TRADE UNIONS FOR ENERGY DEMOCRACY

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THE ROAD LESS TRAVELLED

RECLAIMING PUBLIC TRANSPORT FOR CLIMATE-READY MOBILITY

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Trade Unions for Energy Democracy (TUED) is a global, multi-sector initiative to advance democratic direction and control of energy in a way that promotes solutions to the climate crisis, energy poverty, the degradation of both land and people, and responds to the attacks on workers' rights and protections.

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TRADE UNIONS FOR ENERGY DEMOCRACY

This paper is dedicated to the memory of Lawrence J. "Larry" Hanley,
International President of the Amalgamated Transit Union, who passed away on May 7, 2019.
Larry was a dedicated fighter for the rights of working people and for justice in their communities,
and was recognized especially for his exceptional leadership in forging coalitions between riders and drivers to demand more, better, and more affordable public transportation.
He will be sorely missed.

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Reclaiming Public Transport for Climate-Ready Mobility

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If we are to meet the goals of the Paris Agreement and address the climate crisis, an immediate and ambitious expansion of public transport globally is necessary. The environmental benefits of mass public transport are enormous, but so too are the social and economic benefits of creating a better life for all by improving access to mobility, reducing congestion and air pollution in cities and creating millions of new decent jobs.

— International Transport Workers Federation, 2017[1]

If you cannot tackle transportation, you cannot tackle climate change.

— Yvo de Boer, former Executive Secretary,
UN Framework Convention on Climate Change (UNFCCC)[2]

This working paper will examine some of the key questions at the heart of climate-related debates on transport, and around passenger road transport in particular. It will also look at some of the more important issues surrounding *public transport* specifically, and the failure of neoliberal transport policy to improve and expand public transport in ways that fulfill its full social and environmental potential.

In order to have any chance of reaching widely accepted science-based targets for limiting the risk of dangerous climate change, transport-related emissions must stop rising and begin falling almost immediately—and must fall by several percentage points each year for the next few decades. Public transport systems can make an extremely important contribution to achieving this target. But without a massive shift towards electrified public transport for passenger mobility, especially in cities, it seems almost certain that the effort to reduce transport-related emissions to the levels necessary to reach science-based targets will fail.

It has become commonplace to say that the world's transport systems are undergoing dramatic change. Enabled by the massive growth in smartphones, the rapid growth of ride-hailing platforms, shared car and bicycle systems, and various permutations of on-demand transport options has altered the use of public transportation and taxis as well as of personal vehicles. Analysts are just beginning to grapple with the implications of these changes both for public transport systems, congestion concerns, and emissions levels.

At the same time, there has been a rise in the development of public transport systems—especially in the rapidly growing cities of the global South. Nevertheless, public transport systems have struggled to

keep pace with urbanization and population growth, and this has fueled the increase of both informal transport and individual car ownership. In many instances the lack of public transport options has spurred the rise of "on demand" mobility offered by private providers like Uber and Lyft.

Meanwhile, emissions from the transport sector overall continue to rise, and emissions from road transport are no exception. As we show below, reversing this trend in order to meet the Paris targets presents an extremely formidable set of challenges—challenges that the entrenched policy approach seems completely unable to meet.

The Climate Challenge and the Role of Public Transport

Many have noted that public transport can play a significant role in reducing emissions. While it is difficult to quantify this potential precisely—in part because the contribution that public transport can make will depend largely on other transport-related policy decisions—there is ample reason to believe it is very substantial. According to a study by the International Association of Public Transport (UITP), public transport consumes half the energy per passenger-kilometre that private cars do, and even less during rush hour.[3] Doubling the market share of public transport would prevent the emission of half a billion tons of carbon dioxide (CO2)-equivalent by the year 2025, and only 10 percent of urban transport energy consumption is linked to public transport.[4] Despite this potential, far too little policy attention has been paid to public transport, and to the range of complementary policy interventions that would ensure it can achieve its potential.

There are, of course, major decarbonization challenges arising from other forms of passenger transport (such as air travel) as well as freight. Some of those challenges intersect with mass transit, since they may share infrastructure, sources of energy, etc. But these issues go beyond what we can address here.

The Need for a Policy Shift

In the pages that follow, we show that reaching the emissions reduction targets established under the Paris Agreement will not happen without a major shift in transport policy—a shift that places mass public transport at the center of future passenger mobility. And realizing the potential of mass public transport to meet emissions-reduction targets will require a decisive turn away from both neoliberal policy approaches, and the model of development that is centered on providing "on-demand personal mobility" at almost any cost.

We also show that neoliberal transport policy has not only failed to bring about the kinds of emissions reductions that are necessary, but actually made matters worse in crucial ways. Although public transport is growing alongside urbanization in many places, this growth is currently not sufficient to slow the rise in transport-related emissions—let alone help bring them down. As we show below, the neoliberal commitment to pursuing decarbonization by "unlocking private finance to help governments achieve their climate goals"[5] (including for transport), has failed miserably.

Another major policy-related problem is the disproportionate emphasis on small electric vehicles (EVs) as a "replacement technology" for internal combustion engine (ICE) cars and trucks. This has led to a

situation where there is currently too little emphasis on pursuing ways to minimize unnecessary or unwanted mobility, which together could reduce the numbers of vehicles needed to provide safe, efficient, sustainable mobility for all. Many discussions of EVs not only focus on small electric vehicles—whether personally owned, or the "shared, autonomous vehicles" of an imagined future—but also treat their mass deployment as both inevitable and desirable. Such discussions also tend to assume that a system based on such vehicles can and will make a major contribution to achieving emissions reduction targets. We show that, firstly, the mass deployment of small EVs is far from inevitable and, secondly, that the potential emissions benefits of doing so have often been exaggerated.

The Work of the International Transport Workers Federation

This paper builds on the pioneering work of the International Transport Workers Federation, a Global Union Federation that represents 20 million transport workers in 147 countries. In 2010 the ITF's World Congress in Mexico City adopted a *reduce, shift, improve* model to lower transport-related emissions. Taking an "economy wide" approach, the model consists of three main approaches: (a) *reducing* the movement of people; (b) *shifting* the ways in which people move, away from high-carbon to low-carbon modes of transport; and, (c) *improving* our use of both existing and new methods and technologies to promote energy efficiency.[6]

More recently, the ITF has committed to a set of policy proposals titled "People's Public Transport."[7] This work is forthcoming (late 2019) as part of the ITF's "Our Public Transport" program.[8]

Reflecting the growing interconnectedness of electricity and transport, the ITF supports extending both "transport and energy democracy." Consistent with the TUED approach, the "People's Public Transport" initiative recognizes that, "Market-focused approaches are impeding further advances and breakthroughs. We need faster development of renewables to support the decarbonisation of transport. Transport unions have a visible stake in the struggle for energy democracy and public renewable power. Both the power sector and the transport sector must be subjected to more democratic participation and public ownership, so that the decarbonisation of both sectors can proceed unhindered in a planned and coordinated way, with a guaranteed just transition for workers."[9]

The ITF also supports the electrification of public transport, noting that, "There has been an unjustified emphasis on electric cars providing the solution to decarbonisation, while there has not been enough investments in the electrification of public transport. Electric cars charged using renewable energy can help meet transport needs in the future, but much greater emissions gains are possible from the electrification of public transport fleets including BRT services."[10]

Burning Up the Road

Current policy takes for granted the need to accommodate growing consumer demand for more and better "mobility options" and convenience. This focus tends to prioritize the availability of large numbers of smaller vehicles (mainly cars), which are available "on demand" at almost any location accessible by city streets. Such a focus fits well with the priorities of companies that manufacture and sell

cars—although it should be noted that increasingly such companies are aspiring to become providers of transport services, and not just manufacturers of vehicles. But the evidence suggests that this car-centric approach is not even remotely compatible with meeting either mobility needs or achieving decarbonization.[11]

Dramatic technological developments in recent years—most notably the rise of ride hailing and ride sharing services, but also "artificial intelligence" and possibilities for "driverless" vehicles—have generated enormous interest in what are being called "new mobility services." Such technologies may have a significant role to play in helping to end our dependence on fossil fuels while improving the lives of working people, but we believe it is clear that this potential will *only* be realized if such technologies can be developed and deployed outside the imperatives of profit, and integrated into public transport systems aimed at the common good. We show that the current, profit-driven approach to providing and scaling up these services makes them a threat to public transport—and to people and planet—rather than a solution, because they stand in the way of developing the mass public transport systems we need, while driving transport usage, congestion and energy demand ever higher.

We hope this paper will encourage unions representing workers in *all* sectors to deepen their discussions around the future of transport—to join the conversation about what public transport can and should look like in future, and what needs to happen in order to bring that vision to reality. We hope it will also encourage and enable unions in all sectors to engage more actively in the struggle to make public transport central to our collective future.

The Structure of this Paper

In Part One of this paper, we survey the current trends in energy, transportation and emissions. In Part Two, we review the policy landscape, including how transport-related emissions from the transport sector are addressed in the Paris Climate Agreement—which, it turns out, is hardly at all. We also show that neoliberal climate policy has failed to make any real progress in addressing transport-related emissions, while at the same time preventing public transport from realizing its potential. One of the main problems plaguing neoliberal transport policy is its insistence on a "public-private partnership" model. This model spends too much effort trying to "unlock" private investment—investment that, the evidence suggests, will never materialize to the levels required in order to keep up with urbanization, let alone the levels needed to reduce emissions from road transport and meet the needs of working people for "sustainable mobility."

In Part Three, we summarize the myths and realities surrounding electric cars, and highlight some of the major issues associated with their possible mass deployment. In Part Four, we look at developments and trends in urban transport and the rise of "new mobility services," with an eye towards identifying those elements of a "sustainable mobility future" that hold the greatest promise for addressing the urgent ecological and social concerns we face. In Part Five, we summarize some of the climate-related arguments that unions can use in their fight to defend, expand and improve public transport. We believe these arguments are consistent with the values and priorities of many transport unions and progressive trade unionism in general.

Part One: Mobility Rising: Transport, Energy and Emissions Trends

In many cities of the global North, and a growing number of the South, transport systems are changing in ways that can make it seem like they are getting "greener." Bike lanes, pedestrian-only streets, and new public transport systems are being developed. Cities are making commitments to reduce emissions, in some cases quite dramatically. Car ownership is falling in some countries, at least among younger people, with many opting to rely on car-sharing services rather than owning their own vehicles, or even choosing "user-powered" mobility such as bicycles, scooters and even walking.

As we will show in this section, however, such "green" developments are occurring on the margins of the world's transport systems. While each of these developments illustrates something that could be an important part of the sustainable transport systems of the future, any gains they offer are currently more than offset by the ongoing rise in motorized transport and emissions. Rather than becoming progressively *more* sustainable, most of the world's transport systems overall are in fact becoming *less* so.

Carbon Emissions and Global Warming

Over the past century, the average global temperature has risen by roughly 1°C. Most of this warming has occurred just over the past few decades, and it continues to accelerate, with 16 of the 17 warmest years on record occurring since 2001.[12] Rising global temperatures are putting the planet at increasing risk of dangerous changes to weather patterns, disruption of food systems, the proliferation of infectious diseases, and much more.[13]

This warming has been caused overwhelmingly by emissions of carbon dioxide (CO2) and other greenhouse gases (GHGs) from human activities: like from burning coal for electricity, gasoline and diesel for cars and trucks, or oil and natural gas for heat and industrial processes. Energy-related emissions constitute the lion's share of global emissions (roughly 60 percent) and the generation of electrical power is still the largest single contributor, responsible for a quarter of energy-related emissions.[14]

Fossil fuels currently meet more than 80 percent of global primary energy demand, and CO2 from fossil fuel combustion accounts for over 90 percent of energy-related emissions.[15] The consumption of coal, oil and gas has grown dramatically in recent decades. Not surprisingly, energy-related emissions are increasing. Global emissions currently stand at almost double those of the mid-1990s, and emissions from both fossil fuel use and industry rose 60 percent between 1990 and 2014.[16] In December 2018, during the first week of COP24 in Poland, the Global Carbon Project released a report estimating that global emissions from fossil fuels and industry will have grown by around 2.7 percent by the end of the year—the fastest annual increase in seven years.[17]

Despite the decade-long growth of renewable energy, emissions from the generation of electricity alone have increased by *more than 45 percent globally* since the year 2000, while electricity demand has *increased by more than 50 percent.*[18]

More (and Larger) Cars; More Congested Cities

The global growth of urban traffic and overall car ownership plays a major role in rising emissions levels, and is widely projected to continue. Globally, nearly 95 million cars and light commercial vehicles ("light duty vehicles" or LDVs) were sold in 2018. That number was down slightly from the previous year (which was the first drop in sales since 2009), due largely to lagging vehicle sales in China.[19] But it still represents roughly four times the number of similar vehicles sold in 1965. In the global South, transport emissions are projected to grow two to four times faster than overall emissions.[20] Studies by UN Habitat—the United Nations agency tasked with promoting the development of "socially and environmentally sustainable human settlements"—have shown that the limited availability of public transport is a major factor driving the rise of private vehicle ownership.[21]

Rising levels of private vehicle ownership, alongside the tremendous projected growth in urban populations—estimated at an additional 2 to 3 billion people by 2050, mostly in the global South—means that many cities will become dramatically more congested and polluted if current trends continue. In its *Global Mobility Report 2017*, the World Bank warned that, on current trends, passenger traffic will exceed 80 trillion passenger-kilometers per year by 2030—a 50 percent increase over 2015—while the number of cars on the road will double to nearly 2.5 billion, and global freight volumes will increase by 70 percent.[22]

According to the Partnership on Sustainable, Low Carbon Transport (SLoCaT), global land transport emissions could grow to 13 Gigatonnes (GT) per year by 2050, as a result of a near-tripling of transport emissions in developing countries—several times higher than the 2-3 GT by 2050 considered to be compatible with the Paris goal of global "net zero emissions."[23] Transport-related emissions from developed countries are projected to increase over the same period by roughly 17 percent.[24]

The growth of vehicle ownership in some developed countries has slowed in recent years, but this follows a dramatic rise over the past few decades. Some countries have also seen a trend towards larger, less-fuel-efficient vehicles. In the US, according to the International Energy Agency (IEA), "the share of SUVs and light trucks increased from 47% in 2011 to around 60% of total sales in 2017, bringing up the share of these vehicles in the total passenger car fleet to almost half."[25] Transport is now the leading source of CO2 emissions in the US, responsible for 1.9 billion tons of CO2 in 2016, compared to 1.8 billions tons from the power sector.[26] In the European Union, a similar trend has helped fuel a rise in oil demand, which increased by two percent in 2017—the highest annual rate of growth since 2001.[27] According to the latest data and projections from the European Environment Agency (EEA), average CO2 emissions from new passenger cars actually *increased* in 2017—the first such increase since data monitoring started.[28] Sales of SUVs and "crossover vehicles" (essentially SUVs based on full-sized car chassis) are also rising in China, Australia and elsewhere.[29]

Clearly, addressing the full range of challenges around the transport sector, or even just around passenger road transport, is a daunting task. Motorized transport is one of the core enabling factors of the global economy—an economy that reflects the priorities of growth, accumulation, and consumption. Emissions from transport are also dispersed, and every truck, airplane, container vessel, etc., is part of the emissions problem. This means the solutions will have to go to the very heart of the global economy, and will have a major impact on lifestyles and culture.

Furthermore, although proven low-carbon alternatives to fossil fuels exist for such sectors as electrical power generation, food and agriculture, and energy use in buildings, there is currently no widely available low-carbon alternative to the fossil-based fuels used in transport (petrol, diesel, kerosene, etc.). A decade or so ago, biofuels were thought to have potential to gradually replace fossil-based fuels, but a growing awareness of the technical limitations as well as the social and ecological implications of large-scale use of biofuels (particularly corn-based ethanol) has caused policymakers to reconsider.[30]

Transport-Related Emissions Are Rising

Transport currently accounts for roughly 14 percent of total emissions from human sources, and nearly one-quarter of emissions from the use of energy.[31] Although emissions continue to rise across the global economy, the slowing rise of emissions from the power sector means that transport is now one of the fastest-growing sources of energy-related emissions. According to the UN Intergovernmental Panel on Climate Change (IPCC)'s Fourth Assessment Report released in 2014:

> *Greenhouse gas (GHG) emissions from the transport sector have more than doubled since 1970, and have increased at a faster rate than any other energy end-user sector.... Around 80% of this increase has come from road vehicles. The final energy consumption for transport reached 28% of total end-use energy in 2010, of which around 40% was used in urban transport.*[32]

In early 2019, the IEA reported that the transport sector "is now responsible for almost one-third of final energy demand and nearly two-thirds of oil demand. It is also responsible for nearly one-quarter of global carbon dioxide (CO2) emissions from fuel combustion."[33] As noted above, almost three quarters of transport-related emissions come from road transport. This means that controlling and reducing CO2 emissions from cars, trucks, and motorcycles must become a policy priority.[34]

Following the Paris Climate Agreement in 2015, SLoCaT reported that, on a "business as usual" (BAU) scenario, global emissions from land transport could grow from a level of 6.3 gigatonnes (Gt) annually (as of 2013) to 13 Gt by 2050. But in order to be on track to meet the "well below 2-degrees Celsius" and 1.5-degree Celsius targets called for under the Agreement, transport sector emissions "need to peak in the first half of the 2020s," and any delay would require even faster reductions after that.[35] According to the report, emissions from transport need to fall by 4.6 percent every year from 2030 until 2050, and any delay in implementing reductions in the years leading up to 2030 would make achieving net zero by 2050 essentially impossible.[36]

Much of the increase in both transport demand and transport-related emissions is expected to occur in countries outside the Organisation for Economic Co-operation and Development (OECD), with the greatest growth projected in fast-developing countries in Asia.[37] But developed countries are also struggling to reduce emissions from transport. In the EU, emissions from the transport sector have grown continuously since 2014, mainly due to a rise in road transport emissions.[38] Although the global rate of increase shows signs of slowing, transport-related emissions are still projected to continue rising for years to come, at a time when they need to peak, and then fall steadily for many years to come.

