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transport for quality of life

An Eco Levy for driving: cut carbon, clean up toxic air and make our towns and cities liveable

This briefing identifies why road pricing is necessary to reduce traffic levels and how using the funds raised to support public transport is critical to its success.

Contents

Introduction

This is the sixth in a series of eight papers commissioned by Friends of the Earth on the transport policies that are needed to cut carbon emissions in line with the Paris Agreement.

The first paper showed that we will need to reduce demand for car travel significantly, in addition to a rapid transition to electric vehicles, if we are to limit global warming to 1.5°C above pre-industrial levels[1].

Previous papers have explored how alternatives to driving (i.e. public transport, walking and cycling) should be improved, and how land use planning should be changed, to make this possible.

This paper considers what action is necessary to discourage driving, both in urban areas (which are the main focus of these briefings) and for long-distance travel on the strategic road network. It focuses in particular on the potential for an Eco Levy road pricing scheme to reduce carbon.

It explains why road pricing is needed in both towns and cities and also outside urban areas.

It also reports on evidence on the impact of existing urban road pricing schemes on traffic and carbon. It looks at how road pricing could be designed to be fair and achieve public support, and considers the objectives, framing and design of an Eco Levy road pricing scheme.

Why road pricing is needed in towns and cities

In order to reduce car mileage in urban areas, it is necessary to make walking, bike and public transport attractive and viable options. But these on their own are not enough. Even where a viable alternative to driving is available, many people still travel by car. This is partly a result of habit and social norms – we drive today because we drove yesterday. So although good non-car options are necessary, they are not on their own sufficient to stimulate a society-wide change in how people travel.

Charging for driving prompts people to think twice, and to switch to non-car modes of travel for a significant proportion of their trips. This can reduce urban traffic volumes by as much as a fifth (and sometimes more). For example, Stockholm introduced a congestion charge for driving into the city centre in 2006. A few months before the charge came in, the city made major improvements to public transport, including more frequent rush hour services, 16 new bus routes to the city centre, 14 new express bus routes and 1500 new park-and-ride parking spaces at railway stations[2], [3].

The evaluation of the Stockholm congestion charging scheme found that although this expansion of public transport was a prerequisite for charging, on its own it had little effect. However once the congestion charge came into force five months later, there was an immediate reduction of nearly a fifth (19%) in the number of vehicles crossing the charging ‘cordon’ around the city centre. Traffic in the inner city fell overnight by more than 15%. Carbon emissions fell by a similar amount[4].

In other words, Stockholm residents needed a disincentive to drive in order to prompt them to try the alternatives.

The existence of a charge for driving is more important than its size. As one academic review puts it: “in the relationship between charge levels and traffic volumes, there seems to be a discontinuity at the number zero.”[5]

The increase in the congestion charge in central London from £5 to £8 per day in 2005 led to only about a third of the impact that might have been expected from the response to the original charge in 2003.

In Stockholm and Gothenburg, where the congestion charge varies by time of day, traffic fell by the same amount in the off-peak period as during the rush hour, even though the charge was lower.

This means that even quite modest charges may stimulate significant change – it is the fact of having to pay *at all* that makes a proportion of people reassess their transport options.

Local authorities in the UK have had powers to charge for road use for nearly 20 years, but it has only happened in London[6], where Mayor Ken Livingstone introduced the central London congestion charge in 2003, and Mayor Sadiq Khan introduced an emissions charge (the Ultra-Low Emission Zone) in the same area of central London in 2019.

Attempts to bring in road pricing in Edinburgh in 2005 and Manchester in 2008 were abandoned after local referendums voted against them. A proposed scheme in Cambridge was also dropped in 2008.

However since then, experience in other cities (described below) suggests that it is possible for political leaders to win public support for road pricing, and that it is time for UK towns and cities to look at this policy tool again.

Nevertheless, the need for rapid action on climate change means that we do not have the luxury of waiting for each local authority to pluck up the courage to bring in a charge for driving. This means that government leadership is also required to make it a legal obligation for all urban areas to introduce road pricing within the next five years. The only exception to this should be if a local authority can meet climate targets[7] in another way (for example, some towns might adopt a non-residential parking levy[8], similar to the workplace parking levy in Nottingham[9]).

This obligation should be coupled with up-front funding from government to enable towns and cities to rapidly improve their public transport and to build a high quality cycle network, so there are good alternative options for people to use before road pricing comes in.

