Available online at www.sciencedirect.com

ScienceDirect

Transportation Research Procedia 25C (2017) 5088–5098

Transportation Research Procedia

www.elsevier.com/locate/procedia

World Conference on Transport Research - WCTR 2016 Shanghai. 10-15 July 2016

Sustainable development synergies and their ability to create coalitions for low-carbon transport measures

Oliver Lah[a]*

[a]*Wuppertal Institute for Climate, Environment and Energy, Neue Promenade 6, Berlin 10178, Germany*

Abstract

Many low-carbon transport strategies can help achieve other economic, social and environmental objectives. These include improving access to mobility, reducing traffic and parking congestion, saving consumers money, supporting economic development, increasing public health and safety, and reducing air and noise pollution. Based on Avoid-Shift-Improve approaches and case studies from Germany, Colombia, India and Singapore, this paper shows that low-carbon transport generates significant and quantifiable benefits that can create a basis for political and societal coalitions.

Estimates suggest that currently available and cost effective measures can reduce transport Greenhouse Gas emissions by 40-50% compared to 2010. Yet, a number of barriers affect the optimal exploitation of this potential. Considering the possible economic, social and environmental benefits of sustainable transport, the shift towards a low-carbon pathway of this sector can be a win-win situation for climate protection and local development goals. This paper aims to make a contribution to understand these opportunities by highlighting the linkages between objectives, presenting case studies, facts and figures. The paper will also explore assessment methodologies and tools that can help practitioners to assess sustainable development benefits (SDB) and providing evidence for policy-makers to make more informed decisions on transport investments and polices.

Peer-review under responsibility of WORLD CONFERENCE ON TRANSPORT RESEARCH SOCIETY.

Keywords: Climate change; sustainable transport; co-benefits.

* Corresponding author. Tel.: +49 (0)30 2887458-16.
E-mail address: oliver.lah@wupperinst.org

2352-1465
Peer-review under responsibility of WORLD CONFERENCE ON TRANSPORT RESEARCH SOCIETY.
10.1016/j.trpro.2017.05.495

From co-benefits to sustainable development benefits

With regard to the terminology, this paper evolves from using the well-established term *co-benefit* that describes positive side-effects of climate change mitigation actions, towards using the term *sustainable development benefits* to highlight the fact that diverse environmental, economic and social impacts are equally important from a societal perspective. The paper also explores the risks and uncertainties of some impacts of mitigation measures that may lead to trade-offs and negative side-effects. This aim will help to inform priority-setting for decision makers.

From a climate change mitigation perspective, the term *co-benefits* may make sense, as for example safety or air quality improvements are a (positive) by-product of the primary objective. However, from a wider political perspective it would be wiser to refer to these effects as *sustainable development benefits.* This will give a clear indication on the equal importance of all pillars of sustainable development and may facilitate coalition building between sector ministries and stakeholders from the environmental field, such as the environment ministries and NGOs. As the relevant sector institutions (e.g. the transport ministry or local transport departments) may have other primary policy objectives, such as improving air quality, access or safety it is important to emphasize and measure social, economic and environmental benefits of climate change mitigation measures beyond the greenhouse gas emission reductions in order to motivate actors from these groups by showing the synergies in goal achievement and the benefits a given mitigation action will have in terms of the ministry's priorities. While of course, political and institutional structures are very different from country to country and equally on the local level, some of the key priorities and perspectives of institutions are likely to be somewhat similar depending on the mandate of the institution. Similarly, policy objectives will be different for various institutional actors. However, generating the highest potential level of synergies is likely to have a positive impact on the potential to form coalitions that can support the take-up of a specific policy measure or packages of measures (Nemet et al. 2010; Grubler et al. 2012).

Low-carbon transport as enabler for sustainable transport policy coalitions

This paper analyses synergies between low-carbon transport strategies and other economic, social and environmental objectives, as these can substantially increase the measure´s cost-effectiveness and help build political support for their implementation. Low-carbon transport measures, by avoiding trips, reducing demand, shift to low-carbon modes and improving vehicle efficiency can help achieve various further planning objectives including reduced traffic and parking congestion, public infrastructure and service cost savings, consumer savings and affordability (savings targeting lower-income households), increased safety and security, improved mobility options for non-drivers (and therefore reduced chauffeuring burdens for motorists), and improved public fitness and health, in addition to their pollution emission reductions. Sector officials and many other stakeholders place a high value on these benefits, which creates opportunities for join forces to support their implementation. This paper explores the linkages between climate change and typical policy objectives of key stakeholders and political actors.

