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Road transport and CO_2 emissions: What are the challenges?

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ABSTRACT

In order for the world to stay within the safety threshold of a 2°C increase in average temperature agreed by virtually all governments, the transport sector needs to be decarbonized. The two main obstacles that have prevented this from happening have been the absence of a global legally binding deal and the high relative cost of clean vehicle/energy technologies. The Paris Agreement, which commits countries to reductions of GHG emissions, has virtually solved the first problem and paved the way for countries to implement environmental taxes and subsidies in order to change the relative costs of clean alternatives, which would solve the second problem. These policy actions combined with investment in clean infrastructure and regulation can decarbonize the transport sector.

Transport emits CO_2, the most important greenhouse gas (GHG), and if global warming crosses the safety threshold of 2°C then the consequences could be anywhere between bad and catastrophic (Intergovernmental Panel on Climate Change, IPCC, 2014). In fact, there is evidence already that the safety threshold may actually be 1.5°C (Schleussner et al., 2016). To keep global warming below 2°C (or 1.5°C) atmospheric concentrations of GHGs must be stabilized and this will eventually require net zero annual emissions (IPCC, 2014). Worldwide, in 2014 transport as a whole was responsible for 23% of total CO_2 emissions from fuel combustion and road transport was responsible for 20% (International Energy Agency, 2016).

Since the United Nations Framework Convention on Climate Change (UNFCCC)[1] came into force in 1994, global CO_2 emissions have continued to increase (United Nations Environment Programme, UNEP, 2016), with some regions of the world increasing their total emissions substantially, such as India and China, and others decreasing theirs, such as Europe (Olivier and Muntean, 2014, Table 2.2, p. 22). Even in those regions where CO_2 emissions from other sectors are generally falling, those from transport have continued to increase (European Commission, 2015). In Europe, for example, between 1990 and 2012, total GHG emissions decreased by almost 18% but those from transport increased by about 14% (Eurostat Statistics, 2015). Reducing emissions in transport is more costly than in other sectors, such as the electricity sector, and the reason for this is that transport still heavily relies on fossil fuels. However, staying under 2°C, let alone 1.5°C, will require a decarbonization of transport.

Two barriers have prevented substantial reductions of GHG emissions in general and in transport in particular: incomplete international agreements and the high cost of (transport) clean technologies.

Within the UNFCCC, the first attempt to a global deal was the Kyoto Protocol, which came into effect in 2005. It was bound to have a limited impact, as it only required developed countries to take action. On top of this, the US never ratified it, Canada pulled out before the end of the first commitment period, which ended in 2012, and Russia, Japan and New Zealand are not taking part in the second commitment period. As a result, the Kyoto Protocol second commitment period, from 2013 to 2020, only applies to around 14% of the world's GHG emissions.[2]

No international organization, not even the United Nations, has the power to develop and enforce environmental policy (Evans, 2012, p. 96),

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[1] The UNFCCC is the main international agreement on climate change, aiming at the stabilization of GHG concentrations in the atmosphere to prevent dangerous climate change (http://unfccc.int/essential_background/convention/items/6036.php).

[2] http://www.consilium.europa.eu/en/policies/climate-change/international-agreements-climate-action/.

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and this poses a big environmental governance problem. However, proving that convincing virtually all the countries of the world to unite forces and commit to GHG emission reductions was not as utopic as it first appeared, the Paris Agreement, the second attempt to a global deal, was adopted in December 2015 at the 21st session of the Conference of Parties (COP21) to the UNFCCC, which was held in Paris at the end of 2015. The Paris Agreement commits developed and developing countries alike to keeping global warming below 2°C, and aspiring to a target of 1.5°C. The Agreement also states that developing countries will receive financial support from developed country Parties to help them with mitigation and adaptation.

The Agreement came into force on 4 November 2016. The countries ratifying the Agreement, before or after it came into force, include the four largest emitters in absolute terms: China, the US, the EU and India. Japan, number six on the rank, has also ratified the Agreement but at the time of writing this paper, Russia, number five, has not.

The Paris Agreement requires all Parties to put forward their emission reduction targets, or 'nationally determined contributions' (NDCs) and to strengthen these efforts in the future. This includes requirements that all Parties report regularly on their emissions and on their implementation efforts. Furthermore, the Agreement also has a long-term goal of net zero emissions, which would effectively phase out fossil fuels. This will entail a complete decarbonization of the transport sector.

The Paris Agreement, an unprecedented diplomatic success that contrasted sharply with the failure of COP15 in Copenhagen in 2009, promised to set the world on a path towards substantially reducing GHG emissions. Having said that, a preliminary evaluation of all the NDCs pledged by different countries shows that these will still imply a 'median warming of 2.6–3.1°C by 2100' (Rogelj et al., 2016, p. 631) or 2.9–3.4°C (UNEP, 2016, p. xviii).

