavioural effects.

- People in the UK are more motivated to buy an EV for money saving than by going green. The plug-in car grant does help though – according to 93% of people surveyed, and consumers generally give a high weighting to short term savings relative to long-term.
- In summary, people's attitudes and behaviour are critical to the success of policies but current interventions appear to be making a difference

Do dealers discourage electric vehicle purchases? Findings from a study of retail innovation in the U.S. market for electric vehicles
Eric Cahill, UC Davis, USA

Main messages: Electric vehicles (EV) are poorly marketed in retail stores, undermining EV adoption and loyalty. EV sales are actually being discouraged in certain cases. It may take a 10 to 15 year time scale before a transition is experienced.

- New product success hinges on matching the innovation form with distribution strategy.
- Dealers complain the EVs take a longer time to sell.
- Most dealers may be good at selling cars, but not so much at selling EVs in particular.
- Tesla is the exception. What is Tesla doing differently? They have online sales transactions, high-power fast charging, remote trouble shooting, and have an autopilot mode.
- Tesla has retail space designed for convenience, consumer awareness, brand building, and learning.

Integrating electric vehicles into the electricity system
Patrick Jochem, KIT University, Germany

Main messages: There is a strong need to electrify the transport sector (for example to mitigate climate change and air pollution), but there are considerable challenges to doing so.

- An increase in the market share of EVs up to 100% results in a subsequent increase in electricity demand by about 20% for Germany. This demand is however time-flexible and is therefore mainly influencing the electricity grid (if in some regions most charging occurs at the same time).
- By 2030, Germany expects a 12% market share of electric vehicles, which means that charging will have a very small impact on the electricity generation by conventional power and should not pose any major issue for the transmission system.
- Controlled charging is feasible for developed countries. There is only marginal impact on the transport grid. The impact on the distribution grid depends on several factors such as grid architecture, conventional load, and the charging rate.

Norway electric car miracle
Konrad Pütz, Envova, Norway

Main messages: There has been a very positive attitude in Norway toward EV purchasing – the past two years have seen a doubling of the market share per annum. Large levels of public funding helped support the development of the EV market, as did free parking and use of the bus lanes, which increased convenience. Norway has been able to achieve average new car emissions of 96 gCO_2/km, which is the best in Europe. It did this by putting in place the following policies:

- No purchase tax/VAT on zero emission vehicles
- Free parking at public parking spots
- Free use of public transport lanes
- Reduced annual taxes
- Free use of state ferries and toll roads
- Incentives will gradually be reduced
- Time dependant charging

Challenges and opportunities: Development of electro-mobility in the eastern part of the European Union
Janos Ungar, Hungarian Electro-mobility Association, Hungary

Main messages: There is a significantly low development in Eastern Europe, but as the average age of passenger cars is relatively old (around 8 years), there is the possibility of a quick fleet changeover within a decade. Going electric would be a good way to reduce CO_2 emissions.

- In Eastern Europe, the mentality of stakeholders and the government vis-à-vis electro-mobility needs to change by using various innovative measures, highlighting the benefits of EVs by focusing on the lessons learned from countries who have already implemented policies to promote electric vehicle fleets. It was already observed that the attitude of stakeholders changes significantly after gaining first-hand practical experiences with e-mobility.

Charging infrastructure – deficits in interoperability, the need for regulation and the Berlin approach
Hermann Blümel, Berlin Senate Department for Urban Development and Environmental Protection, Principle Affairs of Transport Policy, Germany

Key messages: The Berlin Modell defines a framework that consistantly separates the two roles of CPO and MSP (standard in energy sector). It is open for different CPOs, and even for small companies with only few charging points. This prevents cost intensive roaming models, and it is in line with ambitious regulations for data protection/business secrets/privacy.

- At present there are 21 fast charging stations in Berlin, with only 4 operators of slow charging in public ground. The question posed is if there is a sufficient level of charging infrastructure, why is there no market for electric vehicles in Berlin?
- Public charging means that there are conflicts with other fast growing demands in public space, conflicts with the targets of urban planning, conflicts with conservation of heritage. Intensive parking enforcement is needed.
- The definition of public space in Germany is defined as a space which is owned, operated, controlled, and held responsible by the municipality in that area.

