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Research article

Driving towards transformation? To what extent does global climate governance promote decarbonisation of land transport?

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ABSTRACT

This article aims to analyse the potential for international climate governance to promote the decarbonisation of land transport. It first summarises challenges and barriers that impede the transformation of the sector. On this basis, the article discusses how international governance could potentially assist with overcoming these barriers and mobilising potentials. Subsequently, the article analyses to what extent existing international governance institutions deliver on the potential identified. The analysis finds that while there is a large number of international institutions trying to promote the decarbonisation of land transport, none of them emerge saliently as hubs or core institutions. There is a substantial amount of activity to generate and disseminate knowledge and learning, but the potential for providing guidance and signal, setting rules, providing transparency/accountability and means of implementation could be further exploited. The article concludes with suggestions on how international governance may be strengthened.

1. Introduction

Transport is one of the largest and fastest-growing greenhouse gas (GHG) emission sources worldwide. In 2016, transport accounted for nearly a quarter of energy-related global CO_2 emissions (8 Gt) (International Energy Agency, 2018). Without changes to current trends, global GHG emissions from transport are set to again nearly double by 2050 (International Transport Forum, 2017). Even scenarios assuming substantial improvements in vehicle efficiency and some modal shifts project global transport emissions in 2050 that are still at 2015 levels (Lah, 2017). Achieving the objectives of the Paris Agreement therefore requires unprecedented efforts (IPCC et al., 2018).

International climate policy has traditionally pursued a global approach to mitigation, based on conceptualising the climate system as a global commons (de Coninck et al., 2018). However, opportunities and barriers for decarbonisation differ strongly from sector to sector. Taking these differences into account allows international governance to address each sector in the most effective way (Rayner et al., 2018; Victor et al., 2019).

This article aims to analyse the potential of international governance to promote the transformation of land transport towards sustainability. While many decisions on land transport are taken at the national and sub-national levels, the article will argue that international governance could nonetheless make a number of contributions to shifting the development of the sector into a more sustainable direction. Aviation and shipping are not covered, as challenges and strategies differ substantially from land-based transport (on international transport, see Rayner, this issue).

Some existing literature has already highlighted the potential for sectoral approaches to international climate governance (see e.g. Barrett, 2010; Meckling and Chung, 2009; Sawa, 2010; Schmidt et al., 2008; Victor et al., 2019). This article aims to go further in several respects. First, while most of this literature focused on the industry sector, there was little coverage of transport. Second, it mostly revolved around either negotiating sectoral emission targets with emerging economy countries, or organising international technology cooperation and transfer along sectoral lines. This article takes a broader view of potential means of international governance, going beyond emission targets and technology cooperation. For this purpose, it will employ the concept of governance functions developed in the introductory article of this special issue (see also section 3 below). Third, the article takes a broad approach to international institutions. In recent years, a plethora of new inter- and transnational governance initiatives have emerged which are intended to complement the climate regime under the United Nations Framework Convention on Climate Change (UNFCCC) as part of more "polycentric" global climate

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governance (Jordan et al., 2018). This article maps the international institutions that are trying to promote the decarbonisation of transport and analyses to what extent this governance complex has exploited the potential of global governance to advance the decarbonisation of the sector.

To this end, this article proceeds in three steps in line with the overall approach of this special issue (see Oberthür et al., this issue). First, section 2 identifies key strategies and instruments to move towards sustainable mobility as well as challenges and barriers that impede the transformation of the sector. Second, we analyse how international institutions could principally assist with overcoming these barriers and advancing the sector's decarbonisation ("governance potential": section 3). Third, section 4 assesses to what extent existing intergovernmental and transnational institutions that have relevance for the decarbonisation of land transport have so far delivered on the identified governance potential. The article concludes with some suggestions on how to close the governance gaps identified.

2. Transformation strategies and challenges

This section provides background on challenges and opportunities in the decarbonisation of land transport, providing a basis for the subsequent analysis of global governance. As such, it does not aim to provide a comprehensive review of transport policy literature but takes its starting point from the synthesis in the most recent assessment report by the Intergovernmental Panel on Climate Change (IPCC) (Sims et al., 2014).

Current strategies to foster more sustainable forms of transport focus on providing mobility services and managing transport demand, rather than relying solely on infrastructure. Such strategies often rely on the *Avoid-Shift-Improve* (ASI) framework (Sims et al., 2014, see also more recently Gota et al., 2019; Rogelj et al., 2018):

- *Avoid* travel or reduce travel-length through spatial planning and optimised infrastructure and logistics;
- *Shift* travel by favouring low-emission transport options – walking, bicycling and public transport – over individual motorised transport and road-bound transport of goods.
- *Improve* vehicle and fuels technology and efficiency.

