**Electronic Road Pricing for Oxford**

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**Introduction: Oxford as a UK trial of Electronic Road Pricing**

Oxford is a successful community with high levels of employment year on year, two universities that are expanding significantly over time and substantial areas of well used green spaces of all kinds. It is also home to terrible traffic congestion in rush hours, serious air and noise pollution in a number of areas and high levels of car parking spaces within the City which attract substantial traffic movements. Traffic growth is continuing. Two hundred buses each hour pass each other on the High Street, meaning 17 every minute on average on weekdays. The concentration of public and private enterprises in the City create high volume traffic movements. An economically successful City inevitably means more delivery vehicles for homes, public institutions and businesses, and a lot of taxis. Measures taken to date which might have reduced the negative effects of expanding traffic such as new cycle routes, bus service provision, controlled parking zones and train services have yet to have the levels of investment necessary to reduce the comprehensive burden of traffic in Oxford.

This paper argues that there is nothing inevitable about the current crisis in Oxford’s overall transport situation. It suggests Electronic Road Pricing offers a means of dealing with traffic levels and potentially addresses the need for more funds for investment in sustainable travel options within Oxford. Given the levels of use of trunk roads which serve or are proximate to Oxford, the paper suggests these roads should be within an Electronic Road Pricing scheme covering the City. This can help to reduce traffic and make better use of existing capacity, eg on the A34/A40. This initiative could be considered as a UK trial project, or be introduced in several locations with high traffic density at once.

Since Electronic Road Pricing is intended to reduce traffic on some routes and create income for the road system, it is highly compatible with improving infrastructure for cycling and walking. It therefore should be considered alongside the recent report advocating £150 million of spending to assist cycling in the Oxford area, prepared by Andrew Gilligan for the National Infrastructure Commission.[[1]](#footnote-1) This report also, in its Oxford section, provides a very concise picture of current walking, cycling and traffic conditions in Oxford.

**The UK and Electronic Road Pricing(ERP)**

John Walker did a substantial report on ERP for the RAC in 2011.[[2]](#footnote-2) This exhaustive 157 page report provides a positive case for ERP which can be considered a definitive introduction to its benefits for the UK as a whole. Serious investigation into implementing ERP in Oxford and environs should make use of its detailed analysis, which is not summarised here as it needs to be assessed by those engaged in implementing an ERP scheme in Oxford, alongside the Gilligan report mentioned above. It is also worth noting:

**Extracts from :**

Department for Transport - Feasibility study of road pricing in the UK - Full report

“National road pricing could meet the Government’s objectives

7.11 We believe too that a national road pricing scheme which went live in ten or so years’ time could meet the various objectives that the Government set when commissioning this study - in summary:

more efficient pricing fairness, respect for privacy and promoting social inclusion and accessibility

higher economic growth and productivity for all regions of the UK environmental benefits.

7.12 The ability to meet these objectives would, however, depend on a number of factors about the way it was developed and applied.

7.13 First, it would require a recognition that setting prices and the boundaries between different price levels requires considerable knowledge of localised conditions - the nature of the traffic affected, and the land-use and demographic patterns in the vicinity. Getting these wrong could potentially give incentives to undertake longer journeys, or impinge unfairly on different sectors of the population. We also need to understand better than we do today how different road users would respond to different price signals., recognising that individuals are likely to respond differently depending on the particular circumstances of the trip they are making.

7.14 Second, road pricing is not a complete answer in itself. It is a means of making better use of existing capacity, and as such it is part of the toolkit for addressing the pressures on the road network from congestion and environmental issues. There is no point in trying to use prices to influence behaviour if there is no viable alternative. At different times and places, and for different road users, these alternatives will be to travel at a different time, to travel at the same time but in a different way or to undertake the activity concerned by a different means, such as internet shopping and tele-conferencing. If these options were not available, the result would simply be to disadvantage those less able to pay.

7.15 Hence, road pricing needs to be part of a package of measures. The key is to use pricing as an

incentive to lock in the benefits of other measures, so that the reduction in congestion brings the widest possible benefits. These other measures include better land-use planning, to reduce the distances that need to be travelled, better public transport which can gain from less congested roads, and other supply-side measures such as additional road capacity where possible, school transport and car-sharing schemes.

