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Controlling Greenhouse Gas Emissions Generated by the Transport Sector in ECA: Policy Options

Carolina Monsalve

Safe, Clean, Affordable
TRANSPORT

CONTROLLING GREENHOUSE GAS EMISSIONS GENERATED BY THE TRANSPORT SECTOR IN ECA: POLICY OPTIONS

Carolina Monsalve

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CONTENTS

1. Introduction 1
2. Transport and Greenhouse Gas Emission Trends in the ECA Region 5
3. Climate Friendly Transport Sector Policies in ECA 13
3.1. Road Pricing Instruments 14
3.2. Regulation and Technology 25
3.3. Urban Form and Transport 28
3.4. Rail Transport 31
3.5. Air Transport 35
4. Land Transport Success Stories 39
4.1. The Case of Singapore 39
4.2. Transalpine Rail Transport in Switzerland 41
4.3. Eroding Air Transport's Modal Share: High Speed Trains (HST) in Europe 42
5. Pricing Policy Instruments: How to Use the Revenue? 39
6. Conclusions 49
References 53

List of Figures

Figure 1: Transport Sector CO_2 Emissions (million tons) 6
Figure 2: Transport Sector CO_2 Emissions 6
Figure 3: Top 4 Transport CO_2 Emitters in ECA (percentages, 2008) 7
Figure 4: Road Emissions as Percentage of Transport Sector CO_2 Emissions in ECA (2000=100) 7
Figure 5: Increase in Passenger Vehicle Registration, 2000-2008 (percentages) 7
Figure 6: Motorization Rate – Number of Passenger Vehicles per Thousand (2000-2008) 7
Figure 7: Growth in Road CO_2 Emissions by Country, 2000-2008 (percentages) 8
Figure 8: ECA Transport Sector CO_2 Emissions by Country 8
Figure 9: ECA Motorization Rates and Nominal GDP per Capita (in units indicated) 9
Figure 10: Land Modal Split for Freight Transport, 2000-2008 (percentages) 9
Figure 11: Air Transport GHG Emissions, 2000-2009 (CO_2 equivalent, '000 tons) 10
Figure 12: Retail Price of Gasoline in mid-November 2010 (US cents per liter) 16
Figure 13: Daily Parking Rate (US dollars) 23
Figure 14: Electrification Rate of Rail Network, 2010 (percentages) 32
Figure 15: Freight Modal Split in Switzerland (percentages) 42
Figure 16: High Speed Lines in Europe in Operation, 2011 (in km) 43
Figure 17: High Speed Lines in Europe under Construction, 2011 (in km) 43

List of Tables

Table 1: Low Carbon Scenario Policy Measures for Poland 51

List of Boxes

Box 1: A Typology of Road Charging Principles 17
Box 2: How the Vignette Works in Austria 19
Box 3: Financing Greater Paris Public Transport through the Versement Transport 21
Box 4: Growth of Poland's Suburbs 30
Box 5: The Case of Turkish Railways (TCDD) 33
Box 6: Reducing Emissions from Air Transport – The Case of the UK 37

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1 INTRODUCTION

Greenhouse gas emissions (GHG) generated from transport are among the fastest growing in Europe and in the Europe and Central Asia (ECA) region, posing a challenge in creating a low-carbon future, as economic development has been paralleled with a modal share increasingly dominated by roads.[1] This modal shift, as in the European Union (EU), has been driven by a number of factors, including growing affluence, suburbanization, and falling land use densities in urban areas, which have translated into more widespread vehicle ownership, increasing trip numbers and lengths, while reducing the financial viability of public transport and non-motorized transport. On the freight transport front, while a number of ECA countries had relatively high rates of rail modal share, these have generally been declining and have been approaching EU levels. Thus, ECA is moving toward EU motorization rates for passenger transport—with much higher GHG growth than in the EU-27, although overall levels remain lower—while trucks are making significant inroads vis-à-vis rail.[2] Without any changes to transport policy, these trends in ECA are likely to continue unabated in the next decades.

Transport is a key facilitator of economic well-being worldwide and is likely to continue to grow to meet increasing demand for transport in ECA. Decoupling GHG emissions from the transport sector and economic growth or at least lowering the GHG intensity of future transport growth represents the key challenge and will require departure from the "business as usual" policies in the transport sector.[3] As noted in the EU's 2011 White Paper on transport, the main issue facing the transport sector is how to reduce the system's dependence on oil without sacrificing efficiency and compromising mobility—curbing mobility is not an option, neither for the EU nor ECA.[4] The World Bank's own climate change strategy for the transport sector adopts a similar approach, arguing that climate change mitigation in the transport sector has to be seen in a broader context: sustainable transport

[1] In the case of the EU-27 in 2007 CO2 emissions from the transport sector accounted for 25.1 percent of the total, up from 18.1 percent in 1990. Projections from the European Environment Agency estimate that the sector's emissions will increase by 25 percent over 1990-2020, whereas they are expected to decline from industrial and energy sectors. The ECA region includes Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Croatia, Czech Republic, Estonia, Georgia, Hungary, Kazakhstan, Kosovo, Kyrgyzstan, Latvia, Lithuania, Moldova, Montenegro, Poland, Romania, the Russian Federation, Slovakia, Tajikistan, Turkey, Turkmenistan, Ukraine, and Uzbekistan.

[2] The EU-27 includes Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and the United Kingdom.

[3] OECD/International Transport Forum (2008), *Greenhouse Gas Reduction Strategies in the Transport Sector*. Preliminary Report. Paris: OECD/International Transport Forum.

[4] European Commission (2011*), White Paper: Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system*. Brussels, March 28, 2011, COM (2011) 144 final.

should limit GHG emissions from transport and minimize other externalities, without compromising economic growth.[5]

Concerns about climate change are not likely to be the key driver of transport policies in developing countries, whether in ECA or elsewhere. Instead local co-benefits—such as reduced traffic congestion, improved air quality, or enhanced energy security—are much more likely to drive the development of transport policies.[6] This is the same argument recently put forward in the World Bank's transport climate change strategy: attempting to sell measures to reduce GHG by marketing them as policies aimed at other social costs of transport can be much more attractive to policy-makers, who may not be concerned about climate change or who cannot gain political traction for policies if they are sold to the public exclusively from a climate change angle.[7] Looking at congestion levels in a city like Moscow, and trends toward increased motorization—the number of vehicles has risen since 1990 from 400,000 to 4 million—the issue is as much a classic problem of transport and urban planning as it is a GHG emission problem. In the words of the new mayor of Moscow, the fight against congestion is his major task as the city administrator, an indication of how co-benefits can motivate discussions on improved transport policies which are also GHG friendly policies.

The financing of the transport sector needs to be supported by adequate pricing policies, which can help change existing behavior and thus transport demand, allocate resources more efficiently, and raise funds to invest in more sustainable forms of transport. This means interlocking discussions about financing of transport infrastructure with pricing, as adequate financing needs to be supported by sound pricing policies. However, at present pricing does not reflect the full costs of transport, including costs of negative externalities, while investments in ECA, as in many other regions, are heavily focused on enhancing road capacity and provide policy that is predicated on ever growing vehicle ownership and usage. Changing current pricing to a socially equitable system would require the adoption of the user pays principle, including the costs of congestion, accidents, infrastructure wear and tear, noise and air pollution, not to speak of GHG emissions. Where fuel subsidies exist these should be removed as they distort modal choice and trip frequency. Innovative pricing mechanisms are ones where governments often express considerable interest, given the need to finance new transport infrastructure or upgrade existing infrastructure. Introduction of road tolling can lead to important changes in the relative price of using the road network, both inside and outside urban areas, and can be an attractive policy option for officials searching to obtain funding to finance infrastructure investments; potential co-benefits include reduced congestion and GHG emissions.

[5] World Bank (2012), *Turning the Right Corner: Ensuring Development Through a Low-carbon Transport Sector (conference edition)*. Transport, Water and Information and Communication Technology Department. Washington D.C.: World Bank. Available at: http://siteresources.worldbank.org/INTTRANSPORT/Resources/336291-1227561426235/Turning-the-Right-Corner.pdf

[6] James Leather and the Clean Air Initiative for Asian Cities Center Team (2009), *Rethinking Transport and Climate Change*, Asian Development Bank Sustainable Development Working Paper Series No.10, December 2009. Available at: http://www.adb.org/sites/default/files/pub/2009/ADB-WP10-Rethinking-Transport-Climate-Change.pdf

[7] One of the barriers to the use of a co-benefit approach to climate change is the cost and time it takes to measure co-benefits in a transport project, vis-à-vis the direct benefits.

This paper begins by reviewing recent trends in transport and GHG emission trends in the ECA region, using trends in the EU-15 and EU-27 as comparators.[8] Subsequently, it will provide an overview of climate friendly transport policies for the road, rail, and air transport modes, before presenting some land transport success stories and then turning to a discussion on how to use revenues generated from pricing policy instruments. The objective is to provide a menu of policy options to improve the functioning of the transport sector in ECA, while addressing the externalities generated by the sector.

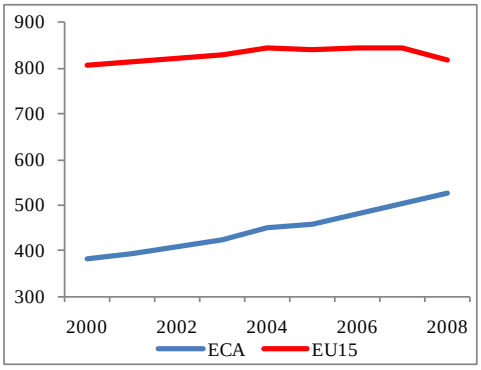
[8] The EU-15 countries include Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden and the United Kingdom. The EU-12 countries include more recent member states: Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Slovenia. All are part of the ECA region, with the exception of Cyprus and Malta.

2 TRANSPORT AND GREENHOUSE GAS EMISSION TRENDS IN THE ECA REGION

Transport sector carbon dioxide (CO_2) emissions generated in ECA are a fraction of EU-15 emissions, but they are rising fast. Whereas in 2000 emissions from the transport sector in ECA were equivalent to 47 percent of EU-15 emissions, this rose to 64 percent by 2008 (Figure 1). CO_2 emissions from the transport sector in ECA are on a rising trend and with a business as usual scenario one would expect the rising trend to continue in the coming decade (Figure 2). Emissions are heavily concentrated in just a few countries: the Russian Federation generates 48 percent of CO_2 emissions from the transport sector, followed by Turkey, Poland, and Ukraine (Figure 3). With four countries accounting for 62 percent of emissions, and particularly with the Russian Federation generating nearly half of ECA transport emissions, from a regional perspective, actions in these four countries to reduce transport generated GHG emissions, or limit their growth are critical to contain regional level emissions. Not surprisingly, road emissions represent the largest contributor to transport sector emissions, exceeding 70 percent (Figure 4). However, data from the EU-27 suggest that the fastest growing emissions come from air transport, a trend that is likely to be replicated in the ECA region as a whole in the future.

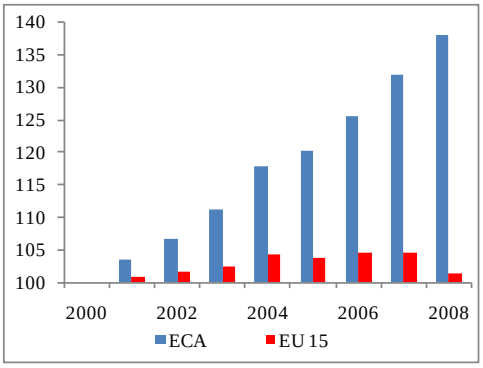
The large increase in transport emissions in ECA is being driven by growth in road transport demand. Figure 5 charts the increase in passenger vehicle registration among the top three ECA emitters— the Russian Federation, Turkey, and Poland—over 2000-2008 and compares this to EU-12, EU-15, and EU-27. For the Russian Federation, Turkey, and Poland passenger vehicle registration has grown dramatically this decade, exceeding 50 percent, and the new EU member states are not far behind with 43 percent growth; this contrasts with the 13 percent growth rate for the EU-15 countries. High growth reflects large discrepancies in motorization rates: 352 vehicles per thousand population in EU-12 in 2008, compared to 501 for EU-15; the motorization rates are much lower in the majority of ECA countries which are not part of the EU. In the case of Turkey the motorization rate is only 95 per thousand population, although rising rapidly. Figure 7 presents data on the growth of CO_2 road emissions by country in ECA, while Figure 8 presents transport sector emissions by country. Growth rates of road transport CO_2 emissions vary widely—from negative values to triple digit growth over 2000-08—while transport sector emissions reveal wide dispersion reflecting in part the size of countries, structure of economy, and level of development.

FIGURE 1: TRANSPORT SECTOR CO_2 EMISSIONS (MILLION TONS)



Source: OECD.

FIGURE 2: TRANSPORT SECTOR CO_2 EMISSIONS

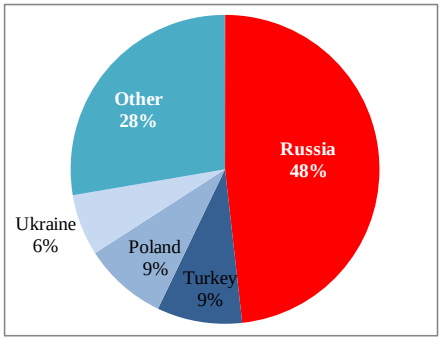


Source: OECD.

There is a close correlation between per capita income and motorization rates in ECA, as elsewhere. Figure 9 plots the motorization rate for countries in the ECA region against GDP per capita—the correlation between the two is equal to 86 percent, which is a close association. This is particularly worrying, because it suggests that demand for mobility has for the most part translated into increased purchase and usage of passenger vehicles and that the future holds inexorable and rapid motorization rate increases. However, in practice the picture may be more nuanced. If we take some of the G-7 economies, such as Canada, France, Germany, Italy, and the UK, with broadly comparable GDP per capita—between US$38,000 and US$45,987 in 2008—the motorization rates vary from a low of 399 for Canada to a high of 596 for Italy, suggesting a large role for country specific factors and a role for transport policies. Going forward, unless policy measures are adopted to make owning and using a vehicle more costly, the trend is likely to be one of accelerating passenger vehicle ownership/registration and road sector emissions.

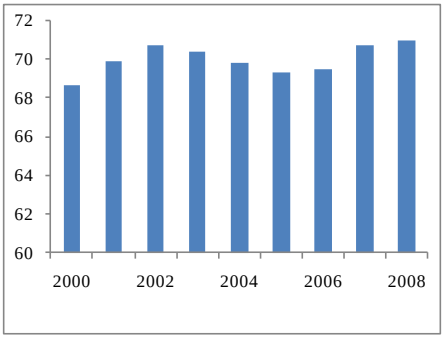
Vehicles are taking an increasing share of the passenger modal split. Vehicle passenger trips, in million kilometers, among the EU-12 have risen from 68 percent in 2000 to 77 percent in 2008, with passenger rail transport halving from 13 to 6 percent and the share of bus and coach rides falling from 22 percent to 14 percent over the same period. In the case of Poland the modal share of passenger vehicle trips has been rising from 65 percent in 2000 to 85 percent in 2008, while for Turkey vehicle trips have risen from 35 percent to 50 percent over the same period. If such trends continue, in a business as usual scenario, it will be extremely difficult to slow down CO_2 emissions growth in the coming decade.

FIGURE 3: TOP 4 TRANSPORT CO_2 EMITTERS IN ECA (PERCENTAGES, 2008)



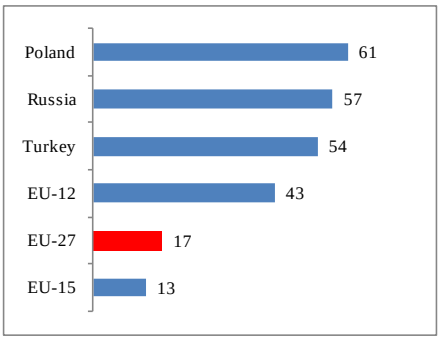
Source: OECD.