Currently, road transport (including both passenger and freight) accounts for roughly 90 percent of energy consumption in transport, and individual passenger travel—mostly by car, but also by

two- and three-wheel vehicles, which are common in many developing countries—is responsible for roughly half of that.[39] According to the IEA, roughly three quarters of transport-related CO2 emissions come from cars, trucks, and motorcycles.[40] On current trends, the total number of vehicles on the world's roads is expected to double by 2030, and to triple by 2050[41]—truly staggering statistics.

Of course efficiency improvements for fossil fuel-burning vehicles are being made all the time. On average, vehicles are becoming more fuel efficient at a rate of about 1 percent per year.[42] The number of electric vehicles on the world's roads is also growing each year, and many of these are replacing what would otherwise be diesel- or petrol-powered vehicles.[43] But as we explain below, current trends strongly suggest that neither of these changes will significantly slow the rise in transport-related emissions.

Peak Oil, Those Were The Days

The growth of road transport is also reflected in rising oil demand. Globally between 2010 and 2015, the transport sector consumed roughly 60 percent of global oil products.[44] Although energy use and emissions from aviation and shipping are growing even more rapidly than those for road passenger transport, the latter is responsible for the largest share by far, and consumes more total energy than the entire residential sector.[45] Passenger transport also remains the leading source of CO2 emissions from energy use, responsible for 20 percent of the total—more than double that from second-place road freight, at 9 percent.[46] According to the International Energy Agency (IEA), "Global oil demand rose by 1.5 million barrels a day (mb/d) in 2017, continuing a trend of strong growth since prices fell in 2014. The rate of growth of 1.6% was more than twice the average annual growth rate seen over the past decade."[47] Based on anticipated economic trends, the IEA projects that global oil consumption will soon surpass 100 mb/d and reach almost 105 mb/d by 2023.[48] Transport-related energy use is expected to increase by 1.4 percent each year from 2012 to 2040, with non-OECD transportation energy use increasing by 2.5 percent annually.[49]

It is also worth noting that despite talk of "peak oil," so far there is no shortage of supply. As the IEA notes in its *Oil Market Report* for October 2018, "Fifteen years ago, forecasts of peak supply were all the rage, with production from non-OPEC countries supposed to have started declining by now. In fact, production has surged, led by the U.S. shale revolution, and supported by big increases in Brazil, Canada and elsewhere."[50] In other words, there do not appear to be any external constraints on oil supply that might assist the effort to reduce emissions in the coming decades.[51]

Who's Driving?

Of course, access to motorized transport is not spread evenly around the planet. As the IPCC notes, just 10 percent of the world's population is responsible for 80 percent of motorized travel; large numbers of people rarely use any motorized transport, and OECD countries "dominate GHG transport emissions."[52] While per capita demand for transport is still much lower in developing and emerging economies than in the OECD, the former is expected to rise dramatically in the coming decades with rising incomes and development.[53] According to a November 2018 report published jointly by GIZ (the German development agency), Renewable Energy Policy Network for the 21st Century (REN21),

and a leading German transportation think tank, the G20 countries in particular "are responsible for 74% of global GHG emissions from fuel combustion," yet only three of them have set targets for transport emissions reductions: Germany, France, and Japan.[54]

It should also be kept in mind that emissions from international aviation and shipping are not even addressed in the Paris Climate Change Agreement. According to the UNFCCC, emissions from international aviation essentially doubled during the period 1990 to 2016, up 98.3 percent, while those from shipping rose by 13 percent during the same period.[55] Direct emissions from aviation alone account for more than 2 percent of global GHG emissions, and according to a 2015 finding by the U.S. Environmental Protection Agency, if global CO2 emissions from aviation represented a country, it would rank as the ninth most emitting country overall, behind the U.S., China, India, Russian Federation, Japan, Brazil, Germany, and Indonesia.[56] The International Civil Aviation Organization (ICAO) forecasts that aviation emissions could grow by a further 300-700 percent by 2050.[57] As for international shipping, its emissions currently account for roughly 2.2 percent of global CO2 emissions, and on current trends are projected to grow by at least 50 percent, and as much as 250 percent, by 2050.[58] And such figures do not even factor in emissions from military or fishing vessels.[59]

More Public Transport, but Still More Needed

The rise in car ownership and use reflects, in part, the fact that although the availability of mass public transport—buses, metro systems, light rail, etc.—has nearly doubled since 1995, that growth has not kept up with the massive rise in demand for mobility. Such a shortfall reinforces demand for private car ownership, fuelling a further decline in public transport use, and further jeopardizing its viability. As UITP explains, "public transport growth is strongest where efforts to increase its supply are matched with private vehicle demand management and urban densification."[60]

Public transport also has major advantages in tackling social inequality and democratizing access to mobility, and all of the gains and opportunities that entails. Because access to mobility is a major factor in determining access to other goods and services, it occupies an especially central role in shaping people's opportunities and quality of life. In the words of Diego Hernández, Assistant Professor at the Department of Social and Political Sciences of the Catholic University of Uruguay, "mobility is not equitably distributed: some people have more transport possibilities than others and some can travel much faster than others and in more directions."[61]

Although the relationship between gentrification and the displacement of working people from urban centers is complex, it is generally recognized that gentrification produces displacement, and that this increases the financial burden on working people to get to their places of work.[62] This means the costs associated with mobility take a greater toll on poorer households—and these costs have increased during the period when people have been increasingly displaced from urban to suburban and peri-urban areas. According to research conducted by The Pew Charitable Trusts,[63] transport-related expenses consume nearly double the percentage of income for households in the lower third of income levels as the upper third—15.7 compared to 8.2 percent. Furthermore, these costs have increased significantly in recent years for households at the bottom of income levels—increasing to the 15.7 percent from just 9 percent four years earlier—while the share of income taken by transport had remained more stable for other segments.

Encouragingly, the modal share of public transport has recently begun growing again, especially in highly developed countries where "urban sprawl" has slowed. In the EU, the use of public transport reached a total of 57.9 billion journeys in 2014, its highest level since 2000. But public transport's share has fallen in many rapidly developing cities in the global South, where the supply of public transport has not kept up with population growth.[64]

What Makes "Public Transport" Public?

In discussions of the power sector, the meaning of the word "public" in a phrase like "public utility" would typically be understood to refer to public *ownership* of the utility, and "public power" would naturally be understood to mean publicly *owned* power.

In relation to public transport, the word functions differently. In the phrase "public transport" (or "public transit"), the word "public" generally refers to the *users* of the systems, rather than their *owners*. Thus, some "public transit" systems are privately owned or operated. At the same time, efforts to *privatize* "public transit" may involve calls for the use of public funds to subsidize private investments, without implying public ownership, and without altering the fact that the end result is still called "public transit." In challenging the privatization of public transport systems and calling for "public ownership of public transport," we need to keep in mind that we are using the word in both of its senses.

Passenger Rail

Globally, rail remains a major component of passenger transport, for both local and long-distance travel. Conventional and high-speed rail together have accounted for roughly 15 percent of all passenger travel (by distance) outside of city limits since the year 2000, and for roughly 90 percent of all rail travel (again, by distance), even despite the growth of metro systems in many cities. According to the IEA, conventional rail on its own (i.e., excluding high-speed rail) provides nearly one-sixth of the world's long-distance passenger travel.

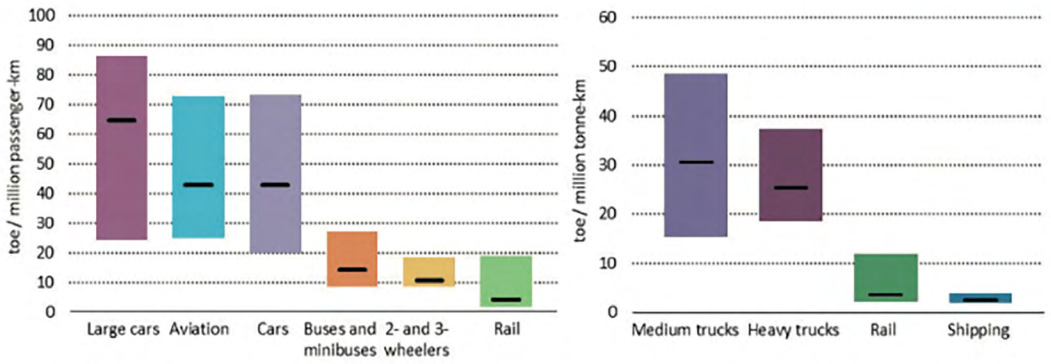
Rail is the most efficient form of motorized transport in terms of energy use, by a significant margin, and therefore holds significant potential to help meet mobility needs while reducing energy use and emissions.[65] According to the IEA, if all of the world's current passenger and freight rail traffic were carried by other forms of transport, the world would be burning an additional 8 million barrels per day of oil—16 percent more than at present.[66]

Several factors contribute to rail's advantage in energy efficiency. Losses due to friction are far lower for steel-to-steel contacts than for those of rubber tires (as much as 85-95 percent lower than for truck tires). Large volumes, infrequent stopping and the efficiency gains from electric motors over internal combustion engines mean additional gains.[67]

Passenger travel by long-distance rail (both conventional and high-speed) has essentially doubled over the past two decades, although this has been driven significantly by a massive expansion of conventional rail in India, where such travel has tripled during this period.[68] By 2016, according to

the IEA, India represented 37 percent of global conventional passenger rail travel, China 29 percent, and Japan 11 percent.[69] During the same period, high-speed rail travel grew globally by more than 11 percent each year—nearly three-times faster than any other non-urban transport mode.

Figure 1.21 Energy intensity of different transport modes, 2017



Notes: toe = tonne oil equivalent. The boxes in this figure indicate the range of average energy intensity in various countries, while the horizontal lines represent the world averages.

Sources: IEA Mobility Model (IEA, 2018a), using assessments based on UIC (2018a); UITP (2018d); ITDP (2018a); National Bureau of Statistics of China (2018); Eurostat (2018); Indian Railways (2018a); Japan Ministry of Land, Infrastructure and Tourism (2018); AAR (2017) and Russian Federation State Statistics Service (2018).

Source: IEA[70]

Clearly, long-distance rail plays a significant role in helping to meet many people's mobility needs, and could potentially play an even greater role in meeting such needs in the future. High-speed rail in particular could provide an alternative to short-haul air travel, which poses one of the greatest challenges to reaching a future of "net zero" emissions. According to the IPCC, rail transport serves 28 billion passengers (i.e., passenger-journeys) globally, covering roughly 2,500 billion person kilometers per year. By way of contrast, aviation provides far less than one-tenth as many passenger-journeys—2.1 billion per year, covering 3,900 billion passenger kilometers.

But for most people, long-distance travel does not play a significant role in their daily commute, or in meeting day-to-day needs. For the majority of trips that people who live in urban areas make, and in achieving their most pressing daily tasks, safe, affordable and reliable mobility over relatively short distances is what matters.

Urban metro and light rail systems already serve the daily mobility needs of tens of millions of people around the world, while reducing congestion, emissions and local air pollution from road traffic. According to a 2018 report by UITP, urban metro systems carried nearly 54 billion passengers—9 billion more than in 2012, with most of the increase in Asia and the Middle East-North Africa (MENA) region.[71] As UITP notes, "At the end of 2017, there were metros in 178 cities in 56 countries, carrying on average a total of 168 million passengers per day." Between the years 2000 and 2017, 75 new urban metro systems were opened, mostly in a few Asian countries—an increase of 70 percent. By the end of that period, the UITP writes, "metro systems in 178 cities in 56 countries were carrying an average of 168 million passengers per day."

As the IEA report also makes clear, most of the world's passenger rail networks have been built with critical support from state resources.[72] Indeed, given the requirements for land, investment, and risk abatement, it is essentially impossible to imagine a rail network of any size being developed without such support. Major public investments in passenger rail over the past century have built urban rail networks in Europe, Japan, China and other emerging economies, especially in Asia. They have also built high-speed rail lines in Japan, Europe and China, and long-distance conventional rail networks in Europe, Japan and India. In other words, the vast majority of passenger rail systems in the world were built as public infrastructure, using public funds.

Passenger Buses

As with passenger rail systems, buses have also historically served as a cornerstone of urban passenger transport, and remain in wide use in cities throughout the world. The vast majority of these are still powered by diesel or natural gas. Nearly all of the world's electric buses are in China: roughly 99 percent of the 385,000 estimated total in 2017. Excluding China, the share of electric buses among the total global bus fleet is trivial, but if we include China that share jumps to 13 percent of all buses as of 2017.[73]

According to Bloomberg New Energy Finance (BNEF), however, the momentum towards electric buses in municipal transit systems is growing, due in large part to rising pressure on cities to improve air quality and reduce emissions. Aside from the obvious local pollution and (potential) emissions advantages over their fossil-fuel-powered equivalents, electric buses enjoy several additional advantages, including lower maintenance costs; reduced noise; and the potential integration into a "smart" electrical grid as part of the system storage capacity. But electric buses also face a number of drawbacks: higher up-front costs (and the fact that falling battery costs create an incentive to delay purchase); range limitations; operational challenges in cold weather; and the lack of standardized charging infrastructure.

Batteries are the second-largest cost component for electric buses, after the costs of financing, but falling battery costs are rapidly reducing the price disparity with diesel buses. By 2030, BNEF projects that batteries will account for just 8 percent of the total price of an electric bus, down from 26 percent in 2016, and the "Total Cost of Ownership" (TCO) is already approaching parity, depending on a number of factors (total distances that must be covered; charging technologies involved; respective fuel and electricity prices).[74] BNEF sees the balance continuing to tip in favor of electric buses in the next few years—increasingly so as demand for electric buses rises, driving prices down through efficiencies of scale in manufacturing.[75]

According to a 2018 study by the US-based Union of Concerned Scientists (UCS), battery-electric buses offer significantly better emissions profiles than comparable diesel and natural gas buses. But the actual emissions profile for *any* EV, including an electric bus, depends largely on the generation source behind the electricity used to charge it. However, based on the national average energy mix in the US, the UCS study found that battery-electric buses already offer an emissions advantage in all parts of the country, and are 2.5 times cleaner on average than diesel buses.[76]

It is important to note however that even diesel buses offer significant fuel use and emissions advantages over cars in many situations. Of course, the degree of that advantage depends on a number of

things—most crucially usage levels, which are themselves affected by many factors. Still, according to a 2009 paper by authors at the Duke University Center on Globalization, Governance & Competitiveness:

> *[I]f a passenger car gets an average fuel economy of 25 passenger miles per gallon (pmpg), a transit bus, even operating far below capacity with 11 people on board, equals the passenger car at 25 pmpg. At peak transit hours, a bus at its capacity of 70 passengers—seated and standing—would get 163 pmpg. These fuel savings are accompanied by commensurate reductions in CO2 emissions per person. While a passenger car carrying one person emits 89 pounds of CO2 per 100 passenger miles traveled, a full bus emits only 14 pounds.*[77]

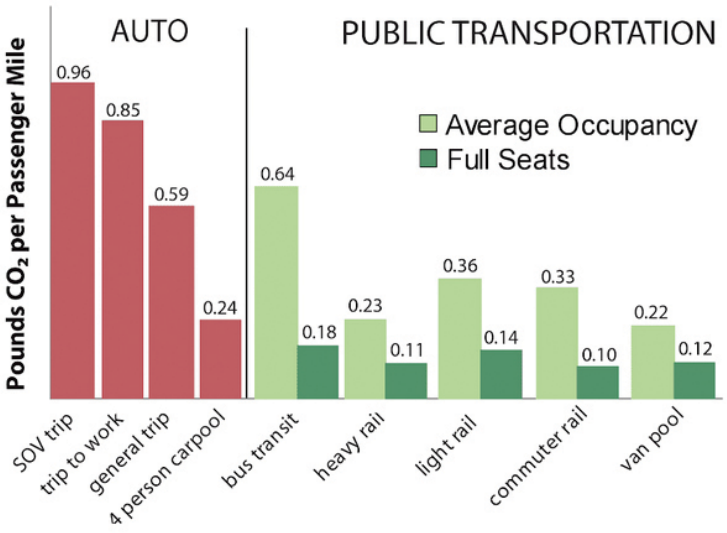


FIGURE 3
Estimated CO_2 Emissions per Passenger Mile for Average and Full Occupancy

Sources:
See Appendix II for data sources and methodology.

