TRANSPORT EMISSIONS

All hail robocabs

Connected and automated vehicles enable new business models, such as self-driving taxis, that could transform transportation. These models have the potential to reduce energy consumption and greenhouse-gas emissions, but only if they are developed with energy use in mind.

Austin Brown

Modern life in the developed world is built on the availability of reliable, low-cost transportation, including public transit, cheap freight and, of course, the personal automobile. But while transportation supports a high quality of life, the sector consumes 62% of petroleum and releases 13% of greenhouse-gas emissions worldwide. Transportation poses a particularly daunting challenge in the global drive to reduce greenhouse-gas emissions, particularly in light of forecast increases in individual car ownership and travel worldwide. In *Nature Climate Change*, Greenblatt and Saxena[1] contribute an exciting addition to the emerging field of analysis exploring the role of advanced connected and automated vehicles (CAVs) as part of the solution: they find that CAV technologies, through automated taxi services, could reduce per-vehicle emissions by more than 90%.

Governments try to optimize many factors — such as safety, service, congestion, access, and equity — as they build and manage transportation systems. Over the past century, roads, parking, and access for personally owned vehicles have dominated this transportation development, especially in the United States. For decades, the basic model of car ownership and use has persisted largely unchanged. But CAVs can disrupt this model, and the public has recently become aware of their potential. High-profile demonstrations of government-sponsored research (like the DARPA Urban Challenge; http://archive.darpa.mil/grandchallenge), innovative technology-company development (like Google's on-road testing), and automanufacturer concept vehicles have generated a range of public responses from enthusiasm to fear. Advocates point to a range of far-reaching benefits that a fleet of CAVs would enable, arguably the most dramatic changes since the invention of the automobile itself. They frequently focus on safety and service — justifiably so, given the potential of CAVs to improve these factors by reducing crashes and providing transportation to underserved groups[2]. But such a profound shift in the transportation system is very likely to impact energy use as well, with both positive and negative effects[3–5].

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Self-driving taxis could take on a small form factor and move people cheaply and efficiently. Recently, technology companies such as Google have helped to speed vehicle development.

Autonomous taxis make a promising early business case for CAVs because they spread higher purchase costs among many users and match appropriate vehicles to trip needs. Consumers have already begun using analogous on-demand services such as Uber and Lyft, which could eventually begin offering autonomous options. Greenblatt and Saxena explore the energy implications of this specific business case and identify three factors that increase energy efficiency and decrease greenhouse-gas emissions of autonomous taxis compared with conventional transportation. First, autonomous taxis are well-suited to electrification because they can match range to each trip and self-recharge between trips or when demand is low, allowing them to use the growing low-carbon electricity supply rather than petroleum. Second, by matching vehicles to trips, smaller, more efficient vehicles could serve most trips, while large vehicles would be available to transport groups or bulky items. Third, autonomous taxis have a lower total cost compared with existing transportation options: each taxi travels more miles due to shared use and uses a higher percentage of cheaper electric miles than other transportation modes. This economic advantage could encourage rapid growth of autonomous taxi use. Automated vehicles can also take advantage of smooth drive cycles and platooning (close-following vehicle trains to reduce aerodynamic drag, similar to a bicycle peloton), further increasing efficiency. The authors conclude that, even with the predicted increase in travel, these combined factors could decrease emissions by up to 94% compared with current vehicles.

These energy benefits are not inevitable, however. Energy use is one factor among many that affects how autonomous taxis will be developed and used. Greenblatt and Saxena's approach is a useful starting point but, like all analyses so far in this nascent research space, it can't yet account for the complexities that we expect as the system develops. The future of transportation energy consumption depends on how the system is used by people, and there are reasons to be cautious. For instance, it's unclear how commuters will behave if autonomous taxis give them the choice either to get to their destinations efficiently or to get there fast; it is arguably human nature to choose convenience in the absence of incentives to do otherwise. Small, efficient vehicles will have to compete for customers with larger, comfort- or productivity-focused models, such as recent concept cars that resemble mobile living rooms. Additionally, travel by car is currently limited by its cost in personal time — there is no reliable estimate of how much demand may increase by when driving no longer requires drivers' attention.

CAVs, and autonomous taxis in particular, offer great promise for creating a better transportation system while mitigating climate change, but only if policymakers go in with both hands on the wheel instead of letting this exciting new technology develop on autopilot. ❐

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INTERNATIONAL NEGOTIATIONS

Towards minilateralism

The UN's climate negotiation process is no longer the 'only show in town', but there is little agreement among particpants on alternatives to replace it.

Robert Falkner

The end of 2015 will see the return of a familiar ritual in international climate politics. Thousands of government delegates, industry lobbyists and environmental campaigners will gather in Paris for the 21st annual Conference of the Parties (COP21) to the United Nations Framework Convention on Climate Change (UNFCCC), ready to go through the usual rollercoaster of politicking, strategizing, and emotional calls for action.

The chances are that COP21 will not be the breakthrough summit that the world needs. In all likelihood, scientists will call on the international community to rise to the occasion and strike a deal on emissions reductions[1]; activists will stage spectacular stunts to dramatize the significance of the make-or-break summit; and at the end, after two weeks of painstaking talks, diplomats will ask for patience and a sense of realism when announcing that they could only reach a modest agreement with more talks to follow. So is it time to consider alternative forums for negotiating climate mitigation, such as the G20 or subnational networks?

In *Nature Climate Change*, Mattias Hjerpe and Naghmeh Nasiritousi[2] report the findings of a survey of climate negotiators and observers on the importance they attach to such alternative international climate forums. Their analysis suggests that no clear rival to the UNFCCC has emerged, with respondents expressing sharply divergent views on their preferred minilateral or regional setting.

International climate governance has evolved considerably from its state-centric origins in the early 1990s, when the UNFCCC regime was created. A growing number of trans- and subnational initiatives now provide forums for climate mitigation efforts: the G20 and the Major Economies Forum on Energy and Climate (MEF) allow small groups of leading economies to coordinate mitigation strategies, the CDP (formerly the Carbon Disclosure Project) invites large corporations to report their carbon emissions and informs investors about climate risks, and the C40 Cities network connects more than 75 major cities and their climate strategies. Governments and international organizations themselves have encouraged the growth of such novel initiatives outside the intergovernmental regime. At the UN climate summit in September 2014, the Secretary-General of the UN sought to galvanize the creation of multi-stakeholder initiatives that promote emissions reductions and climate resilience.

Just as the number of climate actors and initiatives has increased, so has the risk of fragmentation in global climate governance. In their analysis of 922 responses from the International Negotiations Survey, carried out at two consecutive COPs in 2013 and 2014, Hjerpe and Nasiritousi point to a widely diverging range of opinion with regard to the ever more complex field of climate initiatives[2].

It is clear from their findings that there is no frontrunner that could claim to have widespread support and legitimacy outside the UNFCCC. While the G20 is mentioned by 14% of the respondents, the MEF and the Montreal Protocol are only noted by 5% and 4% respectively. Other forums receive even less support. Most government officials favour UN-style multilateralism, while non-governmental organizations generally focus more on domestic and non-traditional initiatives involving non-state actors. Minilateral forums are of particular interest to officials from European and North American governments, but find few supporters in other regions of the world.

Hjerpe and Nasiritousi's research[2] offers a valuable glimpse into the minds of climate negotiators and observers at a critical time in the international process. Whatever the outcome of the Paris climate summit, the search for novel governance mechanisms is likely to intensify. As the authors note, "the UNFCCC is no longer the only show in town", but none of the emerging minilateral forums has gathered any significant recognition and support among practitioners to offer a legitimate alternative