Why road pricing is needed outside urban areas

There is also a strong case for a national road pricing scheme. Only about a third of carbon emissions from cars are in urban areas, and in order to meet the terms of the Paris Agreement, it is necessary to also cut car mileage for motorway travel and travel in peri-urban and rural areas.

Introducing a national road pricing scheme that is applicable to all roads is fraught with difficulty[10]. The urgency of action to tackle climate change is such that it would be better to adopt a more limited and tightly-defined scheme that could be introduced quickly.

We therefore believe that the government should bring in distance-based road pricing on the strategic road network (SRN) i.e. motorways and trunk 'A' roads controlled by Highways England. This has the advantage that it is a relatively 'bounded' task[11], and is an achievable next step from the successful congestion charging scheme in London.

We argued in a previous paper[12] that Highways England's role should be changed, and that it should be given a target to reduce carbon emissions from the SRN. Road pricing would be an effective way to do this - by making long car trips more expensive, it would encourage people to consider travelling by train.

Road pricing on the SRN would have more impact, and be more acceptable to the public, if train fares were reduced and simplified at the same time. Indicatively we estimate that even a modest 6p per km charge for cars to use the SRN might reduce car mileage on motorways and trunk roads by around a quarter, while at the same time raising enough revenue to halve all rail fares[13].

One potential objection to road pricing on the SRN is that it would result in some traffic diverting to other roads. We therefore believe that local authorities should be able to opt in to a Highways England road pricing scheme, so that over time, more roads and areas would become part of it.

Because electric cars do not pay fuel duty, the shift from petrol / diesel to electric cars over the next 10-20 years will substantially reduce the cost of driving. If not addressed, this fall in the cost of driving will increase car mileage, which in turn will cause more congestion (and hence pressure for more road-building), more road crashes, and other negative impacts. A road pricing scheme on the SRN could eventually be extended to include all roads, and to replace fuel duty, to prevent these negative impacts.

Even with strong government leadership, introducing road pricing on the SRN will take several years. In the meantime, fuel duty is an important tool to constrain driving and reduce carbon emissions. However, the Chancellor has frozen fuel duty in cash terms since 2011 – which means that in real terms (allowing for inflation), fuel duty has fallen[14]. The price of fuel at the pump is now 13% lower than it would have been without the freeze. As a direct result of this traffic has grown by 4%[15]. The government has repeatedly said it will increase fuel duty in line with inflation in the next Budget but this commitment has repeatedly been broken[16].

At the very least, fuel duty should be increased to keep pace with inflation. But there is a strong argument for above-inflation increases in fuel duty as an interim measure before road pricing is brought in. The money raised would be substantial - a 1% above-inflation rise in fuel duty each year for the next five years would raise about an extra £280 million in the first year, rising to £1.4 billion in

the fifth year. This could be used to reverse the cuts in bus services that have happened over the last decade, giving people an immediate alternative to driving.

How much difference would road pricing make?

Schemes in central London, Stockholm, Gothenburg, Milan and Singapore, summarised below, provide evidence about the impact of road pricing in urban areas.

The lesson from all these cities is that road pricing can be a highly effective way of reducing the negative impacts of traffic.

SINGAPORE

Area Licensing Scheme (ALS) introduced in 1975, under which drivers paid a daily charge to enter central area (6 km^2). Replaced in 1998 by electronic road pricing, with a toll that varied by time of day and vehicle type each time a vehicle passed a control point. In 2020, the system will change to a GPS-based charging system with vehicles charged per km driven[17].

The ALS reduced traffic entering central area by 44% initially. By 1988, traffic was 31% less than before ALS. Electronic road pricing caused a further drop in traffic in the central area of 10-15%. This was because people who had previously driven to work and used their car for travel during the day switched to public transport for some trips[18].

LONDON

Congestion charge introduced in central London (22 km^2) in 2003. Drivers are liable if their vehicle travels inside the charging zone between 7am and 6pm[19]. An additional 'toxicity charge' for driving in the same area was introduced in 2017. Since April 2019 drivers of the most polluting vehicles pay an extra charge inside the same area (the Ultra-Low Emission Zone, ULEZ). This operates 24 hours a day.

The traffic entering the charging zone during hours of operation fell 18% initially, and 21% by 2007. Impact was biggest for cars (-36% by 2007); less pronounced for vans (-13%) and lorries (-5%). Carbon emissions from traffic inside the charging zone fell 16%, partly because there was less traffic and partly because remaining traffic flowed more freely[20].