A key rationale for this three-fold approach is seeking a balance between managing mobility demand and energy intensity. As synthesised by the IPCC, emission scenarios consistent with achieving the 1.5 °C limit rely on a reduction of final end use in the transport sector of about 15% compared to 2015 levels by 2050. Isolated technology shifts of the propulsion systems of the vehicles without changes to the overall transport system would fail to achieve such reductions (de Coninck et al., 2018). It would also fall short on delivering wider sustainability benefits, such as such as noise and pollution reduction and increased health, and would be less cost-effective (International Transport Forum, 2017).

However, adoption of the ASI approach needs to overcome substantial *institutional barriers* as it runs counter to traditional transport policy and planning paradigms. Traditionally, extending transport infrastructure and increasing mobility by means of individual vehicles has been regarded as critical as a foundation for economic development and well-being (Sims et al., 2014). Any infrastructure extension leads to travel time savings, the assumed monetary value of which leads to positive benefit-to-cost ratios for proposed investments. Over the last decades, national funding for transport projects has been contingent on high benefit-to-cost ratios. This led to the perverse incentive that cities applied for infrastructure extension to receive national funding, irrespective of actual demand. As a consequence, in many cities worldwide 'segregated land-use' is standard urban planning practice. Another practice is priority provision of urban space for automobile friendly infrastructure, such as parking spaces and road capacities (United Nations Human Settlements Programme, 2013).

The adoption of more climate-friendly vehicle technology would require bold efforts in particular in the regulatory and fiscal policy framework but faces strong *institutional and political barriers*. Traditional car makers have made substantial investment in internal combustion engines, which create economic and technological lock-in effects to a certain extent (Skeete, 2017). Many are resolving this dilemma by increasingly investing in electric vehicles while at the same time pressuring governments to slow down the speed of the transition in order to be able to exploit their existing assets as much as possible (Victor et al., 2019).

A strong practical barrier to the implementation of 'avoid and shift' strategies is the longevity of human settlement patterns and transport *infrastructure*. Many cities in industrialised countries are currently *locked-in* to high transport demand levels and would therefore need to be rebuilt substantially to lower transport demand (Driscoll, 2014; Figueroa et al., 2014). At the same time, the rapid and on-going urbanisation in the global South poses a great risk of further emissions lock-in if it replicates the emissions-intensive settlement patterns and transport systems developed in industrialised countries (Seto et al., 2014).

In addition, the ability of jurisdictions to steer their development onto a low-emission course is limited by their governance, technical, financial, and institutional *capacities*. Especially in urbanizing areas in the Global South capacities are often already overstretched by tasks such as providing decent habitation for their rapidly growing populations (Seto et al., 2014; WBCSD, 2010).

As for *economic* challenges, *investment requirements* for establishing transport infrastructure are high. Several studies indicate that total investment requirements in scenarios with emphasis on collective transport may be lower than scenarios focusing on individual motorised modes. However, shifting funding from unsustainable to sustainable transport would require a shift of policy paradigms as noted above. Capital requirements for collective transport may also generally be too high for some developing countries (Sims et al., 2014; SLoCaT, 2018). As for *vehicle costs*, the cost of battery electric vehicle technology has decreased substantially. But purchasing costs of electric vehicles remain higher than conventional alternatives, which poses a substantial barrier to adoption (Victor et al., 2019).

Finally, there are *technological* challenges, such as common standards for charging solutions, which affect market penetration (Pereirinha and Trovão, 2016). In addition, the servicing infrastructure needs to be adapted to the needs of alternative propulsion systems (Sims et al., 2014). Furthermore, the electricity grid needs to be adapted to cope with increasing loads and shifts in the demand profile. These technological and infrastructure challenges are especially acute in developing countries with lower levels of public finance, administrative capacity and electricity infrastructure (Victor et al., 2019).

3. The potential of international cooperation

3.1. Functions of international governance

Drawing on the existing literature on the functions and effects of international governance, the introductory article to this special issue distilled five key functions that international institutions may fulfil to help tackle a certain problem. International institutions are here understood to comprise both intergovernmental institutions, involving only governmental actors, and transnational institutions, which also comprise non-governmental actors (Oberthür et al., this

issue). The five functions are:

- Guidance & Signal: International institutions can signal the resolve of members to pursue a certain course of action such as decarbonisation. These signals derive from the principles and objectives on which international institutions are based and can provide direction beyond the respective institution by giving an indication to business, investors and other actors about which policy trajectories countries are likely to pursue.
- Rules & Standards: In addition to signalling the desired direction of travel, international institutions can also require certain actions from their members in order to achieve the objectives commonly agreed on.
- Transparency & Accountability: International institutions may enhance the transparency of the actions taken by their members by collecting and analysing relevant data, and identifying and addressing problems in implementation of agreed rules/standards.
- Means of Implementation: International institutions may organise the provision of capacity building, technology transfer, and financial resources among members, including coordination efforts for effective allocation, pooling of resources and addressing the issue of who is supposed to contribute how much.
- Knowledge & Learning: International institutions may create knowledge as well as platforms for individual and social learning. The aim is creation and diffusion of scientific, economic, technical and policy-related knowledge on the understanding of and/or possible solutions to the problem at hand.