In addition, on 1 June 2017 President Trump announced that the US would withdraw from the Paris Agreement. This was somewhat expected, given that during his election campaign he had pledged to scrap Obama's Clean Power Plan (CPP).[3] His decision may have also been influenced by a letter that 22 Republican Senators sent him the week before, urging him to 'make a clean break from the Paris Agreement' as this would interfere with his Administration's 'ability to fulfil its goal of rescinding the Clean Power Plant'.[4, 5]

The US pulling out of the Paris Agreement entails a serious setback in practical terms because the US is the second emitter in absolute terms and also one of the countries with highest emissions per capita.

In order to get out of the Paris Agreement, countries can only announce their intention to withdraw three years after the treaty has come into force and the withdrawal process then takes a year (UN, 2015, Article 28). To make a quick exit, the US could instead leave the UNFCCC altogether, a process which would only take a year (United Nations, 1992, Article 25). However, Trump stated he would be open to renegotiating aspects of the Agreement, which means he is not planning to pull the US out of the UNFCCC. Nonetheless, the US has already been internationally condemned, as shown by the criticism aired by academic, business and world leaders, and portrayed in countless news reports from around the world following the announcement.[6]

The Parties to the Paris Agreement face a new governance challenge. Although the US cannot officially pull out until November 2020, it has already stopped efforts to deliver its NDC. An important number of states, cities and CEOs in the US have signed new climate pacts,[7] some of which were agreed days after Trump's announcement, and the EU and China have reaffirmed their commitment to implementing the Agreement,[8] but the fact remains that the second biggest emitter is withdrawing. No country that had ratified the Agreement has threatened to leave as a result of Trump's decision, so it would seem that Parties continue to be committed. There is a risk, however, of spatial leakage of the type suggested by Collier and Venables (2014) and Eliasson and Proost (2015).

Despite Trump's decision and Russia not having ratified it yet, the Paris Agreement can be seen as a triumph of political will.

The cost of clean technologies is the other obstacle. Clean technologies are more expensive than carbon intensive technologies (Stern, 2006; Hepburn, 2015; Sperling, 2014, p. 33), especially in transport (Sims et al., 2014, p. 615). As an example, Liu and Santos (2015) conduct a study for the US case and find that cars running on fossil fuels are the cheapest, even after taking into account the climate change externality. Similarly, a report by the US National Research Council (2013, p. viii) concludes that 'alternative vehicles and some fuels will be more expensive than their current equivalents, at least for several decades', and Greene et al. (2014) highlight high costs as one of the barriers for electric vehicles market penetration.

On the bright side, historical experience of low-carbon technologies shows that as scale increases, costs tend to fall (Hepburn, 2015; Stern, 2006, p. xx), thanks to 'the effects of learning and economies of scale' (Stern, 2006, p. xx; Greene et al., 2014, p. 35). As momentum builds, the costs of buying and operating alternative vehicles, such as electric vehicles, could decrease rapidly, changing things radically.

Until the cost of alternative vehicle/energy systems falls enough to be attractive, taxes and subsidies are needed. Greene et al. (2014) argue that transitioning to electric vehicles requires policy initiatives of many types, such as standards, mandates and subsidies for vehicles and fuels. A carbon tax in line with the generally accepted Social Cost of Carbon (SCC) would not be enough to tip the balance (Liu and Santos, 2015).[9] Instead, taxes and subsidies would need to be political decisions based on environmental, rather than on economic efficiency grounds. The Paris Agreement has paved the way for this type of taxes and subsidies to become politically feasible, because in order for countries to deliver their NDCs they will need to provide incentives for and support the development and adoption of clean technologies, even in sectors where the costs are still high in relative terms.

In addition to subsidizing clean technologies to make them more attractive, government support for R&D is also needed throughout the world. A report published by the US National Research Council (2013, p. 7), for example, concludes that hydrogen/fuel cells and electric vehicles should (continue to) receive federal R&D support. Government subsidies to both public and private R&D of clean technologies are guaranteed not

[3] With the CPP, by 2030, carbon pollution from the power sector in the US would have been 32% below 2005 levels (https://www.epa.gov/cleanpowerplan/fact-sheet-clean-power-plan-numbers) but in February 2016 the Supreme Court stayed its implementation pending judicial review (https://www.epa.gov/cleanpowerplan/clean-power-plan-existing-power-plants). In any case, following an Executive Order, the US Environmental Protection Agency (EPA) announced in April 2017 that it would start a review of the CPP (https://www.federalregister.gov/documents/2017/04/04/2017-06522/review-of-the-clean-power-plan). There are likely to be litigations and the process could take quite some time. Even if the CPP were eventually rolled back it is not clear whether this would have much of an effect because many plants in the US have shifted generation from coal to natural gas, partly because of environmental regulations, and partly because of the change in relative prices (https://www.eia.gov/todayinenergy/detail.php?id=25392).

[4] https://www.epw.senate.gov/public/index.cfm/2017/5/senators-send-letter-to-president-trump-calling-for-withdrawal.