1. Identify synergies to other sustainable development objectives

Low-carbon transport strategies that – in addition to reducing Greenhouse Gas (GHG) emissions - help achieve further economic, social and environmental policy objectives, can have a far more extensive overall impact on sustainable development and count with more political support, than mitigation measures that solely focus on the reduction of GHG emissions (Eckermann et al. 2013). Only a few studies have actually examined the total cost of transport including congestion, air pollution, accidents, and noise, and therefore the total potential benefits of policies and programs that reduce these negative impacts. One example of the results of an estimation of positive impacts are the overall reductions of transport expenditures of a balanced sustainable transport policy in a 2 Degree Pathway that were assessed by the International Energy Agency of being up to USD 70 trillion by 2050 (IEA 2012a). In another example from the local level, the combined benefits were assessed for Beijing to be between 7.5% to 15% of GDP annually (Creutzig and He, 2009).

When preparing arguments for a transport climate change mitigation measure it may help thinking about additional benefits that may be high on the agenda of important policy actors and stakeholders. Energy security, transport access and affordability, air quality, health and safety are all powerful policy objectives that need to be taken into account when designing integrated climate change mitigation strategies and Nationally Appropriate Mitigation Actions (NAMAs) that are geared towards a high level of synergies and co-benefits. The following section provides a short overview with some key messages related to each major sustainable development benefit (based on IPCC 2014):

Access and mobility are vital for individuals and businesses. Many transportation emission reduction strategies also reduce costs by improving affordable travel options including walking, cycling, ridesharing and public transit, and by creating more compact communities with shorter travel distances. Households living in automobile-dependent communities often spend 15-20% of their household budget on motor vehicles, but only 5-10% if they are located in more accessible and multi-modal communities (Isalou, Litman, and Shahmoradi 2014; D Mahadevia, Joshi, and Datey 2013).

Air quality is another major issue to which low-carbon transport can make a positive contribution by reducing vehicle engine emissions such as sulphur oxides (SOx), nitrous oxides (NOx), carbon monoxide (CO), hydrocarbons (HC), volatile organic compounds (VOC), toxic metals, and particulate matter (PM), the finer particles of which can cause cardiovascular, pulmonary and respiratory diseases.

Noise pollution affects individual health and quality of life. Noise is second only to air pollution in the impact it has on human health, creating hearing loss, heart disease, learning problems in children and sleep disturbance. In Europe alone noise generated by traffic is linked to more than 50,000 premature deaths every year (T&E 2008).

Congestion is a major issue in many urban areas and creates substantial economic cost. For example, it accounts for around 1.2% of GDP as measured in the UK ; 3.4% in Dakar, Senegal and 4% in Metro Manila, Philippines (Carisma and Lowder 2007); 3.3% to 5.3% in Beijing, China (Creutzig and He 2009); 1% to 6% in Bangkok, Thailand (World Bank 2002) and up to 10% in Lima, Peru (Kunieda and Gauthier 2007). Re-allocating space from roads and parking to more people centred-activities can further significantly improve the **quality of live** in cities.

Employment and economic impacts relate to a number of direct and indirect effects of sustainable transport, such as direct employment opportunities, e.g. in public transport or improved access to jobs and markets. Improved reliability of travel times for both people and freight can also contribute substantially to the attractiveness of cities and the ease of doing business.

Energy security is a key policy objective on the national level and transport plays a major role in this due to its almost complete dependence on petroleum products. Low-carbon transport can improve energy security for individuals, businesses and national economies (Shakya and Shrestha 2011; Leiby 2007). By improving affordable transport options, such as walking, cycling and public transit, low-carbon mobility also improves overall accessibility (people’s ability to reach desired services and activities), particularly for physically and economically disadvantaged groups, as well as commuters, tourists and businesses (Boschmann 2011; Sietchiping, Permezel, and Ngomsi 2012; David Banister 2011).

Public health benefits result from more active transport (cycling and walking). This is increasingly important due to increasingly sedentary lifestyles and resulting health problems such as diabetes. Although these modes incur risks, these tend to be offset by their health benefits, particularly if cities improve active transport conditions (David Rojas-Rueda, de Nazelle, et al. 2011; Rabl and de Nazelle 2012a). While some strategies towards modal shifts will have a direct mitigation effect, others such as the introduction of environmental zones may cause trade-offs, as they may ban efficiency, but polluting Diesel vehicles or re-direct traffic, which may increase trip length.

Road safety is also a major transport policy objective that many integrated climate change mitigation strategies can help achieve. Road accidents are estimated to kill around 1.27 million and injure between 20 to 50 million annually, mostly in developing countries (WHO 2011).