- The Berlin approach is a role model to guarantee easy, non-discriminatory access to the charging points of all operators.
- Eight years of introducing electro mobility by a huge number of European and national funding programs and projects without any regulation has led to a fragmentation of the market, discriminating structures based on individual business models, a lack of interoperability, limited acceptance of the services by the customers, missing scale effects, high costs to (partially) organize interoperability by roaming technology and severe conflicts with privacy regulations.

Attitudes towards car ownership and public transport

Attitudes towards transport modes: a comparison between US and China
Wei Shiuen Ng, International Transport Forum, France

Key messages: Understanding transport attitudes will lead to better transport demand management tools.

- Californian study sought to understand underlying factors leading to individual's transport choices. 40% of study participants drove alone and 7% carpooled. The most popular reasons for driving included: superior comfort of the automobile, concerns about safety, flexibility, low public transport availability and free parking.
- Most California participants were not open to the idea of carpooling. The primary reasons for taking the train were: environmental benefits, lower cost, less mileage on their vehicles, lower stress than driving.
- A similar study was conducted in China and found that the reasons for driving were very different. Cars are seen as 'dream machines'. Economic factors impact car ownership more than in California. Also in contrast to the California study, 48% of participants would consider delaying or forgoing car purchase plans if car sharing were conveniently available.
- Study concluded that mode choice is a reflection of a complex decision making process, particularly for commuters with options and that little changes in infrastructure and/or work schedule flexibility could make huge differences in behaviour
- Different policies that are targeted at specific user groups will be more effective than implementing one generic program
- Chinese users have a different set of values, travel constraints, alternatives, and preferences that will shape distinctive trends and car share tend to be more well-accepted in Chinese than U.S. cities

Promoting Urban Public Transport in India
Sandeep Garg, India

Key messages:

- The Government of India set up a high powered National Transport Sector Development Policy Committee (NTDPC) to provide advice on the framework for long term development of comprehensive and sustainable transport infrastructure in the country.
- The Delhi Metro Rail Corporation has been able to increase passenger ridership by 122% over the past five years by i) putting in place new infrastructure (including seven new lines), ii) requiring quality standards in terms of reliability, safety, cleanliness, and also by

iii) helping people 'go the first mile' to reach the public transport infrastructure and the last mile to arrive at their destination.

- Ridership is also improving thanks to real time information made possible through web and mobile devices giving passengers details on estimated arrival times and seat availability. Mobile-based payments for a wide variety of public transport (buses, metros, ferries, etc.) is now available, further increasing convenience.

Lessons from Vancouver: Urban Planning and Transport
Holly Foxcroft, Canada

Key messages: The Metro Vancouver region has made policy and programmatic shifts to move to a single economic centre (i.e. Vancouver being the primary employment area within the region) to multiple employment centres thanks to planning measures and changes in the transportation system.

- Having shared regional policy objectives and plans has helped Vancouver and its surrounding cities promote urban planning (densification of housing, shifting employment centres) and public transportation (diversification of transport modes and improved availability).
- Policies have led to changing local preferences – there is less and less interest in car ownership, a decrease in people getting drivers licenses and a reduction in vehicle kilometres travelled; there is an increase in interest in living near where people work and go to school, a rise in commutes by public transport, walking and cycling and a preference for access and proximity to rapid transit for residents and developers.
- Tools used have been reallocation of space from cars to people, strict parking laws, and a policy to provide frequent, reliable transit where people work and live to foster modal shifts away from vehicle use, reducing congestion and urban sprawl.

