DEMAND RESTRAINT MEASURES FOR **LIQUID FUELS**

LITHUANIAN ENERGY AGENCY

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1. Promotion of public transport

Public transport can ensure the efficient movement of a large number of people with low liquid fuel (hereinafter referred to as fuel) consumption, frequently replacing fuel with electricity or alternative fuels. It is therefore an excellent alternative to vehicles when the fuel supply is interrupted or disrupted, and is one of the most important alternatives when considering vehicle-oriented demand restraint measures.

Of all the measures to increase the number of public transport passengers in order to reduce vehicle use, a short-term reduction in the price of public transport tickets seems to be the universally accepted and politically popular solution that is the easiest to implement. The main options for reducing public transport prices are to halve prices (50 per cent reduction) or make it (temporarily) free (100 per cent reduction).

Half price, though it may seem as an attractive option, has one major flaw – it still requires a transaction of one sort or the other – be it purchasing of a ticket, using an app or a dedicated public transport card. All these options are perfectly reasonable for those who already use public transport. But for those whom it is supposed to attract, moreover in combination with increased parking fees or other movement restrictions, it is most inconvenient. For them, the benefit of saving 50 cents on a ticket, in view of all the restrictions imposed and requests for solidarity, is negligible and even may seem as demeaning.

This psycho-social state will most likely demotivate the vast majority of people and will be deemed as a violation of a social agreement – agreeing with temporary restrictions and inconveniences, provided a minimal cost/impact on daily life and all possible opportunities to ease the situation are followed. Thus, half price is not recommended and for all intents and purposes only a 100 per cent reduction – free public transport – is evaluated and calculated here.

During off-peak hours, public transport systems typically have spare capacity. This can be exploited in two ways. First, existing spare capacity can serve to spread out the peak and is particularly useful taking into account the possibilities for employers to introduce different working hours depending on the situation. Second, in some cases it may be possible to expand the frequency and coverage of services provided on weekdays to weekends and to the morning/evening hours. Such development and pricing of public transport services would significantly contribute to encouraging people to refrain from using private vehicles and use public transport in the short term.

In the event of a fuel supply interruption or disruption, the addition of “vehicle-free” zones and streets can be an important incentive and a reminder for people to drive less. If the streets or zones where driving will not be possible are well known to the public in advance, “switching on” or “switching off” this system under certain conditions should not be difficult.

If there is a need to rapidly reduce fuel consumption in road transport, the various demand restraint measures taken, in public transport will have the opposite effect, increasing fuel consumption. Fuel consumption in public transport will increase due to the combined restrictions on the movement of passenger and goods vehicles in cities, significantly higher charges for car parks and paid parking spaces, recommendations to forgo non-essential private car travel and work remotely as much as possible, and reduced (or 100 per cent reimbursed) public transport ticket prices. However, this temporary increase in fuel consumption is more than offset by fuel savings

due to the reduced number of vehicles. In 2019, approximately 124 ktoe of fuel was consumed in public transport

According to data from the Ministry of Transport and Communications of the Republic of Lithuania, modal trip distribution in Lithuania in 2017 was: 54.8 per cent by passenger car; 26.6 per cent by foot; 12.8 per cent by public transport; 5.6 per cent by bicycle or other means. According to these data, more than half – 54.8 per cent – of all trips were by passenger car. This means that some 1,054,400 people (calculated from the total population aged 18–70 on 1 January 2020) travelled daily to work or elsewhere by passenger car. This is the maximum number of passenger cars per day that could go on a trip.

Table 1. Number of residents who have category B driving license.

Year	2018	2019	2020
Area	Urban and rural	Urban and rural	Urban and rural
Number of permanent residents at the beginning of the year	2,808,901	2,794,184	2,794,090
Number of people aged 18–70 at the beginning of the year	1,934,388	1,924,959	1,924,056
Number of persons licenced to drive category B vehicles at the beginning of the year	1,475,006	1,483,787	1,486,745

Given that not all residents own or drive passenger cars, and not all passenger cars are used regularly – some of them are the family's second car, are of larger capacity and used for longer trips, or are very rarely used, it is presumed that only 70 per cent of these residents – 738,100 – travelled by car. Seeing that an average of 1.7 residents use one car, the average number of passenger cars on the country's roads is approximately 434,000.

