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Enhancing the ambition of NDCs through the analysis of sectoral transformations: the example of freight transport

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Carbon emissions from the transport sector, including international air and sea transport, account for about 14% of global emissions and 23% of energy-related emissions. According to the IPCC, without targeted measures, the sector's emissions could double by 2050. Such a trend would be in strong contrast with the achievement of carbon neutrality between 2050 and 2070, which is assessed as a necessary condition to limit global warming to below 2°C and towards 1.5°C consistently with the Paris Climate Agreement objective (IPCC, 2018).

Freight national transport emissions represent about 40% of total transport sector emissions. However, Nationally Determined Contributions (NDCs) submitted by countries in the run-up to COP21 make little mention of any concrete action in this sector: according to the OECD's International Transport Forum, "freight transport has been largely ignored" by the current contributions (ITF-OECD, 2018).

Moreover, the few references to freight transport decarbonisation in the current NDCs almost exclusively focus on the technological issues of the improvement of trucks and associated energy sources, thereby neglecting any complementary strategies on other important drivers of sectoral emissions such as the transformation of systems of production, consumption and trade, and the transformation of infrastructure and logistics operations.

The Paris Agreement requires each Party to the United Nations Framework Convention on Climate Change to submit a revision of its national contribution in 2020. In this context, this *Issue Brief* proposes a logical and coherent structure for the elaboration of a decarbonisation strategy designed around five main categories of strategies and a set of underlying socio-economic and technological determinants and transformations. Each of these categories is illustrated with key indicator data derived from the DDP research group's work on the pathways to deep decarbonisation of the freight transport in France in 2050.

KEY MESSAGES

Achieving a truly deep decarbonisation strategy for freight transport requires to move beyond the conventional focus on improving engine technology and alternative fuel solutions.

Defining a sectoral deep decarbonisation strategy and translating it in a concrete action plan by 2030 requires an in-depth consideration of the drivers of sectoral transformations. This is needed to make the transition understandable and operational by all actors and to support the definition of a robust decarbonisation strategy in a context of uncertainties suited to contribute to raising the level of ambition. This requires, among other things, a rethinking of a set of determinants, such as systems of production, consumption and trade, the need for multimodal infrastructure, the regulatory frameworks of logistics, the development of new vehicles and energy infrastructure needs.

Beyond freight transport, this strategic approach has a more general scope and can be applied to other sectors of activity.

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The main categories and objectives of a decarbonisation strategy for freight transport could be expressed as follows:

1. Transforming production, consumption and trading systems to limit tonnage transported and kilometres travelled;

2. Transforming transport infrastructure and logistics platforms to enable the development of multimodality and intermodality;

3. Transforming the conditions of logistics operations to favour lower-impact vehicle traffic, improve their average load and allow modal shift;

4. Transforming vehicles to enable the penetration of new low-carbon engines and reduce their consumption;

5. Transforming fuel production capacities to meet the sector's needs and reduce the carbon content of fuels.

1. TRANSFORMING PRODUCTION, CONSUMPTION AND TRADING SYSTEMS TO LIMIT TONNAGE TRANSPORTED AND KILOMETRES TRAVELLED

This first category contains a set of questions about the goods that will be needed in future for the economy to function: what raw materials will be used by industry? What quantities will be produced, consumed and transported? What goods will be imported and exported?

Indeed, many of the goods transported today will no longer be required as the low-carbon transition unfolds in the agri-food sector (crop protection and other agricultural inputs, replacement of plastic packaging), in the energy sector (fossil fuels phase-out), and in the construction sector (development of bio-sourced materials). In addition, the quantities of goods transported per inhabitant, per household or per GDP unit will change depending on transformations of the means of production, of the organisation of economic activities, of the development of eco-design in production, but also depending on changes in behaviours of consumption and use of goods. These are all determinants to be considered.

This first component should also examine the spatial organisation of value chains and the kilometres travelled from raw material extraction to delivery of the final product to the final consumer: where are the extraction, processing and final product consumption sites located? What are the reasons for their proximity or remoteness? How are they connected with the transport and logistics system? Among the determinants, the relative proportion of transport and production costs in the total final price of products, as well as the behavioural changes of final consumers, have a significant influence on the location of activities. The organisation of infrastructure (access, quality, price, speed) and the supply of transport and logistics services (frequency, quality, price, speed) are also key elements in locating activities and therefore the distances to be travelled.