Promoting Public Transport in Bangkok
Asawin Asawutmangkul, DEDE, Thailand

Key messages:

- In Bangkok, travellers make more than 22 million trips per day; by 2021 the number is estimated to increase to around 26.2 million trips a day
- Only 5% of Bangkok's area is covered by roads, compared to 38% in New York City and 23% in Tokyo, which leads to heavy congestion.
- Public vans were previously illegal, but now they are regulated and run on routes approved by the Bangkok Mass Transit Authority. With easy accessibility and connectivity to major communities, they offer flexibility.
- Despite having a modern, well-functioning sky train (BTS), people are still reluctant to use it because of the high price compared to the cost of living (much higher cost relative to PPP when compared with metro in Tokyo, Singapore, Hong Kong and Shanghai).
- Another common complaint with the metro in Bangkok is that payment is inconvenient and parking at the stations is difficult. In response, Bangkok is i) developing an integrated ticketing system that will allow easy transfers between BTS and the underground metro (MRT) and eventually the Airport Link, buses, boats, vans and even taxis and ii) changing building codes to encourage park and ride; buildings are limited in height by building

codes. Buildings that provide public parking located within 500 metres of the BTS or MRT are allowed to build 20% higher (called the FAR bonus).

Real and modelled behaviour

This session addressed the issue of how researchers can model transport behaviour.

Improvements in the representation of behaviour in integrated energy and transport system modelling
Jacopo Tattini, Technical University of Denmark (DTU), Denmark

Main messages: Integrated energy and transport models do not consider behaviour, with the exception of multinomial logit models (like MA3T). Better integrating behaviour into energy and transport models could lead to better decision making. A more detailed representation of the transport sector is required to introduce behaviour into integrated energy and transportation models.

Basic understanding of consumer and rapid changes in attributes of new technology
Sonia Yeh, University of California, Davis & Chalmers University of Technology, Sweden

Main messages: Developments have been made in the representation of behavioural choice in short to long term predictions in optimisation modelling. Using California as a case study, the research discussed in this presentation highlights what can be done in a state-wide sense to accurately depict the new technology choice.

- How do we estimate the potential policy impacts? California has a target of 80% reduction in emissions by 2050, will achieve the 2020 target. The state's economy is growing, while emissions are falling. Target to increase renewable electricity to a 50% share by 2030.
- UC Davis was contracted by the California Energy Commission to look at future pathways evaluating the cost-effectiveness of various policies.
- Consumer choice comes in to play with disutility costs – awareness. The MA3T model is a consumer choice model - a nested multinomial logit model which looks at location of people and their driving patterns.
- There are direct costs and indirect costs – the former which considers vehicles prices and fuel cost, the latter focusing on refuelling station availability, range anxiety, model and availability. Indirect costs are endogenously calculated in the model.
- Caution is advised as there is a lot of uncertainty with changes in consumers' behaviours and preferences over time.

Annex 1: Workshop Agenda

Transport, Energy Efficiency & Behaviour

IEA Workshop

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International Energy Agency Headquarters (Room 1)

10-11 May 2016, Paris, France

Tuesday 10 May 2016

Time	Topic	Presenters
9:00	Registration	
9:30	Welcome and Introduction	Keisuke Sadamori, Director, Energy Markets and Security, IEA Brian Motherway, Head, Energy Efficiency Division
9:50	Participants Roundtable	
Session 1 Demand Management **Chair: Sam Thomas, IEA**		
10:00-10:45	Potential Acceptance of Mobility as a Service ('MaaS') – Business Models and Consumer Attitudes	Sonia Yeh, University of California, Davis & Chalmers University of Technology, Sweden
	Intelligent Transport Systems in Reducing Energy Demand in Road Transport	Phil Blythe, Department for Transport, UK
	Discussion	
10:45-11:15 Coffee		
Session 2 Demand Management **Chair: Sara Bryan Pasquier, IEA**		
11:15 - 13:00	Optimised (collaborative) Logistics to Drive Operational and CO_2 Efficiencies	Martin Rapos, Energy and Mobility Director, Routemonkey, Netherlands
	Stockholm's Congestion Tax: Implementation, Acceptance, and Environmental Consequences	Joel Franklin, Royal Institute of Technology, Sweden
	Dynamic Parking Pricing: Experiences in California	Wei-Shiuen Ng, International Transport Forum, France
	Saving Oil in a Hurry: Demand Management Measures	Martin Young, Head of Emergency Policy Division, IEA