7.16 We believe that there are sufficient numbers of road users who could, if the right opportunities were available, change their time or way of travel in response to pricing without serious inconvenience to themselves, and in return gain a better overall transport experience.

7.17 Third, we need to recognise the scale and complexity of any system that would deliver road pricing, and the large degree of change that it would bring about. This suggests that the introduction of national road pricing would be a major delivery challenge, and would not be suitable for a ’Big Bang’ approach. A period of transition would almost certainly be necessary. This would require more thought at a future date.

7.18 If the Government was persuaded of the case for going in the direction of national road pricing, it would be neither appropriate nor necessary to commit to a given timetable or technological solution right now - there are too many uncertainties. But it would need to be driving the agenda, not waiting for local or regional government to make the first moves, but actively working with them, making sure that all the necessary pieces of the jigsaw come together in the right way.

7.19 Fourth, we must recognise that in this Study it was never going to be possible to bottom every single issue, particularly regional differences, and factors such as social inclusion which are very specific to local circumstances. A good deal more preparatory work remains to be done, and we believe there is a good case for that work to follow hard on the heels of this Study.

7.20 Clearly there is a good deal of work to do if road pricing is to become a reality. The Government must accept that it cannot do all this work itself. If it wishes to make road pricing possible, central Government will need to take a lead, and commit to working in a new way over a sustained period across the different tiers of Government, and across administrative boundaries.”[[3]](#footnote-3)

**Is there a mature, working model of Electronic Road Pricing?**

*The Singapore model*

Singapore was the first country to adopt a complete country wide electronic road pricing system, in September 1998. Extensive documentation about the experience there is available in English, on line.

Extracts:

“ERP is an **Electronic Road Pricing System** used in **managing road congestion**. Based on a pay-as-you-use principle, motorists are charged when they use priced roads during peak hours.

ERP rates vary for different roads and time periods depending on local traffic conditions. This encourages motorists to change their mode of transport, travel route or time of travel.

What are its benefits?

* **Minimises traffic volume** in heavily used roads in the CBD and Orchard areas, as well as major expressways.
* **Optimises usage of the road network** by encouraging motorists to consider alternatives.
* **Provides a fair price for motorists.** Charges are based on usage—those who use the roads pay more; while those who use the roads less frequently or who travel during non-ERP hours pay less or don’t need to pay at all.
* **No more monthly/daily licences.**  Motorists no longer need to buy paper licences to drive through high traffic areas in the CBD.
* **No human error.** ERP’s reliable and fully automated system operates 24 hours. Its central computer system ensures gantries are always working properly.”

## “Why do we need ERP?

Traffic congestion is costly to the individual and society. It results in the loss of productive hours, environmental pollution, wasted fuel and adverse health effects. To keep traffic moving, LTA will continue with a holistic and integrated approach using all the tools available, including building more roads, regulating vehicle growth, implementing traffic engineering solutions and promoting the use of public transport. In addition to the various measures, we also need to manage traffic demand through ERP.
With more vehicles on the road, ERP remains effective in addressing current and future traffic conditions and ensuring motorists continue to have a smooth journey.’

<https://www.lta.gov.sg/content/ltaweb/en/roads-and-motoring/managing-traffic-and-congestion/electronic-road-pricing-erp.html>

Lessons from the Singapore experience(2010):

p.4:

“The ERP system starts with the installation of in in-vehicle unit (IU) in each of the ~900,000 vehicles in Singapore. The IU is about the size of a small pocket diary ( a new one costing about S$155) and is powered by the vehicle battery. It is fixed permanently to the right bottom corner of the vehicle's windscreen by a bracket glued on by very high bond tape. The motorcycle IU that has a protective covering to prevent rainwater seeping in is fixed permanently to the front of the machine (e.g. on handlebar). The IU needs a direct line of sight to the radio antennae on the two gantries for effective communication.’

p.5

“The IU’s are color coded for different types of vehicles because the ERP charges vary for them and this is to prevent the IU’s from being switched around . The vehicle classes are cars, taxis, motorcycles, light goods vehicles, , heavy goods vehicles, buses and emergency vehicles. The emergency vehicles are exempt from the ERP charge.’ &