The average annual mileage of a passenger car in Lithuania is approximately 9,000 km, or 27 km per day, with an average fuel consumption of roughly 7 l/100 km. With the introduction of the above-mentioned measures to restrict vehicles and promote public transport, it is likely that at least 20 per cent of all residents who travel to work or elsewhere on a daily basis will choose public transport instead of a personal vehicle for their trip.

Due to the increased passenger numbers on public transport, better adapted public transport routes, improved timetables and reduced passenger car traffic, fuel consumption during the period when the measures to restrict vehicles and promote public transport are in place would decrease by approximately **34.5 ktoe** of fuel.

2. Promotion of remote working

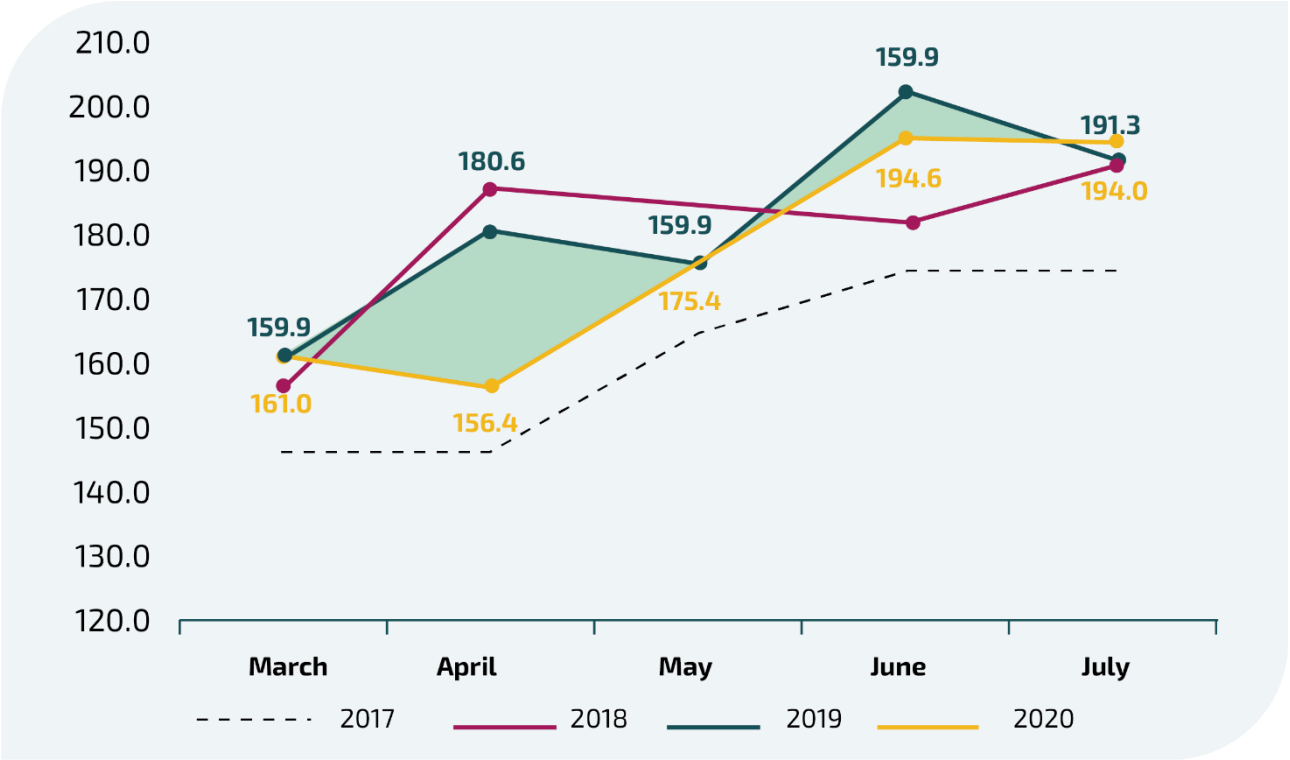
The impact of remote work on fuel consumption reduction is difficult to assess. This requires time to develop socio-economic assessment methodologies and studies or examples implemented in practice with empirical data.