FIGURE 4: ROAD EMISSIONS AS PERCENTAGE OF TRANSPORT SECTOR CO_2 EMISSIONS IN ECA (2000=100)



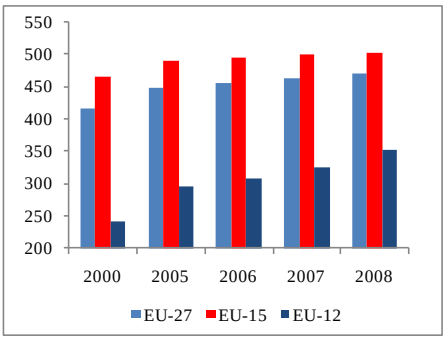
Source: OECD.

FIGURE 5: INCREASE IN PASSENGER VEHICLE REGISTRATION, 2000-2008 (PERCENTAGES)



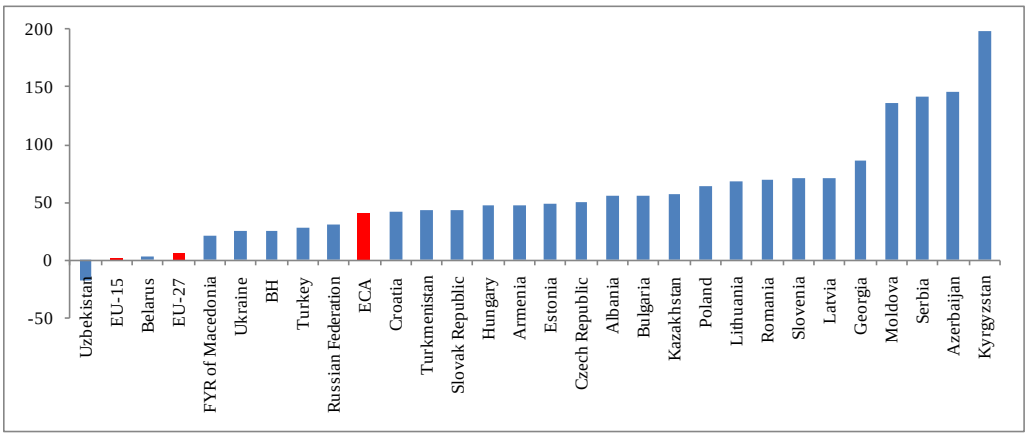
Source: European Commission, Statistical Pocketbook 2010.

FIGURE 6: MOTORIZATION RATE - NUMBER OF PASSENGER VEHICLES PER THOUSAND (2000-2008)



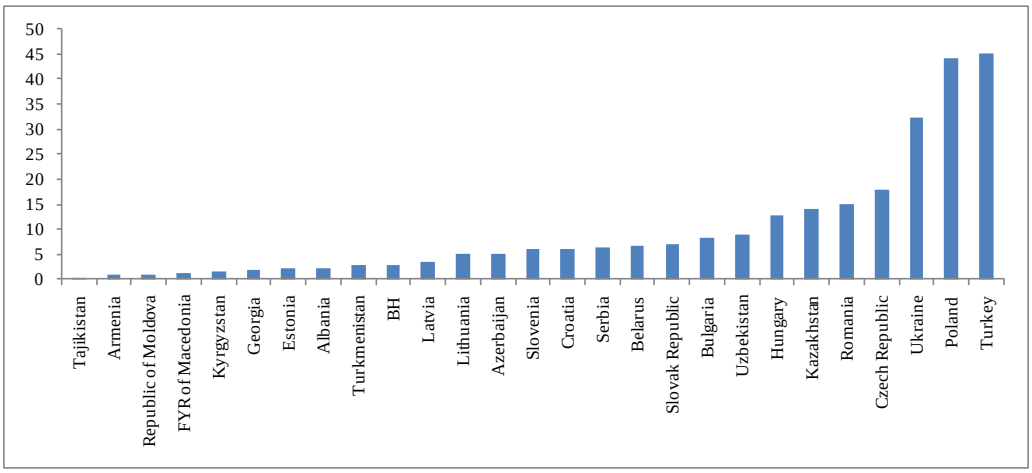
Source: European Commission, Statistical Pocketbook 2010.

FIGURE 7: GROWTH IN ROAD CO_2 EMISSIONS BY COUNTRY, 2000-08 (PERCENTAGES)



Note: Tajikistan excluded from the chart, with emissions growth of 600 percent.
Source: OECD.

FIGURE 8: ECA TRANSPORT SECTOR CO_2 EMISSIONS BY COUNTRY

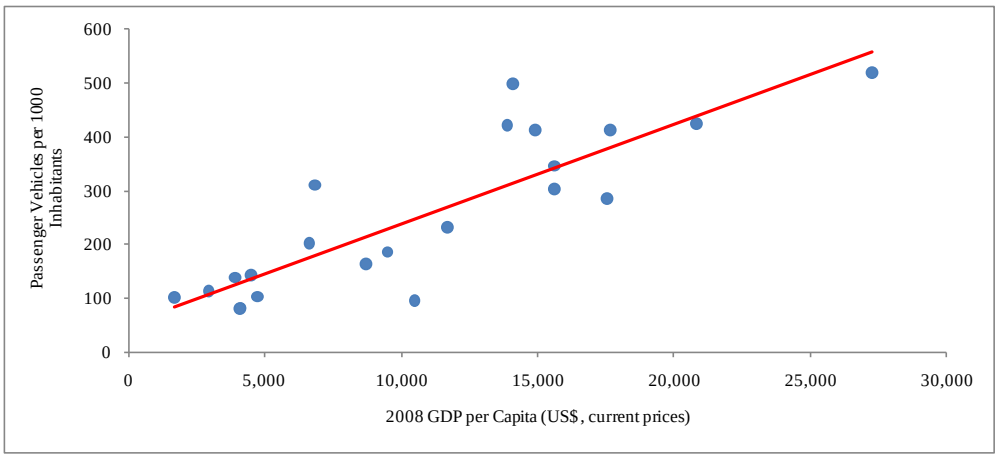


Note: Excludes the Russian Federation, whose emissions total 243 million tons.
Source: OECD.

There have been significant changes in the modal split of freight transport services in a number of ECA countries. Among the EU-12, rail freight transport has seen a sharp decline, with the share of traffic declining from 43 percent in 2000 to 26 percent in 2008, paralleled by a rise in road freight transport from 55 to 71 percent over the period—Poland had a decline in the modal share of rail from 57 to 26 percent over 2000-08. In the case of the Russian Federation, the largest GHG emitter in the region, the modal share of rail has remained largely unchanged, from 15 percent in 2000 to 16 percent in 2008, while for Turkey the modal share of freight is very small, at 5 percent in 2008, down from 6 percent in 2000. While for a number of ECA countries the modal share of rail freight transport remains higher than for the EU-15, the fact remains that the gap is narrowing, and that for the

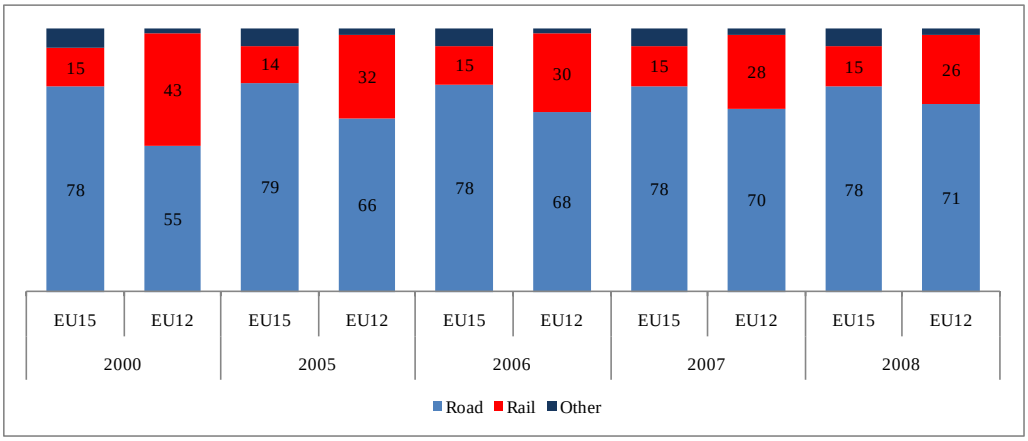
largest emitters rail carries relatively low levels of freight, with the exception of Poland.

FIGURE 9: ECA MOTORIZATION RATES AND NOMINAL GDP PER CAPITA, (IN UNITS INDICATED)



Sources: UNECE, IMF.

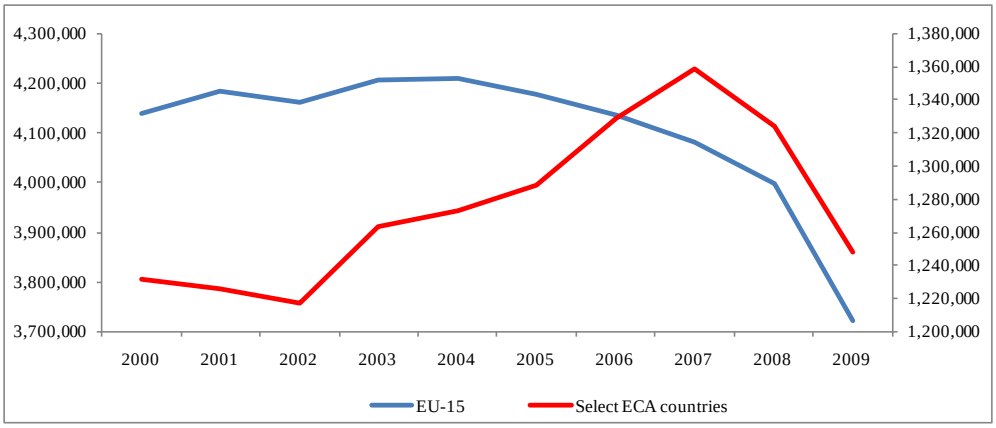
FIGURE 10: LAND MODAL SPLIT FOR FREIGHT TRANSPORT, 2000-2008 (PERCENTAGES)



Note: Modal shares based on road, rail, and inland waterway transport services.
Source: European Commission, Statistical Pocketbook 2010.

EU-27 air transport CO_2 emissions have risen from 8.8 percent of total transport emissions in 1990 to 12.5 percent by 2007 and are the fastest growing source of emissions in the sector.[9] The situation in ECA varies by country, with air transport emissions accounting for only 3.5 percent of the total in Poland, compared to 11.9 percent in Turkey. However, future emissions from aircraft are expected to increase more rapidly than transport emissions in general, due to projected high aviation growth and the continued strength of low cost airlines. To date, the energy efficiency of the aviation system has not kept pace with the growth of the sector and unlike other transport modes GHG emissions vary considerably according to distance, since the largest emissions occur at take-off. In contrast to land transport modes, the impact of aviation is also compounded by the fact GHG emissions are released directly into the atmosphere.[10] Prior to the international economic crisis which started in 2008, air transport emissions were going down in EU-15 countries, whereas they have been rising sharply among the ECA EU member states and Turkey over 2002-2007 (Figure 11). Controlling the growth of air transport emissions in the EU-27 will require slowing growth among the new EU member states, including ECA EU member states.

FIGURE 11: AIR TRANSPORT GHG EMISSIONS, 2000-2009 (CO_2 EQUIVALENT, '000 TONS)



Note: Select ECA countries include ECA EU member states plus Turkey.
Source: Eurostat.

The data presented above on CO_2 and GHG emissions from transport is based on fuel consumption and thus a top-down approach. There is no one-to-one correspondence between changes in fuel and changes in transport activity—within road transport there is no official breakdown of fuel use by vehicle type and not all countries in the region publish data on vehicle-km or passenger-km. In the case of the Russian Federation, it does not publish road passenger-km data in its official transport statistics, only a modal split breakdown by public transport mode, which excludes the largest element. This is somewhat less of a problem for rail and air

[9] At high altitudes flown by large jet airliners emissions of NO_x are particularly effective in forming ozone. High altitude NO_x emissions result in greater concentrations of O_3 than surface NO_x emissions, and these in turn have a greater global warming effect.
[10] David Ross (2009), GHG Emissions Resulting from Aircraft Travel. Carbon Planet. Available at: http://www.carbonplanet.com/downloads/Flight_Calculator_Information_v9.2.pdf

transport. Measuring, modeling and estimating the overall impact of transport mitigation policies represents an important objective if such policies are to be assessed in terms of their efficacy. For example, measuring vehicle fuel economy, defined as km traveled per liter of fuel consumed is often a target of policies, requires measuring fuel consumed for each type of vehicle-fuel combination—whether diesel, gasoline, natural gas—something which is not currently available in most ECA countries. In contrast, in a bottom-up framework, measuring emissions from road transport would require information on (a) the stock of vehicles by fuel type and vehicle type; (b) average annual number of km travelled for each vehicle type; and (c) passenger and ton-km produced by each mode.[11] Developing baseline CO_2 and GHG emissions data from the transport sector will be critical for measuring the impact of mitigation policies—the international financial institutions have a clear role to play in this important area.[12]

[11] Asian Development Bank (2009), Technical Note on Transportation and CO2 Emissions: Folding Them into a Unified View for Forecasts, Options Analysis and Evaluation.

[12] The World Bank Latin America and the Caribbean Region Sustainable Development Department Transport Cluster in conjunction with the World Bank's Environment-Climate Change (ENV-CC) Department sponsored the development of the Transport Activity Measurement Toolkit (TAMT), an open-source toolkit to process GPS log files for vehicle emissions drive cycle calculations to support GHG emission modeling for on-road transport. It provides a framework that helps local institutions to collect high quality, low cost, vehicle activity data in a simplified standardized manner. Further information can be found at http://code.google.com/p/tamt/.

3 CLIMATE FRIENDLY TRANSPORT SECTOR POLICIES IN ECA

A comprehensive approach for addressing climate action in the transport sector in ECA needs to be seen within a framework that factors in broader considerations such as economic growth, as well as public finance and social impacts. It is clear that mitigation policies cannot come at the expense of economic growth, but must be supportive of economic growth and development, if they are to gain social and political acceptability. Mitigation policies also need to be seen within a broader context of co-benefits and "packaged" in a manner that reduces opposition. Poor air quality or high levels of congestion in a city can prompt policy makers to consider the introduction of a road pricing scheme, but this is only likely to gain public acceptability if accompanied by policies aimed at investing to improve public transport and alternative transport modes, such as cycling. Pricing policies can provide the revenue that can then be ploughed back into investments in public transport. While such a policy would reduce congestion, improve air quality, and reduce CO_2 emissions compared to what they would have been otherwise, it is not necessary that such a policy be primarily sold to the public on a global public goods argument of reduced CO_2 emissions.

Transport activity normally grows in parallel with economic activity, but actions to slow down growth may be warranted to help solve local or national transport problems—such as high accident rates, poor air quality, noise pollution, and congestion—or to reduce dependence on imported fuels, among other reasons. Given the preponderance of road transport within the sector, slowing the growth rate of vehicle kilometers traveled (VKT), particularly for passenger vehicles, will be critical. A good way of thinking of mechanisms to reduce emissions in the transport sector is the avoid-shift-improve (A-S-I) paradigm, associated with Holger Dalkmann:

a. **Avoid** growth of CO_2 emissions through urban and interurban development that reduces the need for long-distance travel in passenger vehicles. Singapore is a good example of a coherent and comprehensive set of land use and development policies aimed at reducing the dependence on passenger vehicles, in contrast to the US suburbanization model. This is clearly linked to urban development issues and transport policies developed in response to these.

b. **Shift** transport to modes with lower emissions, by shifting passenger traffic to buses, rail or metro and freight to rail, and away from passenger vehicles and trucks. Given that cities produce a large share of emissions, this would require developing policies to encourage modal shift from passenger vehicles to mass transit, either to increase the modal share of public transport or to slow down a

declining modal share. Increasing the role of rail, particularly for freight, is critical; a successful example that comes to mind is Switzerland.

c. **Improve** vehicles, fuels and operations in order to mitigate emissions with existing and future vehicles technologies, fuel economy standards, and through traffic management policies.