“Initially, the ERP only operated on weekdays. The ERP payment is made via a stored value on an integrated chip contact card (or smartcard), called CashCard, issued by NETS, a company owned by a consortium of seven local banks. The stored value can vary from S$20 to S$500. There is a $2 deposit fee, which is refundable if the card is returned. The card is available at banks, convenience stores and petrol stations. It can be topped up at many of the automatic teller machines. The CashCard plastic is able to withstand the high temperatures (e.g. 4 to 5 hours continuously at high temperatures) experienced inside the vehicle, when it is parked under the hot sun for long periods of time. Since 2009, modified IUs accepting both contact and contactless cards………………. are available.’

p.8:

“In summary, the ERP system has more than met….expectations. It is easily understood by the motorist, easy to use, technically sound and reliable. It has attained its objective of restraining traffic flow. The initial traffic monitoring showed that traffic volumes on the expressways reduced by 15% and speeds increased from 35 to 55 kph during the ERP hours, especially during the morning rush hours, when a reduction of ~14% was observed and resultant improved traffic speeds. There was a 16% reduction in traffic in the Restricted Zone and speeds were respectable between 25-35 kph. With ERP, motorists are given many choices such as paying the ERP charge, changing the time of the journey to pay a lesser charge, changing mode of travel or changing route to avoid the ERP charge.’

 <http://www.environmentportal.in/files/ERP-Singapore-Lessons.pdf>

**What are the advantages of ERP in the UK and Oxford contexts?**

**UK:**

Since transport, including aviation and shipping, remains the major contributor to UK greenhouse gas emissions, ERP may be considered as a means of cutting greenhouse gas emissions in areas of highest road transport use. Since it is comparatively quick to implement, it meets the suggestions of many academics and organisations that cuts in greenhouse gas emissions and air pollution from the transport sector must be the subject of far more ambitious reductions in the UK and elsewhere to avoid dangerous Climate Change and protect the public against the health impacts of air pollution including 40,000 premature deaths in the UK each year. The publication of the Intergovernmental Panel on Climate Change report on the 1.5/2 degree C thresholds on 8th October 2018[[4]](#footnote-4) stresses the importance of reducing greenhouse gases as quickly as possible since the smallest decreases in emissions by the earliest dates are very valuable in terms of reducing impacts. Also, the head of the International Energy Agency has indicated 2018 is likely to be the year of the highest greenhouse gas emissions ever.[[5]](#footnote-5) In short, the need for a self-funding means of reducing polluting surface traffic has never been greater.

ERP is advantageous compared to congestion charging. It is possible to set a wide variety of bands, since charging is automatic and is achieved electronically. This means charges for very low impact transport can be very low, with a wide variety of bands up to the most polluting vehicles seeking to occupy space in urban centres, where the charges would be at the highest levels.

Fuel duties will decline as more wholly electric vehicles are introduced. Given a backlog of road repairs, the need for restoring bus subsidies to keep traffic levels down in many areas, and a need for long-term security of income for running the overall road transport system, it can be argued that a national system of Electronic Road Pricing is essential in the long-term.

Traffic congestion, air pollution, accident black spots and the creation of more space for cyclists and pedestrians can all be addressed if traffic management by ERP is used to achieve traffic reduction in highly congested areas.

**Oxford:**

The projected 7 million more cars alone by 2040 on UK roads cannot be contemplated. It is difficult to imagine any Government attempting to accommodate such an increase given the implications of traffic attempting to enter urban areas where options for increasing road capacity are very expensive and very limited. In the case of Oxford, traffic levels are already very high and problematic throughout the whole City and not just the urban centre, with 21 Controlled Parking Zones already. Given that economically more successful areas in the UK are likely to have more of any road traffic increase than less favoured areas, it is clearly imperative to prevent highly productive communities from being ‘suffocated’ by excessive traffic increases. ERP can help with this by deterring some drivers from entering the Oxford area.

Domestic and international tourism are more likely to be attracted to Oxford if ERP, along with additional pedestrianisation and pedestrian priority areas, helps to reduce traffic in central Oxford and allow greater freedom of pedestrian and cyclist movements.

Since about a third of households in Oxford do not have access to a car already, then the arrival of ERP may stimulate lower levels of car ownership and use. It may also increase use of bicycles, as congestion charging did in London. More cycling, and more walking, is essential to the promotion of public health in a society plagued by obesity. Living more active lives in later life also will help to reduce visits by the elderly to GP surgeries or hospitals.