Due to the global coronavirus epidemic, Lithuania was in lockdown from 16 March to 16 June

2020. During the lockdown, strict bans were in place for domestic travellers, the hours of operation were limited for bodies and institutions or prohibited altogether, remote work was encouraged wherever possible, and it was strongly recommended to only leave home for urgent matters. These restrictions on interaction and movement helped to reduce the spread of the epidemic. They also had a side effect: reduced fuel consumption due to a drastic change in the mobility of the population. The lockdown in Lithuania is an excellent example of how fuel consumption can change when such stringent measures are introduced nationwide, in all sectors of the economy, massively impacting the behaviour of the population.

Fuel consumption (liquefied petroleum gas, petrol, road transport diesel) in April and May 2020, when the lockdown restrictions were in place for the entire month, was an average of 6.67 per cent lower than during the same months in 2019, Figure 1.

Figure 1. Total fuel consumption, thous. tonnes



When Lithuania went into lockdown and introduced strict restrictions due to the global epidemic, fuel consumption decreased by 6.67 per cent, which indicates that fuel consumption is inelastic in the short term, i.e. there is little fluctuation when circumstances change, even very significantly. In addition, it can be argued that the population's caution and fear of infection were key assumptions for the relatively strict observance of the restrictions imposed.

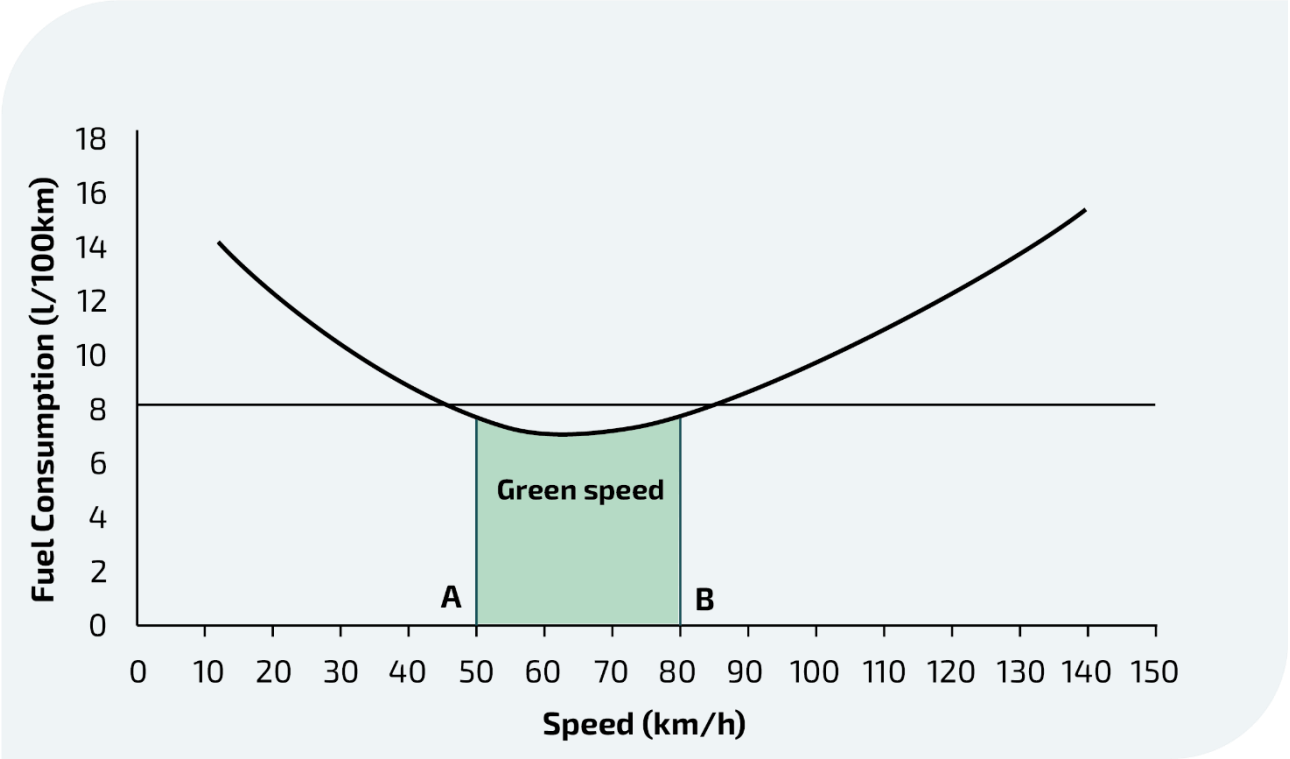
In the event of unforeseen circumstances, such as a fuel supply disruption and the declaration of a state of emergency that would require a significant reduction in fuel consumption, it would be wrong to expect the effects to be similar to those of a global epidemic and lockdown.