Based on this conceptual framework, the following section will reflect on how international governance could help overcome the challenges outlined in the previous section or help to amplify opportunities that are connected with moving to more sustainable transport systems. The objective is not a comprehensive review of existing literature, but to provide a basis for the empirical core of this article, the analysis of the governance complex. The mapping of options for international cooperation therefore started from the synthesis of existing literature on international climate policy in the most recent IPCC assessment report and the 1.5 °C special report (de Coninck et al., 2018; Stavins et al., 2014). In addition, the authors reviewed existing literature on international sectoral approaches. However, as noted in the introduction to this article, the five governance functions outlined above imply a much broader potential scope for activities of international institutions than so far discussed in this literature. The authors therefore also undertook an expert review of additional literature on international climate policy cooperation.

3.2. Guidance and signal

Given the longevity of transport *infrastructure* and the high *investment requirements* as discussed in section 2, investments into transitions towards sustainable mobility require a stable policy environment. International fora and agreements may contribute to such stability by providing a reference point for national and local transport policy. Assessments of the transport sector's performance use global targets to track domestic action and to assess the effectiveness of current measures (e.g. Arioli et al., 2020; Gota et al., 2019). As such, international agreements establish expectations regarding national transport policy and thus provide a basis and legitimacy for demands from domestic pro-compliance actors. International agreements may thereby help to overcome *institutional barriers* to change within governments and to overcome *change resistance* by vested interests (Dai, 2010).

If governments agreed to an international emission target for land transport, this might serve to highlight that transport has so far essentially been free-riding in climate policy. For example, in the EU, transport and international aviation are the only sectors where emissions have increased since 1990, by 20% and 117% respectively. In all other sectors emissions have been reduced by between 20% and 42% (European Commission, 2018). Focusing on the individual sectors instead of looking only at aggregate global emissions could highlight this particularly bad performance of the transport sector and thereby send a signal that substantial change in transport policy is needed.

3.3. Setting rules to facilitate collective action

Rules that may be agreed within international institutions may either be obligations of result, i.e. to achieve a certain outcome, such as the legally binding emission targets under the Kyoto Protocol, or obligations of conduct, i.e. to undertake specific actions (Bodansky, 2012). As for obligations of result, setting sectoral emission targets at national level might help to directly address *change resistance* within governments. For example, the German Climate Change Act of 2019 established legally binding annual emission budgets for all sectors, including transport, and made the respective government ministries legally responsible for compliance with the budgets (Bundesgesetzblatt, 2019). This example could be replicated internationally, that is, countries could commit to establishing sectorally differentiated short- and long-term climate strategies, with specific targets and measures for transport. Countries could also agree that in addition to sectoral targets, national climate strategies should also describe current and envisaged measures to facilitate transparency and accountability (see next section).

As for obligations of conduct, international coordination on vehicle regulations could help to overcome *standardisation problems*. Such coordination might in fact be organised relatively easily due to the high concentration of vehicle manufacturing and demand. Ten countries account for ¾ of car sales, and just three regions – the EU, China and California – account for half of sales. If a relatively low number of frontrunners aligned their regulatory trajectories, this could therefore exert strong influence on the global market and help overcome *change resistance* by incumbent manufacturers. The literature discusses in particular two regulatory options for international coordination, namely vehicle performance standards and phase-out requirements for conventional vehicles (Bodansky, 2007; Sims et al., 2014; Victor et al., 2019).

In addition, a substantial body of literature recommends international co-ordination on emission pricing, with the ultimate objective to achieve a globally uniform emission price (e.g. Keohane et al., 2017; van den Bergh et al., 2020). Emission pricing can help overcome *economic barriers* by making low-emission transport modes and vehicles more attractive than high-emission options. However, other authors are sceptical about the practical and political viability of international coordination (e.g. Green, 2017; Verbruggen and Brauers, 2020). One suggested alternative is international coordination on a "climate budget reform". Under such an agreement, countries could in the first step commit to tally all levies they are imposing on high-emission activities and all subsidies they are providing to low-emission activities on the one side, and all levies they are imposing on low-emission activities and all subsidies they are providing to high-emission activities on the other side. In the second step, they could commit to progressively shift resources from the latter to the former, e.g. by abolishing fossil fuel subsidies and introducing emission pricing (Verbruggen, 2011; Verbruggen and Brauers, 2020). In this context, countries and finance institutions could also commit to shift public funding from

high-emission to low-emission transport *infrastructure* (Global Commission on the Economy and Climate, 2015). Even the first step, providing transparency on current spending, could already help to overcome *change resistance* within governments by highlighting to what extent expenditures are not aligned with the Paris Agreement.

