Annex J
Costs

Introduction

J.1 Understanding costs is critical to establishing the feasibility of road charging. The Department for Transport therefore commissioned Deloitte Consulting to research the potential costs of various types of schemes and the key cost drivers underlying them.

J.2 It is important to understand that this research gives us only indicative costs for implementing a particular set of scenarios in a given way at the current state of the market. Although Deloitte used current best information to estimate costs, much of this information is incomplete, and much is likely to change over time. Moreover, the scenarios that we asked them to look at made a large number of assumptions about design and scope, many of which would probably alter.

J.3 The costs described in this Annex consequently need to be treated with caution[1]. They allow us to estimate the approximate order of magnitude of the costs associated with different schemes, the relative order of costs between different types of schemes and, most importantly, the key cost drivers behind each type of scheme. But they do not tell us what any actual scheme would ultimately cost.

J.4 This Annex outlines the conclusions of the study about the costs of a national, distance-based, road charging scheme, and then goes on to consider more localised charging schemes.

Implementing national distance-based charging

J.5 It is not possible to predict with any certainty what a national, distance-based, charging scheme using satellite technology would cost in the middle of the next decade. This sort of system has never been tried before and, without detailed design and testing, it is not possible to specify accurately what would be required. Moreover, the technology is still developing and, by the time this sort of scheme could be introduced, it would probably fall markedly in price.

---

1 All costs are given in real terms, at 2004 prices. Both base costs and costs with optimism bias applied are given. Optimism bias is the tendency for a project's costs and duration to be underestimated and/or benefits to be overestimated. HM Treasury guidance on optimism bias, based on the recent history of major public sector projects, was used. Costs are broken down into establishment costs (the costs associated with procuring the equipment, systems and facilities needed to set up a road charging scheme), and running costs (the costs needed to run this infrastructure on a day by day basis). The methods of financing any road user charging scheme are yet to be determined, so we present here the figures net of any possible financing costs associated with raising capital which, given the size of some of the establishment costs, could be significant.

J.6 This uncertainty is reflected in the research that DfT commissioned. Its consultants were only able to produce a range of indicative costs for such a scheme on the basis of available information and assumptions. The variation between their higher and lower estimates of the costs to set up such a scheme was more than £50 billion. If we assume that the OBUs required for a national, distance-based, charging scheme would cost £100 per vehicle, the cost of setting up a scheme would be a figure in the order of £10 billion. If, on the other hand, we assume that OBUs would cost £525, the total cost of establishing a scheme could be £27 billion. If we were then to add optimism bias, this could produce a figure of £62 billion.[2] Their estimates of what it would cost to run such a scheme each year also varied significantly, although to a lesser extent. Depending on how much telecommunications between OBUs and the back-office cost each year, the average annual running cost of a national, distance-based, charging scheme would be a figure somewhere between £2 billion and £3 billion. With optimum bias applied, these annual costs could be some £5 billion.

J.7 At one level, these figures clearly do not help us very much, other than to demonstrate that we cannot, at this stage in time, put a meaningful cost on something so undefined, 10-15 years in the future. What it does tell us, however, is that, until the cost of the technology comes down, any such scheme is likely to be expensive to set up and run. Our expectation is that the cost of the technology *is* likely to fall, as we get a clearer understanding of the sort of system that would be needed, the technology develops and the vehicle market evolves. But this cannot be left to chance. The challenge for Government is to work with component manufacturers, the automobile industry, and European partners to get the right technology in vehicles, exploit the potential synergies with existing areas of government activity, and bring the cost of such a scheme down.

Setting up a national distance-based charging scheme

J.8 Potentially the biggest cost involved in *setting up* a national, distance-based, charging scheme would be the cost of establishing a vehicle fleet with the necessary equipment on-board.

J.9 We assumed that this sort of scheme would require every car to have a complex hybrid OBU equipped with GNSS technology for position-fixing, microwave for verification, and cellular communications for data transfer. The technology involved is still relatively new and concomitantly expensive. Moreover, given its relative novelty, this type of technology is currently equipped in very few vehicles and is not configured in a way that could easily be used for road charging.

J.10 If every vehicle in the fleet had to be equipped from scratch, it would be prohibitively expensive. By way of example, if these units were to cost £100, buying 30 million of them would cost £3 billion. In addition, there would be the cost of fitting – which could also cost several billion pounds, depending on the amount of labour needed – and, of course, the cost of equipping all the new vehicles that entered the fleet each year.

J.11 However, this type of technology is developing rapidly. The extent to which technology tends to increase in power, but fall in price, over time is well known. Just as calculators were once

2 This assmes full national coverage and that all vehicles would need to be fitted.

an expensive, luxury item, but are now cheap, mass market, products, so it is possible that the sort of OBU required for distance-based charging may become much more affordable.