The IPCC (2014) pointed out that an integrated approach that addresses transport activity, structure, intensity and fuels is required for a transition towards a 2°C stabilisation pathway as well as generating sustainable development benefits (Table 1). Different types of mitigation actions tend to bring along different impacts and benefits. Policy makers interested in the implementation of mitigation actions and looking for specific *co-benefits* should take this into consideration when selecting and prioritizing mitigation actions for implementation. Mitigation actions in the transport sector can be grouped roughly into three categories. Strategies that **avoid** total motor vehicle travel, e.g. by creating more compact, multimodal communities, and providing incentives for travellers to **shift** from automobile to more resource-efficient modes (walking, cycling, ridesharing, public transit, telecommunications that substitute for physical travel, and delivery services) tend to provide the greatest total benefits, reflecting the high costs (both, internal and external) of motor vehicle travel and the road and parking facilities it requires. **Improving** motor vehicle fuel efficiency and shifting to alternative fuels, on the other hand, provides fewer co-benefits. Table 1 gives an overview of the three categories and the respective development benefits they bring along.

Table 1 A high-level overview of mitigation strategies and their potential economic, social and environmental co-benefits (based on IPCC, 2014)

Intervention level	**Emission reduction approach**	Sustainable development benefits (and risks for trade-offs)		
		Economic	**Social**	**Environmental**
Activity	***Avoid*** Reduce total vehicle travel by reduced trip distances e.g. by developing more compact, mixed communities and telework.	Reduced traffic and parking congestion (6,7). Road and parking cost savings Consumer savings Energy security (1,2). More efficient freight distribution (14). Reduced stormwater management costs	Improved access and mobility, particularly for non-drivers, which improves their economic opportunities and productivity (9) Affordability (savings for lower-income households) Accident reductions	Ecosystem and health benefits due to reduced local air pollution (20). Reduced land consumption (7, 9). Potential risk of damage to vulnerable ecosystems from shifts to new and shorter routes (15,16).
Structure	***Shift*** to low-carbon transport modes, such as public transport, walking and cycling	Improved productivity due to reduced urban congestion and travel times across all modes (6,7). Improved energy security (1,2).	More equitable mobility access and safety, particularly in developing countries (8). Reduced accident rates from improved walking and cycling conditions, and shifts from automobile to public transit (7,11). Total accidents can increase if extra safety measures for cyclists are not introduced (22).	Ecosystem and health benefits due to reduced local air pollution (20).

			Reduced exposure to air pollution (7). Health benefits from shifts to active transport modes (7,12).	
Intensity	***Improve*** the efficiency of the vehicle fleet and use	Reduced transport costs for businesses (4,5). Improved energy security (1,2).	Reduced fuel cost for individuals and transport operators (1,2). Health benefits due to reduced urban air pollution (20).	Ecosystem and biodiversity benefits due to reduced urban air pollution (20).
Fuels	***Reduce*** the carbon content of fuels and energy carriers	Some measures may reduce the costs for businesses; others may increase (4). Improved energy security (reduction of oil dependency) (1,2). Reduce trade imbalance for oil-importing countries (3).	Lower exposure to oil price volatility risks (1,2). Electric and fuel cell powered vehicles give air quality improvements (13,20) and noise reduction (10) Potential increase in accidents due to electric vehicles (2-wheelers, cars, buses, trucks) being silent at low speeds (24). CNG and biofuels have mixed health benefits (19,20). A shift to diesel can improve efficiency, but tends to increase air pollution (23).	Electric and fuel cell vehicles Air quality improvements (13,20). Biofuels: Potential adverse effects on biodiversity, water and nitrification (24). Potential issues associated with sustainable supply of biofuels (21). Unsustainable mining of resources for technologies e.g. batteries and fuel cell (17,18).

References: 1: (Greene 2010); 2: (Costantini et al. 2007); 3:(Kaufmann, R.K., Dees, S., Karadeloglou, P., Sánchez 2004); 4: (Boschmann 2011); 5: (Sietchiping, Permezel, and Ngomsi 2012); 6: (Cuenot, Fulton, and Staub 2012, Lah 2014); 7: (Creutzig, Mühlhoff, and Römer 2012); 8: (David Banister 2008); 9: (D. Banister 2008; Geurs and van Wee 2004); 10: (Creutzig and He 2009); 11: (Tiwari and Jain 2012); 12: (Rojas-Rueda et al. 2011); 13: (Sathaye et al. 2011); 14: (Olsson and Woxenius 2012); 15: (Garneau et al. 2009); 16: (Wassmann 2011); 17: Eliseeva and Bünzli 2011; 18: Massari and Ruberti 2013; 19: (Takeshita 2012); 20: (Kahn Ribeiro et al. 2012). 21: (IEA 2011a), 22: (Woodcock et al. 2009) , 23: (Schipper and Fulton 2012), 24: (Sims et al. 2014,)

