Beyond Business-as-Usual: Achieving a Paradigm Shift towards Low-Carbon Transport

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Achieving a Paradigm Shift towards Low-Carbon Transport

By Theodoros Zachariadis

Transportation is responsible for a continuously rising share of global carbon emissions. Carefully designed regulations, supported by land use strategies, fiscal policies and local incentives, and enabled through targeted international development assistance, can reverse these unsustainable trends.

“If per capita carbon emissions in both China and India rise to U.S. per capita levels, then global carbon emissions will increase by 139 percent. If their emissions stop at French levels, global emissions will rise by only 30 percent. Driving and urbanization patterns in these countries may well be the most important environmental issues of the twenty-first century.”


Transportation is a major contributor to global energy consumption and greenhouse gas emissions, accounting for about one fourth of total energy-related carbon dioxide (CO₂) emissions worldwide. Together with power generation, it is the fastest growing sector in the world. But unlike power generation, whose emissions may be easier to control because low-carbon or zero-carbon energy sources are already available on a large scale and at reasonable costs, transport emissions are created by the individual tailpipes of more than one billion motor vehicles (mostly passenger cars) as well as from fuel combustion in airplanes and ships, depending almost entirely on petroleum products with still limited low-carbon alternatives. The global car population is projected to exceed two billion by the year 2050, mainly due to increased car ownership in China, India and other rapidly growing economies. And car travel is among the economic activities that are least responsive to price changes: increased mobility improves the standard of living, and automobiles are associated with freedom and comfort. Most citizens of the world wish to have the opportunity to use a car – but can this wish be made compatible with the increasingly strained carrying capacity of the earth and the associated climate challenges?

To consider the magnitude of the problem and reflect on possible solutions to it, we need to do some basic math. It is quite simple to calculate car carbon emissions: multiply the number of cars with the average number of kilometers each car is driven, the amount of fuel consumed by a car per kilometer travelled and the carbon content of each fuel, which determines the amount of carbon emitted during combustion of that fuel. These four factors indicate the options policymakers have in order to curb emissions - they have to reduce or mitigate the growth rate of one or more of these factors: car ownership, use of each car (i.e. how much it is driven), fuel
intensity (the inverse of fuel economy), and fuel carbon content. The latter two factors — fuel intensity and carbon content — are more prone to technological solutions that may not compromise comfort and personal welfare. Unsurprisingly, most international carbon mitigation policies have primarily addressed these two parameters; this was also a natural continuation of earlier successful attempts to reduce emissions of conventional air pollutants such as carbon monoxide, sulphur dioxide and nitrogen oxides.

Unlike air pollutants, however, CO₂ is not an unnecessary by-product of fuel combustion that can be eliminated by using cleaner fuels and exhaust gas treatment technologies; it is the main product of fossil fuel combustion, which forms the basis of our economic welfare. Apart from some technological measures that can modestly reduce the growth rate of CO₂ emissions — improvements in automotive engine efficiency and a shift to fuels with lower carbon content such as natural gas — an unprecedented market transformation is required if automobile CO₂ emissions are to decrease significantly in the future, in line with the stated global objective to contain average global temperature increase to two degrees Celsius (compared to pre-industrial standards) by the year 2050. To understand the magnitude of the transition required, one needs just to consider the enormous inertia of the transportation system: the time it would take to build sufficient infrastructure for charging electric cars or supplying an alternative fuel such as hydrogen; or to replace all existing cars with low-carbon ones; or to expand the public transport network in an already built-up city.

What happens in the industrialized world is important...

For historical and political reasons, the European Union has attempted to assume a leading role in climate change mitigation worldwide. EU climate policies have primarily focused on the passenger cars that have addressed passenger cars have mainly focused on the technological aspects mentioned above — improving fuel economy and reducing the carbon content of automotive fuels. A voluntary commitment of the auto industry to reduce CO₂ emissions of new cars was agreed in the mid-1990s. A decade later, it became apparent that this agreement would not deliver the emission reductions it was meant to, which led the EU in 2009 to implement mandatory regulations on car CO₂ emissions and demand a minimum penetration of biofuels as automotive fuel blends. At the same time, as taxation largely remains at the discretion of each EU member country, there are attempts to partly harmonize vehicle taxation and shift it in order to be more favourable to low-CO₂ cars. High taxes on motor fuels, although not designed for this purpose and despite the low responsiveness of car travel to fuel prices, may currently be the most effective climate mitigation policy in the continent.