Oxford’s historic buildings suffer from deposition of materials from transport, or materials moved by vehicle movements on to buildings. This results in immense clean up costs. Both ERP and more electric vehicles can help to radically reduce these impacts and associated costs. Clearly, the University and other bodies cleaning buildings and streets would benefit financially if this became a less frequent necessity.

As a historic City, Oxford has multiple ‘pinch-points’ which contribute to traffic congestion. Reducing traffic by using ERP will help with traffic flow through these locations. This would also be compatible with extending pedestrianisation and pedestrian priority areas - encompassing a much larger part of the central areas of Oxford than at present.

Downward pressure on school run traffic may be achieved through the introduction of ERP. The extra costs, although marginal, may well discourage some parents from adding to traffic congestion in general, as well as the specific congestion at the many schools with very limited capacity to deal with the school run drop off/pick up.

Clearly, actual traffic reductions in Oxford could make it easier to release car parks for housing. Of course, dual use of car parks for housing around or above surface level is already possible and could be introduced for public and private car parks. We note that this is not in the current draft of the City Local Plan, unfortunately.[[6]](#footnote-6)

A carefully located cordon for the Oxford Electronic Road Pricing Area would include the major roads serving or proximate to Oxford. This can help to reduce traffic and make better use of existing capacity, eg on the A34/A40. The cordon should be capable of being extended during 2 year reviews of a 10 year trial, in order to address any issues of vehicles concentrating, or parking, at the fringes of the Area. The review of the scheme to be conducted after 8 years of operation should decide whether the scheme has been successful, against a list of goals. These should include air pollution improvements, traffic reduction, increases in walking and cycling in the City and others deemed appropriate.

**Are there identifiable disadvantages?**

There is a ‘cordon question’ with the implementation of ERP. In the case of a trial scheme limited to Oxford and environs, the deterrent effect of ERP may cause some drivers to attempt to park wherever it suits them before utilising other means of entering Oxford by cycle, bus, train or Park and Ride bus where available. Setting the initial boundaries of the cordon should try to take this into account. Reviews every 2 years should allow extending the cordon outwards to protect communities against significant increases in car parking by commuters. In short, this policy is for the Oxford City Region.

Park and Ride capacity may well become an issue with an operating ERP scheme. There are land use advantages of decking existing Park and Rides rather than increasing the number of them, wherever the traffic pressure seems to suggest this. However, Park and Ride schemes still accommodate to car users contributing to traffic congestion, greenhouse gas emissions, air pollution and noise. Real terms increases in Park and Ride charges should be used to create downward pressure on car use.

Increased use of buses and trains in the initial stages of ERP operation may run into the difficulty of under-investment in these areas. Whilst bus service levels in parts of central Oxford may be at capacity, there may be scope for better bus services to accommodate a larger bus travelling community on some routes. Under-investment in rail occurred before privatization and subsequently, leaving a rail system without electrification in some locations, with under-provision of carriages and a past legacy of disused rail lines awaiting re-opening. A Rail renaissance in Oxfordshire would be welcomed, and all the more so if accompanied by long-term increases in rail investment over decades. This becomes more of an imperative if ERP is pushing road traffic use downwards, as people need increasing means of public transport to make their journeys eg by rail from Witney/Carterton into Oxford connecting to the Oxford to Cowley rail line and eventually through to Wheatley and beyond.

The location and availability of schools and school places may make some parent ferrying of children to school more difficult under ERP. ‘Walking bus’ arrangements, school minibuses or school buses are already needed to help reduce rush hour traffic and take the burden of the ‘school run’ off beleaguered parents – and communities with schools in the middle of residential areas.

In order to avoid the higher ERP charges of entering parts of Oxford, especially the central area, for deliveries, distribution firms will need to link up with Cargo Bike enterprises to maintain distribution networks. Since it is clear that bicycles can already move far more quickly than vehicles in the congested roads of Oxford, according to the Gilligan report already referenced, there may well be efficiency and productivity benefits of this transformation. It will need to evolve and expand quite quickly after the introduction of ERP. Naturally, distribution firms dealing in greater bulk deliveries, eg to supermarkets, will almost certainly not take up this option and must pay ERP fees appropriate to the areas into which they wish to send HGVs.