2. Measure combination to maximise synergies

Decision making on transport policy and infrastructure investments is as complex as the sector itself. Rarely ever will a single measure achieve comprehensive climate change impacts and also generate economic, social and environmental benefits. Many policy and planning decisions have synergistic effects, meaning that their impacts are larger if implemented together. It is therefore generally best to implement and evaluate integrated programs rather than individual strategies. For example, by itself a public transit improvement may cause minimal reductions in individual motorized travel, and associated benefits such as congestion reductions, consumer savings and reduced pollution emissions. However, the same measure may prove very effective and beneficial if implemented with complementary incentives, such as efficient road and parking pricing, so travellers have both **push and pull incentives** to shift from automobile to transit. In fact, the most effective programs tend to include a combination of qualitative improvements to alternative modes (walking, cycling, ridesharing and public transit services), incentives to discourage carbon-intensive modes (e.g. by efficient road, parking and fuel pricing; marketing programs for mobility management and the reduction of commuting trips ; road space reallocation to favour resource-efficient modes), plus integrated transport planning and land use development, which creates more compact, mixed and better connected communities with less need to travel.

A vital benefit of the combination of measures is the ability of integrated packages to deliver synergies and minimise rebound effects. For example, the introduction of fuel efficiency standards for light duty vehicles may improve the efficiency of the overall fleet, but may also induce additional travel as fuel costs decrease for the individual users. This effect refers to the tendency for total demand for energy decrease less than expected after efficiency improvements are introduced, due to the resultant decrease in the cost of energy services (Sorrell 2010; Gillingham et al. 2013, Lah 2014). Ignoring or underestimating this effect whilst planning policies may lead to inaccurate forecasts and unrealistic expectations of the outcomes, which, in turn, lead to significant errors in the calculations of policies' payback periods (WEC 2008, IPCC 2014). The expected rebound effect is around 0-12% for household appliances such as fridges and washing machines and lighting, while it is up to 20% in industrial processes and 10-30% for road transport (IEA 1998, 2013). The higher the potential rebound effect and also the wider the range of possible take-back, the greater the uncertainty of a policy's cost effectiveness and its effect upon energy efficiency (Ruzzenenti and Basosi 2008).

A number of studies emphasize that an integrated approach is vital to reduce transport-sector greenhouse gas emissions cost-effectively (IPCC 2014, Figueroa Meza et al. 2014). While emissions reductions can be achieved through several means, such as modal shift, efficiency gains and reduced transport activity, it is apparent that the combination of measures is a key success factor to maximise synergies and reduce rebound effects. For example, overall travel demand reduction and modal shifts would need to be substantially stronger if not accompanied by efficiency improvements within the vehicle fleet and vice-versa (Figueroa Meza et al. 2014; Fulton, Lah, and Cuenot 2013). Vital element for this strategy is a policy package as summarised in the table below.

Table 2: Elements of a multi-modal, multi-level sustainable transport package

Examples measures	Complementarity of measures
National measures - Fuel tax - Vehicle fuel efficiency regulation - Vehicle tax based on fuel efficiency and/or CO2 emissions	- Vehicles standards and regulations ensure the supply of efficient vehicles and taxation helps steering the consumer behaviour - Fuel tax encourages more efficient use of vehicles, which helps minimising rebound effects that might occur if individuals and businesses drive more or not as efficient as they would have driving a vehicles with lower efficiency standards
Local measures - Compact city design and integrated planning - Provision of public transport, walking and cycling infrastructure and services - Road User Charging, parking pricing, access restrictions, registration restrictions and number plate auctions, eco-driving schemes, urban logistics	- Compact and policy-centric planning enable short trips and the provision of model alternatives provides affordable access - Complementary measures at the local level help managing travel demand and can generate funds that can be re-distributed to fund low-carbon transport modes

3. Veto players and coalitions for the implementation of sustainable mobility measures

Transport is a complex and multifaceted activity. Policy interventions in this sector can have unintended consequences, positive and negative as they rarely only affect one objective, for example air quality measures may affect fuel efficiency negatively or biofuels may have land-use change implications. Linking and packaging policies is therefore vital to generate synergies and co-benefits between measures. This provides a basis for coalitions that can align different veto players. An integrated policy approach can help to overcome implementation barriers, minimize rebound effects and create the basis for coalitions among key political actors and societal stakeholders.