If the state decides to work remotely in the public sector, recommending this to municipalities and the private sector as well, the maximum impact could reach up to 30 per cent of the lockdown impact. Recommendations and incentives to work remotely could save approximately **47.2 ktoe** of fuel.

3. Speed limits

Vehicle speed affects fuel consumption. The optimum speed for most vehicles is 50–80 km/h – that is when the average fuel consumption for the distance travelled is the lowest, Figure 2. A recent study by the European Environment Agency found that cutting motorway speed limits from 120 to 110 km/h could deliver fuel savings for current technology passenger cars of 12–18 per cent, assuming smooth driving and full compliance with road traffic rules. However, surveys that have been conducted show that at the moment, some 40–50 per cent of drivers drive faster than is permissible.

Figure 2. Relation between fuel consumption versus average speed [1]



Theoretically, a further reduction in speed limits from 110 to 90 km/h would result in fuel savings of approximately 10–15 per cent. According to research conducted in Estonia, the expected fuel savings in passenger cars by reducing the speed from 110 to 90 km/h are 5–6 per cent.[2] In 2019, approximately 2,359.5 ktoe of energy was consumed in the transport sector in Lithuania. In road transport, passenger cars consumed roughly 810 ktoe, with freight transport consuming 1,426 ktoe, and public transport – 124 ktoe of fuel.

In order to rapidly and significantly reduce fuel consumption in road transport in the short term, it is appropriate to introduce additional speed limits. The reduction in fuel consumption by changing the speed is shown in Table 2.

[1] https://www.researchgate.net/figure/Relation-between-fuel-consumption-vers-us-average-speed_fig1_262182035

[2] Estonia's Demand Restraint Programme October 2013

Reducing the speed limit on motorways for all road vehicles from 110 to 90 km/h could save approximately **64.1 ktoe** of fuel.

Reducing the speed limit to 80 km/h not only on motorways but also on other roads could save approximately **149.7 ktoe** of fuel.

Table 2. Fuel consumption after reducing speed.

Vehicle type	On motorways	On motorways and other roads
	% of fuel saved by reducing the speed limit from 110 to 90 km/h	% of fuel saved by reducing the speed limit from 90 to 80 km/h
Passenger car, petrol	-7	-1
Passenger car, diesel	-5	-5
Bus, diesel	-1	-5
Freight vehicle, diesel	-1	-5

4. Fuel rationing for freight transport

According to the Lithuanian Confederation of Industrialists, the data of market participants indicate that transit freight transport (hereinafter referred to as freight transport) consumes approximately one fifth[3] (about 20 per cent) of all diesel sales in Lithuania. In 2019, freight transport consumed about 285 ktoe of diesel.