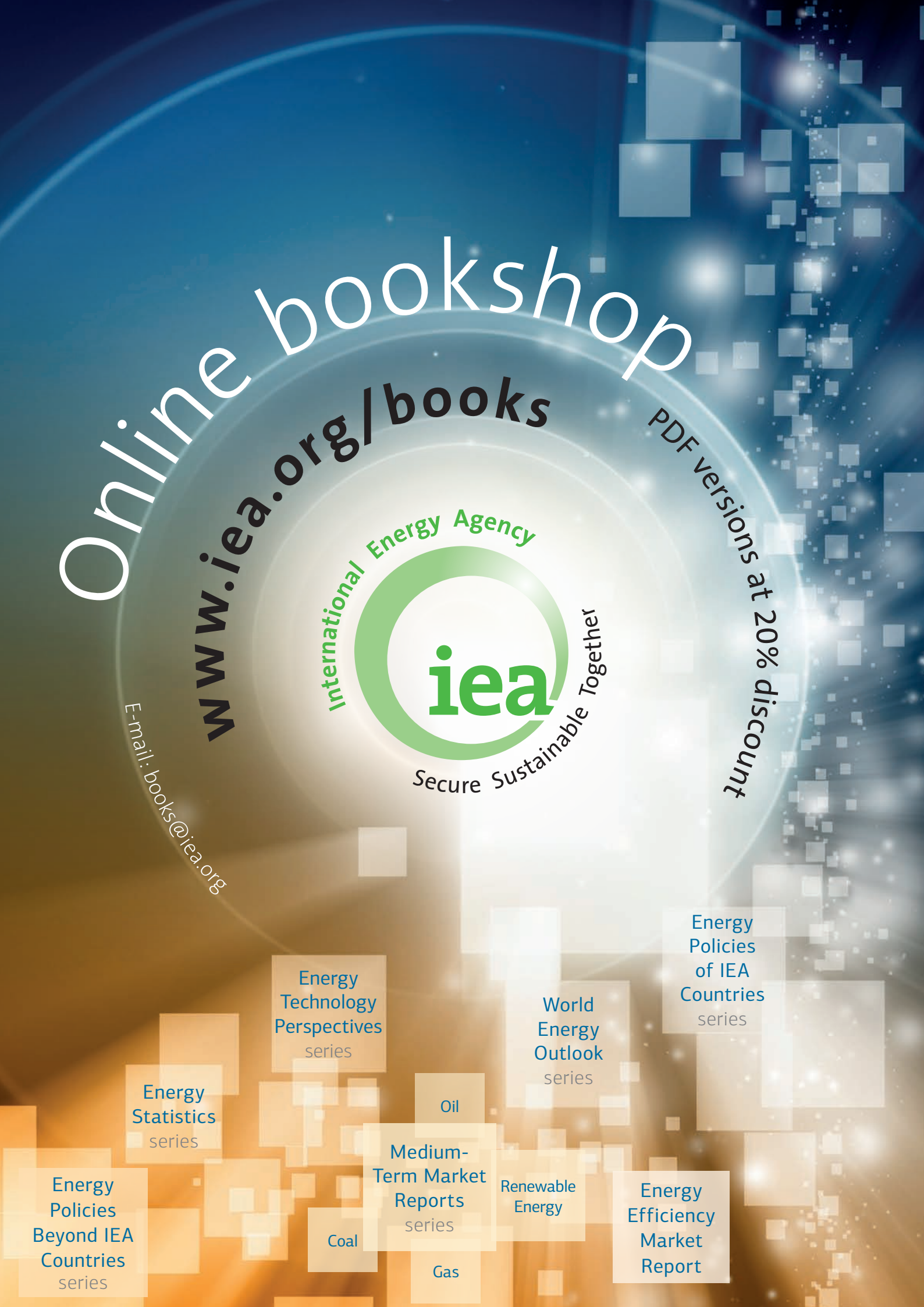
	Discussion	
13:00 – 14:00 Lunch (33 Rue de la Federation)		
Session 3 Driving More Efficiently: Eco Driving, Feedback Systems & Vehicle Components **Chair: Benoit Lebot, IPEEC**		
14:00 - 15:00	Encouraging Eco-driving	Conor Molloy, AEMS, Ireland
	Reducing CO_2 emissions from Vehicles by Encouraging Lower Carbon Car Choices and Fuel - Efficient Driving Techniques (eco-driving)	David Pryke, Department for Transport, UK
	Eco-driving is a Well-Known Topic for Fuel Reduction but What is Really Behind It?	Patrick Vincent, Rationale Driving & Vehicle's Environmental Performance Expert, RENAULT Environmental Strategy Planning, France
	Discussion	
15:00 – 15:30 Coffee		
Session 4: Demand Management and Vehicle Purchasing Decisions **Chair: Jae Sik Lee, IEA**		
15:30 - 17:00	Car Psychology and Barriers to Sustainable Mobility Behaviour	Martin Kroon, Netherlands
	How Governments Promote Efficient Vehicles through Labeling Programs	Zifei Yang, International Council on Clean Transportation, USA
	Encouraging Direct Reductions in Car Use	Sally Cairns, University College London, UK
	Driver Feedback Theory vs. Practice in the United States	Tai Stillwater, Zendrive, United States
	Discussion	
17:00 – 17: 30 Wrap Up: Sam Thomas, IEA		