The set of policies aimed at dealing with A-S-I can be broadly considered to be prices, regulations, and investments. Pricing policies, such as the introduction of a congestion charge aimed at encouraging modal shift from passenger vehicles to public transport and non-motorized transport, but could be combined with restrictive parking regulations—for example, a policy of reducing the number of parking spaces—and investing funds from the congestion charge for improving and extending mass transit. All three sets of policies, pricing, regulatory, and investment decisions are clearly needed, and in practice, it is a whole set of policies, rather than one policy introduced in isolation, which has helped reduce the usage of passenger vehicles in a number of European cities. In what follows a menu of individual policy options is presented, with a greater focus on roads, as this is the sector which generates the most emissions in the transport sector.

3.1 ROAD PRICING INSTRUMENTS

Internalizing costs through road user charging (RUC). When deciding to make a journey a driver will normally consider the costs to him/herself, that is to say the cost of operating the vehicle, fuel, personal cost if delayed due to heavy traffic, and parking costs, when in fact there are many other associated costs. Road pricing theory argues that the socially optimal amount of transport in total and by mode requires that users be confronted with a price at the point of use that reflects the full social cost of his/her trip at the margin or marginal social cost pricing.[13] Social costs are defined to include private marginal costs (fuel, vehicle maintenance, driver and passenger time for a specific vehicle trip), together with any damage done to the infrastructure, the capital costs of the infrastructure, the impact of exhaust emissions locally, regionally or globally in the form of CO_2 or GHG emissions, and the contribution to congestion, noise, and accidents. Internalizing these costs—adopting the user pays principle—requires making each driver pay for their part of the total social costs generated.

Road pricing can be used as a flexible way of charging people and can help end the idea that one can drive a vehicle without thinking about the external consequences to society. Pricing is critical to reducing GHG emissions and represents one of the key transport policies to reduce demand by raising the relative price of vehicle use to alternative mass transit in cities or other modes outside of urban areas. This section presents a brief overview of some of the pricing policy options available to policy makers wishing to contain the growth of the modal share of vehicles, drawing on international experience. The pricing options under consideration include: (a) fuel pricing; (b) toll road pricing; (c) high-occupancy vehicle and toll (HOV and HOT)

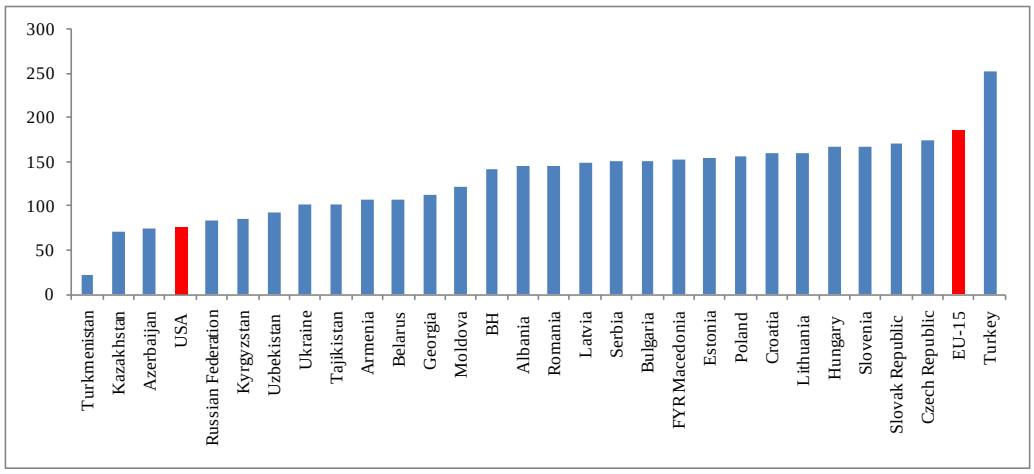
[13] Richard Martin Humphreys (2011), "A Short Primer on Road User Charging." Policy Note prepared for the Albanian Government. Transport Unit, Sustainable Development, Europe and Central Asia Region, World Bank.

lanes, express toll lanes; (d) vignette; (e) heavy good vehicle tolling; (f) urban congestion pricing; (g) vehicle registration fees; (h) parking policy; and (i) insurance per km of driving. Box 1 provides a concise typology road charging principles.

Fuel pricing. Fuel pricing is a particularly effective policy instrument in that it can discourage vehicle usage—although this is a function of the short, medium, and long-term price elasticity of demand—and encourage the purchase of more fuel-efficient vehicles, thereby reducing vehicle-fuel intensity. In general, high fuel tax countries, predominantly in the EU-15, are associated with much lower levels of vehicle usage than in low fuel price countries such as the US. Gasoline prices vary widely in ECA, but are with few exceptions generally higher than prices in the US, albeit lower than the EU-15. In the US, modest fuel taxes of about US$0.10 per liter of diesel and gasoline are levied to cover all direct expenditure for roads and highways—maintenance, refurbishment, new construction, and capital recovery for the roads and highways departments. For comparison, in November 2010, the US price (including taxes) for diesel was US$0.78 per liter and for super gasoline US$0.56 per liter. This is considered by *Deutsche Gesellschaft für Internationale Zusammenarbeit* (GIZ)—which publishes annual international gasoline and diesel retail price data—as the international minimum benchmark non-subsidized fuel transport policy; only three countries in ECA have prices below the US level (Figure 12): Turkmenistan, Kazakhstan, and Azerbaijan.[14] For the highest GHG emitter, the Russian Federation, prices are only slightly above those of the US, while Turkey has gasoline prices that exceed the average for the EU-15 and are the second highest worldwide, and considerably higher than in the Netherlands and Norway, reflecting high special consumption taxes (SCT) and value-added tax (VAT) applied to fuel. A somewhat similar pattern emerges for diesel prices, with the difference that more countries price diesel below US levels: Turkmenistan, Kazakhstan, Azerbaijan, the Russian Federation, Kyrgyzstan, and Uzbekistan. Among the top three GHG emitting countries in ECA, only the Russian Federation has fuel prices below that of the US, whereas Turkey has rapidly expanding motorization growth and high vehicle modal share despite very high fuel taxes.

[14] Available at f http://www.giz.de/Themen/en/dokumente/giz2011-international-fuel-prices-2010-2011-data-preview.pdf

FIGURE 12: RETAIL PRICE OF GASOLINE IN MID-NOVEMBER 2010 (US CENTS PER LITER)



Note: At a crude oil price of US$81/bbl Brent.
Source: GIZ.

Fuel taxes are relatively inexpensive to collect, easy to administer and reasonably equitable, since the charge is broadly proportional to road use. They do not however discriminate between road type, location of the road, or time of usage. On the latter point, this means that fuel taxes cannot tackle the issue of high externalities associated with congestion in peak traffic times. Another weakness is that they do not fully reflect the additional damage done and road space demanded by heavy vehicles.[15] Although trucks consume more fuel per kilometer than vehicles and therefore pay more in tax per kilometer traveled, this is not in proportion to the higher impact in terms of damage to the road surface.[16] For this reason, fuel taxes are frequently supplemented by additional charges on heavy vehicles. Taxes on fuel are also used by governments for other purposes such as restraining fuel consumption or more commonly raising revenues for the budget, reflecting weaknesses in revenue collection in developing and emerging economies.

[15] Humphreys (2011), ibid.
[16] The relative damage to the road surface increases by the fourth power of the axle load.

BOX 1: A TYPOLOGY OF ROAD CHARGING PRINCIPLES

Area Licensing: Allows for provision of a license, which enables the user to enter a certain defined area and can be paper, or electronic, by storage of a registration number. It does not restrict how many journeys one can make within the charging area so its usefulness as a congestion or GHG reducing tool is limited. It is, however, easy to set up and maintain.

Cordon/zone charging: Involves setting up a linear cordon and charging at access points to the zone. The user would then pay a charge depending on how many crossings into the zone were made, or in some cases for how long. It is very versatile and can incorporate varying charging scales according to type of vehicle, time of day etc. However, a disadvantage is that vehicles will often 'skirt' around the edges of zones to avoid paying the charges, increasing the congestion outside the zone.

Distance-based charging: The fee levied is proportional to the distance travelled, and in simple terms, the amount that the driver would pay reflects more accurately the cost of the pollution caused. In urban areas, a cordon might be defined and drivers charged according to the distance travelled within the cordon.

Time-based charging: The driver is charged a fee related to how much time is spent on roads subject to the charge, or in an urban area, within a cordon. Implications of this mean that if traffic congestion is higher, then the driver spends more time in the zone, and hence would be charged more. The driver would then perhaps choose not to enter the zone/cordon at busy times of day. One problem with time-based charging is that it would encourage drivers to drive faster to spend less time in the charging zone.

Congestion charging: It is generally accepted that congestion brings with it a set of consequences relating to pollution and increased journey times amongst other things, and is therefore undesirable. So any means to reduce congestion are important. Through satellite positioning and road-side sensors, it would be possible to tell if a particular vehicle is adding to congestion, and therefore the driver could be financially penalised for this. This would mean that, in an urban area, within a defined cordon, use of any road at any time could result in a *congestion charge* being levied, depending entirely on the traffic conditions. The definition of 'congestion' is critical to the way the scheme is implemented and how users are charged.

Source: University of Nottingham. Available at http://www.nottingham.ac.uk/transportissues/cong_roadcharging.shtml

Increasing fuel taxes remains an option for a number of countries in ECA, although issues of affordability need to be taken into account when considering possible fuel tax rises. Shifting the tax burden to pollution and pollution-generating activities creates powerful incentives to use less energy and emit less CO_2 into the atmosphere while simultaneously promoting tax equity and minimizing the impact of the fuel tax on those with lower incomes. In a number of countries, the motivation for increasing fuel taxes can be to capture the damage done to road infrastructure—something which the World Bank is often advocating to road agencies—and not within a context or framework where the primary motivation is an environmental one.

Toll road pricing. Tolls have been generally used for specific roads, bridges and tunnels, although increasingly they are being introduced for networks. There are two main types—a closed toll system, where any vehicle entering the facility collects a ticket and pays a graduated fee at the exit point—as occurs in motorways in the EU and in ECA countries such as Serbia, Croatia, FYR Macedonia, among others.[17] The introduction of such a system requires that the road be fully 'closed' so no user can gain access to the road without collecting the ticket and paying the toll. The level of facilities required increases, and the provision of a free alternative route is usually mandated by law. Open road tolling (ORT), also known as free-flow tolling, is the collection of tolls without the use of toll booths. The major advantage is that users are able to drive through the toll plaza at highway speeds without having to slow down to pay the toll. ORT may also reduce congestion at the plazas, and hence GHG emissions, by allowing more vehicles per hour per lane. A disadvantage is the increased risk of violators who do not pay. Collection of tolls on open toll roads is usually conducted through the use of transponders or automatic plate recognition. Both methods aims to eliminate the delay on toll roads by collecting tolls electronically by debiting the accounts of registered vehicle owners without requiring them to stop. Given the technological requirements, ORT is more expensive and may be appropriate for only some countries in ECA.

High-occupancy vehicle (HOV) lanes, high-occupancy toll (HOT) lane, express toll lanes (ETL). The traditional approach to increased congestion has been the addition of general-purpose road lanes. However, because of the high costs and impacts of creating new capacity, increasing attention is also being given to strategies that make the maximum use of existing highway capacity—HOV, HOT, and ETL lanes respond to this demand management focused approach.

HOV lanes are designated for use only by vehicles containing two, three or more occupants. HOV restrictions can sharply reduce the number of vehicles using such lanes, permitting vehicles that qualify for the lanes to travel rapidly during peak hours. This should create an incentive for people to switch from driving alone to carpooling, thereby expanding road capacity.

HOT lanes can be used by both high-occupancy vehicles—either without charge or with a reduced toll—and single-occupancy vehicles with a variable toll during peak hours. The toll is determined by hourly vehicle flows and is set high enough in peak hours to keep the number of users down and, consequently, speeds of vehicles on the road up.

Express toll lanes (ETLs). The main difference between HOT and ETLs is that in HOT lanes, HOVs are granted free access, whereas in ETLs all vehicles pay according to the same schedule.

Those who criticize the concepts claim that the lanes provide congestion relief to higher income drivers. With HOT the attempt to address this criticism typically consists of special treatment for HOVs. Vehicles carrying more than a specified amount of passengers are permitted to use the HOV lanes at a reduced toll (hybrid lanes) or for free (HOT lanes). Additionally, public transit vehicles are typically

[17] The introduction of a closed system requires the availability of a free alternative route for road users who chose not to use the tolled route.

exempted from the toll. A counter-argument is that high income drivers already have ways to ease their commute that are not available to the poor, such as buying a home closer to where they work. Creation of both HOV and HOT lanes is much more acceptable if it is done by adding capacity to an existing road, as the conversion of existing lanes reduces the overall capacity of the road, thereby increasing congestion on the remaining normal lanes. HOT, HOV, and ETL should be created only as part of the entire highway network in which they will be located, with full recognition of how those lanes will affect the whole network and impact on congestion in the network. Compared to general-purpose lanes, HOT, HOV, and ETL may provide environmental advantages by eliminating GHG emissions caused by stop-and-go traffic, and by encouraging people to use carpools and mass transit, thereby reducing the number of vehicles on the road.[18] Such lanes can only be implemented in high density road corridors typical of larger metropolitan area with limited travel options and a lack of parallel highway routes.

BOX 2: HOW THE VIGNETTE WORKS IN AUSTRIA

Toll stickers are required for all motorways and expressways under federal administration which can be recognized by the prefixes A and S in front of the number. The prices for vehicles (weighing less than 3.5 tons) are Euro 7.70 for 10 days, Euro 22.20 for 2 months, and Euro 73.80 for one year. Motorcyclists have to pay Euro 4.30, Euro 10.90, and Euro 29.00 respectively. A new type of toll sticker, called a Korridor-Vignette, was introduced in September 2008 to allow drivers to drive the 23 km stretch of the A14 from the German border to Hohenems without having to purchase a full toll sticker. The cost for a one-way trip is Euro 2.00.

On motorways and roads, the toll stickers are controlled by the police and Mautsheriff employees of the federal motorway administration ASFINAG. As a fine, a substitute toll of Euro 110 must be paid by travelers without a toll sticker, and a Euro 220 fine if the toll sticker has been altered (e.g., foil in between the windscreen and the toll sticker). This substitute toll allows the use of A and S networks on the day of payment and on the following day. If substitute toll is not paid, the traveler is subject to a complaint at the administration authority of the county, which may lead to a penalty fee between Euro 400 and Euro 4,000. Furthermore, personal valuables (including the vehicle) can be confiscated from foreigners to guarantee the payment of the penalty.

In addition to the compulsory toll sticker for general motorway and expressway use in Austria, further tolls (per each single usage) must be paid on certain motorway and expressways (e.g. cost-intensive sections in the Alps), where additional Tollgates are installed. Heavy vehicles are subject to a separate, mileage-dependent motorway tolls schedule via technology involving onboard and external monitors.

Source: Humphreys (2011).