J.12 As the price of the technology falls, we would expect this sort of technology to become much more common in vehicles and, eventually, fitted as standard. We can already see a shift in this direction. Many companies have started to use position-fixing technology to track their vehicles' movements; some vehicles now have anti-theft devices fitted which involve position-fixing technology; and some insurance companies are experimenting with it as a way of introducing pay-as-you-go premiums. As these sorts of applications become more widespread, position-fixing technology may gradually become a standard item in new cars, much like CD players, power steering and electric windows.

J.13 Of course, it is unlikely that, left to itself, the market is going to put devices into vehicles that could be used to charge for road use. These devices would have to meet a particular specification, not least to ensure that they were secure and robust against fraud, and they would need communications facilities. To ensure that the market does develop in the right direction, the Government will need to work closely with manufacturing industry to develop common standards and with European partners to develop the necessary regulatory framework at international level. This process has already begun – the European Union adopted an Interoperability Directive earlier this year, which specifies requirements for interoperability and mandates future work – but much more work would be needed.

J.14 The challenge is to see the cost of the components come down, on the back of the widespread use of position-fixing technology in vehicles, and to see that the sorts of devices installed could be used for road charging. The research that we commissioned suggests that the other elements needed to establish such a scheme would, in comparison, be relatively cheap to procure.

J.15 Given that the type of complex hybrid OBU we assume would be needed to implement a national, distance-based, charging scheme would be capable, in most circumstances, of determining its position independently of roadside beacons and of communicating the subsequent records remotely, little roadside equipment would be needed, other than for enforcement purposes. This would cost perhaps £20 million (£60 million with optimism bias) to set up.

J.16 The only other sizeable cost attached to setting up a national road charging scheme would be the cost of procuring the back-office structures necessary to operate a scheme – call centres, data processing centres and billing centres. Given the scale of the operation involved, these costs would be significant – a one-off cost of perhaps as much as £500 million (£1.3 billion with optimism bias applied). But these costs should be set against the potential benefits of national road charging, which could be as high as £12 billion each year.

Running a national, distance-based, charging scheme

J.17 If it were affordable to set up a national, distance-based, road charging scheme, it would have to be run. Any scheme that involves 30 million users is a significant proposition. If that scheme involves collecting complex data, processing this data into charges and issuing monthly bills, it will inevitably be expensive to run.

J.18 The Department's research suggests that the key costs involved in running a national, distance-based, charging scheme are[3]:

- the costs of telecommunications between OBUs and the back-office
- the costs of the back-office processing operation (chiefly the Payment Services Provider) (see Annex I)
- the costs of enforcement.

J.19 If a national, distance-based, charging scheme were to be implemented, vehicle OBUs would probably need to communicate with the charging authority via cellular communications. The costs associated with these cellular telecommunications are extremely hard to predict, because mobile telecommunication is a relatively new and evolving market.

J.20 We do know that, at today's prices, even buying telecommunications capacity in bulk would be expensive. For instance, in Germany, Deutsche Telekom quoted a tariff of £36 per vehicle, per year, for the German Lorry Road User Charge. While this may not sound like a lot, and is substantially lower than current line rental charges for conventional mobile telecommunications in the UK, the sheer scale of the operation that national road user charging would involve would make this an expensive proposition. For a vehicle fleet of 30 million vehicles, this implies a cost over £1 billion annually.

J.21 It is possible that these costs will fall over the next 10-15 years. Telecommunication costs may fall as technology develops. The requirement may change – the frequency of communication selected will depend on a trade off between OBU data storage costs and communications costs. We do not know how this will be resolved. The market might evolve leaving large surplus capacity across some frequencies. And, if road charging were introduced on the scale envisaged, it is likely that any road charging authority would be in a strong position to negotiate favourable terms with suppliers.

J.22 The second major component of running costs would be back-office costs and, in particular, those associated with the Payment Services Provider function[4]. Registering drivers for any scheme, processing records of vehicle movements into charges, and issuing these charges as bills to drivers would require a significant back-office operation and, given the numbers of vehicles, significant cost. The research that we commissioned suggests that, assuming standard staffing ratios, known industry wages in the UK and national average costs for premises and maintenance, annual running costs for the Payment Services Provider function would be in the order of £845 million (£1.8 billion with optimism bias applied).

J.23 This is clearly a substantial annual cost and careful consideration will need to be given to how it could be reduced. The major driver of these running costs appears to be labour. There are substantial potential synergies with existing vehicle and driver services that, if exploited properly, could produce considerable efficiencies which might reduce the additional costs of road charging schemes. It might, for instance, be possible to run these sorts of operations in conjunction with existing services, such as those provided by the DVLA. There are also potential efficiencies to be achieved by careful siting of back offices to take advantage of differentials in the costs of labour.