It is sometimes claimed that transport is the hardest sector to decarbonise (ECMT 2007; IEA 2011c). However, cities, regions and countries around the world are successfully implementing polices and projects which provide substantial emission reductions in addition to other benefits. While currently implemented measures cannot by themselves achieve the established emission reduction targets, they can make important contributions. According to a recent IPCC Assessment Report, only an integrated approach can achieve the levels of reduction needed to shift to a 2°C pathway. This is true not only for the achievement of emission reduction goals, but also for the fulfilment of other sustainable development goals. Reductions in traffic and parking congestion, increased energy security and traffic safety, affordability of transport services, public fitness and health, economic productivity, mitigation of climate change, and the reduction of local air pollution are positive impacts of transport policy that can help motivate people, businesses and communities to implement **comprehensive policies and integrated transport** programs to reduce transport greenhouse gas emissions and generate sustainable development benefits. Different people, groups and institutions may have different priorities, for example, some may be motivated by economic objectives and others by social equity or environmental objectives. The diverse benefits offered by a comprehensive or integrated measure can help build broad community support. The nature of integrated sustainable, low-carbon transport policies is that they address several objectives simultaneously, which generates synergies and helps creating coalitions.

The political and institutional context in which policies are being pursued is a vital factor for the success or failure of implementation (Jänicke 1992). Institutional aspects such as the presence of absence of a environment ministry at the national or environment department on the local level and their respective role in the process as well as the legal power, budget and political influence are likely to have an effect on the implementation of (primarily) climate related transport measures. (Jänicke 2002).

Vital for the success of long-term policy and infrastructure decisions is support from diverse political actors, stakeholders and the public. A societal perspective and the incorporation of sustainable development objectives is a vital step in forging coalitions and building public support. Policy and infrastructure measures and the combination thereof are an important element in generating sustainable development benefits with low-carbon transport as they provide the content of a low-carbon transport strategy. But vital for the success of the take-up and implementation of measures is the policy environment – the context in which decisions are made (Justen et al. 2014). This context includes not only socio-economic, but also political aspects, taking into account the institutional structures of countries. The combination of policies and policy objectives can help building coalitions, but can also increase the risk of the failure of the package if one measure faces strong opposition, which, however, can be overcome if the process is managed carefully (Sørensen, Hedgaard, et al. 2014). A core element of success is the involvement at an early stage of potential veto players and the incorporation of their policy objectives in the agenda setting (Tsebelis and Garrett 1996).

Veto players are political actors who have a distinctive role in the policy process and put a hold to an initiative. Typical veto players are finance ministries and parliaments with legislative prerogatives. This is a substantially different role from **stakeholders**, who have a vested interested in a particular policy process, but do not have the (legal) power stop it. However, both groups need to be involved in the process to successfully implement a measure. **Public participation** can help ensuring durability and support beyond political parties. There is a causal relationship between policy objectives, agenda setting, institutional structures and policy outcomes (Tsebelis 2002, Lijphart 1984). The synergies explored in this paper provide a basis for the inclusion of veto players into the policy process, which is vital for the uptake of sustainable mobility policies. The table below aims to apply the veto players' approach to coalition formation to identify the links between policy objectives and policy actors (Table 1). This aims to highlight that politics and the policy environment play an important role in the uptake of policy measures.

Table 1: Coalition building - examples of potential linkages between climate and other sustainable development policy objectives and actors

Climate change mitigation approach and objective	**Economic implications and actors**	**Social implications and actors**	**Environmental implications and actors**
Avoid vehicle travel by reduced trip distances e.g. by developing more compact, mixed communities and telework.	Reduced congestion: *Local authorities (v)* ↑ More efficient freight distribution: *Businesses and associations* ↑ *Economic development ministry (v)* ↑	Improved access and mobility *Social development ministry* ↑ Accident reductions *Health Ministry* ↑	Reduced land consumption *Local planning authority (v)* →
Shift to low-carbon transport modes, such as public transport, walking and cycling	Improved productivity due to reduced urban congestion and travel times across all modes *Local authorities (v)* ↑	Reduced exposure to air pollution Health benefits from shifts to active transport modes *Local authorities (v)* ↑	Ecosystem benefits due to reduced local air pollution. *Local environmental department & national ministry* ↑
Improve the efficiency of the vehicle fleet and use	Reduced transport costs for businesses and individuals *Local authorities (v)* and Economic and Social development ministries ↑	Health benefits due to reduced urban air pollution *Health Ministry* ↑	Ecosystem and biodiversity benefits due to reduced urban air pollution *Local authorities (v)* ↑
Reduce the carbon content of fuels and energy carriers	Improved energy security *Economic development Ministry* ↑ Reduce trade imbalance for oil-importing countries *Finance Ministry (v)* ↑	A shift to diesel can improve efficiency, but tends to increase air pollution *Health and Environment Ministries (v?)* ↓	Potential adverse effects of biofuels on biodiversity and land-use *Environment and agriculture (v)* ↓