2. TRANSFORMING TRANSPORT INFRASTRUCTURE AND LOGISTICS PLATFORMS TO ENABLE THE DEVELOPMENT OF MULTIMODALITY AND INTERMODALITY

The second category questions the place of the different modes of transport: what place is there for non-road modes, such as river and rail transport, but also maritime and air, in a multimodal transport system according to different types of goods, the different distances to be travelled and the different geographies (cities, mountains)? What need is there for infrastructure and modal supply for these different types of transport, under which conditions and according to what regulations (cost, time, quality)?

The development and interconnection of transport infrastructure and sorting facilities between the different territorial scales (international and regional connections, and those around major conurbations) are necessary conditions to make multimodality possible, along with the development of non-road modes. In addition, the flexibility in the access to different networks, the pricing for the use of infrastructure and environmental externalities, the working conditions of the sectors as well as the traffic speeds and behavioral changes on delivery times are all determinants that influence the costs of the different modes, their transport time and therefore the choice of modes, whether inside or outside towns. Finally, digital innovations in flow management in each sector are also determinants that can improve the technical and economic characteristics of certain modes and make them more competitive than others.

3. TRANSFORMING THE CONDITIONS OF LOGISTICS OPERATIONS TO FAVOUR LOWER IMPACT VEHICLE TRAFFIC, IMPROVE THE AVERAGE VEHICLE LOAD AND ALLOW MODAL SHIFT

The third category should deal with the use of different transport vehicles to meet the transport demand: what different types of road vehicles (two-wheelers, utility vehicles or heavy goods vehicles) are best suited for the transport of goods, depending on territories, distances or loads? Can the loading rate be improved on certain journeys? Can we avoid empty returns by vehicles?

The transformations described in the two previous points have a direct impact on the place of road transport and the types of journeys, the average distances travelled, which therefore have an influence on the choice of road vehicle. Similarly, the delivery times imposed by loaders and consumers represent constraints for logisticians and haulage companies and influence the choice of modes and vehicles, but also the loading of vehicles. The delivery preferences of consumers at home or at local points of distribution also impact the loading rates and empty returns. Finally, collaboration among logisticians, haulage companies, loaders and consumers to improve the transparency of the demand and supply of transport can be another key determinant in pooling flows, enabling modal shift and improving loading rates.

4. TRANSFORMING VEHICLES TO ENABLE THE PENETRATION OF NEW LOW-CARBON ENGINES AND REDUCE THEIR CONSUMPTION

The fourth category should focus on the issue of the renewal of the vehicle fleet and on the technical innovations related to engines and fuels and the transport demand needs (distance autonomy, traction force): to what extent has freight transport by rail and river been electrified? What is the future of low-carbon engines, especially for road vehicles according to changes in transport demand, traffic regulations, different vehicle types and journeys?

Among the determinants, the associated transport costs and tariff dynamics are important. R&D developments, acquisition costs, fuel costs and the distance range are all factors that influence the renewal of fleets.

This element also makes it possible to address the issue of the reduction of unit energy consumption: what are the possible technical gains in terms of aerodynamics, the weight of lorries and materials, regenerative braking systems? What are the possible operational gains derived from eco-driving, the transformation of journeys (distance, speed) and the partial automation of certain functions?

5. TRANSFORMING FUEL PRODUCTION CAPACITIES TO MEET THE SECTOR'S NEEDS AND REDUCE THE CARBON CONTENT OF FUELS

This topic must be a part of any transport strategy to understand the other energy-related challenges and possible emission transfers from the transport sector to the energy or agriculture sectors. This analysis must be built with the actors responsible for the energy production and agri-food system transformation strategies to avoid energy use conflicts between sectors, and to better anticipate fuel quantity needs. Indeed, in the transport sector, the low-carbon vectors that are regularly mobilised as part of the phase-out of liquid fossil fuels are electricity, liquid and gaseous agrifuels, and hydrogen. For example, the role of electricity as a vector is increasingly important in all sectors of consumption, but its use only makes sense if this vector is also decarbonised. Furthermore, the usage of liquid and gaseous agrifuels must be considered with caution, depending on constraints related to land use and other sustainability criteria associated with the agri-food system like the preservation of biodiversity . This fuel is particularly subject to problems in terms of the double counting of raw materials used in different sectors (wood, agricultural waste, etc.). All these fuels require a revision of the development strategy of their related distribution network and refueling stations.