STOCKHOLM

Congestion charge introduced in central Stockholm (35 km^2) in 2006, initially as 6 month trial. Scheme was made permanent after referendum. Charge is payable 7.30-6.30pm, and is higher during rush hour. It is levied on vehicles as they enter or leave the charging zone[21], [22].

The traffic entering /leaving charging zone fell 20%. Traffic inside charging zone fell 15%, and carbon emissions 14%. Car commuter trips into the zone fell 24%, mostly due to commuters switching to public transport. Trips for other purposes fell by similar amount (22%), mostly due to drivers changing destination or travelling less often[23], [24], [25].

MILAN

Pollution charge (known as Ecopass) introduced in city centre (8km^2) in 2008. Charge applied to vehicles as they entered central area; varied according to vehicle type, with no charge for cleanest vehicles. From 2012, the scheme changed to a congestion charge, applied to all vehicles ('Area C'),

but most polluting vehicles banned. From February 2019, ban on most polluting vehicles extended to much larger area (129 km^2, 'Area B')[26], [27].

The number of vehicles entering the city centre fell 47% between 2007 and 2017. There was a large increase in the number of people using the Underground, with counts at subway exits inside the charged area increasing by 12%[28], [29].

GOTHENBURG

Congestion charge introduced in 2013 and made permanent (even though rejected by small margin in a referendum) in 2014. Charge is levied on vehicles each time they cross cordon around city centre or one of two lines that radiate from cordon. Payable 6am-6.30pm; higher during the rush hour[30].

The traffic passing control points during charging hours fell 12%, and traffic on key roads inside charging area fell 9%. Commuters mainly responded by switching to public transport, while other travellers adapted by changing destination or travelling less often. Public transport ridership increased 7% between 2012 and 2013, with most of this increase due to congestion charge[31], [32], [33].

Some of these schemes are principally designed to reduce congestion. Others are intended to improve air quality by imposing higher charges on more polluting vehicles. No road pricing scheme has as yet had a main purpose of reducing carbon emissions.

Nevertheless the carbon reductions of these schemes are significant. Carbon savings of 14-16% are reported inside the London and Stockholm charging zones. Traffic reduction varies from 9% (within the charging zone in Gothenburg) to 47% (number of vehicles entering Milan city centre).

Effects on car driving are usually larger than the overall effects on all traffic. For example, in London the number of cars entering the congestion charging zone fell by 36% by 2007, compared to 13% for vans and 5% for lorries[34].

The cities listed above charge motorists for driving within a particular area, or crossing a control point, but the charge is not based on distance driven. This will change when the Singapore GPS distance-based charging scheme is introduced in 2020[35].

Distance-based schemes are better suited to charging drivers according to their actual environmental impact. For that reason they have recently been described by the Centre for London as 'simpler, smarter and fairer'[36]. They mean that a driver who only drives a short distance on an essential trip pays very little, and people who drive a lot pay more. Charges could also be graded according to the fuel consumption of the vehicle and the time of day. These second generation road pricing schemes could therefore be an even more effective way of reducing carbon emissions than the current area-based schemes.

It's worth noting that in all five cases summarised above, road pricing was introduced as part of a package of measures, and the revenue raised has mainly been used to improve public transport. For example, the Ecopass scheme in Milan was accompanied by new bus lanes, more frequent bus services and traffic calming[37]. As noted above, the Stockholm scheme was preceded by improvements to bus services, and over the longer term the revenue from the scheme is earmarked for metro and train investments[38]. In London, the proceeds from the congestion charge are typically allocated to bus priority and walking and cycling schemes, improving the accessibility of public

transport, fares reductions and similar measures[39].

This link between road pricing and public transport enhancements is important in increasing public support and also increases the effectiveness of the schemes.

Can road pricing be a vote winner?

Politicians are reluctant to introduce road pricing because they are concerned that it will be unpopular. But there is evidence to suggest that once people have experienced a road pricing scheme, their support for it increases.

In London, the proportion of residents supporting or opposing the congestion charge was evenly balanced in the three months before its introduction, with just under 40% supporting and just over 40% opposing it, as shown in monthly surveys. Once it began, support in monthly surveys increased to 48-59% and opposition fell to 24-31%[40]. Around two-thirds (68%) of Londoners felt that they had gained from the congestion charge or it made no difference to them, whereas only a quarter (25-28%) felt they were worse off. This result was consistent across central, inner and outer London. The groups most likely to say they had gained or were not affected were young people, older people, those on a low income and women[41], [42] – that is, the groups that politicians are most concerned about from an equity perspective.