The selection is not exhaustive and depends on the policy environment. Key: positive ↑ negative ↓ uncertain → , (v) potential Veto Player

Conclusion

Considering that significant and diverse benefits can be gained from policies and projects that increase transport system efficiency, their uptake is far lower than economically justified. Shifting to a low-carbon development pathway requires substantial transport sector reforms. Many of these are options that provide significant economic, social and environmental co-benefits and so can conserve energy and reduce emissions at low or event negative costs. Because of their significant and diverse benefits, they offer opportunities to build coalitions involving many different stakeholders with various interests. This can help build support and strengthen the political case for the shift towards a low-carbon mobility pathway. Successful strategies need to be integrated across policy areas, regions and levels of government. One way of incorporating objectives of key players and include them in the process is to establish a cross-cutting working group (first in the department and then across departments and then across levels or government and including key business and civil society players). The table below provides some examples of linkages between climate change mitigation approaches, their linkages to some economic, social and environmental implications and examples of potential veto players and stakeholders. This matrix is mainly an illustrative example and needs to be amended for the specific context.

Acknowledgements

Financial support was provided by the Transfer project, managed by GIZ on behalf of the BMUB and the SOLUTIONS project funded from the European Union's Sevens Framework Programme for research, technological development and demonstration under the grant agreement 604714.

References

Banister, D. 2008. “The Sustainable Mobility Paradigm.” *Transport Policy* 15 (2): 73–80.

Banister, David. 2008. “The Sustainable Mobility Paradigm.” *Transport Policy* 15 (2): 73–80.

———. 2011. “Cities, Mobility and Climate Change.” *Special Section on Alternative Travel Futures* 19 (6): 1538–46. doi:10.1016/j.jtrangeo.2011.03.009.

Boschmann, E.Eric. 2011. “Job Access, Location Decision, and the Working Poor: A Qualitative Study in the Columbus, Ohio Metropolitan Area.” *Geoforum* 42 (6): 671–82. doi:10.1016/j.geoforum.2011.06.005.

Carisma, B., and S. Lowder. 2007. “Estimating the Economic Costs of Traffic Congestion: A Review of Literature on Various Cities & Countries.”

Costantini, Valeria, Francesco Gracceva, Anil Markandya, and Giorgio Vicini. 2007. “Security of Energy Supply: Comparing Scenarios from a European Perspective.” *Energy Policy* 35 (1): 210–26. doi:10.1016/j.enpol.2005.11.002.

Creutzig, F., R. Mühlhoff, and J. Römer. 2012. “Decarbonizing Urban Transport in European Cities: Four Cases Show Possibly High Co-Benefits.” *Environmental Research Letters* 7 (4): 44042.

Creutzig, Felix, and Dongquan He. 2009. “Climate Change Mitigation and Co-Benefits of Feasible Transport Demand Policies in Beijing.” *Transportation Research Part D: Transport and Environment* 14 (2): 120–31. doi:doi: 10.1016/j.trd.2008.11.007.

Cuenot, Francois, Lew Fulton, and John Staub. 2012. “The Prospect for Modal Shifts in Passenger Transport Worldwide and Impacts on Energy Use and CO_2.” *Energy Policy* 41 (February): 98–106. doi:10.1016/j.enpol.2010.07.017.

Eckermann, André, Andrea Henkel, Oliver Lah, Frederic Rudolph, Wolfgang Obergassel, Timon Wehnert, and Laura Wuertenberger. n.d. “Navigating Transport NAMAs: A Practical Handbook on Nationally Appropriate Mitigation Actions (NAMAs) in the Transport Sector.”

ECMT. 2007. *Cutting Transport CO_2 Emissions: What Progress?* Paris: OECD. http://www.internationaltransportforum.org/Pub/pdf/07CuttingCO2.pdf.

Figueroa Meza, Maria J., Oliver Lah, Lewis M. Fulton, Alan C. McKinnon, and Geetam Tiwari. 2014. "Energy for Transport." *Annual Review of Environment and Resources* 39 (1): null.

Fulton, Lewis, Oliver Lah, and François Cuenot. 2013. "Transport Pathways for Light Duty Vehicles: Towards a 2° Scenario." *Sustainability* 5 (5): 1863–74. doi:10.3390/su5051863.

