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Transport adaptation policies in Europe: from incremental actions to long-term visions

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Abstract

This research describes the current state of adaptation in the transport sector in Europe and explores their potential, lessons learnt and limits. The objective is to establish a typology of current approaches and assess their impact in terms of both, short term feasibility and long-term sustainability. As a result, some follow-up actions are suggested for policy making in terms of promoting better integrated consideration of mitigation and adaptation challenges, developing new technical tools and expertise to forecast potential climate change impacts, and expanding adaptation from the current operational focus to the planning and policy making fields.
Data & Methodology (150 words). This research is based on extensive data collection of stakeholders' views and case studies conducted in 2013 and 2014 in the framework of the European Topic Centre on Climate Change Adaptation (ETC/CCA) of the European Environment Agency (EEA), as summarized in report EEA 8/2014 (http://www.eea.europa.eu/publications/adaptation-of-transport-to-climate). The research makes a systematic assessment of the evidence gathered from the perspective of (1) technical base, (2) implicit causality chains and their relevance, (3) short term expected impacts, (4) integration with long-term policies and priorities. The assessment serves to categorize current actions in accordance with their expected impact, compatibility with a long-term low-carbon paradigm, and capacity to build up consensus among stakeholders (at the planning, infrastructure, operations and use levels).
Expected results (100 words): Based on the evidence gathered, it is claimed that there is a risk for incremental adaptation approaches to involuntarily consolidate already-prevailing unsustainable transport practices, so that transition efforts towards low-carbon transport would become more difficult to undertake. A number of innovative adaptive approaches in Europe, based on medium and long-term strategies, which address mitigation and adaptation in an integrated way are described, and ways to mainstream these integrated approaches are discussed.

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Keywords: climate change, adaptation, resilience, planning

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1. Introduction

The origins and current use of "maladaptation" (Barnett, 2010, p.211): "We define maladaptation as: 'action taken ostensibly to avoid or reduce vulnerability to climate change that impacts adversely on, or increases the vulnerability of other systems, sectors or social groups'. There are at least five distinct types or pathways through which maladaptation arises; namely actions that, relative to alternatives: increase emissions of greenhouse gases, disproportionately burden the most vulnerable, have high opportunity costs, reduce incentives to adapt, and set paths that limit the choices available to future generations.

In this paper we will focus on one of these pathways: the impact of adaptation actions in the transport emissions of greenhouse gases, or, more precisely, the risks of interference of adaptation actions with GHG mitigation policies in the transport sector. In Europe, these policies call for a significant reduction of emissions in the 2030 and 2050 horizons.

Burton and Fankhauser (2011) stress the relevance of soft measures in adaptation policies as a means to increase "adaptive capacity". Their arguments, although referring to developing to countries, are also valid for Europe and for the transport sector. One of the reasons for this would be the "pervasiveness and temporal complexity of adaptation decisions (e.g. the need to harmonize or integrate adaptation across spatial and temporal scales)". Soft measures would include "building capacity, identifying priorities, raising awareness". Ford et al (2011) find the adaptation action in transport infrastructure is particularly well documented compared to other sectors, with a focus on "non-structural" actions (planning, guidelines, regulations…) compared to "hard" interventions, and a protagonism from the local (municipal) level.

Collis et al (2014) discuss the comparative merits of adaptation practices based on learning from past incidents and adaptation practices based on resilience engineering. The former view would see complex systems as trapped in a spiral of increasing complexity, cost and vulnerability to cope with; the latter view would optimistically work on engineering-based solutions, based on the capacity to anticipate and plan for the future. The increasing complexity of rail- and more generally of transport- systems would fit well in this controversy. Although there is a historical tendency to look for engineering resilience, the fact is that adaptation practice is heavily relying on the experience from past events in the transport sector. Moving towards "resilience engineering" would require "redundancy and diversity to be built into subsystems, and availability of sufficient time, resources and competence to respond effectively to incidents", so that during disrupted operations, control of the system could be retained.