In Stockholm, 40% of residents supported the congestion charge shortly before it was introduced, but this rose to 53% nine months after its introduction, and 70% seven years later[43]. In Gothenburg, public support before the charges were introduced was just 27%, but this rose to 45% in the congestion charging referendum in 2014, and 51% in a poll at about the same time.

While both Swedish cities showed increasing support after road pricing was introduced, the lower absolute level of support in Gothenburg may have been partly because it is a more car-dependent city than Stockholm (with a public transport mode share of 26% for commuter trips, compared to 77% in Stockholm). It may also be because the revenue raised from the Gothenburg scheme was earmarked for a rail tunnel under the centre of the city, the West Link, which was a focus of significant opposition[44].

There is also evidence that media support for road pricing can shift once the effects of it are seen. In Stockholm, headlines changed from highly negative (e.g. “Congestion charging: even more chaos for road pricing”) in December 2005 to very positive (e.g. “Stockholmers love congestion charging – People have realised the advantages – The dirge has turned into hymns of praise”) in January 2006. The proportion of negative articles fell from 39% in autumn 2005 to 22% in autumn 2006, while the proportion of positive articles rose from 3% to 42%[45], [46].

One reason why support grows after the introduction of road pricing is that people can see that it works. In Stockholm, a large survey after the congestion charge had been in place for a year found a high degree of agreement that the scheme had reduced congestion and improved air quality[47]. Survey respondents said that the congestion charge had more positive effects than they had expected (easier parking, less congestion, less pollution) and cost them less than they had expected [48]. The effects of the charge were plain to see: on approach roads to the city centre, queue times decreased by a third in the morning rush-hour and were halved in the afternoon rush hour[49].

A further reason for support is that in practice, a fairly small proportion of households are responsible for a large share of total miles driven (and hence charges paid, and carbon emissions)[50]. For most people, the additional cost of road pricing is fairly modest.

In one intensively-studied two-week period, nearly half of all privately-owned cars in Stockholm County incurred at least one charge for entering the charging zone. But 75% of the congestion charges paid by private vehicles originated from just 5% of the county's residents, and a third of the charges paid by private vehicles came from just over 1% of residents[51]. In other words, there are more winners than losers.

This is reinforced if the revenues are used to improve public transport, reduce fares, and improve the city environment. The winners tend to be people on lower incomes, young people, single people and women, who pay relatively few congestion charges (on average) and use public transport more than other groups[52].

Looking across numerous studies, the key factors that determine whether a road pricing scheme is publicly acceptable are that the rationale for it is clearly explained and justifiable; that it is perceived to be fair; that it is easy to understand; and that it is effective. Public acceptance increases if road pricing is combined with other measures that improve alternatives to driving, and if people feel adequate alternatives already exist[53], [54], [55], [56], [57], [58].

The most often-mentioned factors leading to successful implementation of the London congestion charge are that it was part of an integrated transport strategy; it was coupled with increased investment in an already well-functioning public transport system; and that the Mayor Ken Livingstone showed strong leadership. The design of the scheme was pragmatic, with the views of stakeholders being taken into account and exemptions and modifications made to the design of the scheme during its development[59].

A road pricing scheme is more likely to be politically achievable early in the electoral cycle, so that politicians are not facing an election at the moment when support is lowest, just before a scheme is introduced[60].

A key determinant of success in London was that there had been good preparation for the scheme (through a technical study into road charging options for London, ROCOL, which was undertaken before the mayoral election), enabling Ken Livingstone to press ahead with implementing the congestion charge immediately after he became Mayor[61].

Objectives, framing and design

A road pricing scheme will only command public support, and be effective in cutting carbon emissions, if it has the right objectives, framing and design.

What's the objective?

In contrast to the schemes described above, some road pricing schemes have the primary objective of raising funds for road construction and maintenance. Many European countries use motorway tolls for this purpose, and in Norway, more than 100 local toll schemes have been implemented with this aim, including some in cities62.

When the first urban toll ring scheme was introduced in Bergen in 1986, almost all the net income was used for road construction, although priorities later shifted so that about half of the income was used in this way. Although the Bergen toll resulted in a small initial reduction in traffic of about 6%, the infrastructure that was built with the toll income facilitated further traffic growth63.