Notes: The average number of passengers for private auto trips is 1.14 for work trips and 1.63 for general trips.

Source: U.S. Federal Transit Administration[78]

Because they often share infrastructure with other road traffic, limiting congestion is crucial to the success of bus systems. According to research by the EU, delays caused by congestion, particularly in urban areas, not only reduce the quality of mobility and hence quality of life but also represent economic damage estimated for 2013 at nearly EUR 100 billion—more than 1 percent of the EU's entire GDP.[79]

Missing the Last Bus Home

There is nothing in what we have presented above that has not been known to policy makers for some time. Public transport is clearly a "climate solution" of immense significance and enormous potential, especially as urbanization continues to grow at a rapid pace. But it remains the case that policies dedicated both to the decarbonization of the transport sector and to the decarbonization of road transport specifically have not seriously impeded the rise in transport-related emissions. The landmark study known as the *Stern Review* acknowledged that, while the process of decarbonization posed challenges for all economic sectors, the challenges for transport would be greater still. According to Stern, market mechanisms—most importantly, carbon pricing—could be effective in shaping the behavior of investors and business owners in key sectors, but markets, thought Stern, may not be able to deliver the kind of radical changes needed in the transport sector.[80]

Part Two: Neoliberal Transport and Climate Policy at the Crossroads

Despite advances in the transport sector, radical change may not be delivered by the markets.

— The Stern Review (2006)[81]

In this section we show how the commitment to neoliberal approaches is holding public transport back from realizing its true potential. This is reflected in the fact that the Paris Climate Agreement's proposals to deal with transport-related emissions are completely out of step with what needs to be done. We will also show how neoliberal transport policy is currently riddled with contradictions and problems of its own making.

The Paris Commitments on Transport: Symptoms of a Policy Failure

The ratification of the Paris Climate Agreement in 2016 raised hopes that countries were about to get serious about addressing the climate crisis. Governments from 195 countries acknowledged the need to limit average global warming to "well below 2 degrees Celsius" (compared to pre-industrial levels), and to try to limit that warming to just 1.5 degrees Celsius. The Agreement stated that governments understood the need for emissions to peak "as soon as possible" and to achieve "rapid reductions thereafter in accordance with best available science" and thus "a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century"—a state commonly referred to as "net zero emissions."[82]

The Agreement itself acknowledged, however, that the emissions reduction pledges submitted by governments—called "Nationally Determined Contributions" or "NDCs"— were not consistent with the "well below 2 degrees Celsius" target, and not remotely adequate to reach the more ambitious 1.5 degrees target. Even if fully implemented, the NDCs would lead to a continuing *rise* in emissions until 2030, and would likely produce an overall average temperature increase of 3 degrees Celsius or more by 2100.[83] As the IEA starkly put it, "There is no peak in sight for world energy-related CO_2 emissions in the [NDC] Scenario: they are projected to be 8% higher than 2013 levels in 2030."[84] Similarly, the OECD's International Transport Forum concluded, "the estimated aggregate annual global emission levels resulting from the implementation of the [NDCs] do not attain 2°C scenarios by 2025 or 2030."[85] In adopting the Agreement, the UNFCCC urged national governments to show "more ambition" during the implementation period (2020-2030) than had been demonstrated in their NDCs.

"Sorry, I Have Bad News"

But there are clear signs that governments are not even reaching their NDC targets, let alone improving on them. In late 2018, the UNEP reported that most G20 countries "are not yet on a path that will lead them to fulfilling their NDCs for 2030," and that on the basis of current policy and NDC commitments, global emissions are not estimated to peak by 2030, let alone by 2020.[86] In the words of UNEP, "the world's original level of ambition needs to be roughly tripled to stay within 2°C warming, and increased around fivefold for the 1.5°C scenario." The IEA reported that in order to have any chance

of meeting their NDC commitments by 2030, emissions would need to peak soon after 2020. But in October 2018, the IEA reported that global emissions rose in 2017 and were on course to rise to record levels in 2018. Reporting the data, the IEA's Chief Economist Fatih Birol said, "Sorry, I have bad news. My numbers are giving me some despair."[87] Meanwhile, in its *Special Report on Global Warming of 1.5°C*, also released in October 2018 ahead of the COP24 talks in Katowice, the IPCC concluded that, in order to stay within 1.5 degrees, human-caused CO2 will need to fall by about 45 percent from 2010 levels by 2030, reaching "net zero" around 2050.

Clearly, the gap between what is happening and what needs to happen is massive, and rapidly widening. That does not mean that the situation is hopeless. The IPCC has concluded that limiting overall warming to 1.5 degrees Celsius remains *technically* possible. The authors of the IPCC's *Special Report* have concluded, however, that meeting this goal "would require rapid, far-reaching and unprecedented changes in all aspects of society," including "transitions in land, energy, industry, buildings, transport, and cities."[88]

That most governments are currently failing to meet their Paris targets is, of course, a problem of immense significance. But in the case of transport, government proposals have also been vague and unconvincing. According to a 2017 UN Habitat study of the Paris Agreement, the overwhelming majority of NDCs that were submitted by governments (113 of the 164 total) include commitments to sustainable mobility. However, barely one-third of those submitted make specific reference to transport-related emissions, and only 15 country submissions give any indication of plans to address their upward course.[89] According to the PPMC's "Global Macro Roadmap," the NDCs "do not yet provide a credible pathway for the comprehensive transformation of the transport sector towards a net-zero-emission, resilient economy, which will be required by 2050 and beyond."[90]

According to REN21, the share of renewable energy in global transport as of the end of 2017 was just 3.1 percent, with more than 90 percent of that coming from liquid biofuels rather than electricity.[91] In the EU—widely seen as leading in the deployment of renewable power generation—just 7.6 percent of energy used for transport came from clean sources as of the end of 2017, and the EU goal of achieving a 10 percent share by 2020 is not expected to be reached.[92]

Meanwhile, global transport-related emissions are currently "growing faster than any other energy end-use sector"[93] and "business as usual" is expected to lead to a massive 55 percent increase in annual transport CO2 emissions by 2030 (compared with 2010 levels).[94] Reaching the "net-zero" target, according to SLoCaT, would require reducing emissions from transport by 4.6 percent every year from 2030 until 2050; any delay in implementing these reductions in the years leading up to 2030 would make "net zero" essentially impossible.[95]

Therefore we see that the inadequacy of the national commitments at the heart of the Paris Agreement is particularly striking in the case of transport where the gap between what needs to be done and what is actually happening is especially wide, and getting wider with every passing year.

Transport and Carbon Taxes

As we have noted in other Trade Unions for Energy Democracy (TUED) Working Papers, neoliberal climate policy has endorsed a "sticks and carrots" whereby governments "incentivize" private investment

while at the same time pursuing a "polluter pays" approach to GHGs. Thus a key feature of neoliberal climate policy has been an insistence on the need for a carbon price, which is seen as central to climate mitigation efforts. The UNFCCC's own assessment of the NDCs submitted prior to the Paris negotiations in 2015 describes how 90 countries—and virtually all of the G20 countries—intend to use "market instruments" to help reach their targets, with carbon pricing being the primary mechanism of choice.[96] Previous TUED Working Papers have documented the resounding failure of carbon pricing, and the need for a radically different approach. In a nutshell, only a small portion of global GHGs (roughly 16 percent) are subject to any price at all, and in the majority of instances the price is below $10 per ton—far too low to change investor (or consumer) behavior to any significant degree.[97] This massive policy failure goes a long way towards explaining why governments are not reaching their Paris commitments.

The failure of carbon pricing has, however, been especially notable in the case of transport. In 2006, the *Stern Review* acknowledged that reducing emissions from transport would pose a set of formidable challenges, but an effective carbon price could, by piling on costs to carbon-intensive production, make low-carbon mobility an attractive investment option. According to the *Stern Review,* "Deep cuts in the transport sector are likely to be more difficult in the shorter term, but will ultimately be needed. While many of the technologies to achieve this already exist, the priority is to bring down their costs so that they are competitive with fossil-fuel alternatives under a carbon-pricing policy regime."[98] More recently, Researchers from Columbia University's Center on Global Energy Policy reported that transport sector emissions levels are "not very responsive to different [carbon] tax rates." Specifically, they found that the difference between a tax rate of $14/ton and a rate of $73/ton of CO2 would be expected to produce just a 1-3 percent reduction over current policy by 2030. This non-responsiveness of transport sector emissions was especially striking when compared to those in the power sector, where the authors found "10 times as much abatement in the power sector in the first year of the tax alone." These results, according to the authors, are "in line with those from other carbon tax modeling efforts."[99]

A key reason for this, according to the authors, is the limited number of alternative fuels that can be substituted for petroleum projects in existing internal combustion engine (ICE) vehicles. In the authors' words, "The short-term responsiveness of transportation emissions to a carbon tax is driven primarily through reductions in driving, rather than fuel substitution. In addition, history suggests driving demand is relatively price inelastic.[100] In plainer language, a carbon tax is likely to have little effect on driver behavior when there are no alternatives to petroleum and no other means of moving around. This is especially true for people who drive in order to make a living.

The World Bank and Neoliberal Policy Contradictions

As mentioned in opening this section, current transport policy is riddled with contradictions. To illustrate this, we need look no further than reports from the World Bank. In its *Global Mobility Report 2017*, the World Bank concluded, "The world is off track to achieving sustainable mobility. The growing demand for moving people and goods is increasingly met at the expense of future generations. It is urgent to reverse this trend. The costs for society… are simply too high."[101] In a 2016 report, the World Bank noted:

> *Overburdened and deteriorating public transport typically reflects an 'underfunding trap': new transport infrastructure cannot get financing, while the revenue generated by existing small-scale and often poor-quality systems cannot cover maintenance and operations. Even larger transit networks with better infrastructure struggle under heavy costs for operation and maintenance. The result of the underfunding trap is a funding gap.*[102]

The same 2016 study noted that private cars "generate more costs than benefits… yet they have a political advantage because their costs are less visible." The reason for this is that although private cars "represent only a minority of urban trips in developing countries, they cause congestion, sprawl, accidents, and pollution that impose huge and disproportionate costs that their operators do not cover." By contrast, expenditures for public transport are made explicit in public budgets, making them easy targets for political opposition, while the public subsidies for roads and other enabling infrastructure on which cars depend are only implicit.[103]

But the World Bank does not make the connection between the kind of growth- and profit-focused policies that institutions like itself, the IMF, and others major institutions routinely pursue, and the proliferation of modes of transport that have created enormous challenges to any serious effort to achieve sustainable mobility. For example, the aggressive promotion of trade liberalization remains a core component of the neoliberal agenda, and this has led to a sharp rise in the movement of goods across borders. In percentage terms, the growth of international trade continues to outpace GDP. "Just-in-time" inventory systems and online shopping are also part of this overall trend. According to the International Transport Forum, freight transport currently accounts for 30 percent of transport-related emissions (and 8 percent of the global total), and emissions from the trade-related transport are expected to grow by nearly 300 percent by 2050.[104]

As is well known, neoliberal policies have led to decades of attacks on public services and the "capture" of state power and the shifting of public attitudes and expectations. For public transport, as with other service areas, this has typically involved first starving systems of resources, and then using the resulting drop in quality as justification for privatizing them. This goes a long way towards explaining why public transport has generally failed to keep up with urban mobility needs. This pattern of provision falling behind rising levels of need is particularly evident in the global South, which is experiencing extremely rapid urbanization.

The P3 Trip and the Underfunding Trap

In the case of public transport, it is important to note that public sources remain a major contributor to covering the costs of public transport infrastructure and operating costs. In the US, according to one set of estimates, public funding covers between 57 and89 percent of bus service operating costs, and between 29 and 89 percent for passenger rail; within the EU, the range for public transport in general covered out of public funds ranges from 23 to 50 percent.[105] As a 2007 World Bank study noted, "Subsidy policies on public urban transport have been adopted ubiquitously. In both developed and developing countries, subsidies are implemented to make transport more affordable."[106] The study could not find a single example anywhere in the world of a public transport system whose operating costs was not subsidized.

Nevertheless, neoliberals view the "underfunding trap" as a chronic condition that can only be successfully managed by attracting private sector investment to make up the shortfall. Therefore the

role of governments should be to "unlock" private investment. To achieve this, governments need to "limit investor risk" and ensure guaranteed returns, and whatever public resources are brought to bear should be used to accomplish these aims. As with neoliberal climate policy in the electrical power sector, public finance in transport is supposed to play a "catalyzing" role, a means to entice private investment. This is the logic that lies at the heart of the "public-private partnership" or P3 model.

P3s are seen as a means of helping cash-strapped governments and public agencies "unlock" funds held by private investors. This would allow governments to obtain the up-front capital needed for infrastructure projects that they supposedly could not otherwise find. According to UN Environment Program (UNEP) the elimination of private investor risk is a top policy priority, and the agency recommends that financial institutions and governments make use of "instruments for de-risking clean investment." This will require, among other things, the "identification and removal of regulatory hurdles, improvement of institutional capacity, and provision of bridging investment subsidies. Such financial de-risking instruments can transfer risk from private investors to public actors."[107] P3s therefore serve to reduce risk to private sector players by shifting a larger share of it onto public entities.

Narrative Lockdown

This view of public financing as a means to unlock private capital and mitigate investor risk is pervasive, and it begins at the top. According to the OECD, "Given the extent of investment required to meet escalating global transportation infrastructure needs, and the growing strains on public finances, mobilising private investment at pace and at scale will be necessary to facilitate the transition to a greener growth."[108] Noting the rapidly rising emissions levels across the transport sector, the Paris Process on Mobility and Climate's *Global Macro Roadmap* calls for "an unprecedented immediate and coordinated mobilization of all transport sector stakeholders, public and private, including policy-makers and representatives of the business sector, and requires the full participation of civil society."[109] Similarly, the Ashgabat Statement on sustainable transport, released in November 2016, referred to "the vital role of public finance, both domestic and international, in meeting sustainable transport needs and in catalysing all sources of finance, including traditional official development assistance, domestic resource mobilization, direct private investment and a wide array of partnership models, including Public-Private partnerships."[110] The statement acknowledged, "Mobilizing finance for sustainable transport will be an enormous challenge, especially given the strain on public finances that exists in many countries."[111]

The idea that private capital must be drawn towards public transport by public funding and policy commitments is rarely challenged by major NGOs who advocate for sustainable transport. According to the World Resources Institute (WRI):

> *Public funding, both domestic and international, should be used strategically to leverage private resources and prioritize sustainable, low-carbon transport modes beyond a focus on roads and highways…. The call to increase private participation in transport reflects a general need to bridge a funding gap to support a shift toward low-carbon transport.*[112]

The SLoCaT report notes that domestic, public sector funding "is still the major source of finance for transport today," but it is "insufficient to meet the investment needed to address the growing demand for transport (passenger and freight) globally."[113]

Aside from its top-to-bottom pervasiveness, at least two things are remarkable about this narrative. First, little attention is paid to the profit-seeking character of the private sector funding that is to be "leveraged," which means that the public funds will essentially be used to ensure investor returns on activities that are not themselves reliably profitable on ordinary "commercial" terms. Second, scant attention is paid to the reasons why public finances under strain in the first place. Unions understand that it was precisely the neoliberal attacks on public services and the wave of privatization and financial deregulation that, respectively, made the public sector a target for budget cuts and downsizing, and subjected it to a proportional loss of taxation revenue. In the global South, "structural adjustment" was particularly savage in this respect. In other words, the underfunding trap was set by neoliberal policy makers, and they have shown themselves thus far to be incapable of escaping its ideological grip. In fact, as we will show in the following paragraphs, the solutions that are being proposed from within the mainstream perpetuate—and intensify—the very dynamics that have caused the problem.