G F Nemet and T Holloway and P Meier. 2010. "Implications of Incorporating Air-Quality Co-Benefits into Climate Change Policymaking." *Environmental Research Letters* 5 (1): 14007.

Garneau, Marie-Ève, Warwick F. Vincent, Ramon Terrado, and Connie Lovejoy. 2009. "Importance of Particle-Associated Bacterial Heterotrophy in a Coastal Arctic Ecosystem." *Journal of Marine Systems* 75 (1–2): 185–97. doi:10.1016/j.jmarsys.2008.09.002.

Geurs, Karst T., and Bert van Wee. 2004. "Accessibility Evaluation of Land-Use and Transport Strategies: Review and Research Directions." *Journal of Transport Geography* 12 (2): 127–40. doi:10.1016/j.jtrangeo.2003.10.005.

Greene, David L. 2010. "Measuring Energy Security: Can the United States Achieve Oil Independence?" *Energy Policy* 38 (4): 1614–21. doi:10.1016/j.enpol.2009.01.041.

Grubler, Arnulf, Francisco Aguayo, Kelly Gallagher, Marko Hekkert, Kejun Jiang, Lynn Mytelka, Lena Neij, Gregory Nemet, and Charlie Wilson. 2012. "Chapter 24 - Policies for the Energy Technology Innovation System (ETIS)." In *Global Energy Assessment - Toward a Sustainable Future*, 1665–1744. Cambridge University Press, Cambridge, UK and New York, NY, USA and the International Institute for Applied Systems Analysis, Laxenburg, Austria. www.globalenergyassessment.org.

IEA. 2011a. "Technology Roadmap. Biofuels for Transport." Paris: International Energy Agency. http://www.iea.org/publications/freepublications/publication/bioenergy.pdf.

———. 2011b. *World Energy Outlook 2011*. Paris: International Energy Agency, OECD/IEA.

———. 2012. "Energy Technology Perspectives 2012." Paris: International Energy Agency.

Isalou, AA, T Litman, and B Shahmoradi. 2014. "Testing the Housing and Transportation Affordability Index in a Developing World Context: A Sustainablility Comparison of Central and Suburban Districts in Qom, Iran." *TRANSPORT POLICY* 33: 33–39.

Jänicke, Martin. 1992. "Conditions for Environmental Policy Success: An International Comparison." *Environmentalist* 12 (1): 47–58. doi:10.1007/BF01267594.

———. 2002. "The Political System's Capacity for Environmental Policy: The Framework for Comparison." In *Capacity Building in National Environmental Policy*, edited by Helmut Weidner and Martin Jänicke, 1–18. Springer Berlin Heidelberg. http://dx.doi.org/10.1007/978-3-662-04794-1_1.

JICA. 2005. "The Master Plan for Lima and Callo Metropolitan Area Urban Transportation in the Republic of Peru; Chapter 6, Traffic Control and Management Conditions." Transport Council of Lima and Callo, Ministry of Transportation and Communications of the Republic of Peru.

Justen, Andreas, Jens Schippl, Barbara Lenz, and Torsten Fleischer. 2014. "Assessment of Policies and Detection of Unintended Effects: Guiding Principles for the Consideration of Methods and Tools in Policy-Packaging." *Policy Packaging* 60 (0): 19–30. doi:10.1016/j.tra.2013.10.015.

Kahn Ribeiro, S., M. J. Figueroa, F. Creutzig, S. Kobayashi, C. Dubeux, and J. Hupe. 2012. "Energy End-Use: Transportation." In *The Global Energy Assessment: Toward a More Sustainable Future*, 93. IIASA, Laxenburg, Austria and Cambridge University Press, United Kingdom and New York, USA.

Kaufmann, R.K., Dees, S., Karadeloglou, P., Sánchez, M. 2004. "Does OPEC Matter? An Econometric Analysis of Oil Prices." *Energy Journal* 25 (4): 67–90.

Kunieda, Mika, and Aimée Gauthier. 2007. "Gender and Urban Transport: Smart and Affordable — Module 7a. Sustainable Transport: A Sourcebook for Policy-Makers in Developing Cities." Eschborn, Germany: Deutsche Gesellschaft fur Technische Zusammenarbeit (GTZ).

Lah, O. 2014. "The Barriers to Vehicle Fuel Efficiency and Policies to Overcome Them." *European Transport Research Review*.

Leiby, P.N. 2007. "Estimating the Energy Security Benefits of Reduced U. S. Oil Imports." *Estimating the Energy Security Benefits of Reduced US Oil Imports*.

Mahadevia, D, R Joshi, and A Datey. 2013. "Ahmedabad´s BRT System: A Sustainable Urban Transport Panacea?" *Economic and Political Weekly*, no. 48: 56–64.