The RAC has argued for road pricing on all UK roads, replacing fuel duty, with some of the income used for road-building64. From an environmental perspective, it is nonsensical to use revenues from road pricing in this way because road-building generates traffic (therefore increasing carbon emissions), as the Norwegian example shows. In any case, road pricing obviates the 'need' to build more roads because it can match traffic volume to the available road capacity.

In the past, a national road pricing scheme with the dual objectives of replacing declining fuel duty revenue and reducing congestion has been proposed. Proponents of this scheme argued that it should increase the cost of driving in congested urban areas but should be fiscally neutral (ie should not increase the total tax paid by drivers). A scheme with these objectives would be problematic because it would make driving in rural areas cheaper, and hence result in more traffic, more carbon emissions, road casualties, noise, pollution and community severance in these areas65.

These examples suggest that road pricing in urban areas and on the SRN should have the explicit **objective of cutting carbon emissions** and improving the environment. This is not compatible with an objective of raising money for more road infrastructure. Similarly, a scheme on the SRN (or a national scheme covering all roads) will not be effective if its objective is confined to reducing traffic in the most congested areas.

What's the framing?

Over the last two decades, almost all the discussion about road pricing in the UK has been framed in terms of congestion-relief, or as a way of dealing with the impending decline in fuel duty or raising money for roads. The problem with this rather technocratic framing is that it doesn't strike enough of a chord with voters. It's too much about efficiency and not enough about values. Drivers may find congestion annoying, but it isn't an issue that stirs the heart.

However, if road pricing is framed as a way of tackling climate change, cleaning up toxic air, and making towns and cities healthier and more liveable, many more people will care strongly about it, and that will create the space for politicians to act66, 67.

It's notable that the recent introduction of the Ultra-Low Emission Zone in London received strong support from groups like Mums for Lungs. Just before ULEZ came in, the focus of London's Evening Standard was on the fact that 'more than 800 parents, doctors and teachers have written to Mayor Sadiq Khan urging him to expand the zone to cover the whole of Greater London.'[68]

Similarly, the Ecopass scheme in Milan, which was initially framed as a clean air measure, received one of the highest levels of popular support of any of the schemes described in this paper. In a 2011 referendum, 79% of voters supported a proposal for it to be extended to all vehicles and widened to cover more of the city, alongside improvements to public transport, with the aim of halving traffic and pollution[69].

Other evidence shows that a framing of 'achieving environmental improvements' has the most positive impact on levels of support. Earmarking the income from road pricing to improve public transport is more popular than using it as a way of raising tax[70], [71].

Residents are more likely to support a scheme to improve the environment than a scheme to finance infrastructure[72]. In Gothenburg, the linkage of the congestion charge to a big project, the West Link rail tunnel, reduced its popularity (even though the rail tunnel was supported by politicians and business leaders)[73].

In Stockholm support for the congestion charge fell in 2016, partly because the revenue is starting to be used for 'mega-projects' which will take a long time to complete and offer no immediate benefits[74].

This suggests that **framing road pricing as an Eco Levy** is likely to result in more support (and therefore a greater chance of implementation) than framing it as a congestion charge or a way of raising money for big infrastructure schemes.

How should an Eco Levy for driving be designed?

The evidence from the road pricing schemes discussed above provides some pointers about how an Eco Levy should be designed so it has maximum effect on carbon emissions and receives public backing:

1. There should be **up-front investment in public transport** in the months before an Eco Levy is introduced.

2. The **revenue should be invested in quick wins** that further improve the alternatives to driving. These include more bus services; cheaper fares (or free bus travel); segregated cycle lanes; and street improvements to create great spaces for walking.

3. The scheme should be **simple and easy to understand[75]**. The levy should apply 24-hours a day, 365 days a year. It should be distance-based, like the scheme that will be introduced in Singapore in 2020, and should apply to all driving throughout a built-up area (ie all types of roads). It should be lower for battery electric vehicles.

4. It's important to design the scheme in a **flexible** way, making exemptions and adjustments to achieve wider buy-in.

However, assuming an Eco Levy covers a whole city, as opposed to a city centre, blanket exemptions for residents won't work, since that would make most car mileage exempt. In Milan, where the new 'Area B' scheme covers most of the city, residents with more polluting cars are permitted to use their cars in the city on a certain number of days per year (50 in 2019; 25 in 2020) before they become liable for a penalty charge. With a distance-based Eco Levy, residents could be given a certain number of 'free miles' each year[76]. These could be supplemented by a certain number of free trips by public transport each year.