Paying the Toll

Meanwhile, the process of weakening and privatizing public transport services has deprived many working people and communities of the affordable and accessible mobility they need in order to lead lives of dignity and even modest satisfaction: getting to work and back home; accessing education, healthcare, and entertainment; maintaining social ties; etc. The UN Rapporteur on Human Rights recently warned that privatization "often involves the systematic elimination of human rights protections and further marginalization of the interests of low-income earners and those living in poverty"; among the consequences is that "large swathes of public life are increasingly devoid of human rights protections."[114]

The UN Rapporteur's report also summarizes the economic as well as social damage inflicted by P3 arrangements. It cites a September 2018 study conducted by the European Court of Auditors, which examined twelve P3s in road transport and information and communications technology, finding that they had "widespread shortcomings and limited benefits." As the UN Rapporteur's report also noted:

> *Infrastructure projects will be most attractive to private providers where significant user fees can be charged and construction costs are relatively low. But the poor are badly placed to pay, cannot afford to use many services, and often live in distant or otherwise underserviced areas. Water, sanitation, electricity, roads, transport, education, health care, social services and financial services are far less likely to be provided adequately or at good quality levels to the poor.*[115]

The Missing Billions

The "underfunding trap" that today plagues public transport needs to be viewed against the backdrop of the larger "investment deficit" that currently haunts efforts to pursue a broader economy-wide decarbonization. As we have discussed in other TUED working papers, a major reason for the overall investment deficit is that many of the emissions-reduction solutions and low-carbon technologies are either not profitable or are not well suited to meeting the demands of investors.[116] This has also been well documented by union-based research groups and their policy allies.[117] The investment deficit also draws attention to the failure of the "sticks and carrots" approach that seeks to "incentivize" investing in the "green economy" by way of subsidies and to discourage investing in carbon-intensive projects by way of "pricing" emissions.[118]

Although estimates of the total investment needed to drive an economy-wide decarbonization vary considerably, there is essentially universal policy consensus that current levels of investment fall far short of what is required,[119] According to the New Climate Economy Commission's 2014 report, *Better Growth, Better Climate*, overall infrastructure investments on the order of $90 trillion are needed over the next 15 years, just to replace ageing stock and keep up with economic growth projections.[120] More recently, *Mission 2020* concluded that additional investment in climate action would have to be "well beyond $1 trillion" annually by 2020, and to remain at that level for "at least the next decade and a half."[121]

According to the International Renewable Energy Agency (IRENA), transforming the energy sector in line with the Paris target to keep overall warming "well below two degrees Celsius" (2°C) requires cumulative additional investment of $29 trillion over the period to 2050; this is in addition to the $116 trillion of investment already assumed over that period in their baseline reference case.[122] In 2017 the IEA estimated that limiting warming to 2 degrees would require energy investments of roughly $3.5 trillion (on average) each year until 2050. (For comparison, energy sector investments in 2015 totaled roughly $1.8 trillion.) The IEA concluded that investment in low-carbon "demand-side" technologies during this period—mainly efficiency gains and electrification of vehicles—would need to increase dramatically and steadily, ultimately reaching levels in the 2040s roughly ten times those currently seen.[123] More recently, the IPCC's *Special Report on 1.5 degrees Celsius* concluded that limiting warming to 1.5 degrees would require average investment in the energy system of roughly $2.4 trillion each year between 2016 and 2035—roughly 2.5 percent of world GDP.[124]

It is extremely difficult to separate out transport-specific investment needs, but it is safe to assume that, if public transport is currently stuck in an "underfunding trap", then there is little chance that the current investor-focused policy framework can mobilize the kind of investment levels the various projections say are needed. According to the IEA, transformation of the transport sector would require a cumulative investment of $32 trillion between 2015 and 2050—roughly $13 trillion more than current policy commitments (i.e., the Paris NDCs) are expected to generate. It is also noteworthy that, of that $32 trillion, the IEA assumes $15 trillion for the electrification of vehicles, and excludes investment in charging infrastructure.[125] The IEA also notes that the electrification of road transport "implies significant investment across the whole chain value, from R&D in battery capacity and robustness, to the upgrade of the grid to meet possible local surplus demand and the deployment of charging stations for cars and catenary lines for trucks," and that quantifying these requirements "would require a further analysis."[126]

Of course, there is always a need for "further analysis." But the most pressing need is for policymakers to acknowledge that neoliberal policy, through its sweeping attack on public services, *is itself the cause of the underfunding trap*. The insistence on using public funds to "unlock" private investment is *an intensification of the very policy that has caused the problem*.

Big is Beautiful?

Not only are the levels of investment in public transport inadequate, much of the "public private partnership" investment that is actually mobilized gets directed towards "megaprojects." According to a 2017 World Bank report on private-sector investment in infrastructure projects,[127] the transport

sector accounted for 39 percent (US$36.5 billion) of P3 investment that year, while energy accounted for 56 percent (US$51.9 billion). P3-related transport investment in 2017 was roughly double that of the previous year (US$18.8 billion), although the large increase was mainly due to just three very large projects, namely, a high-speed rail project in China (US$6.8 billion), another in Indonesia (US $6.0 billion), and a large monorail project in Thailand (US$3.1 billion). These three projects account for the large increase in overall private investment in infrastructure in the Asia-Pacific region for that year. In total, transport-sector P3 investment in 2017 was spread across 66 projects, including 39 for roads, 15 for ports, seven for railways (mainly high-speed / intercity), and five for airports. Clearly, if data for 2017 is any indication, P3 investment in transport infrastructure is mostly focused on either accommodating more vehicle travel (road building projects), facilitation of international trade (ports) or expanding modes of transport that primarily serve the business class (airports, intercity rail).

Public contributions to P3 projects of this nature can be direct or indirect. Direct contributions typically take the form of capital expenditure on project construction costs, revenue guarantees (to ensure profitability from otherwise uncertain fare-based income streams), grants of land, etc. Indirect forms of support may include guarantees involving tax breaks or other policy interventions designed to remove financial or economic challenges that might otherwise undermine such projects' ability to generate reliable, sufficiently profitable returns for investors.[128]

For transport in particular, direct capital subsidies were the most common form of government support in 2017: Of the 66 transport projects covered by the World Bank report, 24 received direct capital subsidies of one form or another. Between 2012 and 2017, transport-sector projects received more than three-quarters (78 percent) of all direct government capital subsidies studied.[129] The transport sector is thus a major route through which public funds provide a platform for private investors to secure long term contracts that guarantee those same investors revenue streams—a typical arrangement for P3s, which effectively amount to transfers of public money directly to private investors.

There is also considerable evidence to support the claim that the kinds of guaranteed returns associated with P3s tend to induce corruption. As documented in a 2014 Public Services International Research Unit (PSIRU) paper, *Why Public-Private Partnerships Don't Work*, the lucrative long-term service contracts generally associated with P3s provide "huge incentives for corruption, both to ensure that the work is done through a [P3] rather than the public sector, and to take the only opportunity to capture the contract."[130]

The Search for Reliable Revenues and the Preference for Megaprojects

These data partially capture what is going on in the world of transport sector P3s, but they tell us little about what is *not* happening. Despite the policy mantra that private sector funding is key to scaling up public transport, public funding remains a major source of financing for transportation projects almost everywhere; in many contexts it is the main source. As with other sectors and services, private investors are generally not interested in public transport unless their investment is essentially guaranteed to deliver a "satisfactory" return, and most public transport is not well suited to serve this purpose. The end result is a major investment gap that has left the potential of public transport to assist in meeting sustainable mobility needs almost entirely unrealized.

According to the IEA's Renewable Energy Technology Deployment (RETD) Technology Collaboration Programme, efforts to minimize investor risk and ensure guaranteed returns have produced meager results. It is often the case that, when it comes to transport, any degree of risk is too much.[131] This also helps explain why the share of public sector financing tends to be higher in transport P3 projects than in those for the power sector: 41 percent compared to 16 percent, across 163 such projects analyzed by the World Bank for the year 2015.[132]

At the same time, use of the P3 approach in the transport sector has tended to favor a relatively small number of "megaprojects," which do not really serve the needs of working people. And the impacts many such projects have had on those workers who make their living as informal transport workers—mostly serving poor and working class communities—is rarely taken into account.[133]

A major reason for this bias towards "megaprojects" is the inability of many more "mundane" public transport projects to generate a guaranteed revenue stream that can produce healthy returns on investment. According to Arthur Guzzetti, Vice President of Policy for the American Public Transportation Association (APTA), such a dedicated revenue stream "is what piques the private sector's interest.... It absolutely won't work without that."[134] Put differently, if investment in public transport is predicated on generating revenue streams and therefore "returns on investment" for private interests, then the kind of investment needed to scale up public transport will not happen. Working people in urban areas will continue to suffer the consequences of congestion, pollution, and traffic accidents. Perhaps most crucially, public transport's central role in achieving economy-wide decarbonization will remain unrealized.

The plain reality is this: Urban public transport systems are rarely able to cover (let alone exceed) their operating costs through fares alone. Studies show that, in key countries and regions, the percentage of operating costs recovered from passenger fares is generally declining. In the US, the average "farebox recovery" ratio—the percentage of operating costs covered by passenger fares—fell from 39.9 percent in 2000 to 36.9 percent in 2010, according to a report by WRI.[135] The additional operating revenues must therefore come from other sources: directly from general government budgets, or by way of earmarked taxes (such as a carbon tax). But such revenues entail significant "political risk," and are vulnerable to being cancelled or scaled back when elected governments shift budgetary allocations and priorities.[136]

There are also significant *technical* complications that arise when attempting to use P3s for urban mobility infrastructure. As Guzzetti explains, transport projects funded via P3s are especially difficult to integrate into an overall transport system. In order to manage the accounting associated with the project, those segments of the system that are managed under a P3 agreement must be physically and administratively separated from the rest of the system, so that the revenues can be tracked and accounted for separately. As Guzzetti puts it, "If you have a [transit] line that just blends into your system, that is going to be very hard."[137]

In India, an in-depth study conducted by a planning commission working group on urban transport for the country's twelfth five-year plan concluded that the P3 model was especially unsuited to transport projects, noting that its research had shown that "internationally private investment has not been successful in urban transport projects because the usually unstable revenues of these projects make them commercially unviable." The study further noted that, of 113 world cities with

metro rail, 88 percent have been developed and are operated by the public sector, and that outside of India, no city in the world had attempted to provide full metro transit service through a P3, with one exception: the failed "Star Putra metro rail" experiment in Malaysia. Therefore, the report recommended that the Indian government, having "bet big on public-private partnership" to deliver the ambitious infrastructure targets envisaged in its twelfth economic plan, "make an about turn at least in the case of urban transport infrastructure." The working group suggested that P3s be considered for only 20 percent of the metro projects in the country over the next five years, while the vast majority "should be funded by central and state resources with adequate financing from domestic and multilateral lending agencies."[138]

These findings and examples leave little room for doubt that the P3 approach is more of an *impediment* to the struggle for public transport and decarbonization than it is any part of the *solution.* The P3 approach amounts to an egregious example of the kind of "zombie policies" that neoliberalism offers to solve the problems that the neoliberal approach caused in the first place.

Part Three: The Electric Car — Myths and Realities

At the end of the day, it seems that smaller markets are clustered at the higher end of the EV penetration ranking. This suggests it will be much more difficult to mandate and effect massive vehicle fleet shifts in favor of EVs in much larger markets without significant government subsidies and/or mandates, as well as significant infrastructure investment in EV charging facilities.

— G. Allen Brooks, long-time energy industry investment analyst and Managing Director, *Energy Musings*[139]

The policy mainstream acknowledges that sustainable motorized mobility will require widespread electrification. But as we will show in this section, mainstream discussions of electrification of transport have focused very heavily on electrification of individually owned small vehicles, and especially electric cars. In other words, EVs will simply replace conventional internal combustion engine vehicles (ICEVs) on a more or less "one-for-one" basis. In policy terms, this "mass replacement" scenario has come at the expense of paying needed attention to mass public transport and has perpetuated a car-centric model of urban mobility. As we will see, this approach is simply not compatible with the need to decarbonizing passenger transport and meeting climate targets.

Although electric vehicles (or "EVs") refers to a wide range of vehicle types, including trucks, motorized scooters and bicycles (200 million electric bikes are currently on China's roads, for example), large buses and electrified rail cars, much of the policy discourse focuses heavily on small "personal consumer" vehicles for passenger travel cars. From one perspective, this is understandable: The individually owned car remains the primary mode of transport for large and growing numbers of people. This focus is also consistent with the recent and anticipated growth in vehicle sales, particularly in the global South, noted above. It also fits well with the interests of vehicle manufacturers, whose business models depend on vehicle sales (at least until they can come up with consistently profitable alternative business models).

But the focus on individually owned EVs has added considerable confusion to the discussions on how to decarbonize road transport, and have almost certainly served as a significant distraction from—if not an impediment to—devoting the kind of attention to public transport that is urgently necessary. We explore below the serious implications this policy bias has had for the prospects of electrification and decarbonization, and why a different approach is necessary.

However, some voices in the policy mainstream are attempting to put forward a somewhat different vision for the future of EVs. Blurring the traditional lines of demarcation between individual car use and conventional public transport modes, these voices advocate a role for EVs based on "shared mobility," drawing also on the possibilities for automated or driverless vehicles made possible by modern communications technologies.[140] We will examine what this vision of electrification means for public transportation and the decarbonization of transport in the next section.

But the focus on scaling up EVs raises a number of critically important questions and related concerns. We will briefly examine six of those questions here. First, how realistic are the projections for the global growth of EVs? Second, when subsidies have been used in an effort to hasten the growth of EVs, what have the real impacts been? Third, what would be the impact on transport-related emissions levels should EVs reach these levels of deployment? Fourth, what kind of impact will mass-scale EVs have on electricity demand? Fifth, how–and by whom–can charging stations be deployed at scale? Sixth, what ecological impact would high levels of EV deployment have?

EVs: The Main Attraction or a Side Show?

Discussions on EVs have largely been shaped by an optimistic assessment of their potential to essentially displace ICE vehicles in a competitive market. For example, according to BNEF, EVs are not only poised to make dramatic breakthroughs in terms of vehicle sales, but this will "yield dramatic benefits in terms of asset utilization (in other words cost), flexibility, service levels and cleanliness.... [I]t simply makes no sense to have an inherently analogue power unit—vibrating, volatile-liquid-consuming, hot-polluting-exhaust-producing—at the heart of a fully digital, sensor-pervaded, solid-state-electronics-controlled system."[141]

On this vision, "dirty" vehicles will be replaced by "clean" ones. Importantly, the explosive growth of EVs and, eventually, automated vehicles, will be ignited by the desires of consumers for cleaner, safer travel. According to BNEF, large car companies are pivoting towards this new market and the technologies are evolving at a breathtaking pace. Global sales of EVs will therefore rise to 11 million by 2025 and reach 30 million in 2030, "as they become cheaper to make than internal combustion engine (ICE) cars."[142]

But how realistic are these projections? When viewed in isolation, the growth of EVs has been fairly impressive in recent years. According to data from Macquarie Bank, global sales of EVs rose from 740,000 in 2016 to 1.1 million in 2017—a year-on-year growth rate of 51 percent—while sales of EVs in China, the US, Europe, Japan and Canada in 2017 accounted for 1.7 percent of new car sales in those markets, significantly up from their share of 1.1 percent the previous year.[143] These figures led Macquarie to claim, "It is only a slight exaggeration to say 2017 was the year electric vehicles became mainstream." Two years earlier, the IEA had announced that the year *2015* was "the year electric vehicles went mainstream."[144]

But the claim that EVs have become "mainstream" is a massive exaggeration. Globally, nearly 95 million cars and light commercial vehicles (of all power sources) were sold in 2018; of those, just over 2 million were powered by electricity.[145] Although that represents a near doubling of sales over the previous-year (which saw sales of 1.1 million), it is still just a little more than 2 percent of total sales—and one-third of the 2 million EVs sold in 2018 were not battery-driven but *hybrid* vehicles, which still rely in part on liquid fossil fuels. If we consider the world's total road vehicle fleet—estimated at 1.2 billion vehicles in 2014—only a small fraction of 1 percent are powered by electricity.[146]

These figures have nevertheless done little to temper the enthusiasm and optimism behind many headlines—and even many serious policy papers—that confidently claim that EVs are poised to grow dramatically in the next decade or so, and that the ICE vehicle will soon be towed toward the scrap yard of history. Even if it turns out to be accurate, BNEF's prediction that EVs will reach 30 million annual sales by 2030 is tantamount to saying that ICE vehicles will still occupy more than 70 percent of the global car market (and that is based on the very conservative assumption that annual vehicle sales will be around 100 million).