Although from an economic perspective, some authors see over-investment in protection capital as a safe bet to avoid the risks of potential losses due to vulnerability (Dumas & Hau-Dong, 2013), there is substantial consensus within the transport sector about favouring "low-regret actions" such as revised maintenance and operational practices, or users' information and management, rather than undertaken costly upgrading or new infrastructure building which current uncertainty about the future climate cannot fully justify (Przyluski , 2012; Molarius, 2012, Stamos & Mitsakis, 2014; EEA, 2014).

Section 2 in this paper establishes a framework for analysis, exploring the traits that can make it difficult the convergence of mitigation and adaptation policies. The key traits of mitigation policies in transport are identified from the European Commission's Transport White Paper (EC, 2011a). The analysis results in a review matrix to be applied to a sample of recent adaptation actions in Europe. Section 3 provides a summary description of the adaptation actions in the sample, and explores their potential impact, synergies and conflicts, in terms of GHG emissions. Finally, section 4 provides a discussion on the key lock-ins identified in the adaptation and mitigations paths and suggest policy actions to better align adaptation actions with long-term mitigation goals in transport.

2. The framework for analysis

2.1. Time and physical scales for adaptation and mitigation

Moser (2012) provides a detailed discussion of the general interactions between mitigation and adaptation measures. She takes into consideration the temporal and the spatial scales, to conclude that there is an intrinsic difficulty in taking both dimensions together in one specific sector: the scales of relevance are radically different for adaptation and mitigation actions, and they mobilise different expertise and practitioners within the sector:

"Adaptation options tend to be discussed as efforts focused mainly on the relatively near-term (i.e., with immediate effectiveness) and on local scales. By contrast, mitigation options, especially with an eye to the global impact they need to have to affect atmospheric GHG concentrations, tend to be viewed as long-term solutions and involving primarily higher (national and international) scales of governance" (p.169).

Adaptation focuses on the identification of actions, which should be implemented in the short-term, and tend to adopt a local, project-specific focus. Mitigation keeps a strategic, long-term perspective, and a global focus; transport maintenance managers, operators or service providers will typically be involved in adaptation actions, whereas planners and decision-makers will dominate mitigation policy discussions. Even researchers and innovators will tend to be different, with shorter implementation paths and more focused innovations for adaptation and complex, disruptive solutions with longer and more uncertain implementation paths for mitigation. Therefore, it cannot be surprising that adaptation and mitigation, in transport and other sectors, are rarely discussed from a jointly, comprehensive perspective. Much less are adaptation and mitigation measures examined from "a systems perspective, for the length of the measure's lifecycle and its impacts on natural and human systems" (id, p.170).

Lacking specific mandates to consider both mitigation and adaptation at the same time, harmonization of both policies in transport and in other sectors are likely to be based on particular opportunities, such as during regularly scheduled policy and planning processes or in the aftermath of particular climate-related events. (Id, p.171). In short, the universe of interactions between adaptation and mitigation is seen as if the common range for spatial and temporal interaction were quite small (Fig. 1a). This may be the case in some cases in transport, but there is a chance that, at least for some specific dimensions of adaptation and mitigation policies, the realm for interaction, particularly for measures with a long life-time cycle, is actually significant (Fig. 1b).