3.4. Transparency and accountability

International institutions may enhance the transparency of their members' actions by collecting and analysing relevant data, and identify and hold Parties to account for any implementation deficits (Gupta and van Asselt, 2019). To support international co-ordination on sectoral targets and policies as suggested in the previous section, countries would need to agree on requirements to provide sectorally differentiated accounts of national emissions, measures taken and their impacts. Such international scrutiny and penalties for non-compliance may help to overcome institutional *change resistance* within governments. In addition to the effects of government-to-government scrutiny, international transparency provisions and review processes also provide non-governmental actors with information and political fora to appeal to public opinion and exert pressure on governments (Dai, 2010). In this way, international transparency requirements may help such actors to generate pressure for change and overcome political barriers such as resistance by incumbent manufacturers by highlighting how much transport is currently off track in climate protection in many countries.

3.5. Means of Implementation

International institutions can help with the mobilisation of resources to overcome problems related to *capacity constraints and access to capital* Many urban areas in the world are committed to doing more against climate change but lack resources and institutional capacities to deliver low-carbon mobility systems. Therefore, international resources should be used to strengthen administrative and planning capacity (Seto et al., 2014; WBCSD, 2010).

Commitments to reforming public transport funding as discussed above could also extend to the international provision of means of implementation. That is, countries and international financial institutions could agree that all provision of support must be consistent with the objectives of the Paris Agreement (Larsen et al., 2018).

3.6. Knowledge and learning

Capacity building, knowledge exchange and peer-learning can be vital enablers of transformative change. For the transport sector in particular, the *scale and complexity of projects* means that learning from similar experiences may be a vital trigger for a project to move forward (Lensink, 2005; Shaw et al., 2009). Provision of knowledge and learning may also lead actors to re-interpret their interests and thereby help to overcome *change resistance* within governments and by incumbent industries. Organisation of a process of collective appraisal may support the acceptance of knowledge and information and thereby provide a common ground for further advancing discussion and action (Mitchell, 2006). An impressive example where knowledge and learning contribute to transformation of transport is the diffusion of the European Commission's concept of Sustainable Urban Mobility Plans. The Commission finances a range of networking and learning initiatives for city administrations in Europe and beyond, leading to the actual implementation of innovative urban mobility policy measures, specifically in smaller cities which often lack specialist expertise (Werland, 2020). Organising such learning partnerships to cover all regions globally could therefore yield substantial transformative impact. Table 1 provides a synthesis of the governance potential identified in this section.

Table 1
Synthesis of potential for international cooperation and governance.

Guidance and Signal	Setting Rules	Transparency and Accountability	Means of Implementation	Knowledge and Learning
• International decarbonisation target and roadmap for land transport	• International requirements for sectoral emission targets in national short- and long-term strategies • International coordination on vehicle standards and phase-out dates for fossil fuelled vehicles. • International coordination on emission pricing • International agreement on climate budget reform, including abolition of fossil fuel subsidies, introducing emission pricing and reform of priorities and criteria for infrastructure investments	• Robust sectoral emission inventories • National accounts of measures taken and their impacts, in particular reporting on those measures where international coordination has been agreed	• Provide resources for administrative and planning capacity • Make all finance, technology and capacity building compatible with the PA	• Collect and aggregate information on current trends and lessons learned in transport policy and organise collective appraisal • Organise learning partnerships to promote uptake of sustainable transport solutions

4. Governance supply

4.1. Evidence base

This section discusses to what extent existing international institutions have activated/exploited the governance potentials identified in section 3. To answer this question, we established a database of institutions that are relevant for the decarbonisation of land transport. Following the approach laid out in the introductory article of this special issue, to be included, institutions needed to feature in particular two characteristics:

(1) they need to aim at realising a common purpose, in this case decarbonisation of land transport, through the setting of rules, standards and guidelines, or through the provision of targeted support; and
(2) have procedural rules for making and implementing decisions (including on substantive rules), thereby providing fora for exchange, deliberation and decision-making.

These criteria aim to delineate international governance institutions from international coalitions and lobby groups as well as ad hoc fora, platforms, projects, programmes and networks.

On the basis of these criteria, we first derived an initial list of potentially relevant institutions from existing databases of international institutions (Mitchell & IEA Database Project, 2019; UNEP DTU, 2020; UNFCCC, 2020). The resulting list of institutions was subsequently complemented with further institutions identified through literature and expert review. To determine which institutions meet the criteria outlined above, the authors analysed their self-proclaimed governance statements. Where such statements were not included in the existing databases, they were retrieved from the websites of the institutions. The results of this analysis were reviewed by two project-internal reviewers and two external reviewers.

While there may be discussion about whether some additional institutions should have been included, based on the reviews we have received we are confident that our list captures the large majority of the international institutions that are relevant for the decarbonisation of land transport.

Discussing all the institutions we identified as relevant one by one would exceed the size limitation of a journal article. The following subsections therefore present a synthesis of major findings. An overview table of how each individual institution contributes to the individual governance functions is provided in the supplementary material.

