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Beyond emission targets: how to decarbonize the passenger transport sector?

Results from the Deep Decarbonization Pathways Project for Transport (DDPP-T)

DDPP-T Consortium

Reaching the ambitious climate objective of the Paris Agreement requires decreasing significantly sectoral emissions from the transport sector. However, the ambition pledged for the transport sector under the Nationally Determined Contributions (NDCs) remains very limited. The DDPP-T analyzes Paris-compatible sectoral strategies for the passenger transport that can serve to inform the 2018 Facilitative Dialogue and the preparation of future, more ambitious, NDCs by 2020.

In a context of an expected steep increase in global mobility demand, deep decarbonization will require a mix of different “well-known” options: the rapid diffusion of low-carbon vehicles and low-carbon fuels and the modal shift towards low-carbon modes like public transport and non-motorized transport (cycling and walking). However, while crucial, these options are not ‘silver bullets’ that on their own meet the decarbonization challenge, given their intrinsic individual limitations.

The project adopts an integrated approach of sectoral deep decarbonization strategies articulating the diffusion of low-carbon technologies with the future of mobility and all its drivers, such as the demographic and economic situation, the localization of population centers, the transport and urban planning, the lifestyles and the features of mobility services. The strategies are context-specific in order to capture different country circumstances, and consider a long-term horizon to inform the short-term conditions enabling structural changes of the transport system.

Building on four country analyses (France, Japan, Mexico and the United Kingdom), this *Issue Brief* derives five cross-cutting messages for a deep decarbonization of the passenger transport sector.

KEY MESSAGES

- Deep decarbonization of the passenger transport sector requires strong actions on four pillars of transformation. Only a consistent articulation of these synergistic pillars allows an effective deep decarbonization.
- Deep decarbonization can help alleviate the time and monetary burden of constrained mobility for households. But the transition can be challenging.
- Deep decarbonization can be compatible with satisfying mobility needs of all categories of population.
- Deep decarbonization should combine context-specific actions, adapted to the different countries, mobility needs and travel distances.
- Deep decarbonization should consider an early ramp-up of low-carbon technologies through the 2020’s, consistent with the high shares required by 2050.

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In 2014, the transport sector was responsible for 23% of total energy-related CO_2 emissions (i.e. 7.5 $GtCO_2$). Reaching the ambitious "well below 2C" climate objective of the Paris Agreement requires decreasing significantly these emissions. However, the ambition pledged for the transport sector under the Nationally Determined Contributions (NDCs) remains very limited. 63% of NDCs include mitigation measures specific to the transport sector but less than 50% include more than one specific action and only 9% put forward an explicit emission reduction target for the sector.[1] Therefore, many initiatives have been launched since COP21 in 2015 to investigate specific aspects related to the decarbonization of the transport sector.[2]

The DDPP-T (see Box) analyzes Paris-compatible sectoral strategies for the passenger transport that can serve to inform the 2018 Facilitative Dialogue and the preparation of future, more ambitious, NDCs by 2020.[3] Elaborating such consistent deep decarbonization strategies requires an integrated insight into the future of mobility and all its drivers beyond the technological ones; specific country circumstances should also be taken into account, and a long-term horizon should be considered. Based on these principles, country-driven passenger transport strategies of passenger transport decarbonization to 2050 have been developed by four teams in France, Japan, Mexico and the United Kingdom.[4] They all achieve deep reductions of emissions per capita, between 50% and 80 % across all countries and all scenarios, reaching a range of 0.1-0.5 tCO_2 per capita in 2050, down from 0.9-1.7 in 2010. This paper analyses the cross-cutting lessons learnt from these studies on deep decarbonization strategies for the passenger transport sector.

1. Nationally-Determined Contributions (NDCs) offer opportunities for ambitious action on transport and climate change, Oct 2016, PPMC-Slocat (http://www.ppmc-transport.org/wp-content/uploads/2015/06/NDCs-Offer-Opportunities-for-Ambitious-Action-Updated-October-2016.pdf)
2. Notably the Global Macro Roadmap by PPMC, the "Decarbonizing Transport" Project by ITF, and the Science-Based Target Initiative (SBTi) by WWF/WRI/CDP/UNGC.
3. See also: Levaï, D., Baron, R. (2017). Beyond emission targets: ambition in the context of the 2018 Facilitative Dialogue. IDDRI, *Policy Briefs* N°12/17 — Miles Project Consortium (2017). Beyond emission targets: how to strengthen the ambition of NDCs? Results of the MILES project informing the 2018 Facilitative Dialogue. IDDRI, *Policy Briefs* N°08/17.
4. www.iddri.org/projects/ddpp-transport

1. Deep decarbonization of the passenger transport sector requires strong actions on four pillars of transformation. Only a consistent articulation of these synergistic pillars allows an effective deep decarbonization.