The subjects covered in these last two components have been raised in numerous publications and are typically the most often analysed, in this paper we therefore decided to focus on the first three, which are generally less discussed and analysed in climate strategies.

6. OUTLOOK AND ISSUES ASSOCIATED WITH NDCs REVISION

The transformations described above are not all independent. For example, the development of infrastructure influences the location of activities and therefore the kilometres travelled, but also the development of multimodality. The definition of a coherent and ambitious strategy therefore reveals a major issue related to the ability to integrate all of these dimensions within a consistent analysis framework.

While the definition of an initial strategy based on these five categories is an interesting first approach, it is not sufficient in the short term if it does not address all the underlying issues and transformations (some examples of which are mentioned in this *Brief*). Indeed, broad directions and quantified objectives regarding these elements do not enable the operationalisation of the transition, and are therefore insufficient to shift from a theoretical strategy to a concrete plan of action to be undertaken by 2030, which is the goal of the NDC revision. Moreover, a commitment to objectives that is not associated with a detailed analysis of the determinants and levers of action to operationalise the transition may even endanger this objective in the future and the associated political consensus.

Lastly, actions taken in the short term have consequences for longer-term potential, raising the risk of limiting the capacity for a more rapid and deeper reduction of greenhouse gas emissions. For example, changes in vehicles and in transport and logistics infrastructures represent a commitment over one or several decades and require significant investment from all stakeholders. In the same way, changes in behaviour and administrative regulations may require adaptations spanning several years and decades.

For all these reasons, policies and measures must be designed with a systemic vision to build policy packages that can bring about all of the necessary changes for deep sectoral decarbonisation and include the social and economic national priorities. It is in this perspective that the DDP research group in France analysed the issue of freight decarbonisation and developed a method that enables the coherent linkage of the main determinants of the sector's transformation to achieve a deep national decarbonisation by 2050 (Box 1), and to deduce action strategies by 2030 capable of informing the revision of the NDCs. This method has been implemented in France with two contrasting scenarios to illustrate some of these main issues and to shed light on the consequences of these transformations and their links. However, this approach is generalisable and can be deployed in other economic sectors.

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BOX 1. FREIGHT INDICATORS ILLUSTRATING THE FIVE CATEGORIES

The Deep Decarbonization Pathways (DDP) initiative is developing methods (Waisman *et al.*, 2019) and building Paris-compatible deep decarbonisation pathways for 2050 at the national scale that can be used inform national dialogues and prepare the revision of ambitious national contributions in 2020.

The latest work of the DDP research group in France (IDDRI, 2019) illustrates these different categories through certain key indicators quantified for two scenarios in France:

Category 1. The analysis of transported tonnes shows that it is possible, assuming similar economic development and population growth, to define two worlds where the quantities of tonnes transported vary from -9% to +49% of tonnes transported in 2050 compared to 2010, and where the average distances vary from -20% to +3% in 2050 compared to 2010.

Category 2. The analysis of the different modes of transport show that it is possible, through the development of infrastructure and adapted operating conditions, to obtain in 2050 a share of tonne-kilometres (tkm) transported by road between 60% and 81%, and by rail between 15% and 34%.

Category 3. Traffic analyses show that the share of road tkm travelled by light road vehicles is about 2% in 2050 but could represent between 33% and 41% of road vehicle-kilometres (vkm), while the proportion of road tkm travelled by articulated trucks can range from 87% to 89% in 2050 and can represent 39% to 43% of road vkm. Vehicle loading analysis shows that it is possible for road transport to have loading rates that increase between 2010 and 2050 up to 60%, and empty returns ranging from 5% to 50% in 2050, depending on the vehicles and journeys.

Category 4. The analysis of the energy used for rail transport shows that the electrification of freight transport by rail could reach up to 95% of tkm in 2050. In the road sector, the analysis of autonomy requirements, costs and fuel availability makes it possible to obtain a stock of light road battery electric vehicles ranging from 79% to 89% and heavy battery electric vehicles ranging from 36% to 56% in 2050. At the same time, the analysis of fuel savings for road vehicles related to technological innovations could reach up to 40% over the period 2010-2050, depending on the different types of vehicles and engines.

Category 5. The analysis of energy production methods shows that the carbon content of the various fuels used tends towards zero in 2050.

The development of the methodology for freight transport has been the subject of extensive work by the DDP Transport research group in France comprising IDDRI, IFSTTAR, CIRED and EDF R&D, with a contribution by ADEME.

➜ For more information: ddpinitiative.org

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