Vignette. A road tax vignette is a form of tax on vehicles, used in several non-English speaking European countries. Vignettes are used in Austria, Bulgaria, Czech

[18] For a discussion of the US experience, see the Federal Highway Administration (2003), *A Guide to HOT Lane Development.* US Department of Transportation, March 2003. Available at: http://ntl.bts.gov/lib/jpodocs/repts_te/13668_files/images/13668.pdf

Republic, Hungary, Montenegro, Romania, Slovakia, Slovenia and Switzerland, while other types of road toll are being imposed on drivers in several other European countries. The small, colored toll sticker is affixed on a vehicle passing through motorways and expressways, which indicates that the road tax has been paid. Vignettes are valid for a fixed period of time, often one year but usually also available for less, and can be obtained at border crossings, gas stations and labeled points. A vignette system is cheap to operate as it does not need toll plazas or the infrastructure of a modern toll system. After the initial purchase, vignettes represent a sunk cost, so there is no disincentive to travel at a particular time or route, as cost is not based on distance travelled. It is therefore less effective in limiting distance travelled when compared to tolls and in that sense the value in terms of reducing GHG emissions is more limited.

Heavy-goods vehicle (HGV) tolling. Given the higher environmental and road damage caused by HGV, a number of countries in Europe have introduced HGV tolling. Switzerland introduced a toll-system for trucks over 3.5 tons in January 2001, Austria introduced an electronic toll collection system for trucks over 3.5 tons in January 2004, and Germany introduced a toll system for trucks over 12 tons on January 1, 2005.[19] In 1999 the EU adopted the Eurovignette Directive on charging HGV for the use of trans-European road infrastructure, authorizing countries to levy road time-based or distance-based charging on HGV above 3.5 tons, provided the charges did not exceed the recovery of costs necessary to maintain and replace road infrastructure. It prohibited the recovery of external costs based on the polluter pay principle. Since the beginning of 2008 the Eurovignette is an electronic system and physical vignettes are no longer printed, although as mentioned earlier individual EU states can have their own national vignette system. A revision to the Eurovignette Directive was adopted by the European Parliament on June 7, 2011, and is awaiting the European Council's formal approval—the changes include: (a) allowing charging for traffic-based air and noise pollution; (b) wider differentiation of toll rates to allow for better traffic management and to reduce congestion; (c) usage of revenue for construction of alternative infrastructure, research and development into clean vehicle technology; and (d) extension to all of the EU's 30,000 km tolled motorway. An example of an ECA country adopting an HGV toll is the Czech Republic.[20]

[19] The German Toll Collect system is based on a technology using satellites; truck operators may choose to either install on-board units for automated tracking of movements or to book their route in advance using the internet or computerized booking terminals.

[20] The obligation of motor vehicles and trailer combinations with a total weight equal to or greater than 12 tons to have a toll sticker affixed on the windshield was cancelled as of January 1, 2007, and replaced with a distance-based toll charge based on modern microwave technology. Vehicles that are subject to the toll must be equipped with a small electronic device which communicates with the tolling system.

BOX 3. FINANCING GREATER PARIS PUBLIC TRANSPORT THROUGH THE VERSEMENT TRANSPORT

In the Ile de France—an administrative region composed mostly of the Paris metropolitan area—the French tax, *versement* transport is a key resource of public transport financing. Funding for public transport comes from a variety of sources, including users (ticketing), the region of Ile de France, the city of Paris, the French government, county contributions and company contributions through the *versement transport* or transport tax.

The transport tax is a tax calculated on wages and was created in France in 1971. The tax rate applicable to companies is defined by the Board of the *Syndicat des transports d'Ile-de-France* (STIF), the authority that controls the Paris public transport network and coordinates the different transport companies operating in the region. The actual rate depends on the Paris metropolitan area where employees work, with three rates: 1.4 percent, 1.7 percent, and 2.6 percent. Every company employing more than nine staff in Ile-de-France has to pay the transport tax. A regressive system is applied to companies who employ more than nine staff: they pay nothing the first three years, and then the three following years the amount is reduced by 75 percent, 50 percent, and then 25 percent. The taxes are collected by the same public body that recovers social security contributions, retaining 1 percent of the value collected.

Payment is reimbursed by STIF for companies that (a) provide permanent accommodation to their employees on worksite; (b) provide their employees with transport to and from the workplace, and (c) those companies located in new towns, of which there are currently two.

The transport tax is one of the main sources of income to finance public transport in Ile de France, accounting for 35 percent of funding (covering both operations and investments) in 2008, slightly below the 36.9 percent of funding through transport fares—of which the user receives a refund from his employer of at least 50 percent of the fare. In contrast, public contributions make up only 12.6 percent of funding, and parking fines only 0.4 percent.

As a percentage of STIF's budget, the tax generated Euro 2.97 billion in 2008, equal to 67 percent of STIF's budget. In contrast, the income from parking fines was only Euro 36 million or 1 percent of STIF's budget—50 percent of parking fines collected go to STIF and the funds are used for investments in quality of service and renovation of rolling stock.

Source: Syndicat des Transports d'Île-de-France (STIF).

Urban congestion pricing. Congestion pricing is a system of charging users of a transport network to reduce traffic congestion. The application on urban roads is limited to a small number of cities, including London, Stockholm, Singapore, and Milan. The London Congestion Charge is a fee paid by drivers travelling within the Congestion Charge Zone (CCZ) and as its name suggests was introduced with the aim of reducing congestion, as well as raising investment funds for London's transport system. The zone was introduced in central London in February 2003, and extended into parts of west London in February 2007, although this was discontinued in 2008. The 2007 report prepared by Transport for London (TfL) found that traffic entering the charging zone was 21 percent lower than in 2002, creating opportunities over this period for re-use of a proportion of the road space made available. Reduced levels of traffic mean that when compared to conditions without the scheme congestion charging continued to deliver congestion relief that

was broadly in line with the 30 percent reduction achieved in the first year of operation. Congestion charging was also estimated to have led directly to reductions of about 16 percent in CO_2 emissions from traffic within the charging zone over 2002-2003, these more directly reflecting the overall traffic reductions and efficiency gains. Over the post-charging period 2003-2006, vehicle fleet improvements are estimated to have reduced emissions from road traffic, both within the central London charging zone and more widely, by 17 percent for NO_x, 24 percent for PM_{10} and 3 percent for CO_2, assuming a stable traffic mix. In terms of revenues and costs, over 2006-2007, the London Congestion Charge generated GBP 213 million (US$ 346 million) in total revenues, compared to total operating and administrative costs of GBP 90 million (US$147 million), with the near totality of revenues used for upgrades to bus infrastructure and operations.

Vehicle registration tax. In a number of countries there is a tax when registering a vehicle and the tax can be included in the retail price of the new vehicle or it is paid by the owner of a vehicle imported from abroad upon applying for registration. This tax can be linked to GHG emissions in different ways. In the Netherlands, for example, this tax is equal to 45 percent of the selling price of a vehicle and provides a discount or overcharge based on CO_2 emissions.[21] In the case of Norway, the vehicle registration fee is designed to make large-engine sports vehicles costlier than compact vehicles through the payment of a GHG tax at the time of registration, which is a function of the hydro-fluoro carbon (HFC) content in the air-conditioning system of the vehicle. Critics of high registration taxes argue that a tax on vehicle ownership rather than usage—through fuel taxes for example—creates little incentive to reduce vehicle usage once the high fees, which represent a sunk cost, are paid. However, when combined with high fuel taxes, as is the case in Norway, the overall impact is to reduce both motorization rates and vehicle usage.

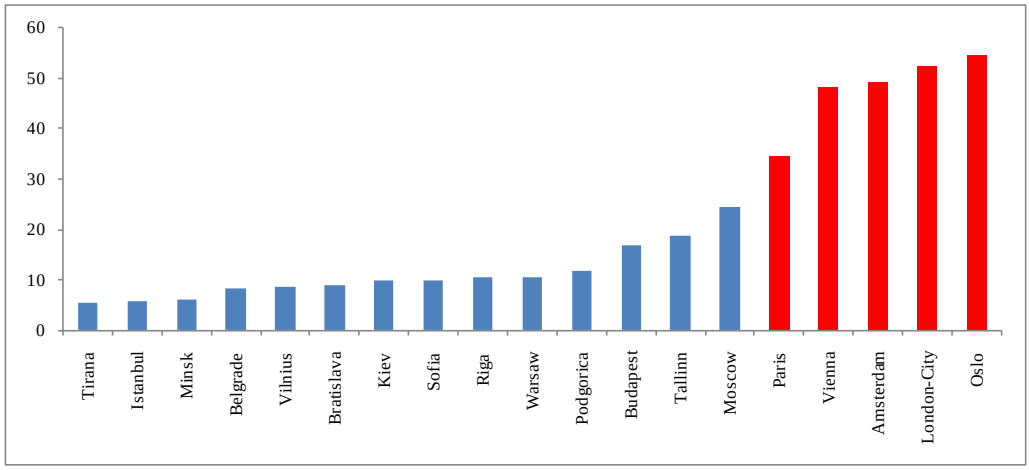
Parking policy. One pricing mechanism to discourage using vehicles is adopting a policy of high parking pricing, particularly if parking is expensive in relation to public transport. An annual survey on daily parking rates shows that in most cities in ECA, parking fees are quite low when compared to cities in EU-15 (Figure 13). In the EU, changing parking policies are part of larger goals, such as complying with air quality standards or reducing GHG emissions. While London and Stockholm and a few other cities have introduced congestion charging, this has not spread widely, whereas charging for parking is widespread, and thus raising rates would be relatively straightforward. However, parking pricing policies are usually complemented with policies aimed at controlling the growth of parking spaces. Generally, the amount of on-street parking is a function of municipal policy, while off-street parking is controlled by zoning and building regulations. Parking management options include, among others (a) high pricing; (b) emissions based parking charges; (c) parking supply caps; (d) regulating the location of parking; and (e) earmarking parking fee revenues for non-vehicle transport development.[22] A recent study reviewing parking policy in the EU reviews some innovative options

[21] The CO_2 charge applies only to passenger vehicles which were first put into service on or after February 1, 2008. Higher vehicle registration taxes have to be paid when more than 232 grams of CO_2 per km (for petrol vehicles) or more than 192 grams of CO_2 per km (for diesel vehicles) is emitted.
See http://www.cleanvehicle.eu/info-per-country-and-eu-policy/member-states/netherlands/national-level/

[22] While supply caps and regulating the location of parking are not pricing policies, they have been included here as part of a broader parking policy review.

that can be used as a mechanism for controlling vehicle usage, which are not pricing policies but can complement parking pricing policies, including.[23]

FIGURE 13: DAILY PARKING RATE (US DOLLARS)



Source: Colliers International (2010), Global/Central Business District Parking Rate Survey.

- ***Reducing parking spaces.*** The city of Copenhagen (Denmark) aims to discourage travel to the city by vehicle and parking fees are high. Traffic to the city center has declined by 6 percent since 2005 despite a 13 percent rise in vehicle ownership. The city has been replacing existing parking spaces with increased cycle tracks at a rate of about 32 spots per year, but spaces have also been declining to make way for pedestrians and bus lanes. Cycling has risen from 30 percent of journeys to 38 percent by 2008, followed by vehicles (31 percent), public transit (28 percent), and walking (4 percent).

- ***CO_2 based residential parking permits.*** The city of London (UK) is divided into 33 boroughs, and each local authority handles parking issues. Emission standards are recorded at the time a vehicle is registered; this has allowed several boroughs to charge CO_2 based parking fees. Richmond-Upon-Thames introduced CO_2 based residential parking permits back in 2007. In the City of Westminster, the cost of residential parking permits is a function of engine size and is free for electric, gas, and hybrid vehicles. Vehicle sharing services are also permitted free on-street parking.

- ***Parking supply cap.*** Zurich has adopted a restrictive parking policy in response to limited road capacity, as well as air and noise pollution concerns. Total NO_2 emissions are considered when determining the amount of parking space allowed. Parking prices are normally as high in residential as in city center areas, and in 1996 the city adopted a parking supply cap,

[23] Michael Kodransky and Gabrielle Hermann (2011), Europe's Parking U-Turn: From Accommodation to Regulation. Institute for Transportation & Development Policy, Spring 2011. Available at http://www.itdp.org/documents/European_Parking_U-Turn.pdf.

which means if a space is created off-street in the capped area, an on-street space must be removed to keep the overall supply unchanged.

- ***Park and ride facilities.*** The building of park and ride facilities at the end of tram lines has been a key strategy to increase public transit usage and reduce the number of vehicles driving through the city center of Strasbourg in France. A number of other policies have been adopted to discourage vehicle usage, including parking policy, bicycle promotion, investments in public transit, and pedestrianization, and these have led to a decline in the modal share of vehicle use from 52 percent in 1997 to 46 percent by 2009. Warsaw has developed park and ride facilities to reduce downtown congestion.

Insurance per km of driving. Insurance per km of driving or pay as you drive (PAYD) insurance directly incorporates distance traveled as a rate factor. Studies suggest that accident costs increase with annual vehicle kilometers driven and as a result, PAYD increases actuarial accuracy. PAYD pricing rewards motorists when they reduce their mileage, providing financial savings and additional benefits including increased safety, congestion reduction, road and parking facility cost savings, energy conservation, GHG emission reductions, and increased insurance affordability.[24] Such insurance is available in the US and Australia. Mileage can be verified with odometer readings at the start and end of the insurance policy term, which is relatively inexpensive to implement. Critics argue that distance based insurance premium penalize suburban and rural motorists, who would pay more and lack public transit. However, one way to address this is to adopt an optional PAYD approach—as opposed to universal PAYD—which would allow drivers to choose this type of policy if they save compared to standard premiums. As several private insurance companies already sell PAYD policies this suggests the existence of consumer demand for such a product. However, if optional PAYD is used a recent study suggests the impact of optional insurance policies fully prorated by annual VKT driven would reduce total travel by 3 percent, compared to universal PAYD, which would reduce travel by 11.5 percent.[25]

Efforts to model the potential effects of pricing policies on GHG emissions in transport require significant amounts of information. Pricing strategies may affect: (a) the number and type of vehicles owned by a household; (b) where people live and work; (c) the number of trips they take; (d) the time of day trips are taken; (e) whether they choose to drive or use transit or another transport mode; and (f) vehicle operating speed and frequency of accelerations and decelerations.[26] This means that the impacts of road pricing on GHG emissions depend on each of these factors over time and the resulting impact on VKT and vehicle operating conditions. However, to date in the US "improved and more detailed analytical approaches are being developed at the national level but are not yet widely used. New and emerging comprehensive analytical approaches to quantifying transport and GHG impacts are both data and resource intensive, thereby limiting their use to larger agencies with

[24] Todd Litman (2011a), *Pay-As-You-Drive Vehicle Insurance in British Columbia*. Victoria Transport Policy Institute. Available at: http://www.pics.uvic.ca/assets/pdf/publications/PAYD%20Insurance_May2011.pdf
[25] Todd Litman (2011a), ibid.
[26] Oregon Department of Transportation (2009), *Potential Effects of Tolling and Pricing Strategies on Greenhouse Gas Emissions*, Final Report prepared by Cambridge Systematics, Inc. with CH2M Hilll, February 2009.
Available at http://www.oregon.gov/ODOT/TD/TP/docs/tolling/whitepaper1.pdf

access to more advanced analytical tools."[27] This means that for most countries in ECA data on GHG emissions based on fuel consumption will continue to be the norm in the foreseeable future, providing much less accurate information than what would be required to measure the mitigation impact of specific pricing policies.

A key variable affecting the impact of the various pricing policies is the sensitivity of vehicle travel with regard to costs. If price insensitive, then pricing reform can be considered ineffective, but if on the contrary price changes have large impacts on travel, then pricing reforms can be considered more effective and rebound effects stemming from increased fuel efficiency are higher. Recent evidence from the US finds short-term price elasticities of demand of -0.1 to 0.3 and long-term price elasticities of demand of -0.3 to -0.6—a 10 percent price increase reduces vehicle travel by 3 to 6 percent.[28] As higher transport elasticities suggest that pricing strategies are relatively effective and beneficial, and that fuel efficiency improvements provide smaller net energy savings, this supports the case for implementing pricing policies to contain congestion, road accidents, air pollution, and GHG emissions. There is a need to estimate short-term and long-term price elasticities in ECA countries, in light of fuel price rises in recent years, and other pricing changes, in order to gauge the potential impact of various pricing policy options.