**Exemptions**

Inevitably, some groups of road users will want to be exempt from ERP. This seems reasonable in a small minority of cases provided their claim is socially justified but ONLY if they are using a wholly electric vehicle. Each category of vehicle not currently electric should be subject to phase out no later than 2030 to ensure progressive air quality improvements and cuts in greenhouse gas emissions.

*Possible exempt groups in electric vehicles:*

The disabled

The mobility impaired

*Exempt groups with sector by sector target dates for all electric vehicles, eg 2030 latest:*

The Fire Service

The Police

The Ambulance Service

Patient Transport

Taxis

**Implementation**

**Trail period of 10 years with reviews of impacts/modifications every 2 years**

**APPENDIX: THE NEED FOR A EUROPEAN SYSTEM FOR ELECTRONIC ROAD PRICING:**

It is unlikely that the UK would proceed with ERP on its own. Issues of compatibility with schemes abroad may arise, and some countries are clearly looking at models of ERP or the less flexible congestion charging already including Denmark and the Netherlands. Whether in the EU or not, the UK will need to consider how the EU approaches this issue so that UK domiciled vehicles can move freely to and from the continent. Here is an example of how it might work:

**Road charging for cars**

What the European Commission should do

|  |
| --- |
| May 2017 Summary from the European Federation for Transport and Environment (T&E)Transport will look very different in the coming decades. If we are to tackle growing emissions from the sector, then changes are badly needed. Transport is now the largest contributor of CO2 emissions in the EU. The upcoming trends of vehicle autonomy and electrification of transport will transform demand patterns and impose additional burdens on infrastructure. Air pollution, noise and other externalities associated with car use are a persistent issue and result in significant health costs and damage every year. Distance-based charges can help address a variety of such issues in one single instrument. This briefing is a summary of T&E’s [position paper](https://www.transportenvironment.org/publications/road-charging-cars-what-european-commission-should-do).  The European Commission is set to favour distance-based charging for all road vehicles in the upcoming review of Directive 1992/62/EC (known as the “Eurovignette” Directive), expected on 31 May as part of the new Road Package. Whereas the Directive focused solely on trucks and buses in the past, the upcoming review will extend the scope to both passenger cars and vans.  In order for this Directive to have a real-world impact on reducing emissions, the Commission should: 1. **Promote distance-based road charging that differentiates tolls according to the emissions from vehicles**. Any toll should be differentiated by both the air pollutant and CO2 emissions from the vehicle being charged. This should be done in a fair and non-discriminatory manner with clear incentives in place for zero-emission vehicles.
2. **Mandate the fitting of the in-car technology to enable tolling in all newly manufactured vehicles**. The fitting of “one box” technology for cars should become mandatory on carmakers. Certifying and fitting this technology as standard would lead to significant cost reductions for road users. “One box” technology would include basic GNSS and communication components necessary for different ITS applications (tolling being one of them). The EU should also ensure that funds are made available from the EU budget for member states to invest in the roadside technologies required to operate tolls.
3. **Allow countries to design their tolls in order to protect ‘exposed’ communities**. The EU should focus their efforts on ensuring the technical harmonisation and cost-effectiveness of tolling systems across borders, as well as a unified method of determining tolls. Member states should be free to amend their tolls in order to account for people in low-income communities or rural areas where no alternative means of transport are available.

 Road charging is not a silver bullet to decarbonise transport but it can play an important role in any country’s attempt to reduce emissions from the sector. The concept is only useful if it’s implemented in a way that promotes clean and sustainable transport behaviour.  |

# 1. Road charging for cars in Europe

## 1.1. Current situation

Road charging involves vehicle users paying for their use of road infrastructure. The set-up of the scheme can take very different forms as the area covered by the scheme can vary from urban centres or motorways to the entire road network. Pricing can be flat, time-based or distance-based. Furthermore, tolls can be differentiated by the vehicle’s characteristics, location and time of day to account for CO2 emissions, air pollution, noise, and congestion.

In Europe, many of the road charging schemes for cars are time-based (known as “vignettes”). This is the case in eight member statesi that charge for the use of roads for a fixed period of time (common periods of time are 10 days, monthly or annually). Ten member states charge road users based on the distance driven. These types of schemes are usually applied to motorways only, to raise funds for road construction and maintenance (road tolls).