Meanwhile it has become apparent that, in order to make real progress in curbing automobile carbon emissions, it is necessary to enrich policy options with non-technological interventions in the first two factors of the emissions ‘equation’ mentioned above, i.e., in car ownership and car use. In response to this need various policies addressing personal transportation have been initiated at a regional or local level across Europe. Such measures comprise urban road charges, targeted parking policies, active promotion of walking and cycling in city centres, ‘ecodriving’ seminars, speed restrictions in urban areas, and environmental zones where access to high-emission vehicles is prohibited. Although most of these actions have primarily intended to tackle other, more localized negative impacts of car travel such as congestion, accidents, noise and air pollution, they usually

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contribute to CO₂ reductions as well. According to 2009 Economics Nobel Laureate Elinor Ostrom, a ‘polycentric’ approach to climate change is required if we are to achieve meaningful emission reductions worldwide; localized measures may thus prove to be a critical ingredient of such a ‘polycentric’ approach in the transport sector, where billions of individual drivers are involved. And whereas it is desirable to achieve global economy-wide greenhouse gas mitigation agreements in which transportation will have its ‘fair share’ of obligations, a portfolio of smaller scale actions such as those mentioned here may be more realistic within a complex world with different circumstances and priorities.

Europe is not alone in this path; a fundamental change has taken place in all industrialized nations in the last decade. In addition to earlier concerns
over energy security, the climate change issue has led OECD countries to adopt regulations on automobile greenhouse gas emissions. As Deborah Gordon and Daniel Sperling noted in an article in the November-December 2011 issue of this magazine, the new U.S. fuel economy standards to take effect gradually up to 2025 are much more aggressive and will make the future automobiles in the U.S. consume almost as little fuel per kilometre as their European counterparts – a very remarkable change compared to the trends of the last decades.

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... but the non-OECD world matters most
No matter what achievements OECD countries make in curbing their emissions, analysts agree that essentially all growth in transportation energy use will come from less industrialized nations in the future. The developed world can lead by example in this attempt by continuing to reduce the carbon footprint of its own transport sector. It can also provide poorer nations with technological know-how and the experience of more or less successful policies. But perhaps most importantly, it can offer funding for transportation infrastructure, along with guidance on the prudent use of these funds.

Up to now the dominant planning paradigm in the non-OECD world, which has been financially supported by Multilateral Development Banks, has been the ‘Predict and Provide’ approach. It focused on building sufficient road infrastructure for new cars and trucks and largely ignored other transport modes. In this way it favoured mobility over accessibility, violated principles of good planning and efficient pricing and often resulted in excessive motor vehicle travel and unsustainable development. In order to move to a sustainable transport future experts agree that a paradigm shift in mobility management is required. The ‘Predict and Provide’ motto should be replaced by an ‘Avoid-Shift-Improve’ approach: avoid the need for travel through proper land-use measures; shift travel to the most efficient modes, e.g. public and non-motorized transport for passenger transport and rail and inland waterways for freight transport; and improve vehicle and fuel technologies as well as transport operations to reduce emissions from individual vehicles. This can enable both controlling the growth in motorization and providing alternative transport modes to meet the rising demand for welfare-improving mobility in the developing world.

Financial assistance to less developed nations, in the form of private investments, development assistance from bilateral or multilateral funding mechanisms, and climate-related financing instruments, can be shaped on the basis of sustainability criteria: a substantial amount of funds should be directed towards investments in public transport infrastructure and encourage non-motorized transport – walking and cycling. Smart land use policies can help improve accessibility and avoid urban sprawl, which is mostly unsustainable. According to some estimates, if these strategies are implemented cost-effectively they can reduce urban motor vehicle travel by 30-50% compared with what results from conventional planning practices, and can contribute to economic development and social equity. It is not too late to give the developing world the possibility to opt for a leapfrog approach to transport and climate change, which will be required if the transport sector is to meet the drastic global GHG emission reductions required up to 2050.