3.2 REGULATION AND TECHNOLOGY

Vehicle emission standards. Vehicle emissions comprise the by-products that come out of the exhaust systems of an internal combustion engine, or other emissions such as gasoline evaporation, or brake dust. These emissions contribute to air pollution and are a major ingredient in the creation of smog in some large cities. European emission standards define the acceptable limits for exhaust emissions of new vehicles sold in EU member states. These emission standards are defined in a series of EU directives staging the progressive introduction of increasingly stringent standards. Currently, emissions of nitrogen oxides (NO_x), total hydrocarbon (THC), non-methane hydrocarbons (NMHC), carbon monoxide (CO) and particulate matter (PM) are regulated for most vehicle types, including vehicles, lorries, trains, tractors and similar machinery, barges, but excluding seagoing ships and airplanes. Non-compliant vehicles cannot be sold in the EU but standards only apply to new vehicles.[29] CO_2 emissions generated by vehicles in the EU are subject to a voluntary agreement with vehicle manufacturers. This contrasts with the US Corporate Average Fuel Economy (CAFE) program, which specifies obligatory limits. For ECA, where a significant share of the vehicle stock is imported second hand from the EU, a policy that aimed to set standards exclusively for new vehicles would be

[27] Ibid.

[28] Todd Litman (2011b), *Changing Vehicle Travel Price Sensitivities: The Rebounding Rebound Effect.* Victoria Transport Policy Institute. March 2011. Available at: http://www.vtpi.org/VMT_Elasticities.pdf

[29] The EU's heavy-duty emission standards are applicable to new motor vehicles with a technically permissible maximum laden mass of over 3,500 kg, with engines that operate on diesel, natural gas or LPG. The first set of standards, Euro I, was introduced in 1992, and since then the EU has sought to tighten these standards. In October 2008 the Euro V standards came into force for new vehicle models issued during the year (the standards became applicable for all existing models a year later). In July 2009 the EU approved a set of stricter emission standards – Euro VI – which will come into force in January 2013 for new models (2014 for new registrations of existing models). To promote the early introduction of Euro VI-certified vehicles, EU member states may utilize tax incentives, subject to a number of conditions.

much less effective than in the EU itself, although countries could introduce a maximum age for imported cars. As emission standards are made more stringent in the EU, this should eventually have a trickle-down effect in ECA, with cleaner vehicles being sold in the region.

Key factors when introducing or reforming vehicle emission standards are the availability of vehicle fleet data and import-export characteristics, as well as enforcement considerations. As highlighted by a recent report from Global Fuel Economy Initiative (GFEI) on emissions in Central and Eastern Europe, only countries who became EU member states are under the obligation to create national vehicle databases, but for most countries in the region there is a lack of information on fuel economy, the amount of vehicles sold, and the national vehicle registries tend to be unreliable.[30] According to this report, current average fleet-wide fuel economy levels for light-duty vehicles is only available for the Russian Federation, with average fuel efficiency for domestically produced vehicles of around 9 liters/100km, and 10 liters/100km for imported vehicles, and for Serbia with an average fuel efficiency of 7-8 liters/100km. The OECD average figure in 2005 was around 8 liters per 100 km for new vehicles (including both gasoline and diesel vehicles). The lack of adequate data requires finding the financing, whether domestic or international, to fund projects which aim to collect fuel economy related data to create a baseline. A second issue in the region is that vehicle efficiency regulation, where available, is not always enforced.

In the case of the Russian Federation, fuel economy legislation has been adopted and *Rostehregulirovaniye* is the main institution responsible for vehicle emissions standards implementation and control. Vehicle import restrictions refer to import taxes—which are a function of a vehicle's age and type of engine—and the level of emissions. The Russian Federation refers to the EU's Euro standards and is currently implementing Euro 2 standards. Emission standards apply to imported or domestically produced vehicles, whereas the current vehicle fleet will be in circulation until the end of its life-cycle. Euro 3 standards have been introduced in 2008, Euro 4 in 2010, and Euro 5 for 2014.

Biofuels. Biofuel is a fuel derived from organic matter and is gaining increased public and scientific attention, driven by factors such as high oil prices, the need for increased energy security, concern over GHG emissions from fossil fuels, and government subsidies. In a recent report, the International Energy Agency found that by 2050 biofuels could provide 27 percent of total transport fuel and could replace diesel, kerosene and jet fuel.[31] However, an important factor when considering the GHG emission reduction potential of biofuels is considering the life-cycle assessment (LCA) to evaluate the potential impact of a product or activity on human health and the environment over the entire cradle-to-grave life cycle of that product or activity.[32] The possibility to use biomethane in order to meet biofuel targets and the usage of renewable biomethane produced from waste resources could be supported by EU policy—it results in lower net GHG emissions than any other type of vehicle fuel and also has the added benefit of providing an efficient

[30] Global Fuel Economy Initiative (2010), Cleaner, More Efficient Vehicles: Reducing Emissions in Central and Eastern Europe. Working Paper 3/10
[31] International Energy Agency (2011), *Technology Roadmap – Biofuels for Transport*. Paris: International Energy Agency.
[32] T. E. McKone et al (2011), *Grand Challenges for Life-Cycle Assessment of Biofuels*, *Environ. Sci. Technol.*, 2011, *45* (5), 1751–1756

method for biological waste treatment. For ECA countries which are EU member states, EU policy mandates that the share of energy from renewable sources in transport by 2020 be at least equal to 10 percent. This could provide some traction for biofuels to feature more prominently in ECA member states in the following decade. At the moment, biofuels remain very marginal in the region.

Hybrid electric and plug-in electric vehicles. A hybrid electric vehicle combines a conventional (usually fossil fuel-powered) engine with some form of electric propulsion. Common examples include hybrid electric vehicles such as the Toyota Prius, while a plug-in electric vehicle (PEV) is a vehicle that can be recharged from any external source of electricity, such as wall sockets, and the electricity stored in the rechargeable battery packs drives or contributes to drive the wheels. When considering the GHG impact of PEVs it is important to keep in mind that if electricity production depends heavily on high-carbon energy resources—as is the case in a number of ECA countries—then the net effect of PEVs will be modest. To date PEVs have made limited inroads in the US, with only three companies producing more than 10,000 vehicles annually, in contrast to projected new light duty sales in the US of 12 million in 2011—breaking into the mass market has yet to happen in any country.[33] In contrast, 2 million hybrid automobiles and SUVs have been sold in the US through May 2011, with a new vehicle market share of 2.8 percent in 2009.

Natural gas vehicles. A natural gas vehicle (NGV) uses compressed natural gas (CNG) or liquefied natural gas (LNG). Worldwide there are 12 million NGV vehicles, with the highest share in the European region in Armenia, where 30 percent of vehicles run on CNG.[34] This reflects the fact that a large percentage of the fleet has been retro fitted for bi-fuel operation. CNG filling stations date from the time of the USSR and the successor states, Armenia, Belarus, Moldova, the Russian Federation, Tajikistan, and Ukraine have kept their national programs running, although Armenia is the only country where the penetration rate exceeded 30 percent in 2008. The price of CNG in the Commonwealth of Independent State Countries (CIS) is significantly lower than gasoline or diesel and has been a critical driver in the expansion of CNG penetration in Armenia. As with other alternative fuels, the use of NGV requires the development of fuel storage and infrastructure available at fueling stations. In the US CNG is popular with public transit agencies, including in Washington D.C, while the national fleet exceeds 100,000. Compared to other alternative fuels, NGV has taken a significant share of the vehicle market—exceeding 10 percent of the total—in Argentina, Bangladesh, Bolivia, Colombia, Iran, and Pakistan. In the latter case, the NGV share is 82 percent in 2010.

The US Environmental Protection Agency calculates the potential benefits of CNG versus gasoline for light-duty vehicles as reducing: (a) carbon monoxide emissions by 90 to 97 percent; (b) carbon dioxide emissions by 25 percent, (c) nitrogen oxide emissions by 35 to 60 percent; (d) potentially reducing non-methane hydrocarbon emissions by 50 to 75 percent; and (e) emitting little or no particulate matter. In 2007, the California Energy Commission (CEC) found that CNG reduces GHG

[33] Report of an Expert Panel (2011), *Plug-in Electric Vehicles: A Practical Plan for Progress, The Report of an Expert Panel*, School of Public and Environmental Affairs, Indiana University, February 2011.
[34] Information on natural gas vehicles in the Europe region can be found in the website of the Natural and Bio Gas Vehicle Association: http://www.ngvaeurope.eu/

emissions by 30 percent in vehicles and 23 percent in buses compared to gasoline and diesel.[35]

For the alternative fuel options, a policy that focuses exclusively on public transport vehicles' fuel type or consumption would be relatively straightforward to monitor and implement. Replacing buses with any of the alternative technologies discussed above, or with trolleys, is much more feasible than having a sizeable impact on the passenger vehicle market. However, because public transport represents a small share of a region's or country's emissions, the impact would not be as significant as the adoption of these new technologies by the passenger vehicle fleet or a modal shift from vehicles to public transit. Policies that seriously aim to reduce CO_2 emissions from the road sector must aim at controlling the growth of vehicle ownership and usage, while reducing emissions per km travelled.

This brief survey on regulation and technology suggests that the most promising mechanism to reduce air pollutants and GHG emissions in ECA would be through the imposition of vehicle emission standards and vehicle import restrictions, with biofuels, electric, hybrid vehicles possible technological options only over the long-term. In a medium-term framework, making vehicle emission standards more stringent, by moving them in line with EU standards, could have a significant effect as far as the new vehicle fleet is concerned. For second hand vehicles, most of which come from abroad in a number of ECA countries, adopting vehicle import restriction regulations which set emission standards could be a powerful tool to control the growth of GHG emissions. In Lithuania, only new imported vehicles must satisfy EU requirements, while there are no national requirements on second hand vehicles. Closing this loophole will be critical going forward.

3.3 URBAN FORM AND TRANSPORT

Urban form, which refers to the physical layout and design of a city, impacts on daily travel patterns and thus on annual VKT. Growth management issues, such as urban sprawl, growth patterns, and phasing of development heavily influences urban form. In turn, urban form plays a key role in determining transport mode choice and travel distance—many studies have shown that vehicle dependence and transport energy consumption per capita are far greater for low-density suburban neighborhoods. The relationship between transport and urban form is mutually reinforcing, in the sense that transport investment decisions influence spatial patterns of development, which in turn influence patterns of travel, and these in turn influence future transport investment decisions and investments. Clearly, changing what can be a "vicious circle" requires addressing urban development and planning issues, which will set the transport demand needs for decades to come.

[35] See Fuels and Advanced Vehicles Data Center of the US Department of Energy website at http://www.afdc.energy.gov/afdc/vehicles/natural_gas_emissions.html?print

Once a country has developed an urban form characterized by extensive urban sprawl, it becomes exceedingly difficult to control GHG emission growth.[36] This is because low-density development where there is separated land use, as is common in the US, makes a passenger vehicle the only efficient transport option. A recent study looking at 142 US cities found that population density has been declining by 9 percent during the 1970s, by 14 percent during the 1980s, and by 32 percent during the 1990s, suggesting an accelerated decline in population density, which if unchanged, would make it exceedingly hard to reduce GHG emissions generated by passenger vehicle transport.[37] The population density-VKT relationship can be weakened according to the type of land-use policies in place, such as zoning for mixed use, raising density maximums, and eliminating minimum parking regulations. Avoiding the development of a US high-energy model and instead developing one based on more compact, transit served urban city, could reduce transport energy needs by up to three-quarters. From a transport perspective, urban sprawl has a number of negative effects, apart from increasing VKT. It also makes it more difficult to develop financially viable mass transit systems.

The ECA region saw very large changes in residential housing following the post-socialist transition, which have contributed to rising suburbanization.[38] While population growth has not been significant in many cities, this has been compensated by a large reduction in the size of the average household, reflecting a response to cramped living conditions in former communist times. Other significant changes to the housing market have been the privatization of the existing housing stock, development of residential mortgages, high demand for residential property from international buyers, and a marked increase in average dwelling unit size. As a result of these changes, there has been (a) a decrease of residential use in the urban core, as commercial uses outbid other activities from central zones, leading to residential depopulation and gentrification; (b) an increased rate of residential suburbanization; and (c) a relaxation of land development controls. In the case of Estonia, construction of single family housing increased five times between 1990 and 2002, while other types of residential property has not even doubled, with most of the new construction taking place in the suburban periphery. The high growth of vehicle ownership seen over the same period in the region has reflected in large part suburbanization, which has been supported by large public investments. Thus, unlike many other developing regions, suburbanization is taking place in the context of slow or negative population growth. On the positive side, suburbanization patterns have tended to be much denser than in the US. Nevertheless, the trend of rapid suburbanization over the last two decades is a worrying one if projected forward into the next decades.

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[36] From 1969 to 1989 the population of the US increased by 22.5 percent, while the number of miles driven by the population, measured in vehicle-miles traveled increased by 98.4 percent. See Susan Handy, Robert Paterson, Jumin Song, Jayanthi Rajamani, Juchul Jung, Chandra Bhat, Kara Kockelman (2002), *Techniques for Mitigating Urban Sprawl: Goals, Characteristics, and Suitability Factors.* Research Report 4420-I. Conducted for the Texas Department of Transportation in cooperation with the US Department of Transportation, Federal Highway Administration by the Center for Transportation Research, Bureau of Engineering Research, the University of Texas at Austin. Available at: http://www.utexas.edu/research/ctr/pdf_reports/0_4420_1.pdf

[37] Steve Hanket and Julian D. Marshall (2009), *Impacts of Urban Form on Future US Passenger-Vehicle Greenhouse Gas Emissions*. Energy Policy, doi:101016/j.enpol.2009.07.005.

[38] This section is based on Kiril Stanilov (2007), "Housing Trends in Central and Eastern European Cities During and After the Period of Transition", in Stanilov (ed), *The Post-Socialist City: Urban form and Space Transformations in Central and Eastern Europe After Socialism*. Dordrecht: Springer. Turkey was obviously not affected by the post-socialist transition, but has also faced the development of suburbanization.

BOX 4. GROWTH OF POLAND'S SUBURBS

Poland has a relatively high urbanization rate (61 percent), and most recent population growth in Poland has happened in and around larger cities. The suburbs of larger metropolitan areas have absorbed much of the population growth and been the site of the majority of new housing developments. While population overall is declining, the suburbs of Warsaw are growing, as are smaller cities' suburbs.

The shift towards suburban sprawl of Polish cities has significant implications for urban transport as well as other urban services. It is accompanied by a shift towards single-family units, likely with greater per capita residential energy requirements. Importantly, expansion into peri-urban areas has been occurring at great distances from the city center, with haphazard new developments along main arteries driven by low land prices. Residents depend on private vehicles for commuting into the city. Meanwhile, public investment has focused on improving and expanding roads rather than public transport. Most metropolitan areas do not have properly integrated public transport networks: Warsaw's network is fragmented and focused on the center city.

A main result has been that the hard urban cores that defined Polish cities before 1990 have given way to scattered suburban developments that make public transport networks in those areas impractical as well as raising challenges for provision of water, sewage, electricity, and solid waste management services. All of these aspects will contribute to raising GHG emissions in metropolitan areas. The jurisdictions that make up Polish metropolitan areas need to come together around an integrated regional urban planning approach to guide new developments in a more sustainable fashion.

Source: World Bank (2011), *Transition to a Low-Emissions Economy in Poland*. Poverty Reduction and Economic Management Unit, Europe and Central Asia Region, February 2011. Washington DC: The World Bank.