Mobility demand management, captured by the evolution of distance traveled per capita, relies on structural measures. The analysis shows that it is possible to trigger absolute demand reductions in industrialized countries, and to control the increase in developing countries (see Section 3).

Energy efficiency combines improved technical efficiency of vehicles and the shift towards less energy intensive modes, like public transport or non-motorized modes. Action on this pillar is measured by the strong reduction of energy per capita and energy per pkm, by 29-74% and 44-63% respectively, over 2010-2050 and across all country analyses.

The decarbonization of electricity and fuels is not a transport-specific action strictly speaking, but is crucial for increasing the availability of low-carbon energy carriers that can be used for mobility services. For example, the decarbonization strategy in Japan, Mexico and UK involve more than 95% reduction of the carbon intensity of electricity (gCO_2/kWh) by 2050.

Finally, **the shift to low-carbon energy carriers** for transport use enables a decrease of the average carbon intensity fuel use, through technical (eg, from fuel-based to electric vehicles) and structural shifts (eg, from fuel-based cars to electric public transport). Starting from an initial very low level in 2010, the share of non-fossil fuel energy (electricity, liquid and gaseous biofuels) increases to 34-73% in 2050 across the four country analyses.

Because of the synergetic effects between these four pillars, deep decarbonization of passenger transport cannot be achieved if any of the pillar is absent or implemented at insufficient scale. Action on one pillar often has positive effect on the potential of another pillar.

For example, demand reduction and energy efficiency triggering lower total energy demand means that a given absolute production of biofuels covers a higher share of end-use energy. This is notably key in air transport, for which biokerosene represents for example between 15 and 30% in 2050 in UK and Mexican scenarios. Given production constraints related to land use, the control of air mobility level is a key companion strategy for the deployment of a high share of biofuels.

Similarly, the scale of energy efficiency, mobility demand and modal shift affects the number of low-carbon vehicles to be deployed in the system. For example, different assumptions on these three dimensions across the two scenarios developed for France and the UK lead to significantly different deployment of low-carbon vehicles by 2050, ranging respectively from 12 to 20 million cars and from 20 to 36 million cars, for the same sectoral emission levels

2. *Deep decarbonization can help alleviate the time and monetary burden of constrained mobility for households. But the transition can be challenging.*

Constrained mobility represents an important burden for households, in terms of time spent traveling and allocated budget. Reducing distance traveled through spatial reorganization, teleworking or modal shifts towards less expensive public transport and non-motorized transport are key decarbonization strategies that also support the alleviation of this travel burden.

The results show that time spent on constrained mobility can be decreased in Japan by up to 50% in 2050 compared to 2010 levels. This is notably permitted by reduced distance through spatial reorganization of settlements, improved average speed of public transport and non-motorized modes thanks to dedicated lanes and decreased congestion for remaining private modes.

The scenarios also show that the budget share spent on constrained mobility can be decreased between 2 and 5 percentage points over 2010-2050. The example of France shows that the largest decreases can be obtained when combining avoidance of some specific trips, reduction of the distances traveled thanks to revised spatial organization, and modal shifts from private mobility to public transport and non-motorized modes. Public transport, which reaches up to 60% of mobility in 2050 in Mexico (up from an already high 45% level in 2010), appears as a particularly important option to support access to mobility for low incomes population.

However, the positive effect of decarbonization strategies on budgets in 2050 should not hide the transition challenge to 2020 and 2030. First, forward-looking policies are needed to enable the spatial reorganization in cities and the development of relevant network of public transport infrastructure. The latter aspect is particularly crucial in non-metropolitan areas where public transport faces the challenge of lower density of settlements. This transition challenge points to the need to adopt context-specific actions, able to support the required changes in different segments of mobility (see section 4).

Second, even with forward-looking policies, the total cost of mobility may increase in the 2020's and the 2030's notably because, despite continuous decreases of costs for low-carbon vehicles permitted by learning effects, it may take some time before their costs fall below those of current vehicles. This effect is observed in the scenarios of France and Mexico, where the budget for constrained mobility increases by 1 percentage point in 2020 and 2030 compared to 2010 level. This challenge points to the need to support the fast ramp-up of low-carbon vehicles in the tarnsition period (see section 5).

3. *Deep decarbonization can be compatible with satisfying mobility needs of all categories of population.*

In developing countries, development needs require an increase of average distance traveled from their current relatively low level. The two scenarios for Mexico show that the same economic development can be satisfied with different mobility needs. Indeed, with the adoption of a sustainable urban design and the development of teleworking, the total annual distance traveled would be reduced by 1,000 pkm/cap in 2050 compared to BAU assumptions, but still be 70% higher than 2010 levels reaching 14,000 pkm/cap.