The situation is very different for trucks and buses (so-called “heavy duty vehicles”/“HDVs”)ii. Only four member states have no any road charging scheme in place to charge such vehicles, and those which have time-based systems are shifting gradually to electronic distance-based road charging. Currently, eight member states have electronic networkwide distance-based schemes. The Eurovignette Directive defines how such tolls can be structured. Currently, the toll can be based on infrastructure damage, which is differentiated by vehicle weight, EURO class, and time of day. Additionally, trucks can be charged based on certain external costs; namely air pollution and noise. The maximum amounts are defined in the annex of the Directive.

There is no similar framework for cars (or vans). Currently, the Commission only monitors such schemes and ensures that the Treaty principles of non-discrimination and proportionality are respected. However, the Transport Commissioner Violeta Bulc has voiced support for a standardised Europe-wide road-charging scheme for all road vehicles: HDVs, vans, and cars that is based on distance travelled. The upcoming review of the Eurovignette Directive provides a perfect opportunity to introduce this into law.

**1.2 Why should Europe move towards distance-based road charging?**

Distance-based charges can play a role in addressing a variety of issues in one single instrument: charging vehicles for every kilometre driven can help tackle CO2 emissions, pollution and congestion while raising revenue for a country’s public budget. Therefore, it’s becoming increasingly important to develop an EU-wide framework for distance-based road charging for all cars.

While not a replacement for effective fuel taxes at national level, road charging can complement fuel taxation and raise revenue while contributing to additional CO2 emissions reductions. The latter can be achieved by making drivers aware of the true costs of a car trip. Car users tend to overlook incremental or invisible costs (such as maintenance costs) and don’t usually take into account other burdens that car use imposes on society, such as CO2 emissions, air pollution, and congestion. They also create routines around car use which makes it very difficult to change. The use of the car becomes commonplace, leading people to choose driving over other transport modes without considering the full cost, and cars end up being used more than necessary. Road pricing based on distance travelled can link driving decisions to the real costs of driving. This can lower excess driving demand and shift mobility to other modes or means of transport, reducing overall CO2 and air pollutant emissions.

## 1.3. Road charging is fair if correctly implemented

Distance-based charges are considered to be a fairer form of road pricing to the extent that they make road users pay for the costs they impose on the infrastructure (user-pays principle), as well as pay for the externalities they create (polluter-pays principle).

There are some concerns about the distributional effects of distance-based charges. Evidenceiii is mixed but it seems road charging is not necessarily regressive. In Stockholm the congestion charging scheme was found to be progressiveiv. For nationwide road charging schemes, there is no scheme in place but the Netherlands and Finland have considered the possibilityv. The Finnish study concluded that the new kilometre fee would reduce the tax burden on all income groups compared to the current tax regime. They also note, however, that the abolishment of fixed taxes will make heavier cars cheaper, which will be more beneficial for the wealthier groups. Regarding the Dutch study, Cost-Benefit Analyses have been performed and are overall positivevi.

Whether road pricing is regressive or progressive depends on the circumstances but the use of revenues can ultimately ensure that the scheme is socially fair. Road pricing in itself is progressive since wealthy people tend to drive more in general and therefore would pay more for the use of roads. However, it can also have regressive effects if it prevents the lower-income groups from making as many trips as before or makes them pay more as they tend to live farther away from urban centres and need longer commutes to go to work. Even if this is the case, disadvantaged groups can be compensated through revenue redistribution or discounts and exemptions. The additional revenue raised allows governments to reduce other taxes (such as labour taxes) and economic distortions. Revenue can also be invested in developing public transport, a close substitute of car use. The upcoming proposal for a Directive shall allow member states to implement their tolls in a way that would ensure their social fairness.

The reduction of air pollution also makes road charging more progressive. Air pollution tends to affect the poor more as they live closer to major motorways and roads (where housing is cheaper) and thereby are more exposed to dangerous exposure. By reducing externalities, road pricing is more beneficial to these people. In London, the congestion charging scheme marginally reduced inequalities in air pollution exposurevii.