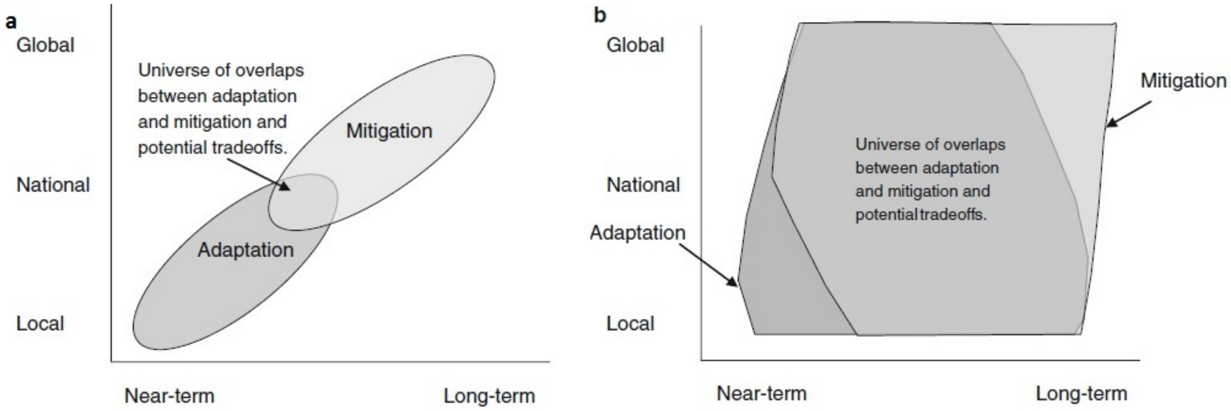

Fig. 1. Overlap of Adaptation and Mitigation and the Universe of Potential Tradeoffs (a) current; (b) desirable.

There is little guidance for fixing an optimal mix between mitigation and adaptation policies, in terms for example of investments. Research in this field is still limited and conducted with highly aggregated and poorly calibrated top-down models (Bosello et al, 2013).

The development of policy pathways can facilitate the analysis of interactions between mitigation and adaptation. During transport mitigation planning processes, policy pathways have become increasingly popular since the mid-1990s. The achievement of ambitious GHG reduction targets for transport needs a long-term perspective and a backcasting approach to identify key actions in time, which could facilitate those targets. (Quist et al, 2006). A similar approach can also be conceived for adaptation, with the adoption of an 'Adaptation Pathways' approach to identify the timing and sequencing of possible 'pathways' of adaptation measures over time under different scenarios; and the development of a monitoring framework that triggers defined decision points (see Ranger et al, 2013 for a practical application). A key difficulty, however, for establishing adaptation pathways, remains the significant uncertainty concerning future climate conditions.

Scrieciu et al (2013) revise the weaknesses of traditional economic assessments in climate policies, including adaptation and mitigation. In particular, they underline the relevance of including transaction and transition costs, and the importance of the sequencing of policy measures or policy pathway for assessing the achievement of the stated objectives. Regletably, the climate economics literature on the links between sectoral demand behaviour, institutional constraints and climate policy responses, including sequencing is still limited (id, p.191).

Fig. 2 exemplifies the need to include a path-dependency perspective to adaptation and mitigation in transport. While addressing policies independently, there is a significant risk to optimise one of the two dimensions (adaptation or mitigation), while getting poor, if any improvements in the other. The current institutional framework would be a significant barrier to explore an integrated approach that could find a fare compromise between adaptation and mitigation options.

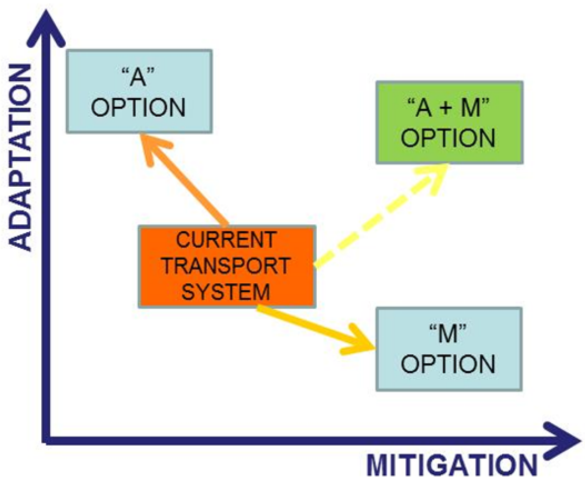

Fig. 2. Conflicting mitigation and adaptation paths.