A number of policy measures are available to produce more compact urban forms. These include urban codes and land regulations, including urban growth boundaries, density controls, and spatial planning. However, a number of other policies to be considered include transport policies already mentioned: urban development patterns can be affected by transport policies including pricing policies such as taxes, tolls, and parking fees, and by avoiding undue concentration on low-density road transport infrastructure, at the expense of urban mass transit. More generally, transport investments and policies can be used in the selection of sprawl mitigation or sprawl avoidance techniques. In the case of the US it is well known that the development of federal transport investment policies and the construction of interstate highways contributed to the development of urban sprawl, as have subsidies and regulatory incentives for companies to relocate from cities to suburbs, zoning regulations which limit population densities, and separate land use. Restraining the growth of urban sprawl can also benefit from changes to development and property taxes, as well as taxes toward urban regeneration. In the case of ECA there is evidence of an accelerated development of the suburbs in the post-socialist period and the same can be said for urban development in a number of Turkish cities (Box 4).

3.4 RAIL TRANSPORT

Railways are a complex system with a number of actors, including rail infrastructure managers, operators, and regulatory agencies and a patchwork of networks in ECA and a variety of rolling stock. Due to the long lifetime of rail infrastructure and rolling stock, there are limited opportunities to renew the asset base with more energy efficient stock over the short-term, but significant opportunities over the longer turn. However, given the fact that rail transport generates much less GHG emissions than road transport, even in the absence of upgrades to rolling stock and infrastructure, a modal shift from road towards rail will reduce GHG emissions, and generate additional co-benefits, such as reducing highway congestion and reducing air pollutants. To provide an illustration, to transport 100 tons of freight from Basel (Switzerland) to the port of Rotterdam (Netherlands) 4.7 tons of CO_2 emissions are generated by road, 2.4 tons by inland waterways, and 0.6 tons by rail.[39]A recent independent study commissioned for the US Federal Railroad Administration found that on average rail was four times more fuel efficient than trucks, reducing GHG emissions by 75 percent.[40] Emissions from the rail sector can be reduced through electrification and energy efficiency, but the largest reductions would come from the growth of intermodal transport, with a shift from road to rail, as detailed below.

Electrification. There is considerable evidence that electric trains are more energy efficient than diesel-powered trains and have a smaller CO_2 footprint, as they are generally lighter, the electricity can be generated from energy sources which are more efficient than a diesel engine, and because regenerative braking can be used to return power to the system to be used elsewhere (for suitably equipped electric trains). According to a study that attempted to quantify the GHG emissions reduction potential of various technical options for the European rail sector, electrification is the most promising, capable of reducing emissions by 20 to 40 percent.[41] Rail electrification rates vary considerably within ECA, with a low of 7 percent in Lithuania to a high of 75 percent of the network in Bosnia and Herzegovina, considerably above the EU-27 average (Figure 14). However, more important than the size of the network which is electrified is the percentage of the traffic which is carried on electrified lines. About 80 percent of the European rail fleet runs on electric power, meaning most trains can switch to cleaner electricity when it becomes available.[42] In addition, modern trains within the EU are equipped with regenerative brakes that recover energy from power generation when braking.

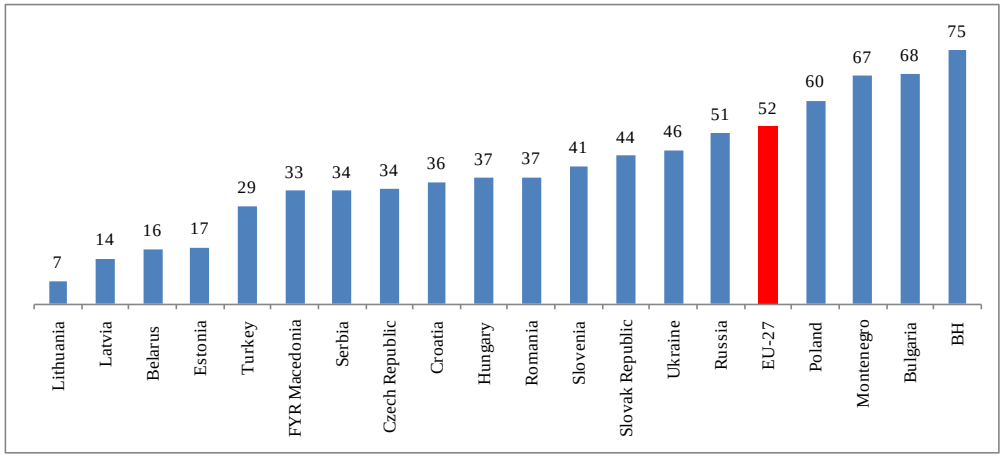
[39] Krohn, Olaf, Matthew Ledbury and Henning Schwarz (2009), *Railways and the Environment- Building of the Railways' Environmental Strengths*, January 2009. Brussels: Community of European Railway and Infrastructure Companies (CER). Available at: http://www.cer.be/media/090120_railways%20and%20the%20environment.pdf

[40] Association of American Railroads (2011), Freight Railroads Help Reduce Greenhouse Gas Emissions. April 2011. Available at http://www.aar.org/AAR/~/media/aar/Background-Papers/Freight-RR-Help-Reduce-Emissions.ashx

[41] Tom Hazeldine, Alison Pridmore, Dagmar Nelissen, and Jan Hulskotte (2009*), Technical Options to Reduce GHG for non-Road Transport Modes.* Paper 3 as part of contract ENV.C.3/SER/2008/0053 between the European Commission Directorate-General Environment and AEA Technology plc. See http://www.eutransportghg2050.eu

[42] Krohn, Olaf, Matthew Ledbury and Henning Schwarz (2009), ibid.

FIGURE 14: ELECTRIFICATION RATE OF RAIL NETWORK, 2010 (PERCENTAGES)



Source: UIC.

Increased electrification of the ECA rail network would be an expensive proposition. Upgrading can result in significant costs, especially where tunnels and bridges have to be modified for clearance and due to the alterations required in the signaling system. Lines with low levels of traffic may not be eligible for electrification, as the flip side of lower costs of running trains is higher maintenance costs. In addition, when converting rail lines to electric, connection to other lines have to be considered—through traffic from non-electrified lines, if significant, can be costly as it requires engine switches or dual mode engines to be used and is an issue for long distance trips.

Energy efficiency. Even though rail transport is more energy efficient than other transport modes, improving energy efficiency is an important mechanism to reduce contributions to climate change further as well as to save costs. The main opportunities for mitigating GHG emissions associated with rail transport, after electrification, are improving aerodynamics, reduction of train weight, introducing regenerative braking and on-board energy storage, mitigating the GHG emissions from electricity generation, and traffic management.[43] Of the various technical options available, the one with the highest impact is likely to be regenerative breaking, followed by energy efficient driving techniques.

[43] Reduction of train weight includes usage of double deck trains, aluminum rail vehicle bodies, wide-body trains, articulated trains, and lightweight coach interior equipment. See Tom Hazeldine, Alison Pridmore, Dagmar Nelissen, and Jan Hulskotte (2009), ibid.

BOX 5: THE CASE OF TURKISH RAILWAYS (TCDD)

With a modal share in the freight market of just 5 percent, rail is clearly underperforming in Turkey. The Republic of Turkey General Directorate of State Railways Administration (TCDD) operates rail services in Turkey and is a state-economic enterprise affiliated to the Ministry of Transport with monopoly powers to provide rail services. It is organized on a functional and regional basis and is vertically integrated, owning and operating three affiliated companies responsible for the manufacture of locomotives, passenger coaches and freight wagons, as well as several ports that have rail access. The ports are the only part of TCDD that operates profitably, and are cross-subsidizing rail operations. Given the existing organizational structure, it is difficult to assess the financial performance and profitability of its constituent parts.

The TCDD commission, established to explore reform options, envisages the creation of a new joint stock company—Turkish Railway Transport Corporation, DETAŞ—which would be created as a rail undertaking, providing passenger and freight rail services as a subsidiary of TCDD. Improvements in TCDD's financial performance anticipated from implementing the new laws cannot be achieved without these being passed. Many services and lines, in addition to those subsidized, would not be operated if TCDD were functioning on a commercial basis. Similarly, necessary staff reductions depend on legal provisions for TCDD to be able to offer incentives for early retirement and voluntary departures. There is a general consensus that TCDD's financial and operational performance requires structural changes—in particular a commercial structure—that would create incentives and opportunities to increase traffic and productivity.

The railway commission proposal moves TCDD toward lines of business structure, thereby improving transparency, and allows for additional organizational change, including the separation of passenger and freight, which are positive steps forward. However, they stop short of giving the rail companies commercial legal status, and opt instead for the legal status of a state enterprise. Corporate governance will be improved if the railways have a commercial legal structure, creating the right commercial incentives for operating the railways—this will minimize government involvement in day-to-day management, and should increase the independence of the board. The company has identified a number of long-term problems, including: (i) heavy financial losses and growing debt; (ii) products and services not meeting market demand; (iii) highway-oriented transport policy and regulations; (iv) intensive political interference; and (v) high labor costs.

Reforms are necessary for the financial survival of TCDD and to redirect state funds towards financing infrastructure as opposed to operating subsidies. Doing this makes good financial and fiscal sense, and would also deliver improved operational performance. Taking modal share away from roads, and thus reducing the growth of GHG, would be a co-benefit of the reform process, but not the key driver of reforms going forward. This example illustrates the difficulties faced by a number of countries in ECA to operate commercially oriented railways, as well as political and social sensitivities arising from labor unions, the need to reduce staffing, and more broadly the challenges in transforming railways if they are to compete effectively with road transport.

Source: Carolina Monsalve (2011), *Railway Reform in South East Europe and Turkey: On the Right Track?* Transport Unit, Sustainable Development, Europe and Central Asia Region, Report No. 60223-ECA, March 2011. Washington D.C.: The World Bank.

Promoting intermodal transport and modal shift from road to rail. Increased usage of combined or intermodal transport, for example by taking a container off the road and putting it on a long-distance freight train and using trucks for short pre-and post-rail transport can cut energy consumption by almost half.[44] In the EU trucks account for around 75 percent of inland freight journeys, and while the figure is lower in ECA, this represents a huge potential to integrate railways to modern, efficient, logistical chains, enhancing economic competitiveness while at the same time reducing road congestion and the negative environmental effects of road transport, particularly in relation to CO_2. For a number of countries in ECA, supporting modal shift from road to rail will require making the rail mode more attractive—pricing road externalities is part of the equation. However, it will also require (a) improving the operational performance of the rail undertakings; (b) investing in infrastructure rehabilitation and upgrades; and (c) particularly for countries with small network sizes and potentially large transit volumes, reducing delays in border crossing points. In this sense, policies encouraging modal shift to rail are the same set of policies required to sustain a competitive rail sector.

A recent rail report from the World Bank in South East Europe and Turkey highlights a number of problems faced by the sector in this sub-region of ECA and proposes a series of measures to strengthen it.[45] The report notes that despite recent transport demand trends towards increasing individuality and flexibility—which have tended to shift both passenger and freight traffic on to roads—there exists a large and growing market segment for rail transport, particularly along international freight corridors. The expansion of EU rail networks into new EU member states has created important opportunities in the long-run for rail freight, given the extra capacity on East-West axes and high growth rates of trade between EU-15 and EU-12 countries, as well as with candidate and potential candidate countries. However, this potential for a significant modal shift, particularly for freight, using international rail corridors connecting EU-15 and EU-12 countries and beyond, has not been realized in recent years.

The reasons for this are numerous, and include strong competition from other modes, not only roads, but also short-sea shipping and inland waterway navigation. This would include Pan-European Corridor VII through the Danube, multimodal corridors with RoRo ships between North Adriatic ports and Turkish Ports, and multi-modal corridors with short-sea shipping between North Sea ports and Turkish ports. At the same time, with the accession of Romania to the EU in 2007, the port of Constanta has become the gateway to the Black Sea, with new container train products being transported from central Europe to Constanta, which before would have been transported by rail via Bulgaria and from there to Turkey. There are already examples of road transport logistics providers using road, inland waterways, maritime, and road supply chains in South East Europe and Turkey, with prices that are about 15 to 30 percent lower than rail rates and significantly lower transit times.

[44] Olaf Krohn, Matthew Ledbury and Henning Schwarz (2009), *Railways and the Environment- Building on the Railways' Environmental Strengths*, January 2009. Brussels: Community of European Railway and Infrastructure Companies (CER). Available at: http://www.cer.be/media/090120_railways%20and%20the%20environment.pdf

[45] Carolina Monsalve (2011), *Railway Reform in South East Europe and Turkey: On the Right Track?* Transport Unit, Sustainable Development, Europe and Central Asia Region, Report No. 60223-ECA, March 2011. Washington D.C.: The World Bank.

One of the reasons for the higher rail transit times are processing times at rail border-crossing points (BCPs) in South East Europe.[46] Creating incentives for the private sector to participate in developing intermodal (logistic) terminals to establish conditions for shifting more traffic from road to rail—by creating block trains for longer distances, for example—would require significantly higher commercial speeds along rail corridors and substantial reductions in border stopping times. In turn, this does not require large infrastructure investments, but improvements in border-crossing agreements (BCA) and the functioning of BCPs, through information data exchange, trust, and cooperation between neighboring rail undertakings and infrastructure managers.

The fragmentation of the rail market in ECA continues to be a reality. The current market structure is largely characterized by incumbent rail undertakings operating national networks, while trade flows have increasingly become cross-border in nature. This is a particular stumbling block for the Western Balkan rail undertakings, given the small size of the national networks and the number of border-crossings involved in transferring goods out of the region. A number of initiatives announced in 2010 suggest that there is momentum for change, and a belated recognition of the need to increase regional cooperation and coordination. Coordination of rail operators along corridors should be established to improve and develop services, while ensuring the independence of the partners as regards pricing of the service and avoiding foreclosure. For a number of large countries in ECA, notably Turkey, the issues are different, as the domestic rail network is large enough to sustain significant rail freight traffic, but poor management of the state-owned company has led to a declining modal share (Box 5). Reforming the railways to make them competitive, financially sound, and capable of taking modal share from road transport should be a key priority to address GHG emissions in ECA.

3.5 AIR TRANSPORT

Reducing emissions from air transport poses significant challenges over the medium-term. As recognized by a recent report produced by International Civil Aviation Organization, while medium-term mitigation of CO_2 from the aviation sector could come from improved fuel efficiency, such improvements are expected to only partly offset the growth of aviation CO_2 emissions, with the amount of CO_2 emissions projected to grow by 3 to 4 percent annually at a global level.[47] This poses a serious challenge for all regions, including ECA. A number of policy options are available to reduce the pace of GHG emissions growth, as detailed below.

EU Emissions Trading Scheme (EU ETS). For the EU-12, the EU has decided to impose a cap on CO_2 emissions from all domestic and international flights—from or anywhere in the world—that arrive or depart from an EU airport, by including air transport in the ETS starting from 2012. The EU ETS started on January 1, 2005 and covered in the past only energy intensive industrial installations and like any ETS

[46] Uhl, Klaus-Juergen (2010), *Review of Practices at Border-crossing Points in Selected Rail Corridors and Assessment to Improve Performance.* Consultant Report prepared for the World Bank, July 2010.
[47] International Civil Aviation Organization (2010), *ICAO Environmental Report: Aviation and Climate and Climate Change*. Available at: http://www.icao.int/environmental-protection/Documents/Publications/ENV_Report_2010.pdf

the emission level to be achieved is set and the market determines the price of carbon. Airlines will receive tradable allowances covering a certain level of CO_2 emissions from their flight per year, and after each year operators must surrender a number of allowances equal to their actual emissions in that year. If the airlines anticipate that their emissions will exceed their allowances, they can buy additional emission allowances on the market or adopt measures to reduce emissions—for example, investing in more efficient technologies.

BOX 6: REDUCING EMISSIONS FROM AIR TRANSPORT – THE CASE OF THE UK

In January 2009 the Government set a target that CO_2 emissions from UK aviation in 2050 should be at or below 2005 levels and this despite the support for a third runway at Heathrow Airport which would raise aircraft traffic movements from 480,000 to 605,000 per annum. The Governments asked the Committee on Climate Change to report on how this target could be met.