In order to reduce the amount of fuel consumed by freight transport, it is proposed to introduce a limit on the amount of fuel freight transport can buy per fill-up. Banning freight transport from buying a full fuel tank could significantly reduce fuel consumption.

Depending on the manufacturer, the average fuel tank capacity in these vehicles can vary from 470 to 900 litres, so the average fuel tank capacity is assumed to be approximately 600 litres. According to the data and technical specifications provided by manufacturers, the average fuel consumption per 100 km is roughly 30 litres, Table 3. Limiting these vehicles to 150 litres of fuel per fill-up could save approximately **213.9 ktoe** in fuel.

Table 3. Average freight transport fuel consumption per 100 km by manufacturer.

Manufacturer	Fuel consumption l/100 km
Scania	24.9
Volvo	39.0
DAF	30.0
Mercedes	29.0

[3] https://www.lpk.lt/lpk-pateike-pastabas-nacionalinio-oro-tarsos-mazinimo-plano-projektui-tikslas-sveikintinas-taciau-priemones-butina-pamatuoti/

5. Driving ban based on the last digit of the vehicle registration plate

In extreme circumstances, a driving ban based on the last digit of the vehicle registration plate is a fairly simple tool that is fairly easy to implement. In the short term (up to a few months), such a restriction can significantly reduce fuel consumption. It should be noted that the longer such a ban is in place, the less effective it is – more violations occur; if a person has access to other vehicles (has more than one car; family cars; borrows a car, etc.) the number of trips does not decrease; work cars are used.

There are two ways to ban driving based on the vehicle registration plate. The first is where the ban is applied based on the last digit of the vehicle registration plate – from 0 to 9. The second is where the ban is applied based on whether the last digit of the vehicle registration plate is an even or odd number. It is worth noting that this ban is directed only at light vehicles – passenger cars and its impact is evaluated accordingly.

5.1. Based on the last digit of the vehicle registration plate – from 0 to 9

This ban is imposed for 10-day periods, during which each day a different vehicle registration plate end digit is banned from driving. Over the course of the period, theoretically, 10 per cent fewer cars are on the roads. However, it cannot be assumed that fuel consumption is reduced by the same amount. Considering the fact that in Lithuania, an average of 1.7 people use one car, and taking into account the above-mentioned circumstances reducing the effectiveness of the measure, the impact of this ban is likely to be no more than 4.5 per cent.

In 2019 passenger cars consumed about 810 ktoe. The impact of this ban on the reduction of fuel consumption is determined by multiplying fuel consumed (by passenger cars) by 4.5 per cent. This ban could save approximately **36.5 ktoe** of fuel.

5.2. Based on the last digit of the vehicle registration plate – even or odd

This ban applies depending on whether the last digit of the vehicle registration plate is an even or odd number. Cars can only be used on alternating days, based on whether the last digit of the vehicle registration plate is an even or odd number. This means that only half of the vehicles can be on the roads every day. Such a ban could halve fuel consumption, but taking into account the above-mentioned circumstances reducing the effectiveness of the measure, the impact of this ban is likely to be no more than 35 per cent.

The impact of this ban on the reduction of fuel consumption is determined by multiplying fuel consumed (by passenger cars) by 35 per cent. This ban could save approximately **283.5 ktoe** of fuel.

6. Accompanying measures

In addition to the key measures described, which directly contribute to the reduction of fuel consumption, additional indirect measures may also be applied to accompany the key measures. Such accompanying measures help create a more favourable environment for implementation of the key measures, increase their impact, and inform the public about future developments, thus enabling them to prepare in advance and adapt to short-term changes.