5. Once it has been implemented, the impacts of the levy on traffic, carbon emissions, air quality, use of public transport, and people's perceptions should be monitored and communicated, so **residents understand the benefits** and can see that other people like them support the scheme.

6. The government should **provide support to the first local authorities** to implement an Eco Levy for driving. Alternatively, a leading city – such as London – could set up the systems for a distance-based Eco Levy, and share or sell their expertise to other local authorities (as well as implementing the levy itself). This would be quicker than each local authority implementing a levy independently, and would have the benefit for drivers that the technology and payment method would be the same everywhere.

Conclusions

The following are must-do actions to reduce transport carbon.

Urban areas should implement a distance-based Eco Levy for driving within five years. The government should make this obligatory, as a means of achieving local carbon budgets.

The government should provide up-front funding to urban areas immediately to enable sustainable transport alternatives to be improved in preparation for the Eco Levy.

The money raised from the levy should be invested in more bus services, cheaper fares (or free bus travel); segregated cycle lanes and street improvements for walking.

Highways England should be required by government to introduce an Eco Levy on the SRN, with the money raised being used to reduce rail fares, providing an attractive alternative for long-distance travel.

Notes

1.We estimate car mileage will need to be reduced in the order of 20-60% by 2030 compared with 2016 levels, depending on a range of factors such as the rate of uptake of electric cars, improvements in conventional car emissions, and rate of decarbonisation of the power grid. Hopkinson L. and Sloman L. (2019) More than Electric Cars: Why we need to reduce traffic to reach carbon targets. Briefing for Friends of the Earth.

2.Swedish Road Administration (2006) Trial Implementation of a Congestion Tax in Stockholm

3.Schuitema G., Steg L. and Forward S. (2010) Explaining differences in acceptability before and acceptance after the implementation of a congestion charge in Stockholm Transportation Research Part A, 44, 99-109

4.City of Stockholm (2006) Facts and Results from the Stockholm Trials Final Version December 2006

5.Lehe L. (2019) Downtown congestion pricing in practice Transportation Research Part C, 100, pp200-223

6.Strictly speaking, there is also a small scheme in Durham, introduced in 2002, but it applies to just one street.

7.We argued in a previous paper that government should set budgets and targets for carbon emissions from transport for local authorities, aligned with national budgets and targets for transport carbon. Hopkinson L. and Sloman L. (2019) Getting the Department for Transport on the right track (weblink to be added). Briefing for Friends of the Earth.

8.This would be like the workplace parking levy that was pioneered in Nottingham in 2012, but the law should be changed so it can also be applied to parking at supermarkets, leisure centres, visitor attractions and other destinations. Flack S. (2018) Workplace parking levy in Nottingham - and more...

9.Flack S. (2018) Workplace parking levy in Nottingham - and more....The levy in Nottingham is paid by all employers with more than 10 commuter parking spaces. Employers can choose whether to pass on the charge to their employees: amongst the biggest employers, eight out of 10 do this. The money raised from the levy (about £10 million per year) has enabled Nottingham council to develop a tram network; improve the railway station; buy a fleet of electric buses for a network serving the city's main employment sites, hospitals and universities; and provide sustainable travel grants to employers. Since Nottingham council introduced the levy and public transport improvements, trips by public transport have increased by 15%, and traffic volumes have fallen by 9%. In fact, Nottingham achieved the largest reduction in traffic mileage per person of any English local authority outside London in the five years to 2015 (Sloman L., Cairns S., Goodman A., Hopkin J., Taylor I., Hopkinson L., Ricketts O., Hiblin B. and Dillon M. (2018) Impact of the Local Sustainable Transport Fund: Synthesis of Evidence Report to Department for Transport).

10.Difficulties are not so much technical as political and strategic, as discussed

11.Walker J. (2011) The Acceptability of Road Pricing RAC Foundation.

12.Hopkinson L. and Sloman L. (2019) Getting the Department for Transport on the right track (weblink to be added). Briefing for Friends of the Earth.