Such a path-dependency approach should take into consideration, inter alia, how short-term actions (those typically adopted for adaptation purposes) may facilitate or jeopardise the transitions toward low-carbon mobility at the heart of all long-term mitigation visions. A closely associated challenge in the path dependency process is linked to the adaptation options privileged by decision makers. Whereas some stakeholders may prefer engineering resilience as a straight-forward response to modal vulnerabilities (in a sector still highly separated into modal silos) particularly with public-funded investment in transport infrastructure, there is a need to fully explore soft, low-regret actions to increase the resilience of the transport system through reforms in the institutional and organisational levels, demand management through communication and interaction with transport users and development of alternative mobility options through reinforced integration of transport modes (Fig. 3).

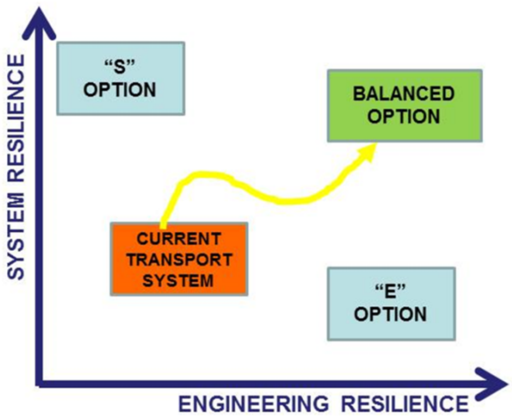

Fig. 3. Engineering resilience vs. system resilience.

A first review of the interactions between mitigation and adaptation in transport can be attempted at the European Union (EU) level through a review of recent policy action and progress in both fields. The mitigation path can be characterised through a review of the GHG targets and strategies of the European transport policy, as described in the Transport White Paper (EC, 2011a). This is a long-term vision (with benchmarks in 2030 and 2050) for a transition to a future transport system mainly characterised by a substantial reduction of the dependency of fossil fuels. The characterisation of the adaptation path is more challenging. The EU adaptation strategy (EC, 2013) only provides some general indications for the transport sector, and has to be complemented by a review of recent transport adaptation actions at the European and member state levels, based on the recent review undertaken by the European Environment Agency (EEA, 2014) and the information provided by the EU adaptation platform CLIMATE-ADAPT (climate-adapt.eea.europa.eu). The adaptation actions can subsequently be assessed from the perspective of their compatibility with the long-term mitigation path defined in the Transport White Paper.

2.2. Reviewing key traits of low-carbon transport systems

The core vision of the Transport White Paper combines the concept of "free travel across Europe" with that of "breaking oil-dependence, while keeping efficiency and mobility (EC, 2011a, §16 and §17).

The mitigation goals in the Transport White Paper are those previously established in the EC's roadmap towards a low carbon economy (EC, 2011b): a reduction of at least 60% of GHGs by 2050 with respect to 1990; by 2030, the goal for transport would be to reduce GHG emissions to around 20% below their 2008 level. This is taken forward in the Transport White Paper mainly through the focus on breaking oil-dependence and increasing (energy) efficiency.

This core vision is subsequently articulated in more detailed options for long-distance, medium-distance and urban transport (EC, 2011a, §21), which are summarised in a list of 10 "benchmarks", referring to:

- First point Technological innovation, with a focus on sustainable fuels and propulsion systems, including electrification of urban transport.
- More efficient modal split, with a focus on the promotion of for targeted freight and passenger demand flows.
- Adequate infrastructure, including the deployment of the Trans-European transport network (TEN-T) and convenient intermodal nodes (such as rail access to key airports and ports).
- Better management of traffic flows and provision of information to transport users through information and communication technologies (ITCs): intelligent transport systems (ITS) for roads, ERTMS for rail, SESAR for aviation…

The Transport White Paper strategy combines the use of market instruments with the implementation of innovation, and the development of adequate infrastructure (EC, 2011a, §34). It is worth noticing the demand management instruments are explicitly dismissed from the strategy: as it is put in the White Paper, "curbing mobility is not an option" (EC, 2011a, §18).