EV Subsidies: Too Good to Last

Optimistic projections of EV growth seem to assume that EVs will continue to benefit from various government incentives and subsidies as well as fuel economy regulations that have yet to be introduced.[147]

Because EVs are currently more expensive than their ICE equivalents, a wide range of subsidies has been used with the aim of making EVs economically competitive. Norway is a particularly interesting example. While Norway is by a wide margin the world leader in per capita EV adoption,[148] this is to a very large extent the result of extremely generous tax exemptions, other subsidies, and preferential access to parking and special traffic lanes. Together these policies are worth many thousands of dollars per vehicle.[149] Such subsidies—themselves ironically made possible in large part by the country's vast oil wealth—are simply not sustainable over time.[150]

It is worth noting that some subsidies supporting EVs go not to the buyers, but rather to the companies that produce the vehicles. In the US, an analysis of federal EV subsidies determined that 73 percent of the program's total budgetary cost went to car manufacturers—$5.5 billion of a total $7.5 billion. That $5.5 billion (consisting of both grants and subsidized loans) included $2.4 billion that was, in the words of the report's authors, effectively "a gift from the government to the electric vehicle industry."[151]

In addition, there is at least some compelling evidence to suggest that subsidies aimed at individual consumers tend to favor wealthier households. According to data from the U.S. Internal Revenue Service, the overwhelming majority of financial benefits from the U.S. EV tax credit—nearly 78.7 percent—went to households with a gross income of at least $100,000, and fully half of the tax credits went to households with an income of $200,000 or higher.[152] Researchers at UC Berkeley's Haas Energy Institute had previously found that roughly 90% of all EV tax credits had gone to the richest 20% of households, and that the program was the "most extreme" case from a whole range of "clean energy" tax credits—also including home weatherization, installing solar panels, and others— that disproportionately benefitted the rich.[153]

But what happens when EV subsidies are scaled back or phased out altogether? While it is too soon to say definitively, there are clear signs that EV sales are currently very dependent on subsidies. Until July 2015, the U.S. State of Georgia had offered a $5,000 tax credit for all "zero emission vehicles" (ZEVs) sold in the State, and was responsible for 17 percent of ZEV sales in the U.S. (compared to a population share of just 3 percent). Once the tax credit was eliminated, sales dropped by nearly 90 percent—and by even more for less expensive models.[154] More recently, China's Ministry of Finance announced in March 2019 that it would cut EV subsidies by 50% in order to encourage local manufacturers to "rely on innovation rather than government assistance as the industry matures and costs fall"; the Ministry warned that it would phase out subsidies entirely by 2020 or soon after. Immediately following the announcement, EV company shares dropped sharply. Of course, China is currently the world's largest EV market, and the cut in subsidies could have a profound effect on EV sales, at least in the short term.[155]

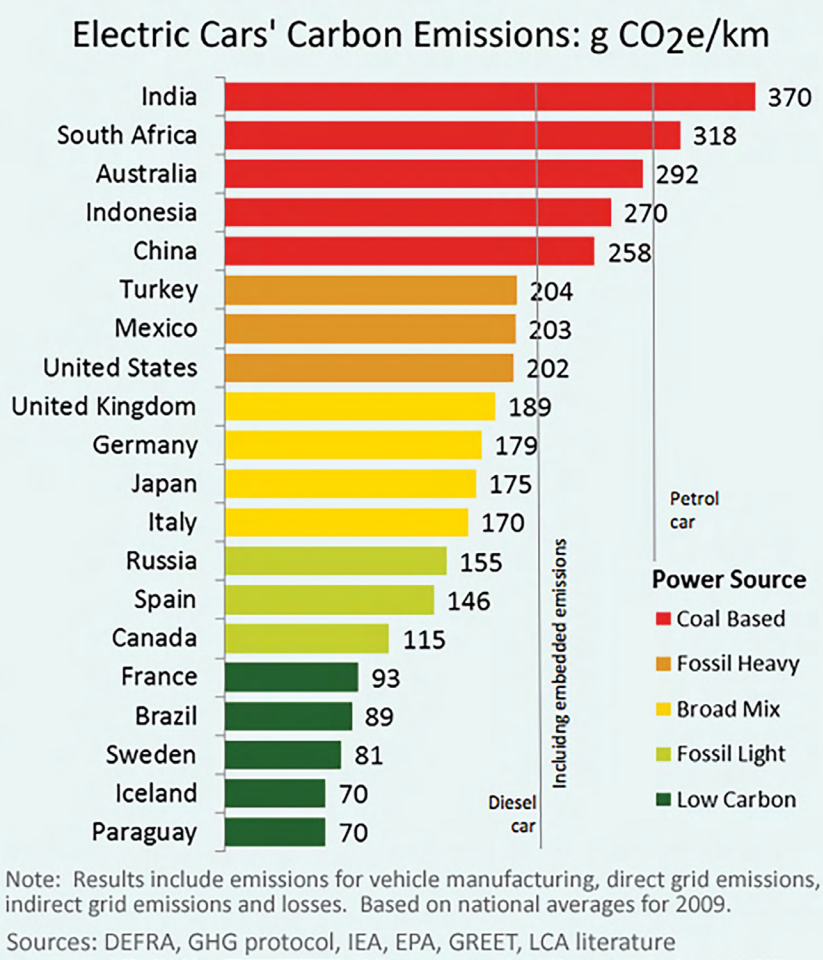
Subsidies for EVs are also exposed to political risk. EV drivers in the U.S. do not pay tax when they buy petrol. This has already reduced U.S. gasoline tax revenues by $250 million annually—even while EVs are still just 1% of total vehicle stock.[156] And several states are considering imposing a mileage tax on electric vehicle drivers to make up for the lost revenue on fuel sales.[157]

Analyses of the impacts of EV subsidy regimes have found other problems, including that they may lead to additional car purchases (rather than substitution for an ICE vehicle, the latter still being preferred for travel where range limitations might be an issue); that they may actually encourage people to drive more in order to "justify" the expense of the new purchase; and that for some journeys they are more likely to displace the use of public transport rather than use of an ICE vehicle.[158]

Do EVs Reduce Emissions?

The main decarbonization scenarios take for granted that a large share of emissions reductions from transport will take the form of the EVs (broadly defined) replacing existing ICE vehicles, and that this replacement will provide a major contribution to the required reductions. For instance, the IEA envisions at least 20 percent of all road transport vehicles being electrically powered by 2030.[159] For its part, UN Habitat believes car and battery manufacturers, energy producers and distributors "will strive to increase the global market share of electric vehicles in cities to reach at least 30 percent by 2030."[160] In a 2017 joint report, the IEA and IRENA concluded that the share of electric cars would need to rise to nearly 70 percent by 2050 in order to be consistent with the a 2 degrees scenario.[161] By focusing on vehicle-substitution in this way, such projections pay insufficient attention to possibilities for changing patterns of mobility that *reduce the need for vehicles on the road*.

In fact, the GHG emissions advantage of EVs over ICEVs is actually far less than is widely supposed—particularly when the electricity used to charge the vehicles is still generated mostly from fossil fuel sources. In such instances the emissions advantage is often minimal.[162] Speaking from the World Economic Forum in Davos, Switzerland in early 2019, Fatih Birol, Executive Director of the IEA, pointed to the limits of EVs in helping to meet emissions targets. Although there are currently nearly 5 million EVs on the roads globally, Birol noted, this number remains a small fraction of the more than 1 billion ICE vehicles currently in service around the world. And, said Birol, even if the number of EVs on the road were increased by 60 times, to 300 million, the impact on global CO2 emissions levels—given the current global power generation mix—would be minimal.[163]



Source: Energy Matters, adapted from "Shrink that Footprint: Shades of Green"[164]

It has been known for some time that EVs offer only a limited "emissions advantage" where the power generation mix relies heavily on fossil fuels. According to a report by the European Environment Agency (EEA), life cycle GHG emissions for a typical battery-powered EV in Europe, based on the average European electricity mix in 2013, were just 17-21 percent lower than comparable diesel-powered vehicles, and just 26-30 percent lower than petrol.[165]

It also bears noting that there is widespread recognition among transport industry observers—even those who are optimistic about EVs—that they are, in the words of one, "a relatively expensive way of reducing CO2 emissions."[166] According to another, EVs are "probably the most challenging to electrify cost-effectively.... The case for electrification is actually stronger for other types of vehicles [and city transit buses in particular]."[167]

In fact, the emissions-reduction potential of electric buses is indeed far greater per passenger mile. A recent report from BNEF found that by the end of 2019, electric buses will have displaced more than three times as much diesel from total global consumption as that displaced by electric cars—a cumu-

lative amount of 270,000 barrels per day. According to BNEF estimates, each 1,000 electric buses on the road displace 500 barrels of diesel demand each day, whereas a similar number of battery electric vehicles remove just 15 barrels.[168]

EVs and Power Sector Decarbonization

The emissions footprint of EVs is also highly dependent on the source fuel for electricity generation. If an EV is charged by electricity largely generated by coal or gas, then the emissions benefits are less than they would be if the EV were charged using renewable sources of power. Globally, the portion of electrical power generated by all low-carbon sources (including large hydroelectric and nuclear power) is roughly one third. Given the current global mix of fossil-based, nuclear and renewable sources, a one-for-one replacement of ICE vehicles with EVs is therefore not going to produce the levels of decarbonization needed to seriously address rising transport-related emissions. Of course, if the energy mix is deeply and rapidly decarbonized—a scenario that, as we have shown in previous working papers, is itself not remotely likely without a radical policy shift toward planned, coordinated, decommodified and publicly owned alternatives—then the emissions advantage of EVs could improve accordingly.

But what impact would a massive increase in EVs have on electricity demand? If EVs were to grow quickly, the pressure on renewables to keep up with rising electricity demand would increase accordingly. The policy consensus currently holds that electrification of virtually the entire economy is essential if fossil fuel use is to fall to the levels scientists say are required to limit global warming. But mainstream policy voices have yet to seriously confront the fact that the current approach to scaling up electricity generation based on renewable sources is not producing enough capacity to meet even *current* electricity needs—let alone the needs of potentially hundreds of millions of electric or hybrid vehicles. Additionally, with one or two important exceptions, there have been almost no studies devoted to quantifying the amount of additional electricity that might be needed, or whether current renewable energy technologies can fully meet the demands that the widespread electrification of transport might pose.[169]

According to IEA and IRENA, in order to limit average global warming to less than 2 degrees Celsius, the share of renewable energy would "need to increase from around 15% of the primary energy supply in 2015 to roughly 65% in 2050."[170] But this scenario from IEA / IRENA also assumes that overall energy demand in 2050 would remain at roughly current levels, due to extensive improvements in energy intensity between now and then, rather than continuing to grow along current trends. This is an *extremely* optimistic assumption—not least because it also ignores the *additional renewable energy* that would be needed to power massive numbers of new electric vehicles.

Currently, it is impossible to see how transport-related emissions can be reduced in a manner consistent with the Paris targets without a bold approach to *both* the deployment of renewable energy *and* a decisive shift in the way in which requirements for mobility are created, sustained and met. The approach we need must ensure sufficient generation capacity to power the kinds of mobility that we need, while also meeting all other requirements for electrical power.

For instance, in addition to the essential role of renewable sources in decarbonizing power generation and transport, mainstream scenarios also anticipate such sources will play a major role in decarbon-

izing industrial processes, as well as in heating and cooling for buildings. The prospects for meeting this full spectrum of electricity demand are currently very poor. To date, rising deployment of renewable energy and improvements in energy efficiency have had only a minor impact on the energy mix globally, and have been completely inadequate in terms of displacing fossil fuels. Despite headlines regularly proclaiming each new "record" of growth in deployment for wind or solar generation, the ongoing overall rise in demand for energy continues to exceed the growth in renewable sources, so that the use of fossil fuels—especially natural gas but also oil products—continues to rise as well. For transport in particular, according to REN21's 2018 *Global Status Report* on renewable energy, the renewable energy share of transport "continues to be low" at a mere 3.1%, with more than 90 percent of that being met by liquid biofuels rather than electricity.[171]

"If You Build It, They Will Come": EVs and Charging Infrastructure

Whatever form they take, and no matter how they are used, EVs must have their batteries charged in order to be of much use, and major questions remain about the availability and ownership of charging infrastructure. In the words of one industry analyst, "Electric vehicles are unlikely to win broad market acceptance unless they can be charged quickly and easily anywhere."[172]

The current approach has also yet to produce a clear and convincing means to deploy the kind of charging infrastructure needed to support the widespread use of private EVs. There is currently a great deal of uncertainty about how charging services should be built, and who should own them. In the US, some public utilities have sought opportunities to own and operate such stations as a source of revenue at a time when demand for electrical power has stagnated and revenues from centralized power generation have fallen accordingly. Several States have rejected such requests from utilities, mainly on the grounds that it would involve forcing all of the utilities' customers to pay for a service that only a small minority will use, at least in the short to medium term. Other states have raised concerns that utility ownership would "stifle private competition." But there is also a growing recognition that failure to ensure the widespread availability of charging stations will undermine the ability to meet ambitious targets for electrification of transport and emissions reductions.[173]

A recent UK study summed up the fundamental problem of a market-led approach: "Electric transport requires an infrastructure of charging points. It is a classic infant infrastructure problem: the network is economic only when there are lots of EVs charging from it; and the EVs are worth buying only if the infrastructure is in place."[174] Another study estimated that fully decarbonizing UK transport would require a massive increase in power generation. The yearly energy demand of transport fuels is currently more than double the UK's national electricity consumption. Replacing the energy currently provided by fuels with electrical power would require an extraordinary increase in renewable energy generation capacity.[175]

In China, the city of Shenzhen—often called "China's Silicon Valley"—avoided this dilemma by building the world's first "all-electric public transport network." According to transportation authorities, the city operates more than 16,000 electric buses (triple the number operating in New York) and 19,000 EV taxis. These 35,000 vehicles are charged at more than 5,000 public charging points located throughout the city.[176] Other problems notwithstanding, the Chinese case provides an example of the speed and scale of change that is possible.

Ecological and Human Rights Impacts

The scale of production of EVs envisaged under the various scenarios also raises serious questions about ecological and human rights impacts, given the quantities of various minerals required to produce the batteries that power them, including lithium, cobalt, nickel and various "rare earth" metals. Expert opinion varies on how easily demand for each of these minerals can be met, and on the likelihood of serious shortages or conflict in the face of dramatic increase in the EV production. Both the U.S. Department of Energy[177] and the European Union[178] have issued reports warning about the possibility of such shortages.

The "scramble for lithium" has seen leading EV makers attempting to lock in long-term supply contracts, and lithium-mining companies are seeing both their stock prices and their operations surge.[179] Chinese companies in particular are reported to have been aggressively moving to secure the lithium reserves needed to drive the country's projected expansion in EV production and use. According to Nikkei Asian Review, "China already has about 20% of the world's lithium reserves, but it has acquired up to 40% of global reserves."[180]

Globally, demand for cobalt to be used in EVs is also expected to increase dramatically. As with lithium, China has taken a leading position in securing stocks of cobalt. In the first nine months of 2017, Chinese companies imported $1.2 billion worth of cobalt from the Democratic Republic of Congo (DRC), compared to just $3.2 million by India, the second-largest importer.[181] According to mineral consultancy CRU Group, "China controls 62 percent of the world's cobalt supply, with 90 percent of that coming from the Congo."[182]

Many of the materials and processes involved in manufacturing renewable energy components are also highly polluting, particularly compounds of gallium and cadmium used in solar PV equipment. China currently dominates global reserves and production of such minerals, although its absolute dominance—once over 95 percent—has been eroded by increased operations in the U.S. and Australia.[183]

Of course, the mining of these minerals immediately raises serious questions about human rights, and any rapid scale-up in production of EVs would also mean a significant expansion of mining activities, with all of its attendant ecological and social disruptions. Currently, 54 percent of cobalt currently produced comes from the DRC, where an estimated 40,000 children work in mining, much of it for cobalt.[184]

Such considerations should make clear the need to seek pathways to decarbonization, including for transport (and the power generation necessary to decarbonized transport) that minimize the need for such minerals.

Part Four: Taming the TNCs: From Uberization to Enhanced Public Mobility for All

We have shown that the defense, improvement and expansion of public transport is essential if we are to help control and then reduce transport-related emissions. We have also shown how the current

neoliberal policy framework must be rejected in order for public transport is to fulfill its true potential. This applies to both transport policy specifically (and the obvious shortcomings of the public-private partnership approach, alongside pressures to privatize part or all of public transport systems) and it applies at the level of macroeconomic management. The neoliberal framework has failed to impede the rise of emissions and will continue to do so until it is completely rescinded.

We have also shown how the rapid proliferation of small, individually owned EVs is by no means guaranteed to take place at the speed and scale necessary to make a major contribution towards decarbonization. The disproportionate attention given by policy makers reflects a car-centered approach to transport policy, and this approach is seldom influenced by the lived reality of enormous numbers of people around the world, who face increasingly burdensome travel in order simply to get to work (often involving long, stressful, and energy-sapping commutes), or to carry out other daily tasks (shopping, accessing healthcare or education, etc.).