13.Car / taxi traffic on the SRN was 111 billion vehicle km in 2017, according to TRA4111 Strategic road network traffic, and income from passenger fares on the rail network was £9.7 billion in 2016/17, according to Office of Rail and Road (2018) UK rail industry financial information 2016-17. We assumed each 10% increase in the combined cost of fuel and

road user charges reduces miles driven by 3% (i.e. an elasticity of -0.3, in the mid-range of fuel price elasticity estimates quoted by Road traffic demand elasticities); a cost of petrol of £1.21/litre; and average new car fuel consumption of 5.5l per 100km (by the time road pricing is introduced, this will be the average fuel efficiency). Using these assumptions, a 6p/km charge for cars on the SRN would reduce car distance by 27%, and raise £4.9 billion per year, sufficient to halve the cost of rail travel. A 6p/km charge is equivalent to about the price of a cup of coffee (£2) added to the average 33km daily commuter return trip, or about £316 per year for an average car mileage of 5272km/year. It would be feasible for about three-quarters of the avoided car mileage to switch to rail: assuming average car occupancy of 1.55, we estimate this would increase rail passenger mileage in England from roughly 60bn km to roughly 95bn km (similar to the increase in rail passenger mileage in the last 25 years). It would require investment in upgraded line capacity and new rail lines, and increased train frequencies. Some of the avoided car mileage might switch to long-distance coach; some might have higher vehicle occupancy (e.g. through car sharing for commuting); and some destination substitution would also be likely to take place (e.g. driving to a nearby shopping centre rather than a more distant one).

14.House of Commons Library (2018) Taxation of road fuels. Fuel duty for petrol and diesel has been 57.95p per litre since 2011.

15.Begg D. and Haigh C. (2018) The unintended consequences of freezing fuel duty.

16.Office for Budget Responsibility Fuel duties: policy measures accessed 31.03.2019. Planned fuel duty increases have been announced and then cancelled 13 times since 2010.

17.Lehe L. (2019) Downtown congestion pricing in practice Transportation Research Part C, 100, pp200-223

18.Chin K. (2005) Road pricing - Singapore's 30 years of experience

19.Lehe L. (2019) Downtown congestion pricing in practice Transportation Research Part C, 100, pp200-223

20.Transport for London (2008) Central London congestion charging impacts monitoring: sixth annual report.

21.Börjesson M., Eliasson J., Hugosson M. and Brunell-Freij K. (2012) The Stockholm congestion charges – 5 years on. Effects, acceptability and lessons learnt Transport Policy 20, 1-12

22.Eliasson J. (2014) The Stockholm congestion charges: an overview Centre for Transport Studies, Stockholm Working Paper 2014:7

23.Börjesson M., Eliasson J., Hugosson M. and Brunell-Freij K. (2012) The Stockholm congestion charges – 5 years on. Effects, acceptability and lessons learnt Transport Policy 20, 1-12

24.City of Stockholm (2006) Facts and Results from the Stockholm Trials Final Version.

25.Trivector Traffic (2006) Changes in travel habits in Stockholm County: effects of the Stockholm trial.

26.Cavallaro F., Giaretta F. and Nocera S. (2018) The potential of road pricing schemes to reduce carbon emissions Transport Policy 67, 85-92

27.Lehe L. (2019) Downtown congestion pricing in practice Transportation Research Part C, 100, pp200-223

28.Lehe L. (2019) Downtown congestion pricing in practice Transportation Research Part C, 100, pp200-223 reports that the number of vehicles entering the city centre fell from 159,000 per day in 2007 to 85,000 per day in 2017.

29.Croci (2016) Urban road pricing: a comparative study on the experiences of London, Stockholm and Milan Transportation Research Procedia, 14, 253-262

30.Börjesson M. and Kristoffersson I. (2015) The Gothenburg congestion charge. Effects, design and politics Transportation Research Part A, 75, 134-146

31.Börjesson M. and Kristoffersson I. (2018) The Swedish congestion charges: ten years on Transportation Research Part A, 107, 35-51

32.Börjesson M. and Kristoffersson I. (2015) The Gothenburg congestion charge. Effects, design and politics Transportation Research Part A, 75, 134-146

33.West J. and Börjesson M. (2018) The Gothenburg congestion charges: cost-benefit analysis and distribution effects Transportation, 1-30

34.The smaller impact on vans and lorries probably reflects the fact that there were fewer alternative options for making deliveries and transporting goods than there were for personal travel (although, with the advent of e-cargo bikes, this could change).

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