The road ahead
Irrespective of carbon emission mitigation efforts in other economic sectors, transport emissions should decrease greatly in the coming decades if the global climate objectives are to be met. Research shows that transportation is not the sector of top priority for reducing greenhouse gas emissions since carbon abatement costs in other sectors of the economy may be lower. Nevertheless, if global climate forecasts are not too erroneous, it is not justified for policy makers to postpone transport-related climate policies until other sectors have assumed their ‘fair share’ of mitigation effort. If there is indeed a probability for catastrophic climate change, even if very low, action must not be delayed.

To reduce automobile emissions we need mandatory regulations, which should go hand-in-hand with fiscal policies and local actions. This argument is not very attractive to economists as there is ample theoretical and empirical evidence that a fuel/carbon tax is a more efficient solution than a command-and-control regulation of emissions, with considerably lower transaction and enforcement costs. Despite these well-known arguments, one thing is certain: raising fuel taxes is unpopular, hence very few governments implement tax increases. If we must act soon to curb automobile carbon emissions, there is little point in waiting for
‘enlightened’ leaders to risk their political future by raising fuel taxes; if a first-best option is infeasible, alternative policies that have proved to be effective in the past are better than nothing. Economic models usually predict that the enforcement of tougher standards greatly increases the compliance costs of firms and reduces the welfare of consumers. However, the behaviour of economic agents is dynamic; people respond to incentives and gradually adapt to stringent regulations, therefore the regulatory costs calculated ex-ante by models may be overestimated.

Therefore, carefully designed regulations to promote low-carbon technologies and fuels are a reasonable way forward for climate policy in transport. Close cooperation between policy makers and the automobile and fuel industries is imperative for this purpose; fortunately, such cooperation has already been successful in the recent past and has helped overcome most transport-related air quality problems in North America and Europe. Economic policies such as CO₂-related vehicle taxes, road charging schemes and local incentives towards sustainable mobility – as long as they do not imply unreasonably high carbon abatement costs – are necessary complements to regulations; and, as stated earlier, a ‘polycentric’ approach comprising measures at international, national and local level may be more appropriate for addressing the transportation-climate problem in the real world.

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How effective can these policies be? Not very much, according to conventional wisdom. Low-carbon technologies, investments in public transport and better urban planning are useful but cannot stop the growth in car traffic worldwide. Optimistic scenarios of decoupling of travel demand from economic growth and saturation in automobile use have proved to be wishful thinking so far. Notwithstanding these very legitimate concerns, some things seem to be different now: there are currently some indications that ‘business-as-usual’ transportation forecasts may not apply any more. Firstly, market transformations are happening in the industrialized world, leading to unprecedented improvements in fuel economy and perhaps to changes in citizens’ behaviour towards the private car. Secondly, there is some (albeit not yet robust) evidence that space restrictions in densely populated areas of the developing world may be restraining the growth in automobile use already now, at low levels of motorization. Thirdly, rapidly developing economies such as China and India are adopting (or are expected to adopt soon) fuel economy regulations that would not have been expected a few years before. On the other hand, although such optimism is justified to some extent, one should always keep in mind that tremendous effort is required in order to accelerate technological improvements and restrain growth in automotive travel demand in the long run.

**Sustainable transport is not only low-carbon transport**

Beyond the ‘cars and climate’ topic discussed in this article, we should not lose sight of the general picture. It is important to remember that transportation poses much broader challenges to sustainability. High carbon emissions are only one of the many symptoms of poor urban transport; cars and trucks are at the centre of broader problems such as congestion, accidents, noise, and air pollution. If we are to attack these problems effectively, we have to frame the issue as a transport problem in general and not merely as a CO₂ problem. In fact, some of the largest benefits of CO₂ reductions come as indirect benefits of other strategies to improve transportation. Although technology improvements to cars are extremely important, technology is probably the smallest uncertainty. The major problem is the future growth in global vehicle kilometres travelled – the two first parts of the equation explained in the beginning of this article – which affects all transport-related problems mentioned above.

On the road to sustainability, a global paradigm shift is required in the transportation sector. Trends in both the developed nations and the less industrialized but rapidly growing countries show some encouraging signs – perhaps for the first time in the last decades. At any rate, the future of the automobile cannot be like its past. International cooperation and financing, guided by prudent technology, economic and behavioural policies, is required in order to realize this shift and reverse business-as-usual projections of future, globally unsustainable, mobility levels.

*This article is based on contributions from leading international experts to the collective volume, edited by the author, “Cars and Carbon – Automobiles and European Climate Policy in a Global Context,” Springer: 2012.

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