Here it is important to keep in mind that the vast majority of these workers are statistically more likely to be killed or injured by a car than they are likely to own one. And the lack of accessible public mobility has made car ownership a necessity for millions of others. The "Yellow Vest" protests in France that broke out in late 2018—reported to involve large numbers of people from outside urban areas, who have been pushed ever further from city centers—was described in the *New York Times* as revealing "a crisis of mobility in all its forms."[185] The real lives of billions of ordinary people are often rendered invisible by the "me-focused" narrative promoted by large car corporations who cater almost exclusively to the world's more affluent people and "emerging markets." Meanwhile, the idea of healthy and vibrant communities connected by modern and comfortable public transport networks has no place in this profoundly anti-social discourse.

Regarding climate change, the evidence suggests that modern public transport systems remain the best option in terms of advancing transport-related decarbonization goals. But the case for the expansion of public transport does not rest on climate concerns alone. As noted above, the policy mainstream understands the need to provide safe, secure, high-quality and accessible mobility, and the unique role public transport can play in meeting those needs. There is no need to repeat those arguments here. The International Transport Workers Federation (ITF)'s work is outstanding in this respect, and it also shows how worker concerns can be addressed in ways that also serve the broader public good.[186]

In this section, we consider how public transport systems are being challenged by the proliferation of ride-hailing and ride-sharing companies like Uber. For present purposes, ride-sharing (or trip-sharing, or shared mobility) refers to rides or trips that are actually shared between different individuals or different parties and paid separately, whereas ride hailing refers to any app-based system to secure a ride from a taxi or other "on-demand" ride service from a "transport network company" (TNC). These rides may or may not be shared.[187]

The implications of this challenge are yet to be fully assessed, but public transport advocates are already issuing dire warnings with regard to the disruptive impact that TNCs are having on existing public transport systems and the threat these impacts pose to the future of public transport. Although not always central to the discussion, the climate-related implications of this threat are likely to be extremely serious. On current trends, there is a real risk that public transport's contribution to ad-

dressing climate change could dramatically decrease, precisely at a time when it needs to increase by orders of magnitude.

Union responses to the growing presence of (TNCs) have understandably focused on worker-related issues, but future responses could be made more compelling if climate-related arguments were also included. This would also allow unions to make a case for both strengthening the presence and extending the reach of public transport while at the same time reducing vehicle miles traveled (VMTs) and emissions in urban areas. There is reason to believe that recently developed app-based or platform technologies can be harnessed in ways that could make a significant contribution to improving and expanding public transport. But the struggle to harness these technologies for the public good must be viewed as part of the struggle to protect, improve, and qualitatively expand traditional modes of public transport. We call this "enhanced public mobility" because it seeks to improve public transport in ways that can take full advantage of some of recent technological changes and innovations. Public transport authorities are already making some progress in this respect, but the incorporation of these technologies risks being obstructed by political attacks on public transport systems as well as the loss of revenue that has in many cases resulted from the rise of unregulated "predatory mobility."

As noted elsewhere in this report, traditional modes still have an extremely important role to play in achieving "sustainable mobility for all." Finding the right balance between traditional modes (trains, buses, etc.) and the need for low carbon first- and last-mile mobility will require consistent input from drivers, riders and the communities they serve. It will also require making sure ridership data is used to improve public transport and generally serve the public good, and not—as data are used today—to the detriment of public systems.

Therefore the fight for public transport—*and* the fight against climate change—will involve a struggle for ownership and control over these technologies, so that they can be used to complement and improve the public transport services of the future rather than displace or undermine them. In this respect, the future of urban mobility stands at a crossroads. If current trends in new mobility or "Uberization" continue, the challenge to decarbonize road transport will become even more formidable than it already is.

Waiting On the Platform?

Urban transport systems are currently undergoing dramatic changes. Mobile phones have enabled web- and app-based "platforms" and these have led to a dramatic growth in ride-hailing and ride-sharing services. These and similar app-based innovations have spurred an explosion of both scheduled and "on demand" transport options and services. The use of these options has grown dramatically. For example, Uber reached 1 billion trips worldwide by the end of 2015, and 2 billion by mid 2016.[188] By May 2017, Uber had clocked up 5 billion trips.[189] The number of Uber-like companies has also proliferated, hiring perhaps millions of drivers in total." Uber claims to have "employed" 3 million drivers worldwide, and Lyft 1.4 million drivers.[190] TNCs are also growing in the global South. In 2017, DiDi reportedly carried out up to 25 million daily trips across 400 cities in China for a total of 7.3 billion rides for the year.[191] In Southeast Asia, a TNC company called GRAB out-competed Uber, buying the latter's business in key countries and "driving the ride-hailing giant out of several fast-growing markets such as Indonesia and Thailand."[192]

Aside from ride sharing, there has been a boom in new startup companies providing "new mobility services." These include route-planning applications like Google Maps and Citymapper that compete for users by integrating data for a wide variety of transport modes and options to provide a range of alternatives and real-time journey duration estimates, as well as making visible options for ride-hailing and ride-sharing services. Citymapper's "Smart Ride" relies on a fleet of minivans operating on a fixed network, coordinating passenger pick-ups and drop-offs in what has been called essentially "a cross between a taxi and a bus."[193] Other startups are "launching ride-sharing apps, dockless bike hires and responsive bus networks in cities around the world."[194]

Transport policy makers and urban planners are today looking at ways to respond to these new forms of (mostly unregulated) mobility. Some studies have suggested that public transport systems were improved as a result of applications run by third party operators that make it easy for people to buy tickets and plan their journeys, and this can lead to an increase in ridership. They see the potential to integrate these new services into public transport systems, on a "P3" basis where the public transport authorities contract with private companies. A 2017 working paper claimed that companies that harness and use data and technology to streamline the dispatching and tracking of trips, monitor user experience, arrange services and handle payments, can make public transport more attractive and also more competitive. By providing dynamic trip-planning and ticketing services, private companies can encourage city dwellers "to take multimodal journeys by enhancing access to information and simplifying ticket purchases." [195]

This may be so, but ride-sharing and ride-hailing companies like Uber and Lyft are qualitatively different from platforms that offer these planning and ticketing services in that ride-sharing and ride-hailing companies offer (for some) an alternative to using public transport and this could pull passengers away from using mass public transport systems.

The Impact on Public Transport: The Case of the United States

Many public transport advocates have already concluded that the impact of companies like Uber and Lyft on public transport systems will be mostly disruptive, and perhaps catastrophically so. One commentator has stated, "My fear is that Uber is going to lead to a cycle of cataclysmic disinvestment. They will try to siphon off the most profitable customers and leave public transport a rump service."[196]

In terms of the US, there is some evidence to suggest that ride sharing is indeed eating into public transport ridership levels, and some local authorities are looking to companies like Uber and Lyft to provide mobility as an alternative to maintaining "low ridership" public transport routes—and they are willing to subsidize users.

A 2016 survey of seven U.S. cities found a 6 percent reduction in the use of public buses following the introduction of ride-hailing services, and a 3 percent reduction in the use of light rail. The researchers concluded: "Current evidence suggests that ride-hailing is pulling more people away from public transit in cities, rather than adding riders."[197] A 2017 paper by the Institute of Transportation Studies at the University California, Davis, found that the activities of Uber and similar companies "contributed to a 6 percent drop in public transit use."[198]

According to that same study, ridership on public mass transit is down in nearly every major U.S. city, and these declines have been associated with the increase in ride sharing.[199] For example, ridership has declined significantly on San Francisco's new BART train line to the airport as Uber and Lyft saw their ridership to the airport rise almost six-fold. The ridership decline led to BART (Bay Area Rapid Transit, the regional mass transit system) revenue falling under budget for the year by $3.6 million. It took San Francisco a decade to secure the billions in state and federal funding to extend this line to the airport, and now its usage is being undermined by ridesharing.[200]

The study also cites irregular or unreliable public transport as one of the primary reasons for using a TNC like Uber or Lyft, finding that users were disproportionately young, better educated and earned above $35,000 per year (roughly the median annual income for this age group). [201] Nearly half of respondents said that if a ridesharing service had not been available, they would have taken a bus, train, bike, or simply walked. It also found that, if rideshare users did not have that option, up to 61 percent of their trips either would not have been made at all or would have been done via public transport, bike, or on foot.[202]

Looking at global trends, the Institute for Transportation and Development Policy (ITDP) has concluded that the negative impacts go beyond reducing the number of passengers using public transport: "The expansion of new mobility services could lead to worsening traffic congestion, more vehicle accidents, added air pollution, and other unwelcome effects, which some cities have attempted to forestall with regulation."[203] A 2015 study by the International Transport Forum (ITF; not to be confused with ITF the Global Union Federation) found that a shift from walking and cycling to shared vehicle travel could result in a significant increase in vehicle miles traveled, thus increasing congestion and travel times, even as vehicle occupancies increase.[204] In New York, utilization rates—the time drivers spend driving billable trips divided by the total time they spend in their cars with the app running—were about 58 percent for Uber and Lyft in the second half of 2017, with Juno's utilization about 50 percent.[205] In London, both taxis and TNCs were exempt from congestion charges, although revenues from London's congestion charge were used by the city to support bus network improvements and other projects. However, the exemption was removed in April 2019 and Uber announced it would raise its fares in order to offset the impact of the charge.[206]

The availability of Uber and similar companies has already led to decisions by city authorities to reject making improvements to public transport systems and to subsidize riders to use Uber and similar companies instead.[207] Some authorities have offered incentives to low income people to use car-sharing services like Car2Go as an alternative to providing and maintaining public transport systems. However, in California, less than 1 percent of households earning under $35,000 hold a car share membership compared to 2.4 percent of households earning over $100,000.[208] "Even where car share vehicles are physically available, barriers such as a lack of credit card, lower computer or internet access, or language barriers may inhibit low-income carless residents from participating in car sharing."[209]

Going for Broke? Predatory Mobility

There are clear signs that TNCs and their backers in Silicon Valley see urban transport as a lucrative future market, and view traditional public transport as competing for the same potential mar-

ket share. The idea that public transport should make way for private ride-hailing companies is aggressively promoted by the industry. Uber CEO Dara Khosrowshahi's declaration "I want to run the bus systems for a city" sends a clear privatization message.[210] Tesla's Elon Musk has called public transport "a pain in the ass," which he hopes to replace with his "hyperloop" alternative: a futuristic model of transport based on "tubes" with reduced air pressure through which passenger or freight "capsules" would be whisked at high speed—and a model widely seen as highly impractical.[211] New mobility entrepreneurs would therefore oppose the expansion of public transport and happy to celebrate the demise of existing public transport systems. Whether or not they are aware of it, these new mobility entrepreneurs are echoing the anti-public diatribes of far right voices that see public spending on public transport as a "waste [of] taxpayer money on unpopular, outdated technology like trains and buses just as the world is moving toward cleaner, driverless vehicles."[212]

But major questions remain about the financial viability of Uber and other TNCs. A 2016 analysis of Uber's financial performance by transport sector expert Hubert Horan found that despite being "the most highly valued private company in the world," the company was also "losing more money than any startup in history," in the form of $2 billion annually of investor funds which were effectively subsidizing rider fares in order to capture the urban mobility market. As Horan put it at the time, "Uber has been aggressively pursuing global industry dominance, in the belief that the industry has been radically transformed into a 'winner-take-all' market."[213] For 2017, the company posted losses of $2.2 billion, and then $1.8 billion for 2018, with concerns over slowing growth of revenues.[214] In other words, the company continues to hemorrhage cash, with no clear end-game to achieving durable profitability. In essence, Uber's strategy has been to gamble that it could retain sufficient investor backing to drive out all competitors and then recapitalize through a public stock listing ("initial public offering," or IPO) and use its monopoly position to dramatically increase ride prices, recoup losses, reward its venture investors and begin operating at a profit based on far higher ride prices for consumers. (According to Horan's 2016 analysis, riders were paying on average just 41 percent of the costs of each ride at that time.) In the words of one commentator, "After burning through $10.7 billion in nine years, Uber still hasn't found a way to turn a profit."[215]

Horan has also reported how, in March 2019, Lyft's public filing documents provided a picture of "a company with negative cash flow, growing annual losses that have reached nearly a billion dollars, and declining rates of revenue growth"[216]—essentially the same picture he had previously found for Uber. According to Horan:

> *Lyft's prospectus provides absolute no data demonstrating that it has the ability to profitably raise prices over time, increase operational efficiency or win significantly greater market share.... Lyft makes no attempt to lay out a possible path to future profitability, or even a timeline as to when breakeven might be achieved.*[217]

Policy makers who are being swayed by the idea that partnering with TNCs offers a cheap alternative to traditional public transport may soon have to confront the fact that the financial, social and ecological costs associated with TNCs far outweigh their benefits. According to one commentator, "Uber's business model is to subsidize fares and flood streets with taxi-like cars in order to grab market share and eventually market pricing power. Most customers who love Uber don't realize that the company actually subsidizes about 50 percent of the cost of every ride. So every time a passenger gets into the car, they are only paying half of the actual cost. The other half is paid by Uber's wealthy venture capital funders."[218]

It is worth noting that car-hailing TNCs like Uber and Lyft have also been buying other shared-mobility-service companies like Lime that provide electric scooters, or Jump and Motivate bikes, etc.[219] While these actions are typically presented in terms of providing "one stop" convenience to users, it is not difficult to see how they also fit well with a business model aimed at establishing a monopoly over mobility options, with the aim of reaping the potential future rewards of such a dominant position.

Unions vs. Uber

For unions, changes in urban transport have unfolded so rapidly that it has been hard for them to keep up—and the speed of change appears to be accelerating. For example, when the ITF (the union federation) was preparing its report on transport workers and climate change in 2009, Uber had just been formed.

So far, unions have rightly been concerned about the impacts of app-based, ride-hailing companies like Uber, Lyft, Juno and others, on the wages and conditions of the drivers working for such services. Drivers typically use their own vehicles to provide the service, with a fixed portion of the fee paid as a commission to the driver.[220] But unions have also been concerned about the impacts of such new services on drivers for traditional taxi services. In New York City, drivers for TNCs such as Uber and Lyft and other TNCs outnumber traditional yellow cab drivers by a ratio of 4-to-1,[221] and their rapid proliferation has been identified as a contributing factor in the suicides of several "yellow cab" taxi-drivers.[222]

In late 2017 the New York Taxi Workers Alliance (NYTWA) joined with allies to get the city to raise the hourly wages of the 80,000 drivers working for TNCs.[223] The union stated:

> *With more than 80,000 Uber cars on our roads, no driver can get enough fares to feed our families. Uber created this crisis of congestion on our streets. Uber caused this crisis of plummeting incomes for all drivers. And Uber is worsening the MTA [Metropolitan Transit Auhority] crisis, siphoning income away from public transit by subsidizing its passenger fares.*[224]

More recently, a June 2018 study found: "Ninety percent of New York City's app-based drivers are immigrants, and only one out of every six has a four-year college degree. Driving is their only job for two-thirds of the drivers. Eighty percent acquired their vehicle to enter the industry and would risk losing their investment if they switched to working in another industry."[225]

There are also wider equity concerns about the impacts of such systems as they become increasingly enmeshed in urban mobility while other inequalities still exist.[226] Because such services generally require users to have a smartphone and credit card, substantial numbers of people are currently unable to use them. Even in the US, roughly one-sixth (17%) of adults do not have a smartphone,[227] and an even higher proportion of households have no credit card.[228] These figures are almost certainly significantly higher in the developing world, which is precisely where motorization and urbanization are growing the fastest.

Unions in major cities around the world have rallied to the defense of both the workers who drive the buses and subways in major cities and the public transport systems that employ them and serve communities.[229] Unions in Italy, Spain, the UK and elsewhere have also been involved in legal battles to regulate companies like Uber or to ban them altogether. In some of these battles, unions have formed

alliances with taxi companies. For example, in May 2015, unions in the taxi sector in Italy were successful in persuading a court to give Uber fifteen days to take its smartphone platform offline. The court determined that Uber resembled a taxi service but its pricing system was not subject to the laws governing the traditional taxi services; Uber fares are lower because its drivers do not have to bear the expenses incurred by taxi license holders such as the cost of installing meters, insurance and maintenance checks. Unions were concerned about the prospects for employment in the sector in terms of job quality, security and remuneration.[230]

As Uber and similar companies have grown, so have the legal efforts to have TNCs comply with the kind of regulations that traditional taxi companies have been subjected to for decades. In a growing number of instances, cities and countries (among them Bulgaria, Denmark, Hungary, and Italy) have banned Uber altogether.[231]

Some drivers have even formed their own cooperatives. As the International Transport Workers Federation (ITF) notes, in Austin, Texas, "taxi drivers - digital and off-line drivers - organized together for better wages and working conditions. They managed to set up their own taxi cooperative and Uber and Lyft even temporarily left the city.[232] The ITF notes how "Other examples of cooperative taxis that were formed as an alternative to the exploitative practices of the likes of Uber and Lyft, include Union Cab in Madison, Wisconsin; Coop Taxi in Montreal, Canada; and COOP Taxi in Seoul, South Korea."[233]

How do TNCs and "New Mobility Services" Impact Emissions Levels?