**2.** **Why is an EU framework necessary?**

Following the German case of a national road toll being incompatible with EU law and discriminatory to non-German drivers, it is clear that - in light of vehicle pollution, climate targets, and declining fuel tax revenue - more member states in the future may decide to introduce national road tolls for light-duty vehicles without consideration of EU-wide ramifications. To pre-empt a proliferation of divergent schemes that might distort the single market and be costly, it is imperative that the Commission introduces an (optional) EU-wide framework of key principles to be adhered to in any future road tolling schemes.

Setting up a nationwide scheme requires the implementation of a technology that monitors traffic flows, registers distance driven, applies the charges and controls payments. Failure to reach common standards for communication between cars and back office, and interoperability between technologies at the EU level will create barriers to the operation of the internal market and significantly increase costs of roll-out and operation. If each member state implements its own independent scheme, the mobility of people between EU countries will be considerably hindered.

It will also increase costs for governments, businesses and citizens. Road users would have to own a road charging device for each country they drive through and hold several contracts for every scheme implemented, increasing significantly the burden for users. It will also raise significant challenges for enforcement vis-a-vis foreign cars and increase the risk of discriminatory charges. Manufacturers of the technology would also not benefit from wide scale deployment, missing an opportunity for economies of scale and lower production costs.

T&E commissioned a study by TNOviii to assess different technology options for road charging of cars. Several technologies can be used for Electronic Toll Collection (ETC). The system needs to be able to measure road use: it should register distance travelled and, in more advanced systems, identify road type, location and time.

## 2.1. The best way forward: GNSS-based road charging

TNO conducted an extensive evaluation of the main technologies used for road pricing and concluded that the most appropriate for a nationwide distance-based scheme is an in-car technology based on GNSS (Global Navigation Satellite System). A 2004 study commissioned by the European Parliamentix also supports this conclusion, indicating that the implementation of a scheme on the entire road network for all vehicles requires a more flexible technology such as GNSS-based tolling.

The majority of the member states which have a distance-based scheme in place have opted for the GNSS technologyx. Technically, it would be possible and relatively easy to enlarge these schemes to include cars, by installing OBUs on cars and expanding the operations of the back office. GNSS technology is also compatible with DSRC-based systems, which has the advantage of not making existing DSRC systems obsolete. The opposite does not hold true, which makes GNSS a very interoperable technology.

GNSS-based road charging is also more appropriate for a scheme that covers all roads. Unlike DSRC-based systems, it does not require large investments in roadside equipment and is more flexible, being easily expanded to other roads (only needs software update). The GINA project, sponsored by the European Commission and the GNSS Agency (GSA), concluded that the more complex the road charging scheme is, the less cost-effective are DSRC and ANPR (Automatic Number Plate Recognition) but the costs of GNSS do not rise as rapidlyxi. After implementation, GNSS-based road charging generates lower operating costs, which is essential when considering nationwide implementation that includes roads with low traffic volume and thereby low revenue potential.

The fitment of “one box” in-vehicle unit during the car manufacturing process which aggregates all applications based on the same components (GNSS, communication channel, DSRC) can further reduce costs and create a multi-service platform for ITS applications. This should be an open platform to allow different developers to offer services, but at the same time it should ensure car safety and security. The European Parliament’s 2014 study claims that such a box could deliver significant cost reductions, requiring an investment of €100 with operational costs of less than €10/month.

The Commission should not only set interoperability standards but it should also consider mandating the essential capabilities to enable GNSS-based road charging for all new cars. By fitting certified technology as standard the EU could greatly reduce the roll-out and operation costs of road charging schemes at national level. The additional cost for manufacturers would likely be limited since much of the necessary ITS technology is already fitted to most new cars. The main challenge would then be to certify and calibrate this technology to enable its use for tolling.

# 3. Conclusions and policy recommendations

Transport will greatly transform in the coming decades. Coupled with other measures at EU and national level, distancebased charging is an effective means to positively influence how people move around. Kilometre-based road charging can reduce air pollution, greenhouse gas emissions, congestion, and noise. Furthermore, the reduction of revenues from already insufficient fuel taxes that comes as a result of decarbonisation means that countries will need to rethink how they tax transport. Distance-based tolling is an effective means of securing revenue for a country’s public budget and is far more efficient than time-based systems.