4.2. Overview

Generally, the governance complex is characterized by a large number of institutions, but hardly any of them emerge saliently as hubs or core institutions in what appears to be a relatively fragmented governance landscape. The only intergovernmental organisation that is specific to transport is the International Transport Forum that is administratively hosted by the Organisation for Economic Cooperation and Development (OECD) but politically independent. Its membership of 62 countries extends beyond OECD countries. As a think tank for transport policy it mainly operates through global dialogues (ITF, 2020). In addition, a number of other UN organisations are active in the area of sustainable mobility, such as UN Environment, the United Nations Human Settlements Programme (UN Habitat), and the United Nations Economic Commission for Europe (UNECE). Multilateral development banks focus on the provision of means of implementation. The G20, the International Energy Agency (IEA) and the International Renewable Energy Agency (IRENA) also pursue transport-related activities.

Furthermore, several city networks are dedicated to addressing climate change, including through action in the transport sector, such as C40 Cities, the Global Covenant of Mayors for Climate and Energy, and ICLEI – Local Governments for Sustainability. In addition, a number of transnational institutions, initiatives, projects and partnerships are specifically dedicated to sustainable mobility and provide support to local and national governments as well as private sector actors. A full overview is provided in the supplementary material. The UNFCCC has sought to play an orchestrating role for such activities by non-state and sub-national actors. Its Secretariat established the Nonstate Actor Zone for Climate Action (NAZCA), an online database/registry in which no less than 17 000 actors have registered their climate change mitigation and/or adaptation commitments (UNFCCC Secretariat, 2019). In addition, the UNFCCC established the so-called Lima-Paris Action Agenda, which was subsequently further developed and rebranded to become the "Marrakech Partnership for Global Climate Action" (MPGCA), to intensify work with non-Party actors. Transport is one of the thematic areas in this process.

4.3. Guidance and signal

The potential for providing guidance and signals as discussed in section 3 has so far been exploited in some respects but not in others. The Paris Agreement in Article 4.1 aims at globally peaking GHG emissions as soon as possible and achieving net zero emissions by the second half of the century. Another Paris-related signal is the goal laid down in Article 2.1(c) to make all financial flows compatible with the long-term objectives of the Agreement. However, there is no breakdown of the global ambitions to the individual sectors. Therefore, there currently is no multilaterally agreed target specifically for the transport sector.

Other institutions have promulgated decarbonisation targets for transport, but these have limited reach and authority. In 2016, the ITF launched the Decarbonising Transport project to help decision makers establish pathways to carbon-neutral mobility. However, this is mainly a knowledge-building exercise, not a target-setting process (ITF, 2019). In 2019, the MPGCA convened teams of sectoral specialists to produce 'Climate Action Pathways', including a pathway for the transport sector. These pathways include visions for a 1.5-degree climate-resilient world as well as actions needed to achieve that future. However, the activities under the MPGCA have no direct link to the governmental negotiation process (Obergassel et al., 2019). In addition, two transnational initiatives explicitly stipulate that transport sector emissions should be net zero by 2050: the Paris Process on Mobility and Climate (PPMC), and the Transport Decarbonisation Alliance (TDA) (PPMC, 2018a; 2018b). However, while such initiatives may contribute to shifting paradigms, their pledges have no legal standing.

In terms of guidance for specific actions, Agenda 2030 with its Sustainable Development Goals (SDGs) and the New Urban Agenda (NUA) emphasise the role of an integrated policy approach to sustainable mobility, focusing on access and mobility for all. The NUA, adopted by UN Habitat in 2016, includes action-oriented guidelines on how to implement the city-related SDGs, including by focusing on compact urban development, providing better public transport, increasing public spaces and pursuing integrated policy approaches (United Nations, 2016).

In summary, while two transnational initiatives have promulgated the aim to achieve net zero transport emissions by 2050, these pledges have no legal standing. There is no respective multilateral agreement among governments. On the positive side, Agenda 2030 and the NUA provide multilaterally agreed guidance on strategies for re-orienting transport towards sustainability.

4.4. Setting rules

The potential for setting rules as discussed in section 3 has so far been exploited only to a very limited extent. Article 4.2 of the Paris Agreement requires Parties to submit nationally determined contributions (NDCs) and Article 4.19 invites them to develop long-term climate strategies. However, there are currently no requirements for these documents to have a sectoral breakdown.

There is some movement on coordination of vehicle standards: The United Nations Economic Commission for Europe (UNECE) has established the World Forum for Harmonization of Vehicle Regulations to work on a system of regulations on technical specification of vehicles. This includes work on emissions and fuel efficiency standards such as the new "Worldwide Harmonised Light Vehicle Test Procedure" to determine a vehicle's specific CO_2 emissions (Fontaras et al., 2017). However, there is no international coordination on the level of ambition of emission and efficiency standards.