3 Together, these three cost elements could account for as much as 80 per cent of annual running costs. There would, however, be a wide range of other cost elements which we estimate could amount, in total, to a little over £500 million annually.

4 We assumed that the system architecture set out in Annex I would be used.

J.24 Another important cost would be enforcing road charges. At present, any road charging scheme would have to rely on a network of ANPR cameras to detect vehicles which were evading the charge. These cameras are expensive to install but, crucially, expensive to operate. They require large amounts of manual intervention to verify vehicle registration mark reads and this costs substantial amounts of money. Our research suggests that the annual costs associated with enforcing a national road charging scheme using this type of technology would cost a figure in the order of £273 million (about £530 million with optimism bias applied)[5].

J.25 It is, of course, likely that at least some of these costs would be recovered from evaders who were caught. However, further action could be taken to reduce the cost of scheme enforcement. For instance, the EU has commissioned a study of Electronic Vehicle Identification (EVI). EVI involves installing a device in vehicles, which can be interrogated to give a unique vehicle identifier. It might, in future, be possible to use EVI rather than ANPR to enforce a road charging scheme. This would markedly reduce the costs of enforcement, because this type of system would significantly reduce the need for manual intervention in the process to verify reads of vehicle registration marks.

Conclusion

J.26 It is not possible, today, to determine how much additional government expenditure, if any, would be needed to set up a national, distance-based, road charging scheme. Such a scheme does seem unaffordable today, although we need to remember that the assumptions used in this analysis about how a scheme would be designed require further development. The challenge for Government is to work with component manufacturers, the automobile industry, and European partners to get the right technology in vehicles, and exploit the potential synergies with existing areas of government activity, to improve affordability. Any scheme that involves using sophisticated technology in respect of 30 million vehicles is going to involve significant costs, whenever, and however, it is done. But, against the sort of benefits associated with national distance-based charging, it might be justifiable in the next decade.

Implementing limited road charging

J.27 While a national, distance-based, charging scheme seems unaffordable today, simpler, smaller-scale forms of road charging are a different proposition. The costs of introducing road charging in city centres and on key strategic roads, using technologies such as microwave, are significantly lower.

Local urban charging schemes

J.28 A daily licence scheme using ANPR cameras for enforcement has already been set up in London by TfL, and microwave systems have been deployed elsewhere in the world, such as in Trondheim and Singapore. We know from the experience of these cities that these sorts of charging schemes could be set up relatively cheaply. To explore cost issues further, we looked at several scenarios assuming that a number of towns and cities around Britain introduced

5 These figures assume an evasion rate of 3 per cent of vehicles.

city centre or wider urban schemes using either daily licences supported by ANPR or microwave technology.

J.29 This research suggests that it would cost something in the order of £218 million (£382 million with optimism bias applied) in total to set up the sort of daily licence scheme used in London in seven other cities, and approximately £122 million (£201 million with optimism bias applied) each year to run[6]. The main thing that drives these costs is the back-office. As noted above, ANPR technology involves significant processing overheads and corresponding back-office costs, because of the need for users to purchase a licence to access the charged zone each day, and because identifying vehicles using automatic number plate reader cameras involves significant human intervention to verify vehicle registration mark reads. Back-office costs account for two thirds of establishment costs and over half of running costs.

J.30 Microwave schemes potentially involve greater establishment costs because of the need to equip all regular users with microwave OBUs. These units are not expensive – perhaps £15 – but potentially large numbers of them would be needed even for relatively small schemes, and they have a limited lifespan, which would mean that they would need to replaced on a regular basis.

J.31 More significant, however, is that, whereas small urban schemes using a daily licence system backed up by ANPR are unlikely to be covered by the terms of the proposed EU Interoperability Directive (as they are not electronic), we expect that electronic urban charging schemes would have to comply with the Directive. This would necessitate the introduction of additional structures, such as those envisaged in the Department's 'Road User Charging Organisational, Functional, Process and Data Model.' This would involve additional costs, although these would be progressively offset by the economies of scale that could be achieved as more towns and cities opted to introduce electronic road charging, and if existing electronic toll schemes could be included.

J.32 The widespread introduction of electronic charging using microwave technology remains, however, relatively affordable, even in the short term. The research that we commissioned suggests that it would cost a figure in the order of £320 million (about £680 million with optimism bias applied) to set up city centre microwave schemes in seven towns and cities and to convert London to microwave electronic charging. It suggests that it would cost an estimated £220 million (about £410 million with optimism bias applied) to run these schemes each year[7]. Introducing electronic charging using microwave technology not just in city centres but across much wider urban areas would cost more, perhaps £800 million (about £1.7 billion with optimism bias applied) to set up, and perhaps £720 million (£1.4 billion with optimism bias applied) each year to run. This is because expanding charging out into the wider urban area increases the numbers of users and the numbers of journeys.