In its upcoming proposals, the Commission should:

1. **Promote distance-based road charging that differentiates tolls according to vehicle emissions**. Any toll should be differentiated by both the air pollutant and CO2 emissions from the vehicle being charged. This should be done in a fair and non-discriminatory manner with clear incentives in place for zero-emission vehicles.
2. **Mandate the fitting of the in-car technology to enable tolling in all newly manufactured vehicles**. The fitment of "one box” technology for cars should become mandatory on car makers. Certifying and fitting this technology as standard would lead to significant cost reductions for road users. “One box” technology would include basic GNSS and communication components necessary for different ITS applications (tolling being one of them). The EU should also ensure that funds are made available from the EU budget for Member States to invest in the roadside technologies required to operate tolls.
3. **Allow countries to design their tolls so that to protect ‘exposed’ communities**. The EU should focus their efforts on ensuring the technical harmonisation and cost-effectiveness of tolling systems across borders, as well as a unified method of determining tolls. Member states should be free to amend their tolls in order to account for people in low-income communities or rural areas where no alternative means of transport are available.

## Further information

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## Endnotes

iSee <http://ec.europa.eu/transport/modes/road/road_charging/doc/pv_charging.jpg>

iiSee <http://ec.europa.eu/transport/modes/road/road_charging/doc/hgv_charging.jpg>

 iii Levinson, D., 2010. Equity Effects of Road Pricing: A Review. Transport Reviews, 30: 1, 33 — 57.

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2. Plans and studies conducted in the Netherlands (NL), Finland (FI) and Belgium (BE) NL: Geurs , K., Haaijer , R. and Meurs , H., 2010. The Dutch national kilometre charge: impacts on the Dutch car market and environment; FI: Ministry of Transport and Communications, 2014. Fair and Intelligent Transport. Working Group Final Report; BE: Mayeres, I., 2015. Road charging in Belgium: opportunities and latest state of play. VITO
3. Geurs , K., Haaijer , R. and Meurs , H., 2010. The Dutch national kilometre charge: impacts on the Dutch car market and environment.

 vii Pike. E., 2010. Congestion Charging: Challenges and Opportunities. ICCT.

 viii TNO, 2015. Technology options for road pricing (Available from T&E).

ix European Parliament, 2014. Technology Options for the European Electronic Toll Service.

[http://www.europarl.europa.eu/RegData/etudes/STUD/2014/529058/IPOL\_STUD(2014)529058\_EN.pdf](http://www.europarl.europa.eu/RegData/etudes/STUD/2014/529058/IPOL_STUD%282014%29529058_EN.pdf)

 x Germany, Slovakia, Hungary and Belgium.

xi Geurs , K., Haaijer , R. and Meurs , H., 2010. The Dutch national kilometre charge: impacts on the Dutch car market and environment.

1. See: <https://www.nic.org.uk/wp-content/uploads/Running-out-of-Road-June-2018.pdf> [↑](#footnote-ref-1)
2. See: [https://www.racfoundation.org/assets/rac\_foundation/content/downloadables/the%20acceptability%20of%20road%20pricing%20-%20walker%20-%20main%20report%20(may%2011).pdf](https://www.racfoundation.org/assets/rac_foundation/content/downloadables/the%20acceptability%20of%20road%20pricing%20-%20walker%20-%20main%20report%20%28may%2011%29.pdf) [↑](#footnote-ref-2)
3. <https://www.london.gov.uk/sites/default/files/gla_migrate_files_destination/DfT%20road%20pricing%20feasibility%20study.pdf> [↑](#footnote-ref-3)
4. <http://ipcc.ch/report/sr15/> [↑](#footnote-ref-4)
5. See: <https://www.straitstimes.com/world/bad-news-co2-emissions-to-rise-again-in-2018-says-international-energy-agency-chief?fbclid=IwAR3npJ2DpLR3KhRCs4o0N9PxccTH7Wt-bLXYpXpbT-zZ-qAdsLT6SUemDI8> [↑](#footnote-ref-5)
6. See: The current draft Local Plan is in here (from page 27 onwards): <http://mycouncil.oxford.gov.uk/documents/g4532/Public%20reports%20pack%20Monday%2008-Oct-2018%2018.00%20Scrutiny%20Committee.pdf?T=10> [↑](#footnote-ref-6)