2.3. The review matrix

The review of adaptation actions can be undertaken considering the four categories of goals defined in the Transport White Paper: technological innovation, modal change, infrastructure, and ITC-related services (including traffic management and users' information). As a general observation, it is worth noticing that these categories are closer to an "engineering resilience" approach than to "system resilience". Technological innovations and infrastructure deployment and upgrading are expected to maintain or improve the efficiency and performance of the system, avoiding disruptions in operations. The ITC category, however, can be understood as closer to a "system resilience approach", in which ITC tools would be able to facilitate quick recovery, to gain flexibility and to redirect users towards other routes and modes, or even to review their transport plans in case of disruptions. As for the "modal change" category, the robustness of the system as a whole and its various transport modes is also taken for granted, although it can be argued that the concept of robustness is understood in a different way in the various transport modes. Whereas road transport provides high flexibility to users and route alternatives, system management is difficult to implement in case of disturbances; in the other extreme, centralised or planned transport modes, such as rail or aviation, are much easier to manage in case of disturbance, but provide a less extensive coverage of the territory and limited flexibility in terms of re-routing options (Leviäkangas et al, 2011 and 2012).

There are two different aspects to consider for each action: Firstly, checking whether each of the four of mitigation-related categories (implementation of technological innovation, modal change, infrastructure and ITCs) were considered within the adaptation action; secondly, assessing whether the likely effects of the adaptation action within each category would support or jeopardise the mitigation-related goals. This is assessed in a qualitative scale (Table 1).

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All tables should be numbered with Arabic numerals. Every table should have a caption. Headings should be placed above tables, left justified. Only horizontal lines should be used within a table, to distinguish the column headings from the body of the table, and immediately above and below the table. Tables must be embedded into the text and not supplied separately. Below is an example which the authors may find useful.

Table 1. Assessment of mitigation-related effects of adaptation actions.

+++	Strong, synergic effects	- - -	Strong negative effects
++	Moderate effects	- -	Moderate, negative effects
+	Likely synergic effects	-	Some negative effects likely
0	Mitigation Impact not considered		

3. Assessing recent adaptations actions in Europe

Adaptation actions in the transport sector have consistently increased in Europe since the end of the past decade. EEA (2014) provides a good number of examples, based on an extensive screening of 38 actions. Some of these actions have been selected to undertake this assessment, covering the whole adaptation cycle:

- Research and studies (5 actions).
- Vulnerability assessment (6 actions).
- Infrastructure maintenance and design (4 actions).
- Contingency and long-term plans (3 actions).

The information provided by EEA (2014) was complemented by the information available at CLIMATE-ADAPT, the European Adaptation Platform, and by additional references, where available. It is worth noting that none of the case studies provided explicit considerations or analysis of potential mitigation impacts. For the assessment, it was necessary to review the factual information and causality chains provided by each case from the perspective of the Transport White Paper benchmarks. The results of the review are summarised in Table 2.

Table 2. Assessment of adaptation actions.

Adaptation action	Technol.innovation	Modal change	Infrastructure	ITCs & Users
Research and Studies				
EWENT Project	+	++	+++	++
WEATHER Project	0	0	+++	++
ECCONET Project	++	+++	++	+
MOWE-IT Project	0	++		+++
TOPDAD Project	0	++	0	+++
Vulnerability assessments				
Nice airport	0	0	+++	0
Copenhagen airport	0	0	+++	0
Scottish road network	0	0	+++	++
xGEO (Norway roads)	0	0	++	+++
Blue spot concept (roads)	0	0	+++	0
ÖBB database on rail disruption	0	+	++	+
Maintenance & Design				
UK railway drainage standards	0	0	+++	0
EC's revision of standards	0	0	+++	0
French revision of standards	0	0	+++	0
Copenhagen metro design	0	+	++	0
Contingency and long-term plans				
RENFE weather information	0	+	+	0
Long term plans				
Working plans for TEN-T priority corridors	0	+	+	+
DHL: Resilience of future logistics chains	+	+++	+	+++