Olsson, Jerry, and Johan Woxenius. 2012. "Location of Freight Consolidation Centres Serving the City and Its Surroundings." *Procedia - Social and Behavioral Sciences* 39 (0): 293–306.

doi:10.1016/j.sbspro.2012.03.109.
Rabl, Ari, and Audrey de Nazelle. 2012. "Benefits of Shift from Car to Active Transport." *Transport Policy* 19: 121–31. doi:10.1016/j.tranpol.2011.09.008.
Rojas-Rueda, David, Audrey de Nazelle, Marko Tainio, and Mark J Nieuwenhuijsen. 2011. "The Health Risks and Benefits of Cycling in Urban Environments Compared with Car Use: Health Impact Assessment Study." *British Medical Journal* 343 (August): 1–8. doi:http://dx.doi.org/10.1136/bmj.d4521.
Ruzzenenti, F., and R. Basosi. 2008. "The Rebound Effect: An Evolutionary Perspective." *Ecological Economics* 67 (4): 526–37. doi:10.1016/j.ecolecon.2008.08.001.
Sathaye, J., O. Lucon, A. Rahman, J. Christensen, F. Denton, J. Fujino, G. Heath, et al. 2011. "Renewable Energy in the Context of Sustainable Development." In *IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation*, edited by O. Edenhofer, R. Pichs-Madruga, Y. Sokona, K. Seyboth, P. Matschoss, S. Kadner, T. Zwickel, et al. Cambridge, UK and New York, NY, USA: Cambridge University Press.
Schipper, Lee, and Lew Fulton. 2012. "Dazzled by Diesel? The Impact on Carbon Dioxide Emissions of the Shift to Diesels in Europe through 2009." *Energy Policy* 54: 3–10. doi:10.1016/j.enpol.2012.11.013.
Shakya, Shree Raj, and Ram M. Shrestha. 2011. "Transport Sector Electrification in a Hydropower Resource Rich Developing Country: Energy Security, Environmental and Climate Change Co-Benefits." *Energy for Sustainable Development* 15 (2): 147–59. doi:10.1016/j.esd.2011.04.003.
Sietchiping, Remy, Melissa Jane Permezel, and Claude Ngomsi. 2012. "Transport and Mobility in Sub-Saharan African Cities: An Overview of Practices, Lessons and Options for Improvements." *Special Section: Urban Planning in Africa (Pp. 155-191)* 29 (3): 183–89. doi:10.1016/j.cities.2011.11.005.
Sims R., R. Schaeffer, F. Creutzig, X. Cruz-Núñez, M. D'Agosto, D. Dimitriu, M.J. Figueroa Meza, L. Fulton, S. Kobayashi, O. Lah, A. McKinnon, P. Newman, M. Ouyang, J.J. Schauer, D. Sperling, and G. Tiwari, 2014: Transport. In: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.). n.d. "Transport." In *Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.*
Sørensen, H Hedgaard, K Isaksson, J Macmillen, J Åkerman, and F Kressler. 2014. "Strategies to Manage Barriers in Policy Formation and Implementation of Road Pricing Packages." *Policy Packaging* 60 (0): 40–52.
Takeshita, T. 2012. "Assessing the Co-Benefits of CO_2 Mitigation on Air Pollutants Emissions from Road Vehicles." *Applied Energy* 97: 225–37.
Tiwari, G., and D. Jain. 2012. "Accessibility and Safety Indicators for All Road Users: Case Study Delhi BRT." *Journal of Transport Geography* 22: 87–95. doi:10.1016/j.jtrangeo.2011.11.020.
Tsebelis, G, and G Garrett. 1996. "Agenda Setting Power, Power Indices, and Decision Making in the European Union." *International Review of Law and Economics* 16 (3): 345–61.
Wassmann, Paul. 2011. "Arctic Marine Ecosystems in an Era of Rapid Climate Change." *Progress In Oceanography* 90 (1–4): 1–17. doi:10.1016/j.pocean.2011.02.002.
WHO. 2011. "Global Status Report on Road Safety." World Health Organization.
Woodcock, James, Phil Edwards, Cathryn Tonne, Ben G Armstrong, Olu Ashiru, David Banister, Sean Beevers, et al. 2009. "Public Health Benefits of Strategies to Reduce Greenhouse-Gas Emissions: Urban Land Transport." *The Lancet* 374 (9705): 1930–43. doi:doi: 10.1016/S0140-6736(09)61714-1.
World Bank. 2002. *Cities on the Move : A World Bank Urban Transport Strategy Review.* Washington, D.C.: The World Bank.