But what do the proliferation of TNCs and "new mobility services" more broadly mean in terms of altering emissions levels and trajectories? Do these new forms of (mostly urban) mobility pose yet another obstacle in the way of reaching decarbonization goals? Or can they, perhaps, help in terms of reducing emissions by, for example, reducing individual car ownership?

Uber and other TNCs claim that ride hailing and ride sharing will reduce vehicle ownership and this, in turn, will produce environmental benefits. At the global level, 15 of the largest TNCs came together in 2017 to launch the *Shared Mobility Principles for Livable Cities* at the Ecomobility World Festival in Taiwan. Claiming to "lead the transition towards a zero-emission future and renewable energy" the group stated, "Our goal is to align cities, the private sector and civil society around a shared vision to ensure we harness the good and avoid the bad of new business models and technologies.... [W]e share common goals, like a commitment to zero-emission vehicles and efficient use of urban roads."[234]

Researchers have only begun to assess the impact TNCs have had, or might have, on emissions levels. Most of the studies that have explored this and similar questions have focused on individual cities and therefore it is difficult and perhaps unwise to draw any firm conclusions until more studies have been done. But a more comprehensive 2017 study by the University of California (UC) suggests that, if anything, ride-hailers in the U.S. are not getting rid of their private cars as a result of the availability of TNCs. The report states, "Contrary to recent research on the topic, with this more representative sample of people in major cities we find that ride-hailing users on average do not possess significantly fewer vehicles than their non-ride-hailing counterparts, and have more vehicles than those who only use transit."[235]

As the UC study notes, from an environmental benefits perspective, the reduction of vehicle ownership is primarily of value insomuch as it reduces VMTs. The conclusion of the study, while conditional, is this: "based on mode substitution and ride-hailing frequency of use data, we conclude that ride-hailing is currently likely to contribute to growth in VMTs."[236]

A recent study by Schaller Consulting Group is, however, less conditional in its conclusions. The study reported that, in the U.S. at least, "ride-hailing companies added 5.7 billion additional driving miles to city streets, with 70 percent of all trips taking place in nine large cities. Among those who use services like Uber, 60 percent would have otherwise taken public transportation, biked or walked, further contradicting claims that city dwellers would eventually abandoning individual cars en masse."[237] Furthermore, in order to provide "on demand" mobility, there have to be a enough vehicles ready to get to the rider or riders at very short notice. According to one source, the current business model for TNCs "relies upon very short wait times for passengers requesting rides, which in turn depends on a large supply of available but idle drivers and vehicles."[238] Both trends—more riders and rising numbers of vehicle available to move those riders around—runs contrary to the claims made by the TNC companies' *Shared Mobility Principles for Livable Cities* stated commitment to the "efficient use of urban roads."

The study noted that even ride-sharing options such as UberPOOL and Lyft Shared Rides add to traffic-congested roads. In total, those car-pooling options added 2.6 new miles on the road for every mile of individual driving, in total increasing traffic on the road by 160 percent, according to the study. According to the study, "They've added billions of miles of driving in the nation's largest metro areas at the same time car ownership grew more rapidly than the population."[239]

Although perhaps difficult to quantify with any degree of precision, there is normally a positive correlation between traffic congestion and emissions levels, as there is between vehicle miles traveled and emissions levels. In an October 2018 draft report, the State of California Transportation Authority reported that, in San Francisco, TNCs "accounted for approximately 50% of the change in congestion in San Francisco between 2010 and 2016, as indicated by three congestion measures: vehicle hours of delay, vehicle miles travelled, and average speeds."[240] In an attempt to address TNCs' growing contribution to GHGs, California passed legislation in September 2018 to create a baseline for GHGs per passenger mile generated from TNCs, beginning in 2020. By 2021, annual targets for emissions reductions will be adopted, and TNCs will be required to develop emissions reduction plans to meet those targets by 2022.[241] The new law states that plans developed by the TNCs must "be consistent with the Zero-Emission Vehicle Action Plan" and "be technically and economically feasible" and "based upon data reported by the transportation network companies to the commission."[242]

Partners, not Predators? Redefining the Relationship between TNCs and Public Transport

Some analysts have promoted the idea that TNCs can partner with public transport authorities. Rather than prey upon public transport and its ridership levels base, these analysts envisage a "win-win" situation wherein TNCs can supplement public transport services while reducing the costs associated with sustaining and improving the current public transport system.

One example of this approach is captured in the New Climate Economy working paper cited above, which imagines a well-designed "public private partnership" between TNCs and public transport authorities that could produce positive social and environmental outcomes. A P3 approach, this report argues, could deliver "tailored mobility packages to the user" in which on-demand services "play an important role as complement to public transport due to their flexibility."[243]

The report claims that private-sector TNCs and service providers can better match services with demand. For example, the presence of fleets of on-demand electric minibuses could improve access to public transport, lower operating costs, (no need to provide underused buses late at night), and reduce environmental impacts. Private-sector ride-hailing companies could also provide "first- and last-mile ride sharing" to underserved city areas, expanding access and use still further. The working paper suggests that "subsidies could be paid to passengers for on-demand shared rides from areas with poor transit access to transit hubs."[244] The working paper also suggests that "Replacing fixed-route diesel buses with on-demand electric minibuses could yield improvements as well," and that, "Deploying ride-sharing services for first- and last-mile trips to and from public transportation stops, which enables more people to use mass transit instead of their cars, could reduce per journey emissions of GHGs and local air pollutants by 55-80%."[245]

There is nothing in the report to suggest that the selective use of on-demand minibuses or other forms of ride-sharing must be the exclusive domain of the private sector. Similarly, any gains in terms of avoiding transport-related emissions could, it seems, just as easily be accomplished by public fleets of smaller electric vehicles that could fill the kind of gaps in public transport systems that currently exist—a point we return to below.

But it is clearly necessary to distinguish between gaps in public transport that may be intrinsic to systems for technical reasons—for instance, not everyone can have a bus stop at their doorstep—and gaps that are the result of service cuts, underfunding, etc. Gaps of the latter type simply confirm the devastating impact that years of neoliberal policies have had on public services; they reveal nothing about public transport *per se*. Indeed, concerns regarding the need to control and even reduce costs have been magnified by the neoliberal discourse and its concerns to redistribute wealth in an upward direction. A comprehensive U.S. study found that, according to TNC users, as many as one third of rides were due to poor or infrequent public transport services. [246] Had these public transport services been maintained, expanded and improved over the years instead of being starved of resources in the name of austerity, the rise of TNCs could have been significantly curtailed.

A report recently released jointly by UC Davis' Institute of Transportation Studies and the Institute for Transport and Development Policy develops the P3 approach still further, and with an eye on the future. Titled *Three Revolutions in Urban Transport,* the report states, "The world is on the cusp of three revolutions in transportation: vehicle electrification, automation, and widespread shared mobility (sharing of vehicle trips). Separately or together, these revolutions will fundamentally change urban transportation around the world over the next three decades." But without strong policy interventions, the report suggests, these changes could produce a "hell scenario" involving an out-of-control growth in private vehicle use. The report offers projections based on the rapid growth of automated and electric vehicles alongside ride sharing. With the right policies, the "mobility revolution" can, it suggests, be steered in a way that can reduce urban transport emissions by 80 percent by 2050. The report states, "TNCs will never substitute for a robust transit network or compact,

pedestrian-friendly development. However, they can provide safe, reliable, affordable connections to transit, as well as flexibility for more complex trips that require carrying goods, traveling with a companion who has limited mobility, and so on."[247] In other words, the authors assume that TNCs should continue to operate as private entities on a for-profit basis, presumably under contract with public transport authorities, and that this partnership could produce positive social and ecological outcomes.

The problems with this approach should be fairly obvious. Given that in any given city, there is likely to be several TNCs operating at any given time, a public transport authority will need to deal with any number of private TNC "partners." If through a bidding process the number of partner TNCs was reduced to one or two, and these contracts contained what might be termed "mobility service provision agreements," then the public authority would effectively be subsidizing private providers by paying costs incurred by public use of the likes of Uber and Lyft—the very same TNCs that pulled passengers away from public transport in the first place.

The report also urges that priority be given to policies—such as Norway-style subsidies ("purchase incentives") for EVs, public investment in charging stations, etc. Here again, the costs of these investments will be come from the public purse, but at least some of the gains will ultimately accrue to the private manufacturers of the EVs. Who will benefit? Not the public transport system. If EVs become less expensive as a result of purchase incentives and other policy supports, it is likely to lead to an increase in individual vehicle ownership.

Ride Sharing and Enhanced Public Mobility

As noted above, unions have waged a spirited war of resistance against the predatory practices of TNCs like Uber. In many large cities, unions have defended taxi drivers, informal sector workers, and done their best to protect public transport systems.

But there appears to be no compelling reason why unions cannot lead a political effort that goes beyond regulating TNCs—although campaigns of this nature are important and, as we have seen, some have been successful. Such an effort could be built around the need—for social as well as ecological reasons—to incorporate ride-sharing and other "new mobility services" into public transport systems. The app-based or platform technologies that have made ride-hailing and rise-sharing possible, can be harnessed in ways that could make a contribution to improving and expanding public transport and reducing emissions. Traditional public transport modes—buses, trains, etc.—still offer the best returns in terms of social and ecological gains and these should remain at the heart of public mobility in the decades to come. But the struggle to harness app-based and other technologies for the public good can be viewed as an integral part of the struggle to protect, improve, and qualitatively expand traditional modes of public transport—and the need to reduce emissions and protect the climate can be situated at the center of such an effort.

Finding the right balance between traditional modes and the need for low carbon "first- and last-mile mobility" will require consistent input from drivers, riders and the communities they serve. But for "transport democracy" to work effectively, there will probably need to be some recognition of the fact that enhanced public mobility can not become synonymous with personalized "on demand" mo-

bility. However it is configured, without restrictions of some kind this type of mobility risks resulting in an increase in total transport-related energy consumption.[248]

The *Three Revolutions* report is helpful in this respect, as are others that have been written as part of the policy discourse around "sustainable mobility." The report speaks to the need to match service providers with demand, and it notes that one of the key regulatory challenges in the coming years will be to ensure that, "A much larger share of travel [is] provided by more efficient modes (bus and rail systems as well as smaller, right-sized vehicles, whose size better matches travel demand)." Also needed is "a higher average load factor (people per trip), more intense vehicle use, requiring far fewer vehicles to meet passenger travel needs (since personal vehicles currently remain idle 90+% of the time."[249]

Although constrained by a P3 approach that sees a role for private TNCs, the proposals offered are aimed at incorporating shared mobility and automation into public transport systems. Shared mobility—which includes shared vehicle trips as well as public transport modes—"can lead to more efficient use of urban space, reduce traffic congestion, enable more walking and cycling, cut energy use and emissions, and generally improve urban livability." It draws on data from simulations that suggest fully occupied shared vehicles of between 4 and 10 passengers could provide an alternative to both personal vehicles and traditional taxis that are often under-occupied. Car sharing, too, can make a significant contribution to positive social and ecological outcomes in that it "offers a transportation solution for users who don't own a car but would like occasional access to a car for more than a single short trip. Car sharing offers the benefit of serving more people per vehicle than if those people were to use private vehicles, resulting in less need for parking and user cost savings through more efficient vehicle utilization."

Importantly, the report suggests that major travel corridors continue to be served by efficient bus systems such as bus rapid transit, and major cities continue to build rail systems for the busiest travel routes. Furthermore, "smaller buses, with 8-16 seats, grow in number, as these are almost capable of providing point-to-point services and can be summoned – at least to locations nearby specific residences if not to the door. Even with a driver, on-demand small bus and van services provide a very low-cost, convenient travel option for many types of intermediate trips in dense areas. As vehicles become automated, the cost of small-bus travel drops further to become the cheapest per-passenger-kilometer on-demand travel option in the world."

According to *Three Revolutions*, what emerges is "an 'ecosystem' of public transport and ride hailing services that are harmonious and complementary. Small vehicle ride hailing does not displace trips from larger public transport services, except where currently large vehicle public transport is poorly utilized and inappropriate given corridor demand. One result of this ecosystem is significantly higher load factors (average passengers per trip) in all vehicular modes." Sidewalks and bike lanes are added to create continuous networks and ensure maximum safety for these travelers."[250]

Unions (especially those representing public transport workers) would welcome proposals that might improve public mobility in ways that are equitable and less carbon mobility. As noted above, the report's weakness lies in the fact that it assumes that private vehicles can be "replaced with ride hailing of TNC vehicles, shared vehicle trips leading to much higher average vehicle occupancy, and all this coupled with a strong role for public transport and active travel."

But there is no reason that a public transport authority cannot incorporate publicly owned ride-sharing into services a wider system of public transport aimed squarely at the shared public good. Not only would such a system be easier to coordinate, but it would allow public vehicle fleets to be standardized, fully electrified, and charged in public spaces using public charging stations or at a central depot, with (over time) the power coming from a modern grid transmitting and distributing electricity generated by renewable sources of power.

Part Five: Shifting Gears: A Trade Union Agenda for Low-Carbon Public Mobility

As we have seen, progress towards meeting the Paris Climate Agreement targets is badly off track. While the deployment of renewable generation capacity has continued to rise, overall growth in demand is still exceeding new renewable capacity, so that fossil fuel use and emissions continue to rise. For the transport sector, the situation is even more serious, with just 3.1% of energy in the sector coming from renewables, and even that overwhelmingly from biofuels rather than electricity.

This data shines light on an enormous policy failure. As noted above and in other TUED papers, the investor-focused "sticks and carrots" approach to decarbonizing the political economy must go, and a "public goods" approach, anchored in the extension of public ownership and economic democracy, must take its place. As the IPCC notes, meeting the demands established by science "would require rapid, far-reaching and unprecedented changes in all aspects of society," including "transitions in land, energy, industry, buildings, transport, and cities."[251]

Given that blunt assessment from the world's leading scientific body on climate change, it is imperative that unions and their allies face the fact that the dominant market- and investor-focused policy orientation cannot deliver the kind of unprecedented changes the situation demands. That orientation remains captive to the entrenched belief that governments lack the ability to provide the financial resources necessary to address the crisis. Rather than seeing public institutions and services as essential to meeting targets for decarbonization and climate protection, the neoliberal mindset sees the shortcomings in public institutions which it has itself largely caused as an indictment of those institutions rather than of the policies that have undermined them. These institutions and services have been undermined through a lack of resources and degraded in the public mind through political attacks; meanwhile public budgets and public spending have been subjected to restrictions and debt limits that have been designed to prevent the qualitative growth and improvement of vital services like public transport.

The profit imperative taken for granted by the dominant neoliberal policy paradigm stands in the way of reclaiming, expanding and improving public transport systems. As with other sectors, neoliberal policy is inseparably tied to a "full cost-recovery" model. A substantial and growing body of research has documented the chaos such an assumption has wrought in relation to various sectors, including power generation (for instance, at Eskom in South Africa[252]), passenger rail (with Network Rail in the UK[253]), and more—a pattern one researcher has described as based on creating "an illusion of success."[254]

Passenger fares normally only cover a fraction of the costs of building, operating and maintaining public transport systems, and the distance between the revenue (from fares) and system costs appear to be growing.[255] The "full cost recovery" logic of the neoliberal economists encourages transport authorities to raise fares in order to cover costs. Raising fares would stimulate the interest of private investors because strong and steady revenue streams increase the prospect of making profit, but it would merely increase the use of private vehicles and, for those without cars, exacerbate social isolation.

Two-Track Decarbonization: Energy Democracy and Transport Democracy

Transport unions have a visible stake in the struggle for energy democracy and public renewable power. Both the power sector and the transport sector are off track to meet the Paris targets, so the break with neoliberal approaches is essential across these two key sectors, and other sectors also. Both energy and transport must be subjected to more democratic participation and public ownership, so that the decarbonization of both sectors can proceed in a planned and coordinated way. As the International Transport Workers Federation (ITF) notes, the needs for public ownership and transport democracy are intertwined with each other:

> *Decision-making around routes is a political decision based on people's needs rather than private profit. Keeping services in public hands gives government the flexibility to make changes depending on public need – rather than having to pay to update contracts with private companies. Keeping assets and land in public ownership gives us more options and resources for delivering the public transport we'll need.*[256]

To achieve the emissions reductions that are necessary in both power generation and transport will require radical changes in the way electricity is generated, managed and used. Of course, renewable sources will need to be able to generate enough electricity to meet most of our existing needs, but achieving the electrification of transport will require much more electricity. As we have seen, simply replacing internal combustion engine vehicles with individually owned electric vehicles will not deliver the kinds of emissions reductions we need. But the electrification of transport modes (including public buses, trains, and vehicle fleets) is still extremely important, and this "targeted electrification" can be expected to require more electricity. In order to meet climate goals, this will need to be mainly from renewable sources of power.