The Committee starts with an assessment of the maximum increase in air transport demand compatible with the target that CO_2 emissions in 2050, from both domestic and international flights, do not exceed 2005 levels. Projections on growth of demand and emissions are made assuming no carbon price constraining demand, and if no limits were placed on airport capacity expansion, and then considers the scope of reducing emissions through (a) carbon prices; (b) modal shift from aviation to rail/high-speed rail; (c) substitution of communication strategies such as videoconferencing; (d) improvements in fleet fuel efficiency; and (e) use of biofuels. The work set out various scenarios and did not focus on non-CO_2 aviation effects on global warming.

Projected demand. Given real income growth of 150 percent to 2050, and without carbon pricing and capacity constraints, it is projected that demand would rise by 200 percent from 230 million passengers in 2005 to 695 million passengers by 2050. With a rising carbon price and capacity constraints the increase in demand would fall to 115 percent. In other words, demand would more than double.

Modal shift and videoconferencing. Rail/high-speed rail could reduce aviation demand by up to 8 percent, while videoconferencing could reduce business demand by 30 percent by 2050.

Fleet fuel efficiency. Fleet fuel efficiency improvements of 0.8 percent annually in the period to 2050 is likely, reducing carbon intensity of travel by about 30 percent by 2050.

Biofuels. Given issues regarding land availability and sustainability issues, the Committee assumed a 10 percent usage of biofuels as the most likely scenario.

Given these assumptions, demand growth of 60 percent compared to 2005 would be compatible with keeping CO_2 emissions in 2050 no higher than in 2005. This suggests that tax and capacity plans should be designed to limit total demand to around 60 percent, until technological developments suggest that any higher level of growth would be compatible with the 2050 target. This means demand must be constrained significantly compared to the business as usual case, pointing out the challenges in keeping the lid on CO_2 emissions from the transport sector. For faster growing economies in ECA, the challenge would be all the more daunting.

Source: International Civil Aviation Organization (2010), *ICAO Environmental Report: Aviation and Climate and Climate Change*. Available at: http://www.icao.int/icao/en/env2010/Pubs/ENV_Report_2010.pdf

Jet fuel taxation and other environmental charges. When it comes to fuel taxation the position of the European Commission is that member states should eventually remove the exemption traditionally applied to aviation. At present, although it is possible for a fuel tax to be levied on domestic flights within EU member states, it is difficult to do so for international flights, even between member states due to legally binding commitments made in air service agreements between

EU member states and third countries. Such agreements are expected to be renegotiated, but this will take time, making jet fuel taxation an option only in the long-term for the EU-12 countries in ECA.[48] A number of airports apply emissions or noise charges, which would need to be cost-effective and not duplicate emission trading.

Modal shift towards high speed rail. An important motivation for expanding high speed rail is to reduce travel time and to compete with air transport. For routes under 300 km, high speed rail tends to substitute air transport—the Eurostar from Brussels to Paris comes to mind as a successful example of modal shift—and can be important for relieving airport congestion, while for distances exceeding 1,000 km, air transport becomes more attractive. It is important that for each potential high-speed rail project there is a proper feasibility study and traffic demand forecast to see if there is sufficient demand for the services—most likely if it connects to high population urban centers—and to include in the economic assessment the potential benefits in terms of relieving rail congestion, road and air congestion, environmental benefits, location impacts, and to assess the benefits of 140-160km/h versus 200 to 250km/h and 300-350km/h services. The amount of fast and high speed rail reflects the nature of potential traffic along those lines, composition of traffic, and cost recovery considerations. In the ECA region both the Russian Federation and Turkey, the top two GHG emitters in the transport sector, are currently implementing high speed train network expansion programs.

Other measures. Other policies aimed at controlling emissions from air transport include (a) technological improvements (aircraft renewal and replacement and retrofitting aircraft); (b) improved air traffic management, airplane, and airport operations; and (c) usage of alternative fuels such as biofuels. One of the restrictions of renewals is the life cycle of planes, which is between 20 to 30 years, with fleet renewals having a much larger impact than retrofits—this measure is the one that is likely to have the largest impact compared to operational policies and usage of alternative fuels.

[48] European Commission (2005), *Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions*, COM (2005) 459 final. Brussels, September 27, 2005. Available at: http://eur-lex.europa.eu/LexUriServ/site/en/com/2005/com2005_0459en01.pdf

4 LAND TRANSPORT SUCCESS STORIES

While a number of specific policy instruments can be used to mitigate the impact on climate change of transport policies, the implementation of a package of policy measures is likely to have a larger impact in containing the growth of GHG emissions, while the adoption of a more "holistic approach" that employs a combination of instruments with significant co-benefits to society, other than GHG savings, is likely to be more politically feasible. A recent study by the European Environment Agency (EEA) that modeled emissions in the EU reviewed various policy instruments and their impact on emissions by 2050 found that the greatest GHG savings potential arises from a combined package, in which technological improvements that reduce fuel consumption are used in parallel with measures to shift journeys to lower emission modes—modal shift away from roads—and which discourage the need to travel.[49] Particularly with regard to the latter point, high density, mixed-use land planning can have a large impact, but not in the short-to medium-term. This section presents some examples of smart transport policies with positive GHG co-benefits.

4.1 THE CASE OF SINGAPORE

One concrete example of a successful package of policies aimed at controlling the growth of motorization, vehicle trips, and congestion—with positive GHG emission spillovers—is the experience of Singapore. Constrained by limited space a comprehensive set of land development and public transport policies have been in place since the 1970s which have aimed to balance the growth in transport demand and enhance the effectiveness and efficiency of the land transport system. The Singapore story is one of land transport policy development and sustainable transport planning, providing important lessons on how to control the number of vehicles and their usage, as well as increasing the availability of public transit:[50]

Vehicle quota system (VQS). Initially the policy included high import taxes, registration fees, and road taxes, but with time this moved to a combination of a vehicle quota system (VQS) and road pricing. Under the VQS scheme, the government plans for a rate of vehicle growth according to prevailing traffic and road capacity, taking into account the existing vehicle stock and projections of deregistering. This determines the vehicle quota and in turn all purchases of new

[49] European Environment Agency (2010), *Towards a Resource-Efficient Transport System. TERM 2009: Indicators Tracking Transport and Environment in the European Union*. EEA Report No. 2/2010.
[50] Sun Sheng Han (2010), *Managing Motorization in Sustainable Transport Planning: the Singapore Experience.* Journal of Transport Geography 18 (2010) 314-321.

vehicles are required to bid for a license in a twice a month public tender, with the willingness to pay determining the final cost of the license. Evidence suggests the VQS has been successful in reducing the annual growth rate of vehicles to 3 percent, down from 6.8 percent under earlier policies.

Road pricing. This began in 1975 with an Area Licensing Scheme (ALS), which required the purchase of a permit in the central area, with exemptions for ambulances, fire engines, police vehicles. In 1995 electronic road pricing (ERP) was introduced, using radio-frequency, optical-detection, imaging, and smart-vehicle technologies to implement its charges. One of the main advantages of the ERP over the ALS was the ability to vary the charges at different times of the day, and between weekdays and weekends, as well as along different routes. Evidence shows that drivers responded to vehicle pricing in terms of selecting routes, number of trips, and timing of trips, allowing greater vehicle ownership than otherwise as traffic can be successfully controlled. Traffic speed increased by 10 km/hr when compared to the ALS.

Promotion of public transit. The Land Transport Authority (LTA) expanded the number of mass rapid transit (MRT) and light rapid transit (LRT) lines and planned extensions, with the aim of increasing coverage and frequency of service—the extensions will be integrated with land use as the MRT connects new town centers, while the new LRT increases the catchment area of MRT stations. High quality bus services are a critical aspect of public transit, and to make buses attractive, the bus operators must satisfy demanding performance standards.

Taxis. These are an important component of public transport, with Singapore having the highest density of taxis of any major city, combined with low fares, and exacting performance standards for taxi services in terms of waiting times and traffic accidents.

The Singapore experience demonstrates that increasing vehicle ownership—an aspirational objective of developing country middle classes—can be combined with increased demand for public transit by controlling vehicle usage through targeted policies which impact on the price of a vehicle trip. Increased motorization in the absence of a multi-modal public transport strategy would have led to ever rising levels of traffic congestion, traffic fatalities and land use sprawl, as is the case in a number of cities worldwide—the case of Moscow comes to mind. Land transport policies in Singapore have focused on reducing congestion through a comprehensive strategy focusing on five key components: (a) integration of town and transport planning; (b) expansion of road network and improvement of road infrastructure; (c) network and traffic management through new technologies; (d) managing vehicle ownership and usage; and (e) improving and regulating public transport.[51] While this comprehensive approach was adopted with the aim of reducing congestion, it has reduced GHG emissions compared to what they would have been in the absence of such measures, as it encouraged a modal shift by reducing vehicle usage, while encouraging the development of public transport in parallel with land usage developments.

[51] Soi Hoi Lam and Trinh Dinh Toan, (2006), "Land Transport Policy and Public Transport in Singapore." *Transportation 33*: 171-188.

4.2 TRANSALPINE RAIL TRANSPORT IN SWITZERLAND

The number of transalpine trips through Switzerland by heavy goods vehicles more than quadrupled between the opening of the Gotthard tunnel in 1981 and the year 2000. Since 2001, a drop in trips has occurred, due to implementation of flanking transfer measures and the introduction of the distance-based heavy vehicle fee (HVF), replacing the flat-rate heavy vehicle charge that had been levied since 1985.[52] Overall responsibility for levying the new fee was allotted to the Federal Customs Administration. The aim of HVF is to internalize the external costs of trucks and therefore implement the polluter pay principle, with payment based on total weight, emissions levels, and kilometers driven—a 40 ton vehicle pays about Euro 200 (US$284) for a 300 km journey. Annual revenues are about Euro 1 billion and go to the Swiss public transport fund. The quantity of goods transported over Swiss alpine passes by road and rail has more than doubled overall since 1981 to reach 34.6 million net tons in 2009. The share of goods transported by road increased during that period but is still low compared with neighboring countries, as in Switzerland about 60 percent are transported through the Alps by rail.

HVF must be paid on all Swiss and foreign vehicles used for freight transport whose total maximum permitted weight exceeds 3.5 tons and it is levied on all public highways in Switzerland. The amount charged is based on the mileage covered, the total maximum permitted weight, and the emission rating (Euro class) of the vehicle in question. The mileage covered within Switzerland is read off the tachograph that is fitted in almost all vehicles which are subject to the fee. The person who is liable for the fee has at the same time a duty to cooperate. Swiss transport companies regularly declare the mileage covered by their vehicles to the Directorate General of Customs. In the case of foreign vehicles, the mileage is automatically declared at the customs post upon leaving Switzerland. The fee is then either paid directly when the driver leaves the country or charged to an account in the transport company's name.

The system for levying HVF is implemented by the customs administration in conjunction with cantonal highways offices, transport companies and authorized assembly points. The Swiss authorities invested some CHF 290 million (US$ 378 million) to set up the HVF system. This sum includes development—toll system, recording devices, among others—procuring and installing the necessary roadside infrastructure (beacons and associated equipment), and procuring the recording devices.[53] The annual cost of operation, maintenance and additional staff constitutes around 7-8 percent of the total, which is relatively low in comparison with other electronic toll systems. The HVF has led to fewer empty trucks, better capacity use, and a cleaner vehicle fleet, and has raised the competitiveness of rail transport. Funds from HVF have helped finance the Gotthard Base Tunnel, funded by the Swiss public transport fund which in turn is mainly fed by the HVF. The tunnel is an important part of the north-south rail axis through Switzerland, which is expected to open in 2016-2017.

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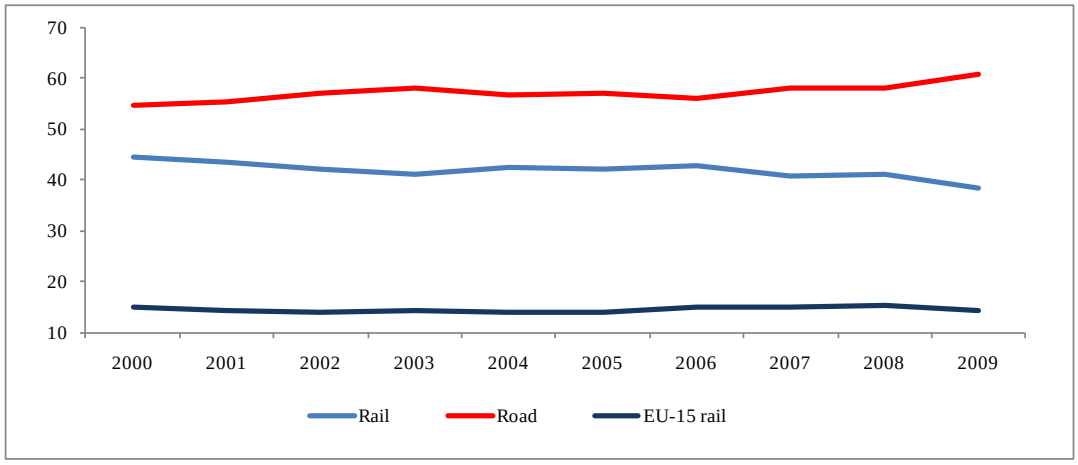
[52] Federal Statistical Office (2010), *Mobility and Transport, Pocket Statistics 2010*, Neuchâtel 2010. Available at: http://www.bfs.admin.ch/bfs/portal/en/index/news/publikationen.html?publicationID=3986

[53] Swiss Federal Customs Administration. Further information available at: http://www.ezv.admin.ch/zollinfo_firmen/steuern_abgaben/00379/index.html?lang=en

Looking at rail freight transport more broadly, and not limited to transalpine transport, the modal share of rail in Switzerland remains high compared to the EU-15 inland modal split. While Switzerland rail's modal share has not increased over 2000-09, but on the contrary has fallen from 44.5 percent to 38.4 percent, this remains considerably higher than for EU-15 countries, where rail's modal share was only 14.4 percent in 2009. Among new EU member states the share of rail in freight transport varies considerably, with declining, but exceptionally high shares for the Baltics—69.8 percent in Latvia, 52.7 percent in Estonia, and 40.1 percent in Lithuania—compared to the best performing EU-15 country, Sweden (37.5 percent). To put this in perspective, the modal split in the US was 45.3 percent for rail in 2007, compared to 32.8 percent for roads.

FIGURE 15: FREIGHT MODAL SPLIT IN SWITZERLAND (PERCENTAGES)



Note: Based on Swiss data for rail, road, and pipelines.
Sources: Eurostat, Federal Statistics Office.

4.3 ERODING AIR TRANSPORT'S MODAL SHARE: HIGH SPEED TRAINS (HST) IN EUROPE

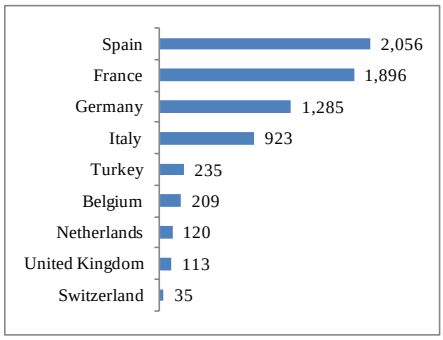
One of the success stories in Europe over the last 20 years has been the development of high speed trains (HST). According to 2011 data, there are over 6,800 km of high speed lines in operation—defined as lines with speeds exceeding 250 km/h—largely concentrated in four countries: Spain, France, Germany and Italy (Figure 16).[54] Meanwhile, there are nearly 3,000 km of high speed lines under construction, with over half in Spain (Figure 17). HST can compete effectively with air transport over average distances—HST has a clear advantage over air transport along routes with travel times between 2 and three hours—as they often are more comfortable but also overall faster. Travel time to the airport, check in and check-out times must also be considered in the total amount of time for air transport. Unlike air transport, trains are less stringent on security measures which can be perceived as less inconvenient. In addition, as airports tend to be located at the

[54] These data are from the *Union Internationale des Chemins de Fer* (UIC; International Union of Railways) updated on July 1, 2011. They consider high speed lines from the Russian Federation—the Moscow-St Petersburg line (650 km), which has been in operation since 2009, with speeds up to 250 km/hr, as planned.

periphery of cities a significant amount of time must be spent to access them, whereas train stations tend to be located in central areas and are therefore generally more accessible.