As for emission pricing, the number of jurisdictions who are implementing emission taxes or trading systems is increasing.

However, transport is not always covered and there is no international coordination on price levels, except in the form of a few links between emission trading systems, such as between California and Québec (Haites, 2018; ICAP, 2020).

There has been some movement on fiscal reforms. The G20 in 2009 agreed to "phase out inefficient fossil fuel subsidies", which in many countries include subsidies for fossil transport fuels. It also introduced a peer review process wherein pairs of countries review each other's subsidies. According to a 2018 tally by the IEA and the OECD, fossil fuel subsidies had actually increased in 2010–2012 despite the phase-out pledge and then started declining. However, the decline was in large part due to the decline of the international oil price, which reduced the gap between international and regulated domestic prices, and thereby the resources needed to be spent by governments to compensate for this gap (IEA/OECD, 2018).

The G20 has also taken up work on infrastructure as a key element of facilitating economic prosperity. As discussed in section 2, shifting infrastructure spending is a key element of moving towards sustainable transport. The June 2019 G20 Finance Ministers and Central Bank Governors Meeting in Fukuoka/Japan endorsed "G20 Principles for Quality Infrastructure Investment". Principle 3 includes a call for aligning investments with NDCs, but not for alignment with the objectives of the Paris Agreement, as called for in Article 2.1(c) of the Agreement (G20 Finance Ministers and Central Bank Governors, 2019). Most NDCs so far fall far short of what would be needed to achieve the objectives of the Paris Agreement (UNEP, 2019). Calling for alignment of investments with NDCs therefore correspondingly falls short.

In addition, several minilateral and transnational institutions collect pledges to transport-related policies and measures from their members. For example, the TDA requires its members to formulate ambitious short (2020), medium (2030–2040) and long term (2050) action plans to decarbonise transport (Transport Decarbonisation Alliance, 2019). C40 and the Global Covenant of Mayors similarly require their members to aim for certain emission reductions, develop climate strategies and/or implement specific measures. For example, the C40 Clean Bus Declaration commits the 22 signatory cities to introducing over 40 000 clean technology buses by 2020 (C40 Cities, 2015).

In summary, there is hardly any firm rule-setting on land transport. While various initiatives collect commitments from their members, there are no firm national transport emission targets, nor are there firm obligations of conduct regarding vehicle standards, fiscal reforms or infrastructure investments. The steps which the G20 has taken on fiscal reforms and infrastructure investments are non-binding and the level of ambition falls short of the objectives of the Paris Agreement.

4.5. Transparency and accountability

The potential for providing transparency and accountability as discussed in section 3 has so far been exploited in some respects but not in others. The UNFCCC regime includes legally binding transparency requirements covering all sectors. The UNFCCC in Article 4 and the Paris Agreement in Article 13 require Parties to provide transparency on national emissions, measures taken, and their impacts in the form of national emission inventories, national communications and international reviews. However, the UNFCCC process focuses mostly on economy-wide emissions. The main feature of the Kyoto Protocol has been its economy-wide emission limits and reduction obligations for industrialised countries. Under the Paris Agreement, Parties' NDCs are diverse, but Article 4.4 stipulates the expectation that over time all countries should move towards economy-wide targets. While the UNFCCC reporting requirements cover all sectors, little attention is paid to sector-specific developments. The UNFCCC therefore does little to highlight the particularly bad performance of the transport sector and thereby induce pressure for change.

Outside the UNFCCC, several institutions work on measuring and reporting developments in the transport sector. Key institutions are the World Bank-led Sustainable Mobility for All (Sum4All) initiative that has developed a global tracking framework and the Agenda 2030 process which has developed a global indicator framework for the SDGs (SUM4All, 2020; United Nations, 2017a). These frameworks provide the potential to track to what extent high-emission and low-emission transport modes are being used within countries. However, the SDG indicator framework is explicitly a voluntary and country-led instrument. That is, the decision which indicators to monitor is at the discretion of countries (United Nations, 2017b).

In summary, while the UNFCCC requires comprehensive reporting, it pays little attention to sector-specific developments. At the same time, transport-specific tracking frameworks by other institutions are voluntary. In addition, none of these frameworks or any other international institution tracks indicators on the extent to which national public transport spending is supporting high- or low-emission pathways.

4.6. Means of implementation

The potential for providing and coordinating means of implementation as discussed in section 3 has already been exploited to a significant extent. Donors and Multilateral Development Banks (MDBs) often use international frameworks to launch new initiatives that aim to assist in the development of implementation projects. For example, the Transformative Urban Mobility Initiative was launched at the Habitat III Forum, Mobilise Your City was launched at the COP25 in Paris and the Urban Electric Mobility Initiative was launched at the UN Climate Summit in September 2014 in New York. These and other initiatives aim to support local and national authorities to build institutional capacities and to develop implementation concepts and bankable projects.