6.1. Eco driving

Aspects of ecological and economical driving are included in the theory and practical tests. As part of their driving lessons, future drivers are introduced to the advantages and basic principles of ecological and economical driving: drive at a constant speed for as long as possible, in the highest possible gear and the lowest possible RPM; when driving, select the gear corresponding to the speed and driving conditions so that the vehicle does not begin to slip and the engine is not overloaded; the impact of this kind of driving on the car and its operation; the benefits of gentle acceleration and the importance of tyre condition. By adhering to these principles, fuel consumption can be reduced by roughly 3.8 per cent.

6.2. Restrictions on the movement of passenger and goods vehicles in cities

The introduction of restrictions on the movement of passenger and goods vehicles in cities can further encourage more drivers to choose public transport for their trips. For this purpose, time restrictions may be imposed on access to certain areas of the city, or certain streets may be declared “car-free”, allowing them to only be used for public transport.

6.3. Increased parking charges

In order to encourage drivers to forgo using their own vehicles for trips in the city, in the short term, significantly higher charges can be set for car parks and paid parking spaces. For example, a fivefold increase in charges would deter a significant proportion of drivers from parking in the blue, red and yellow zones. A measure like this could be very unpopular from a political point of view, but by properly informing the public about the need for such a measure, the negative effects can be mitigated.

6.4. Information and recommendations

If fuel supply is interrupted or disrupted, timely, complete and clear information on the situation and the next steps is absolutely crucial. The public must be informed as early as possible so that it is possible to properly plan and prepare for the changes, and foresee additional (collateral) aggravating circumstances.

The recommendations provided must be accurate, understandable, feasible and designed to manage specific situations, solve problems, or prevent them. The importance of their implementation and their results must be emphasised.

7. Results of the measures

One or a combination of measures may be used depending on the situation caused by the interruption or disruption of the fuel supply. The table below shows the impact of all of the key measures to reduce liquid fuel consumption. Total liquid fuel (fuel oil; liquefied petroleum gases; motor gasoline; road diesel; heating and other gasoil; aviation gasoline; gasoline and kerosene type jet fuel; shale oil and other distillates; bitumen; lubricants; refinery feedstocks, semi-finished products of oil refining, additives/oxygenates; paraffin, waxes; naphtha; emulsified vacuum residue; orimulsion) consumption in 2019 (for transformation, in energy sector, for non-energy use and final consumption) amounted to 2,872.2 ktoe, with approximately 2,359.5 ktoe of which was consumed in the transport sector.[4]

Table 4. Measures to reduce liquid fuel consumption and their impact.

No.	Measure	Description	Impact, savings ktoe	Share of savings from 2019 fuel consumption in transport	Share of savings from total liquid fuel consumption in 2019
1.	Promotion of public transport	Public transport ticket prices are reduced (or 100% reimbursed), traffic restrictions are imposed, parking charges are significantly increased	**34.5**	**1.46 %**	**1.20 %**
2.	Promotion of remote working	Compulsory remote working is introduced in the public sector, and it is strongly recommended that municipalities and all of their institutions as well as the private sector follow suit	**47.2**	**2.00 %**	**1.64 %**
3.1.	Speed limits: 110→90 km/h	Speed limits for all cars on motorways	**64.1**	**2.72 %**	**2.23 %**
3.2.	Speed limits: 90→80 km/h	Speed limits for all cars on motorways and other roads	**149.7**	**6.34 %**	**5.21 %**
4.	Fuel rationing for freight transport	150 l refuelling limit for freight transport	**213.9**	**9.06 %**	**7.45 %**
5.1.	Driving ban based on the last digit of the vehicle registration plate – from 0 to 9	This ban is imposed for 10-day periods, during which each day a different vehicle registration plate end digit is banned from driving	**36.5**	**1.54 %**	**1.27 %**
5.2.	Driving ban based on the last digit of the vehicle registration plate – even or odd	Cars can only be used on alternating days, based on whether the last digit of the vehicle registration plate is an even or odd number	**283.5**	**12.02 %**	**9.87 %**

[4] Statistics Lithuania, Indicators database, Fuel commodities balance, updated 2020-11-23.