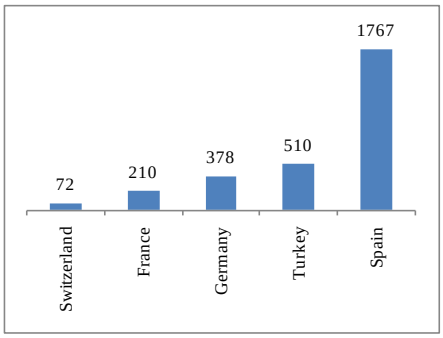
The proof of the success of HST is in the increasing number of passengers and market share captured mainly at the expense of short-haul intra-European air transport. For example, after the high-speed Thalys between Paris and Brussels went into operation, airlines discontinued flights between these cities, with the only remaining competition being road transport. Likewise, the Eurostar, travelling between London-Paris, holds a market share of 60 percent. To take a third example, the Madrid-Seville 472 km high speed line has been operational since 1992 at speeds up to 300 km/h, reducing travel time between the two end points from 6 hours to 2 hours and 15 minutes.[55] The new railway line radically changed the modal split between Madrid and Seville. The share of air transport decreased between 1991 and 2000 from 67 percent to 16.4 percent, while the share of rail increased from 33 percent to 83.6 percent.

FIGURE 16: HIGH SPEED LINES IN EUROPE IN OPERATION, 2011 (IN KM)



Source: UIC.

FIGURE 17: HIGH SPEED LINES IN EUROPE UNDER CONSTRUCTION, 2011 (IN KM)



Source: UIC.

Given the difficulties over the medium-term to reduce GHG emissions stemming from air transport, a modal shift toward HST has helped contain short-haul aviation growth in Europe. Planned high speed lines in Europe equal 8,705 km, excluding 1,679 km in Turkey. While there are some disputes regarding the precise reduction in emissions stemming from HST vis-à-vis air transport, there is no question that rail transport produces less GHG emissions. According to a report from Eurostar, London-Paris and London-Brussels flights generate ten times more CO_2 emissions than it does, based on actual passenger numbers, exact distances of rail and air routes, actual aircraft types, and the mix of electricity sources used by Eurostar trains.[56] In contrast, a report reviewing the evidence on carbon emissions from rail and air travel produced for the Greater London Authority finds that on average high-speed rail produces around one-third the CO_2 emissions of short-haul aviation

[55] http://people.hofstra.edu/geotrans/eng/ch3en/conc3en/hsrbeforeafter.html
[56] http://www.eurostar.com/UK/uk/leisure/about_eurostar/press_release/press_archive_2006/02_10_06_environment.jsp

during operation.[57] In the case of France's TGV, given that the electricity used for powering high speed rail lines is largely nuclear generated, HST creates a low carbon footprint when compared to HST operated in countries such as Belgium or the UK. High speed's rail carbon performance in all countries in Europe is likely to improve over the long-run, as HST uses electric traction, and to meet carbon reduction targets countries in the EU will have to reduce the carbon intensity of electricity supply.

[57] This study estimates that high-speed rail produces 40-100g of CO_2 per passenger kilometer, while aviation produces between 150-350g of CO_2 per passenger kilometer for distances up to 500 kilometers. Ben Bahrens (2010), *Reviewing the Evidence on Carbon Emissions from Rail and Air Travel*, Current Issues Note 24. GLA Economics, March 2010. London: Greater London Authority. Available at: http://www.london.gov.uk/who-runs-london/mayor/publications/transport/current-issues-note-24

5 PRICING POLICY INSTRUMENTS: HOW TO USE THE REVENUE?

One of the questions raised by the introduction of new pricing policy instruments in the transport sector—or raising the rates of existing fees, charges, and taxes—is the issue of what to do with the additional funds. The issue is an important one given the amount of funds that can potentially be collected from pricing policy instruments. There are a number of issues to consider, including productive efficiency, horizontal and vertical equity, and political acceptability. Some policy makers have advocated for a revenue neutral approach, whereby the road user, to take one example, is faced with higher taxes and fees, but the revenues collected are then redistributed and given back to all individuals equally. On the other hand, in a constrained fiscal environment, many policy makers would like to use such additional revenue generated for general budget purposes or as earmarked revenue for key transport infrastructure projects.

Productive efficiency refers to the use of resources so as to maximize the production of goods and services. If one introduces road pricing in a road or network suffering from significant congestion, then pricing leads to less waste than queuing as the mechanism to allocate a scarce resource, in this case roads. This benefit is not affected by how the revenue from road pricing is allocated—channeling the funds into increased road capacity may well lead to increased generated traffic and increased externalities.[58] What is clear, however, is that road pricing revenue should not be reimbursed to individuals using the infrastructure in proportion to how much they have paid, as otherwise there is no incentive to change travel behavior, which is one of the objectives of the introduction of road pricing in the first place.

In public finance horizontal equity refers to the idea that people with a similar ability to pay taxes should pay the same or similar amounts. This is often posited as an argument that road pricing revenue should be earmarked to road improvements or to provide benefits to those who pay the fee—not doing so would transfer benefits from the group that pays the fee from those who do not. However, this argument is weakened by the fact that road usage imposes a high level of externalities, including air pollution, noise, road accidents, and on a horizontal equity basis, funds should only be returned to road users after compensating the remainder of society for the imposed externalities. Evidence suggests that the revenue currently collected from road users is markedly less than the level of social cost imposed, undermining the argument that the funds collected should be used for drivers.[59] Vertical equity refers to the idea that people with an increased ability to

[58] Todd Litman, (2011c), *Using Road Pricing Revenue- Economic Efficiency and Equity Considerations.* Victoria Transport Policy Institute. May 2011. Available at: http://www.vtpi.org/revenue.pdf.
[59] Litman (2011c), ibid.

pay taxes should pay more, as the distribution of costs and benefits should reflect people's needs. To take the example of road pricing again, this is often considered inequitable as it imposes a larger burden on poor people—in other words it is not progressive. However, in general low income persons drive less than those with higher incomes. Where one group stands to lose significantly, perhaps in rural areas, then targeted compensation is an option.

Exponents of revenue neutrality argue that any new user charges, such as road charging, should be compensated through reduced taxes or cash rebates so that existing road users are no worse off. In the US, exponents of the carbon "fee and dividend" approach argue for the introduction of a carbon fee or tax based on the tons of CO_2 that fuel generate. The dividend is defined as the quantity of revenue to be returned, which is equal to 100 percent of the total carbon fees collected and given back to all individuals equally, helping finance the increased cost associated with the carbon fee. The motivation to reduce behavior that produces carbon is to save as much of the dividend check as possible. Other exponents of revenue neutrality argue that higher pricing should translate into reduced value added tax (VAT) or income tax, so that the government's overall take is not increased and there are no additional fiscal revenues.

The revenue neutrality mechanism can be criticized on a number of grounds. The first is that on equity grounds it is not clear that revenue neutrality is equity enhancing, as it assumes that the existing distribution of taxes is acceptable and that it is therefore important to keep it unchanged. If the revenue neutrality mechanism adopted is such that there are reduced taxes elsewhere, this needs to be coordinated carefully with the finance ministry to ensure that the reduction in taxes does not exceed the increased intake from the pricing instrument—this may be administratively complex to implement. Thirdly, analysis of the congestion pricing impact in Stockholm concluded that if the revenues collected are used to reduce taxes, then the overall impact is regressive, while if used to finance public transit, the overall impact is progressive. A number of researchers have concluded that if revenues generated from various road pricing instruments are used to improve public transit they support social equity objectives, by improving accessibility to disadvantaged populations.[60] Revenue neutrality may also face opposition from a political acceptability perspective, as motorists may accept the introduction of tolling only if accompanied by transit service improvements or to finance highway improvements. This can be a powerful argument, as the introduction of road pricing can be politically sensitive and requires broad levels of support. Stating that the funds will be returned in the form of lower taxes, as opposed to visible improvements in bus transport, for example, may not generate sufficient support during consultation processes preceding the establishment of such a system, as there may be skepticism regarding the level and implementation of financial refunds.

Perhaps the most powerful argument against revenue neutrality is the need to find revenues to finance investments necessary for modal shift. As was discussed with the Swiss charges for heavy vehicles, the funds generated are earmarked for rail investments which are needed as part of a broader policy objective that aims to

[60] Litman (2011c), ibid.

ensure that acceptable alternative transport is developed in order to increase the modal share of rail. Similarly, the funds from the London and Stockholm congestion charge are used to improve and expand public transport, which is necessary to accommodate the individuals who choose not to enter these cities by vehicle. Revenue neutrality takes away the funds and raises the question of how these necessary investments are to be financed—whether through higher taxes, increased public expenditures, or public-private partnerships. For these reasons, many politicians welcome the prospect of pricing instruments as a mechanism to finance much needed investments in the transport sector, which are necessary to encourage modal shift. As modal shift requires a whole set of supportive pricing policies, regulations, and investments, finding the funding for transport investments is a key issue.

6 CONCLUSIONS

This paper has reviewed different policy options to reduce GHG emissions in the transport sector in ECA within the context of an avoid-shift-innovate paradigm and a co-benefits framework. Without key changes to the way land development and transport investments are made, and projecting existing trends over the medium to long-term, GHG emissions from the transport sector are likely to continue rising rapidly in a number of countries in ECA. The various policy options and success stories reviewed suggest that these policies have rarely been introduced purely on climate change mitigation concerns. Instead, they have responded to smart transport planning and the need to reduce local externalities, such as air pollution, road congestion, or the desire to improve the quality of urban life. Improving the performance of rail companies in ECA will be critical to support a modal shift from road to rail—this does not require green policies, but policies aimed at making the railways competitive and profitable. This is a positive message, as trying to adopt "green" transport policies purely on a global externality argument is likely to be very difficult to sell politically and there may be scant interest or social acceptability for such measures, with limited prospects of implementation.

For EU member states and candidate member states, EU regulations can potentially act as powerful tools to control GHG emissions. An argument to illustrate this is the application of the EU air quality directive to Belgium and Romania.[61] On April 6, 2011 the European Commission decided to take Belgium to court for failing to comply with EU air quality rules—Directive 2008/50/EC—concerning limit values for particulate matter known as PM_{10}. The PM_{10} limit values were to be met by 2005 (or from the date of accession in the case of Romania), although EU member states may ask the Commission to extend the time for meeting the standards until June 2011. Such exemptions are subject to a number of conditions; member states must present an air quality plan setting out the relevant abatement actions during the extension period and demonstrate that they have taken all the necessary steps to achieve compliance by the extended deadline. On the same occasion, the European Commission warned Romania concerning six areas which exceed PM_{10} limits, with a failure to respond likely to lead to a summons to the EU Court of Justice. While air pollution is not only the result of transport emissions, addressing air quality levels will often require reducing pollution generated by road transport in cities.

EU member states must also comply with the EU climate and energy package which sets specific targets for reducing GHG emissions.[62] The package sets three targets,

[61] European Commission (2011), *Environment: Commission Takes Belgium to Court and Warns Romania over Failure to Comply with EU Air Quality Rules*. Brussels, April 6, 2011. Press release IP/11/435. Available at: http://europa.eu/rapid/pressReleasesAction.do?reference=IP/11/435&format=HTML

[62] European Commission (2008), *20 20 by 2020: Europe's Climate Change Opportunity*. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, Brussels, January 23, 2008, COM(2008) 30 final. Available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0030:FIN:EN:PDF

also known as the 20-20-20 targets for 2020: (a) cutting GHG emissions by at least 20 percent of 1990 levels by 2020; (b) cutting energy consumption by 20 percent of projected 2020 levels through improved energy efficiency; and (c) increasing the use of renewable energy to 20 percent of total energy production. For transport, excluding air transport, GHG emissions need to be cut to 10 percent below 2005 levels, through reduced carbon intensity of the vehicle fleet and increased transport efficiency. Again, this climate change mitigation framework affects all ECA countries which are EU member states: Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, the Slovak Republic, and Slovenia.

Meeting the EU's GHG transport target will be very difficult—a recent report from the World Bank reviewing Poland's policy options found that while the energy sector currently generates near half of Poland's emissions, the transport sector "with precipitous growth and the need for behavioral change in addition to the adoption of new technologies—may end up posing the tougher policy challenge."[63] Transport represents only 10 percent of overall GHG emissions in Poland but grew by 74 percent between 1988 and 2006, with road transport generating 92 percent of sectoral GHG emissions. A high number of imported used cars has a direct impact on the age and technology structure, and emissions levels of the vehicle fleet. Between 2006 and 2010, about 75 percent of cars registered for the first time in Poland were secondhand imports. The report models a package of policies aimed at reducing GHG emissions by 2030, compared to a business as usual scenario (Table 1). Pricing policies feature prominently, in the form of tolling, congestion charging, parking pricing, and fuel tax increases. Even with these series of measures, mitigation is unlikely to keep GHG emissions from the transport sector from growing by 35 percent by 2030. This highlights once more the challenge of reducing transport GHG emissions, as opposed to reducing their growth path.

This suggests a typology of countries in ECA, with varying degrees of pressure to address transport related externalities, both local and global. These can be divided into four categories: (a) EU member states which must comply with EU directives and the EU's climate framework and face sanctions for failure to comply; (b) EU candidate countries such as Croatia, the Former Yugoslav Republic of Macedonia, Montenegro, and Turkey; Croatia is scheduled to join the EU on July 1, 2013 and is therefore the candidate country most likely to need to adapt its transport policies and investments over the short-to medium-term; (c) EU candidate countries, which include Albania, Bosnia and Herzegovina, Kosovo, and Serbia; (d) the rest of the countries in the region. For the latter group, the pressure to adopt green transport policies is low. However, if one takes a city like Moscow in the Russian Federation, there is considerable pressure to adopt measures to reduce traffic congestion, which is seen to impose a heavy cost on the economy. In such a context, policies could be adopted which would have positive impacts on the pace of growth of GHG emissions, suggesting the story is not necessarily or entirely a bleak one for countries without immediate prospects from joining the EU, as there are other pressures to address transport problems.

[63] World Bank (2011), *Transition to a Low-Emissions Economy in Poland*. Poverty Reduction and Economic Management Unit, Europe and Central Asia Region, February 2011. Washington DC: The World Bank.

TABLE 1: LOW CARBON SCENARIO POLICY MEASURES FOR POLAND

Policy	Description	Reduction of GHG by 2030 compared to BAU (%)
Road pricing	Introduction of electronic tolling on motor and expressways; gradual introduction of congestion charging in major cities	4.2
Fuel tax increases for passenger vehicles	Gasoline price increase of 10 percent	5.2
Fuel tax linked to CO2 standard for passenger vehicles	Annual gasoline price increase equal to emissions standard tightening	18
Fuel price increase for trucks	Diesel price increase of 10 percent	1.8
Eco-driving	Introduction of eco-driving course to improve fuel efficiency	4.7
Parking policies	Parking fees for entire inner city regions of all cities	3.5
Promotion of non-motorized and public transport	Promotion of walking and cycling; and of metro, trams, and buses, as well as park and ride	2.3
Larger heavier trucks and logistics efficiency	More use of larger and heavier vehicles with efficient logistical chains and enhanced distribution	25

Source: World Bank (2011).

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