The Radical Horizon: Fare-Free Public Transport

One of the most provocative directions in which thinking around the future of public transport might take us is towards an embrace of "fare-free public transport," in which riders are able to embark and disembark without paying at the point of service. Although this is a topic that easily deserves a paper of its own, it is worth raising here to ensure that it can be part of discussions regarding public transport and decarbonization, and thus can receive the dedicated attention of unions working in this space, in order to identify and take advantage of its potential to advance our aims, as well as ensuring that any potential pitfalls are recognized and avoided.

Roughly 200 cities around the world currently offer some form of fare-free transit.[257] In some cases, this applies only to certain user groups, in certain parts of the city, or at certain times, but in others the system simply operates as free of fares for all who ride. According to one author:

> *Most of the fare-free systems are in Europe, with 21 in Poland, 20 in France and another 15 elsewhere. Estonia's capital Tallinn, home to about 450,000 people, is the largest city in the world with a fully fare-free transit system. Perhaps surprisingly, the United States has 27 fare-free systems — mostly in small towns and colleges where the cost of fare collection out paces the revenue it raises. There are also 11 fare-free systems in Brazil, two in China and one in Australia.*[258]

Of course, the costs associated with fare free public transit must be covered out of other revenues, whether as part of general government or institutional budgets, or from earmarked revenue streams. Looking at precisely this question, a Montreal-based think tank concluded that making the city's metro buses "fare free" would outweigh the costs, particularly in light of the fact that the city's current set of incentives and provision of public infrastructure mean that car drivers are effectively subsidized "at a rate more than six times higher than someone using public transportation."[259] The ITF notes, "Employers benefit from public transport and can also be made to contribute to it either through a special tax or by making them responsible for subsidising their employees' transport routes."[260]

The ITF has also recognized that systems of fare-free public transport could have a place in some contexts:

> *Quality public transport encourages people to get out of their cars or stop driving altogether. In order to make public transport attractive, fares should also be kept low, with free public transport a possible option.... With free fares, public transport is no longer seen as a commodity, but as a common good similar to many other public services, such as parks, cycling paths, streetlights, libraries, health and education.*[261]

The issue of fare-free public transport deserves further investigation, as does its place in progressive trade union climate policy. The ITF's highlighting of this issue can serve as a useful focal point for taking such an investigation forward.

Public Transport as Part of a Whole-Economy Vision for Climate Protection

As noted above, the ITF has developed a "whole economy" approach to reducing emissions in the transport sector with a strong emphasis on the need to expand public transport.[262] The fight for public transport has to be rooted in the recognition that profound changes are necessary at the level of the global political economy.

Taking a whole economy approach also provides us with an opportunity to advance an expansive, hopeful vision of the future, one that has the potential to bring a much wider range of social forces into these struggles.

Informed by this "whole economy" approach to addressing transport-related emissions, following are some ideas that unions may find useful in further developing or refining their concrete policy positions and programs for action.

Transport Democracy and the Green New Deal

The struggle for public transport can play a major role in both tackling the climate challenge while simultaneously helping to make our cities safer, cleaner, healthier, and more interesting and enjoyable places to be. Given the nature and scale of change needed, and given the fact that such change

seems highly unlikely except as the result of organized, dedicated mass action involving a wide range of social forces, with substantial participation by unions. It is therefore vital that unions take up the struggle for public transport and "transport democracy" just as unions are becoming increasingly engaged in the struggle for energy democracy.

The current proposal for a "Green New Deal" (GND) in the United States has intensified debates around climate policy, jobs, social justice, and even socialism. This has also helped sharpen political debates around similar ideas in Australia, the UK, South Africa and elsewhere. On transport in particular, the GND's draft language includes a call to transform transportation systems in the U.S. in order to "eliminate pollution and greenhouse gas emissions from the transport sector as much as is technologically feasible, including through investment in zero-emission vehicle infrastructure and manufacturing; clean, affordable and accessible public transportation; and high-speed rail."[263] While such language obviously leaves many important questions unresolved, it opens important space that transport and other unions can and should be collaborating to take up and address in ways that can help tackle the climate crisis while also helping to defend and grow the labor movement.

Make Public Transport a Social and Ecological Priority

There needs to be more and better public transport, especially in the burgeoning cities in the global South. According to the World Bank's *Global Mobility Report 2017*, "The growth in urban populations has outpaced these developments. As a result, the overall level of public transport supply per capita decreased over the observed time frame."[264] But more investment is also needed in the developed world, where ridership is growing and per capita car ownership among certain groups are falling. Cities like New York and Seattle have shown that investing modern and efficient public transport systems can both boost ridership and reduce vehicle miles travelled (VMTs).[265]

Currently there is a gap between current and projected investments and the levels of investment needed in order for transport to become part of a low-carbon future. "The approach adopted so far," says the World Bank's "Sustainable Mobility for All" consortium, "has failed to bring the necessary scale of action and financing to unify and transform the sector."[266] This problem must be addressed.

Say No to "Public Private Partnerships" (P3s)

While more public investment needs to be devoted to public transport in order for it to meet rising social and ecological needs, there is a need to bring to an end the policy fixation with P3s—a fixation that is shared by many organizations involved in the fight for "sustainable mobility." P3s raise costs for governments and consumers. They introduce the requirement for profit, entail higher borrowing, transaction and competition costs and can often result in higher prices for those using the service.

Private investors are "risk averse" and concerned about revenue streams and returns on investment. The needs of the public, and the environment, have little or no effect on investment decisions that see profit as the primary objective. As this has become increasingly obvious, a growing number of local governments are bringing formerly privatized public services back "in house."[267]

Attempts to reduce the risks of investors through P3s in the hope that investment will follow revenue and profit "certainties" have failed. The idea that government funds will "unlock" large amounts of

private investment capital has also been discredited. Today, most public transport infrastructure is funded by traditional public sources. P3s have only generated a small percentage of the capital invested in transport projects, and these are often "megaprojects" that serve interests of large corporate interests targeting the transport needs of the wealthier classes.

One of the myths surrounding P3s is that private investors have a lot of available money to invest and governments, in contrast, are short of cash. But where private sector actors have invested in transport, they have in most instances resorted to "debt financing," taking out commercial bank loans and, to a much more limited extent, raising capital through bond markets. Government entities can also use debt financing, and at lower borrowing rates. This kind of financing is where most public services came from in the first place.

Advocate a Public Goods Approach to Investing in Public Transport

Achieving the kind of ambitious commitments to sustainable mobility and low carbon transport made in numerous high-level global declarations and statements will be contingent upon the capacity to generate sufficient resources. Currently, a major obstacle to the qualitative expansion of public transport is the widespread perception that governments have limited financial capacities and thus there is a need to "mobilize private sector investment." These two perceptions have become the first and final word for the transport policy mainstream. Thus, the prospects for a qualitative expansion of public transport and the determined pursuit of sustainable mobility will largely depend challenging these perceptions and re-asserting pro-public and non-profit alternatives.

The upfront costs for public transport systems can be considerable, but the social and economic benefits of public transport far outweigh the costs. Improvements in public health, shortened commuter times, etc., will raise productivity and improve the quality of life for many millions of people. According to the IMF, total government investment in transport currently stands at about six percent of total government spending. In 2010 (the most recent data available), this amounted to an estimated $569 billion to $905 billion in public spending. An additional one percent budgetary commitment on the part of governments could generate an addition $100 billion to $150 billion annually, and these funds could be dedicated towards public transport specifically. This extra investment would pay for itself many times over in the form of improved productivity, better public health, and a growth in decent transport-related jobs. But investing more in public transport will reduce the need for other forms of transport-related investments (such as new roads, car parks, etc.).[268] Given the threat posed by climate change, the costs of *not* investing more in public transport are likely to be too high to contemplate.

However, it is crucially important that any proposed public transport projects be subjected to community and worker review in order to improve their design, ensure a quality service and to control costs, and to strike the best possible balance between levels of passenger demand and the availability of the specific service.[269] This approach will help ensure that the impact of additional government resources is fully maximized.

Advocate for Additional Climate Finance for Public Transport

Discussions on climate finance are currently disproportionate to the amount of finance generated, and transport unions operating at the global level can call on global institutions (including the de-

velopment banks) to help countries that want to develop modern public transport systems. Rich governments should end their foot-dragging approach to climate finance and throw their political weight behind public transport as a climate solution.

This will require close coordination with calls for increased finance to support decarbonization of power generation in particular, but also other sectors where investment in decarbonization is required. Where it can be pursued, reversing privatization and expanding public ownership can help hold down borrowing costs and eliminate the requirement to generate profits, allowing available climate finance to achieve more for less.

Support the Electrification of Public Fleets and Transport Modes

Electric vehicles using renewable energy could make an important contribution to emissions reductions, but policies should drive the electrification of public fleets, such as postal service and police vehicles, school buses, as well as Bus Rapid Transit (BRT) services.

Buses currently account for 50-60 percent of the total public transport on offer in Europe, but 95 percent of these still use diesel fuels. The electrification of buses should therefore be a top priority, as is expanding their use. More than 99 percent of the world's electric buses are in China (345,000), and China is also the world leader in sales of two-wheeled EVs, with sales for 2016 estimated at 26 million units.[270] Policies supporting electrification of buses and two-wheeled EVs need to be examined and, where appropriate, replicated.

Rail transport in urban areas already runs almost exclusively on electricity. In the last decade, passenger rail transport has decreased its specific energy consumption by 22 percent.[271] Electrification of buses could produce similar outcomes.

There will also be a role for EVs in app-driven cars escorting passengers to and from public transport hubs when these are located more than a certain distance away from departure points. But these vehicles should be part of municipal or communally owned fleets. Standardization of vehicles in fleets also provides opportunities for economies of scale, easier maintenance (since you do not have to stock parts for multiple models of vehicles, etc.).

Demand a Just Transition for Transport Workers

Led by the International Trade Union Confederation (ITUC), unions succeeded in getting the phrase "Just Transition" into the preamble to the Paris Climate Agreement. The text affirmed "the imperatives of a just transition of the workforce and the creation of decent work and quality jobs in accordance with nationally defined development priorities."[272]

A sound trade union strategy for achieving democratized, sustainable mobility for all must of course prioritize a just transition for workers who will be displaced by the changes needed. This will include up-stream changes in the fossil fuel industries, informal transport workers, and more.

It will also require a strategy in relation to drivers for Uber, Lyft, and other TNC companies. In the short term, existing TNC drivers that have purchased vehicles and gone into debt in the hope of

making a steady income can be urged to register for a position as a public shared mobility driver. A public transport authority can begin to employ drivers working for TNCs in order to staff public fleets of electric minibuses. These workers could be extended the same rights and protections as public transport workers.

Given the explosive growth of TNCs, it will not be easy to absorb what could, in any given large city, be tens of thousands of former TNC drivers into the public system. But governments that allowed TNCs to proliferate cannot turn their back on these drivers and winning their support for transport democracy is critically important.

Advocate for Less Private Vehicle Traffic in Urban Areas

Rising private vehicle ownership currently poses a major challenge to the fight against transport-related emissions and climate change. Robust policies are needed to curtail private vehicles in public spaces. This is needed to reduce emissions and congestion, and to create space (both economic and physical) for the growth of modern public transit systems. In the words of the Institute for Transportation and Development Policy (ITDP), "Reducing private car use not only requires improvements in public transit, cycling, and walking facilities, but also better management of private automobile use."[273]

Major cities in OECD countries around the world have had success with policies ranging from banning diesel cars and enforcing congestion charges, to no-car zones, bike paths and bike sharing. These interventions have contributed to either lower car ownership or fewer VMTs.[274] The experiences in OECD countries are generating a growing body of knowledge and lessons that can be drawn upon in formulating policy agendas and demands in other places. In particular, bold policies are needed to reverse the global proliferation of SUVs.

Push for Community Controlled "ZipCars" and Bike Sharing

In the context of strict limits on private vehicle ownership, public authorities can establish public car sharing services. A managed "public goods" approach to car sharing could complement and help grow public transport rather than compete with it.[275] If properly integrated into an overall public transport system, "Zipcars" and similar managed fleets of shared vehicles can likely make a contribution to reducing emissions, and if these fleets were powered by renewable energy, their contribution to climate protection would increase still further.[276]

Such results suggest that a managed approach to car sharing that removed commercial imperatives, and that was designed to complement and help expand public transport could play a crucial role in decarbonizing transport and reaching climate targets. Standardization of fleet vehicles also brings potentially considerable economies of scale in production and maintenance. Less congestion also creates space for "net zero" vehicles to meet the mobility needs of elderly or physically challenged people.

Make Data-Driven "New Mobility Services" Part of Public Transport

The explosion of communications technologies has seen a sharp rise in "shared mobility" and "new mobility services" (particularly ride-hailing). New companies like Uber, Lyft, Car2Go, and others have

emerged. Policy makers have generally succumbed to the incursions of these new platform-based companies, or have proposed a P3 approach that gives these companies even more economic space and profits.[277]

The full range of emerging shared mobility services should be considered for inclusion into a new vision of decarbonized public urban electromobility. "Demand responsive" new mobility services can be integrated into urban transportation systems. The communications technologies that provided the foundation for these services were almost invariably created as the result of public projects, and this should be part of the argument for treating such services as public. Travel data should be part of "the commons" and managed by communities and serve the public good.

Currently ride hailing companies are having a predatory effect on public transport systems, and often increase congestion and emissions. They also erode the living standards and quality of life of taxi drivers. App-driven shared vehicle services like Uber and Lyft have been identified as a contributing factor in several recent taxi-driver suicides in New York City.[278]

But reclaiming of public, democratic control is just the first step towards finding ways in which to make ride-hailing a viable part of public transport. Likely more difficult will be to determine the collection of policies that will be necessary to balance flexibility and on-demand convenience for individuals-as-riders with the minimization of traffic congestion and energy demand on the transport and supporting systems as a whole. This will be especially necessary during the period in which there is a need to urgently reduce emissions and demand for energy while the renewable generation capacity and supporting transmission, storage and distribution infrastructure are scaled up. It may well be that at some point in the future humanity will be able to "afford" a very high degree of on-demand convenience for human and freight mobility—there is, after all, many times more energy than humanity could likely ever use arriving in the form of solar radiation on an ongoing basis—but we should not assume that this can be provided during a period of transition that requires to be treated as an emergency.

Setting up the kind of public app-based platform such as those used by Uber and Lyft requires skills and some degree of experience. Some public transport authorities and traditional taxi companies are already playing catch up in this respect. It is likely that many public transport authorities do not currently have the capacity to create their own platforms at this time, but this could change quite quickly with a targeted commitment of resources. This could be expedited at the level of government ministries, and a standard version can be customized for individual towns and cities.

The case for enhanced public mobility can be made stronger by pointing out that the roads and satellites that TNCs have "occupied" were paid for by public funds. The data that TNCs claim to own would not have been generated without public satellites, and many TNC users were until recently unaware that such stores of data even existed. Public transport authorities have the capability of generating and storing passenger data as a means of improving service, and many of them are probably already doing so. But TNCs should be required to release existing stores of data so that public transport systems can be further improved.

Strict regulations requiring (over time) the electrification of private delivery services is also an important policy option, especially given the rise of home delivery retail systems such as Amazon. However, delivery services should be subjected to intense social scrutiny in order to assess their impact on

emissions, high street retail outlets, and the possible erosion of "social capital."
Meanwhile, subsidizing the purchase of private electric vehicles is not a good use of public funds; instead the tax revenues from sales of private vehicles should be redirected towards public transport. Given the many social, economic and environmental benefits, not to mention the urgency and necessity of responding effectively to the climate emergency, a "public goods" approach is fully justified.

Developing the infrastructure and inputs needed to develop public transport will create jobs. For example, large numbers of charging stations will be needed, and these should be public and their deployment should be subjected to community-level control. Essential electric vehicles need to be charged in a way that does not restrict access.

If supplemented by "first and last mile" public mobility services (also free) where appropriate—for instance, to connect suburban commuters to public transport—the environmental, social and economic gains could be very considerable. When workers pay for public transport in order to get to their place of work, this is effectively a subsidy to their employer—one paid for in part by the workers themselves.

The potential advantages of such systems are many, ranging across: improved performance in the form of reduced route times, due to less time required for payments; greater accessibility for lower-income groups; even reduced passenger aggression.[279] Such a change can also introduce challenges, including for instance the potential need for additional vehicles if usage increases to the point that crowding becomes a problem. But these hardly seem insurmountable in the face of a global ecological crisis that must be solved. There are no electric buses on a dead planet, after all, and the trains do not run on time.

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