This assessment suggests that adaptation actions are currently taking a short-term perspective, with a focus on maintenance and quick recovery of operations. This perspective reduces the "universe of overlaps" between adaptation and mitigation, as illustrated in Figure 1. This approach favours low-cost, low-regret actions, which are likely not to have a strong (positive or negative) impact on mitigation, particularly compared to costly infrastructure upgrading or construction.

Adaptation actions do not pay much attention the expected long-term transition paths embedded in mitigation strategies and transport policy documents. Ironically, although resilience analysis typically include scenarios for 2050 and beyond, these scenarios include changes in climate and extreme weather events, but not the materialisation of key expected actions towards low carbon mobility; resilience gain or lost due to electric cars, massive modal change to rail or expanded information to users are generally not analysed.

Certainly, the inclusion of such future low-carbon traits of the transport system in adaptation studies and actions is challenging. Adaptation is the result of a combination of decisions from managers, operators and users, and it remains difficult to assess to what extent the expansion or reduction of certain transport modes may result in a resilience gain or loss for the system as a whole. By now, it is already difficult to undertake even simple comparisons, as the respective resilience merits of road as a flexible system versus rail and aviation as centralised systems (Leviäkangas et al, 2012), and further research seems to be necessary.

Further use of ITC in transport is generally considered as a safe bet from an adaptation perspective: it provides gains in resilience, and ITC investments are primarily driven by other considerations, such as efficiency of operations and provision of information to users and stakeholders at large. The deployment of ITC in transport provide an opportunity to expand the "universe of overlaps" between mitigation and adaptation, and to further explore their potential to serve as a substitute, or at least significantly reduce, the need for costly adaptation action in infrastructure.

Thus far, scant attention has been given to the adaptive impacts of new propulsion technologies and fuels, in spite of its relevance in the European mitigation strategy in transport. From a mitigation perspective, the future of non-motorised transport modes under a changed climate would also be of the utmost relevance, as climate conditions are one of the key drivers for modal choice in short, urban trips; the research project EWENT is one of the rare adaptation actions that have briefly explored this topic (Leviäkangas et al, 2011).

4. Conclusions

The paths explored in adaptation actions in Europe do not pay much attention to long-term mitigation strategies and their transition paths towards low-carbon mobility. Current adaptation efforts are focusing on gaining short-term resilience, taking it for granted that the basic traits of the transport system will not change in the future; this can make it more difficult for transport policies to achieve the transitional benchmarks established in the Transport White Paper and other long-term transport policy documents. Similarly, mitigation strategies do not seem to have explored in much detail how their technological and not-technological innovations would behave under a changed climate.

Assessing the resilience of 2030 and 2050 low-carbon visions in Europe could serve as a means to increase the interaction between mitigation and adaptation research and policy in the transport sector. First candidates for this resilience assessment would probably include E-mobility concepts, rail-based long and medium distance mobility, or the criticality of future multimodal networks from the perspective of peripheral, low-accessibility regions in Europe. The compromise among increased costs, carbon balance and accessibility of various multimodal options deserves further examination to avoid future lock-ins in the development of low-carbon multimodal solutions due to potentially incompatible adaptation choices.

In fact, infrastructure investment is taking the lion's share in current European transport policies. In spite of the mandate included in the TEN-T guidelines (EU, 2013), virtually no consideration has been made about the adaptation needs of the core network corridors in the recently presented working plans, and adaptation considerations seem to have been displaced to the project design level. Therefore, the risk remains that the choices made in those corridors result in suboptimal solutions from a long-term resilience perspective.

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