[5] Also, and in line with Trump's Administration's direction on environmental policy, in March 2017 the US Department of Transportation and EPA announced that they would revisit the previous administration's Corporate Average Fuel Economy (CAFE) standards, which aimed at increasing fuel economy to the equivalent of 54.5 mpg for cars and light-duty trucks by Model Year 2025 (https://www.epa.gov/newsreleases/epa-reexamine-emission-standards-cars-and-light-duty-trucks-model-years-2022-2025). This is likely to relax targets and have an impact on GHG emissions from road transport in the US, which represent 3.3% of global GHG emissions (computed from information available at https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data#Country and https://www.epa.gov/greenvehicles/fast-facts-transportation-greenhouse-gas-emissions).

[6] See for example http://www.bbc.co.uk/news/world-us-canada-40128431.

[7] https://www.scientificamerican.com/article/trump-ignites-climate-pledges-with-paris-withdrawal.

[8] http://europa.eu/rapid/press-release_IP-17-1524_en.htm.

[9] This begs the question of whether the estimates of the SCC are correct. Using these estimates for Europe, for example, shows that fuel taxes more than cover the climate change externality (Santos, 2017).

just on environmental grounds in this time of urgency to reduce GHG emissions, but also on economic efficiency grounds, as argued by Dechezleprêtre et al. (2014).

The problem is that governments across the G20 spend between US$80 and US$88 billion per year subsidizing exploration for fossil fuels (Bast et al., 2014, p. 9).[10] This money should be re-directed to subsidizing clean R&D. The world has proven reserves of coal, oil and natural gas that if burnt, would result in emitting 2795 $GtCO_2$, which is five times the safe amount that can be emitted (Carbon Tracker Initiative, 2011) to have an 80% probability of not exceeding the 2°C threshold (Meinshausen et al., 2009, p. 1161). To stay within 2°C the carbon budget from 2000 to 2049 was 886 $GtCO_2$ (Meinshausen et al., 2009, p. 1161), but by 2011 321 $GtCO_2$ of the budget had already been used so there are only 565 $GtCO_2$ left to go until 2049 (Carbon Tracker Initiative, 2011). In other words, 80% of fossil fuel reserves are 'unburnable' and should remain underground (Bast et al., 2014).[11]

One final remark that needs to be made is that although short term taxes and subsidies and long term innovation to bring relative costs down are essential, they will not be sufficient and other actions will need to be pursued. This is where command-and-control, which has typically been opposed by economists, comes in, although it can be helped with economic incentives. Collier and Venables (2014), for example, suggest that the world coal industry should be progressively closed, with some compensation coming from tradable permits for oil extraction. Just like leaded petrol was eventually phased out throughout the world (Santos et al., 2010), conventional road vehicles relying on fossil fuels could also be phased out with regulation and if there were a clear target date accompanied with heavy taxes and generous subsidies then car manufacturers and consumers would change behaviour.

The idea of internalizing the climate change externality with efficient economic instruments was reasonable back in the 1990s. However, doing this would not be enough any longer for two reasons: (a) carbon pricing was not introduced at global level back in the 1990s for reasons linked to a lack of a global legally binding deal, and it is now too late to rely on that as the only instrument to reduce emissions enough to stay below 2°C; and (b) the SCC spans too wide a range and needs to take values much higher than those generally accepted by the scientific community in order to trigger any change leading to substantial emission reductions, especially from transport.

Carbon pricing is an essential but not sufficient condition to achieve a substantial reduction in GHG emissions. Subsidies both to clean technologies and to R&D of clean technologies, and regulations are also essential as the time window is rapidly closing.

In addition, 'long-lasting infrastructure investments on scale will need to be made in our cities … and transport systems' (Stern, 2016), and government support for battery charging and hydrogen supply infrastructure will be important (Sperling, 2014, p. 33).

To summarize and conclude, although even with the Paris Agreement we may go beyond 2°C as the NDCs do not seem to be enough, the world will be on a safer path. The next step for governments in order to be able to deliver their NDCs is to change the relative costs of clean technologies, especially in transport, with taxes and subsidies until they become competitive, subsidize R&D of clean technologies, invest in clean infrastructure, and implement regulations that will progressively decarbonize all sectors of the economy, including the transport sector.

The US leaving the Paris Agreement weakens the Agreement's potential impact on emission reductions but the initial reaction of the nations that have ratified does not point towards them leaving the Agreement as a result. Political commitment to the environment may win this battle after all.

[10] Bast et al. (2014) calculate this as the sum of national subsidies, defined as direct spending, plus tax and duty exemptions provided by governments, which are between US$16 and US$23 billion per year, investment by state-owned enterprises, which are around US$49 billion per year, and public financing, defined as the provision of equity, loans, guarantees and insurance by majority government-owned financial institutions, which are between US$15 and US$16 per year.

[11] Carbon Capture and Storage technology would only extend the budget to 2050 by 125 $GtCO_2$, after applying the International Energy Agency's idealized investment scenario (Carbon Tracker Initiative, 2013, p. 4).

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