At the Rio+20 conference in 2012, eight MDBs pledged to provide US$175 billion of loans and grants for more sustainable transport in developing countries by 2022. They also developed common arrangements for measuring and monitoring their transport projects (World Bank, 2015). According to their own stocktaking, the MDBs are currently on track towards fulfilling this commitment, having mobilised nearly 85% of the target volume by the end of 2018 (MDB Working Group on Sustainable Transport, 2019).

In 2018, the MDBs announced that they will develop a joint framework for working towards Paris alignment of their operations, including by making their operations compatible with the mitigation objectives of the Paris Agreement (Multilateral Development Banks, 2018). What exactly this means is yet to be worked out and can therefore not be assessed at this stage.

In summary, substantial amounts of resources are being provided for decarbonising land transport. However, there is no clarity on the extent to which international transport spending is Paris-aligned or misaligned. That is, there is no clarity to what extent international finance still supports high-emission transport.

4.7. Knowledge and learning

The potential to promote knowledge and learning has already been exploited to a large extent. Many institutions contribute in one way or another to the development and spreading of collective knowledge and learning (see overview in supplementary material). However, a facilitated exchange among peer countries or cities to

overcome the lack of personnel resources and specialist expertise in some regions has so far not been pursued on a global scale. There is no global framework where non-Party actors could offer their knowledge and capacity. Existing frameworks are regional and not all regions are equally well covered. Better coverage should therefore be pursued (Galvanizing the Groundswell of Climate Actions, 2019).

5. Conclusions and options for enhancing global governance

Moving towards sustainable mobility faces high institutional and political barriers as the current high-emission way of providing mobility is deeply entrenched in current policy, planning and industrial paradigms as well as physical infrastructure. Moreover, many traditional car manufacturers have so far used their political influence to slow down the speed of the transition. In addition, investment requirements for establishing transport infrastructure are high. Finally, there are capacity constraints, in particular in the Global South, as well as technical challenges in moving towards new vehicle technologies.

International institutions may perform five key functions to help mobilise opportunities and overcome barriers:

- Guidance and signal: If the global net zero emission target of the Paris Agreement was broken down to the individual sectors, specifying that land transport emissions should be reduced to zero by a certain date, this would provide guidance for future national and local policy and investments. It would also help throw into relief the especially bad performance of the transport sector and might thereby generate pressure to overcome change resistance within governments and by incumbent companies.
- Setting rules: If there was agreement that countries should themselves break down national emission targets to the individual sectors, through their NDCs, this might further increase pressure to change. In addition, international institutions could co-ordinate vehicle standards or phase-out dates for fossil vehicles to help overcome standardisation problems and induce pressure to change among manufacturers. Countries could also co-ordinate emission pricing or commit to implementing a “climate budget reform”, shifting resources from unsustainable to sustainable transport.
- International requirements for transparency and accountability can underpin pressure to change current transport policies by facilitating scrutiny by other governments and non-governmental actors.
- Means of implementation: International institutions can help with the mobilisation and coordination of resources to overcome problems related to capacity constraints and access to capital, which are acute in the transport sector. Commitments to reforming national transport spending could also extend to the international provision of means of implementation, that is, all international provision of support for transport activities should be consistent with the objectives of the Paris Agreement.
- Finally, provision of knowledge and learning can be vital for enabling transformative change, in particular given the scale and complexity of transport projects. They may also lead actors to re-interpret their interests and thereby help to overcome change resistance within governments and by incumbent industries.

Our analysis of the existing landscape of international institutions found that there is a substantial number of actors that are working to promote the decarbonisation of land transport. However, hardly any of them emerge saliently as hubs or core institutions and the identified governance potential has so far been exploited only to a low extent:

- Guidance and signal: While Agenda 2030 and the New Urban Agenda provide multilaterally agreed guidance on strategies for re-orienting transport towards sustainability, there is no internationally agreed zero-emission target or roadmap for the sector.
- Setting rules: There are no requirements that national targets and strategies should have sectoral breakdowns, nor is there co-ordination on policies and measures such as vehicle efficiency, emission standards or emission pricing. The G20 has pledged to phase out “inefficient” fossil fuel subsidies, but implementation is lacking and there is no commitment to overall green budget reform. The G20 has also adopted Principles for Quality Infrastructure Investment, but they do not require alignment with PA objectives.
- Transparency and accountability: While the UNFCCC and the Paris Agreement require Parties to provide transparency about emissions and actions taken, the climate regime mostly focuses on economy-wide developments, not sector specifics. At the same time, tracking frameworks that are specific to transport are voluntary. Existing transparency mechanisms therefore are not likely to generate substantial pressure to change.
- Means of implementation: Substantial resources are being provided for sustainable transport and the MDBs have pledged to fully align their operations with the Paris objectives. However, there is no clarity to what extent existing portfolios are already aligned or still misaligned. That is, there is no clarity on the extent to which resources are still being provided for high-emission transport.
- Knowledge collection and creation is taking place in many initiatives but there is no framework to facilitate networking and peer-to-peer learning at global scale

Table 2 summarises the main findings of our survey.