19:30 Self-paid dinner – Le Suffren, 84 Avenue de Suffren, 75015

Wednesday 11 May 2016

Session 5 Fuel Switching: Promoting Electric Vehicles Chair: Sara Bryan Pasquier, IEA		
9:30 – 11:00	Understanding Current and Future Potential PEV Buyers: Implications for Policy	Jonn Axsen, Simon Fraser University, Canada
	Growing the UK ULEV Market: Understanding People's Motivations and Barriers	Jo Bacon and Andrew Scott, Department for Transport, UK
	Basic Understanding of Consumers and Rapid Changes in Attributes of New Technology	Sonia Yeh, University of California, Davis & Chalmers University of Technology, Sweden
	Integrating Electric Vehicles into the Electricity System	Patrick Jochem, KIT University, Germany
	Discussion	
11:00 – 11:30 Coffee		
Session 6 Fuel Switching: Promoting Electric Vehicles (Continued) Chair: Sam Thomas, IEA		
11:30-13:00	Norway Electric Car Miracle	Konrad Pьtz, Envova, Norway
	Challenges and Opportunities: Development of Electromobility in the Eastern Part of the European Union	Janos Ungar, Hungarian Electro-mobility Association, Hungary
	Charging Infrastructure – Deficits in Interoperability, the Need for Regulation and the Berlin Approach	Hermann Blьmel, Berlin Senate Department for Urban Development and Environmental Protection, Principle Affairs of Transport Policy, Germany
	Electric VehicleDevelopment in Chinese Cities and the Drivers	Wenjing Yi, ERI, China
	Discussion	
13:00-14:00 Lunch (33 Rue de la Federation)		
Session 7 Shift: Attitudes Towards Transport Modes and Promoting Urban Planning Chair: Pierpaolo Cazzola, IEA		
14:00 – 15:45	Attitudes towards transport modes – a comparison between US and China	Wei-Shiuen Ng, International Transport Forum, France
	Promoting Urban Public Transport in India	Sandeep Garg, India
	Lessons from Vancouver: Urban Planning and Transport	Holly Foxcroft, Canada

	Promoting Public Transport in Bangkok	Asawin Asawutmangkul, DEDE, Thailand
	Discussion	
15:45-16:15 Coffee		
Session 8: Real and Modelled Behaviour **Chair: Fabian Kreuzer, IEA**		
16:15-17:00	Improvements in the Representation of Behaviour in Integrated Energy and Transport System Modelling	Jacopo Tattini, Technical University of Denmark (DTU), Denmark
	Do Dealers Discourage EV Purchases? Findings from a Study of Retail Innovation in the U.S. Market for EVs	Eric Cahill, UC Davis, USA
	Discussion	
17:00 - 17:30 Wrap Up: Sam Thomas, IEA		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