Schemes for strategic roads

J.33 We have also explored the costs of charging on inter-urban roads and, in particular, severely congested sections of the strategic road network. This could, in theory, be done in two ways,

6 We assumed that, following projections in the DfT Ten Year Plan, an additional three metropolitan cities, two large cities, one medium city and one small city would implement charging by 2010.

7 See footnote 6.

either by creating segregated premium lanes or by introducing a charge to use all lanes of congested trunk roads at peak times.

J.34 Setting up premium lanes would involve significant and expensive civil engineering work. This is because premium lanes would need to be segregated by barriers from regular lanes in order to prevent weaving between lanes. The Department's research suggests that establishing premium lanes on the sections of the strategic road network which are classified as 'severely congested' – about 435 km – would cost a figure in the order of £643 million (£1.4 billion with optimism bias applied). The civil engineering needed to segregate charged lanes alone would account for nearly half of these costs, some £290 million (£481 million with optimism bias applied).

J.35 Because only a proportion of drivers would actually use the charged lanes, the number of transactions that the system would need to deal with – detections, processing, bills etc. – would be smaller than for the whole road. Consequently, using these sorts of schemes would be cheaper than charging all lanes. Research suggests that annual running costs would be in the order of £250 million (about £470 million with optimism bias applied).

J.36 We have also considered the costs of implementing charging across all lanes of congested trunk roads, using a combination of microwave systems and ANPR cameras, if the technology advanced so as to enable vehicle registration marks to be read sufficiently accurately at high speeds. Charging all lanes of a trunk road has the advantage that it would be cheaper to set up than premium lanes, because it would not require civil engineering work to segregate lanes. The Department's research suggests that it would cost a figure in the order of £470 million (£1 billion with optimism bias applied) to set up charging on all lanes of sections of the trunk road network classed as 'severely congested' (some 435 km). However, while cheaper to set up than premium lanes, this sort of scheme would cost more to run, a figure in the order of £460 million (about £875 million with optimism bias applied) each year. This is because, unlike premium lanes, all users of the road, at least during peak periods, would be charged, creating a greater volume of transactions, and consequently greater processing costs.

J.37 Clearly, though, despite their relatively limited scope, the costs of these sorts of schemes, remain relatively large, roughly comparable with the costs of establishing electronic urban schemes. The reason for this similarity is that, although less roadside infrastructure would be required, because only individual roads with relatively limited numbers of access points would be affected, it is again the setting up and running of the back-office of the scheme which drives costs. A premium lane scheme or a trunk road scheme affecting even a relatively small proportion of the strategic road network would require a similar back-office infrastructure to urban charging schemes, and, given the high usage of these sections of trunk road, would need to deal with similar volumes of transactions.

J.38 However, if electronic charging were introduced on severely congested sections of trunk road *in combination* with electronic charging in wider urban areas, considerable economies of scale could be possible. Both urban and inter-urban charging schemes could take advantage of the same back-office structures, significantly reducing both establishment and running costs.

Conclusions

J.39 The Department's research into the costs of road charging is relatively speculative and its conclusions must be regarded as indicative and treated with caution. However, it does indicate the overall order of magnitude of the costs associated with different types of road charging schemes, the relative order of costs associated with them and, most importantly for this study, the key cost drivers underlying them.

J.40 A national, distance-based, charging scheme does not seem to be affordable now, but it could become affordable in the future. The cost of this type of scheme is driven by the cost of the on-board technology. Given the propensity for technology to decline in price over time, and the long lead time for any such scheme, it is plausible to expect these costs to reduce to the point that such a scheme became affordable. Working with industry and European partners could accelerate this process.

J.41 In addition, we have assumed that a very sophisticated type of OBU would be needed for a national charging scheme. If a simpler OBU were used, employing perhaps a cell charging approach, costs could be reduced still further. This is one example of how scheme design, specification and costs interact. Significant further work is needed at scheme design level before reliable estimates of total costs can be produced.

J.42 Of course, any scheme that involves using sophisticated technology to charge up to 30 million users is inevitably going to be expensive. While we anticipate that the costs of setting up and running a national road charging scheme will fall, they will remain substantial.

J.43 However, the modelling work that we have done demonstrates that the benefits of road charging could be equally substantial, indeed, in many cases, that they could easily outweigh the admittedly large costs. For instance, a national all roads scheme could produce welfare benefits per annum of up to £12 billion. As time passes, it is likely that these benefits will grow, as traffic volumes increase and congestion worsens.

J.44 In the meantime, simpler, smaller road charging schemes could be set up, using tried and tested microwave technology, in city centres or congested sections of the strategic road network. Although these sorts of schemes would inevitably be much more restricted than the sort of national, distance-based, charging scheme envisaged above, they would create a powerful tool with which demand for some of the most congested roads in the country could be managed. Moreover, if they were introduced in combination, there would be considerable economies of scale.