The following provides some preliminary ideas on how the governance potential identified in this article could be exploited more fully. They are again organised along the governance functions, reflecting on whether existing institutions could be enhanced or new ones created.

On guidance and signal, both the ITF and the UNFCCC have already done work towards developing a zero emission target and roadmap for land transport, the ITF as part of its Decarbonising Transport project and the UNFCCC under the MPGCA as described in section 4.3. Interested governments might therefore use both institutions to work towards ultimate political adoption of a zero emission target and roadmap. For example, the COP could formally take note of the ‘Climate Action Pathways’ developed under the MPCGA or even endorse them and request governments to take them into account when developing the next round of NDCs and long-term strategies.

On setting rules, interested countries could work within the UNFCCC to establish requirements to have sectoral breakdowns in NDCs and long-term strategies. In addition, interested countries could form coalitions outside existing institutions to co-ordinate specific policies and measures such as vehicle emission standards or phase-out dates for conventional vehicles. As noted in section 3, given the high concentration of vehicle production and sales, co-ordination by a limited number of frontrunners would be sufficient to generate significant impact on the market. Countries could also form coalitions committing to providing transparency on their transport spending and to shift resources from high-emission to low-emission transport investments. The existing G20 processes on fossil subsidy reform and criteria for infrastructure spending do not seem likely to advance very far in this regard, given the

Table 2
Synthesis of Governance Supply.

Guidance and Signal	Setting Rules	Transparency and Accountability	Means of Implementation	Knowledge and Learning
• There is no internationally agreed decarbonisation target or roadmap for land transport • MPGCA and ITF have developed sectoral roadmaps, but these have no legal standing • New Urban Agenda and Agenda 2030 provide guidance on strategies for sustainable transport	• There are no international requirements for sectoral emission targets in national strategies • UNECE is working on technical vehicle standards, but there is no co-ordination on performance standards or phase-out dates • Little coordination on emission pricing • G20 pledged to phase out inefficient fossil fuel subsidies, but implementation is lacking • G20 established Principles for Quality Infrastructure Investment, but they do not require alignment with PA objectives	• UNFCCC requires sectoral emission inventories and national accounts of measures taken and their impacts, but pays little attention to sector-specific developments • There are no requirement for transparency on national public transport spending	• Substantial resources are being provided but there is no clarity to what extent overall portfolios are aligned or misaligned with the Paris objectives	• Knowledge collection and creation is taking place in many initiatives • No framework for a structured transnational approach to facilitate networking and peer-to-peer learning at global scale

composition of G20 membership which includes several large fossil fuel producers. As G20 president, Saudi Arabia did not even want to allow use of the word “subsidy” in expert briefings (Farand, 2020).

Efforts to enhance transparency and accountability could build on the Paris Agreement's existing transparency and compliance mechanisms. Interested governments could work to establish arrangements whereby the review processes scrutinise not only aggregate national emissions but also the individual emitting sectors. Moreover, given that the UNFCCC's regime-building process has now mostly been completed with the adoption of the Paris Agreement and its rulebook, there may be potential to dedicate more time and political attention to the UNFCCC's transparency function. The level of scrutiny could also be enhanced if the transparency mechanism provided more participation opportunities to non-governmental actors (Stevenson, 2021).

On means of implementation, interested governments could work within the UNFCCC and the MDBs to establish a clear definition of “Paris alignment”, and towards subsequently phasing out all international support for activities that are not Paris-aligned. This should cover support provided by international institutions as well as support provided bilaterally by individual donors.

With respect to knowledge and learning, better geographical coverage should be pursued. A structured transnational approach to facilitate networking and peer-to-peer learning of countries and cities could foster the wider application of successful practice. The MPGCA could provide the framework for such a structure covering all regions. The ‘Galvanizing the Groundswell of Climate Actions’ initiative suggests that the MPGCA could develop a space (“NDC labs”) where non-Party actors could offer their expertise on how to strengthen and deliver NDCs to interested Parties (Galvanizing the Groundswell of Climate Actions, 2019). Such a space might also be useful for exchange among non-Party actors.

These ideas will require further research to develop fully fledged reform proposals. The findings from our analysis also highlight other potential avenues for further research. Given the high number of relevant institutions, it has not been possible to examine their operations in minute detail. It has also not been possible to fully assess to what extent individual institutions actually deliver on their objectives. While our article aimed at capturing the overall landscape, in-depth assessments of individual institutions therefore hold the potential of yielding further insights on the effectiveness of current climate governance for land transport.

CRediT authorship contribution statement

Wolfgang Obergassel: Conceptualization, Methodology, Investigation, Writing - original draft. **Oliver Lah:** Investigation, Writing - review & editing. **Frederic Rudolph:** Investigation, Writing - review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

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