Beyond these aggregate estimates, the analysis shows that it is possible to decarbonize the transport sector while ensuring a significant increase of mobility for the categories of population with lowest mobility rates. For example, mobility in non-metropolitan areas of Mexico was about only one third of levels in metropolitan areas in 2010 (5,500 pkm/cap vs. 17,000 pkm/cap). The analysis shows that stringent emission reductions can happen in parallel with a doubling of the mobility per capita in non-metropolitan areas by 2050. This is permitted by a large deployment of public transport services and an access to low-carbon private mobility options.

In industrialized countries, the access to mobility does not require to increase the average distance traveled per capita, given already high levels in 2010, between 13,000 and 16,000 pkm/cap in France, the UK and Japan. There, the challenge lies in the capacity to control the trend to continuous increases under the pressure of external factors, like the spatial organization of living spaces and transport modes in cities. In France and Japan for example, scenarios have been developed that consider notably more compact cities and the development of teleactivities, triggering a reduction of the average distance per capita by 19% and 40% respectively compared to 2010 levels.

4. Deep decarbonization should combine context-specific actions, adapted to the different countries, mobility needs and travel distances.

The determinants of mobility and (therefore) the levers of action are fundamentally different in metropolitan areas and non-metropolitan areas. In metropolitan areas, the higher density of populations favors modal shift towards public transport and non-motorized modes for short distances. As an example, the Mexican analysis describes a rapid move to public transport, from 35% in 2010 to 65% in 2050 of total metropolitan demand, which includes Bus Rapid Transit (BRT) taking about a 10% share of metropolitan mobility. In the French scenarios, the development of non-motorized transport (NMT) is important with an estimated increase from 4% in 2010 to 14% of metropolitan mobility in 2050, enabled by a shift from private cars to NMT for short trips of less than 3 km. In comparison, in non-metropolitan areas, the level of public transport services is often lower and non-motorized modes are less relevant because of longer distance trips and low-density areas. Private transport therefore retains a more important role in these areas. In scenarios carried out for Japan, the UK and France, between 50% and 75% of mobility in non-metropolitan areas still relies on private transport in 2050. One of the French scenarios considers the deployment of (low-carbon) autonomous vehicles as an important driver of decarbonization, especially for non-metropolitan transport.

Different strategies should also be considered for constrained and non-constrained mobility.[5] For example, constrained mobility involves rather short-distance trips on regular routes, which are well suited for electric vehicles where charging is not problematic. Across all scenarios, for example, the distances traveled by electric cars in 2050 represent between 60% and 100% of the constrained mobility provided by cars.

5. Constrained mobility corresponds to the travels required for daily activities. A dominant share of this mobility is made of commuting, the rest being related to other daily travels like school, health, shopping, etc.

5. Deep decarbonization should consider an early ramp-up of low-carbon technologies through the 2020's, consistent with high shares required by 2050.

In all deep decarbonization scenarios, low-carbon vehicles[6] take a dominant share of the fleet, between 50% and 92% by 2050 in the four country scenarios. This requires a massive rollout starting now to reach a significant share of global transport energy demand after 2030. Annual car sales in the different countries range between 4% and 22% in 2020 and between 25% and 63% in 2030.

This large-scale deployment implies the need to scale research, development and innovation funding now, increase incentives for quicker deployment of alternative vehicles, and plan the necessary infrastructure, in order to simultaneously increase knowledge and drive down costs by 2030. Policy efforts need to focus on stimulating technology innovation, and build the conditions for accelerated deployment and diffusion. This requires notably clear policy signals favouring an alignment of expectations of the private sector and customers like for example the vehicle incentive scheme based on bonus scrapping premium in France. This requires also specific roadmaps for the development of infrastructure needed to support the large-scale deployment of new vehicles, like the charging infrastructure and related electricity generation and distribution needs for the electric vehicle. Several million charging points will be needed in each country and this development will need to be further analysed and coordinated in combination with the daily-use of electric cars and the localization of these cars. This is a major industrial innovation, as well as an infrastructure challenge, which needs to be prepared immediately in order to lay foundations for effective action in the coming 15 years.

6. Including Battery Electric Vehicles, Plug and Hybrid Electric Vehicles and Fuel Cell Electric Vehicles with low-carbon electricity.

Box. The Deep Decarbonization Pathways Project for Transport (DDPP-T)

The DDPP-T, coordinated by IDDRI, is a sectoral companion project of the Deep Decarbonization Pathways Project (DDPP, deepdecarbonization.org), which investigated low-emission trajectories for the energy sector. It gathers in-country research teams, working independently of their governments, which are responsible for the development of their country study. Research partners are: UCL Energy Institute (UK); CIRED, EDF R&D and IDDRI (France); Tempus Analitica (Mexico); NIES, Mizuho and IGES (Japan). The project will continue in 2018 to include the freight transport sector and cover more countries.