Public Infrastructure: Solutions for Moving People

Submission by the Bus Industry Confederation to the Draft Report on Public Infrastructure

April 2014

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About the Bus Industry Confederation of Australia

The Bus Industry Confederation (BIC) is the peak national body representing the interests of Australian bus and coach operators and suppliers to the industry. As the primary voice of the bus and coach industry the BIC works with all levels of Government, regulatory authorities, strategic partners, our industry and the community to:

- Encourage investment in public transport infrastructure and services
- Coordinate and make more effective existing Federal, State and Local Government policies and programs that relate to passenger transport
- Improve public understanding of the contribution made by the bus and coach industry to Australia's economy, society and environment
- Ensure that the accessibility and mobility needs of Australians are met, regardless of where they live or their circumstances
- Ensure that buses and coaches operate safely and effectively.

About this Submission

This submission addresses the four key themes raised in a recent speech to the Australian Automobile Association by Peter Harris, Chairman of the Productivity Commission. Peter Harris identified four central themes of the Productivity Commission's Draft Report as:

• better process

• better institutions

• better pricing

• greater efficiency.

Where it is possible this submissions aligns responses to the definitions of the four themes identified by Peter Harris. Responses in this submission are drawn from two reports produced by the Bus Industry Confederation with Professor John Stanley from the University of Sydney Institute of Transport and Logistics Studies.

The reports referred to in this submission are *Moving People Solutions for a Growing Australia* and *Moving People Solutions for a Liveable Australia*. These reports and other BIC policy and research can be found at the Ozebus website www.ozebus.com.au

Better Process

"We have found – possibly to no one's great surprise – that infrastructure project identification, development, selection, and design is regularly not done well in Australia." (Peter Harris, 2014)

The BIC's response to this theme focuses on the following:

- Pre-project assessment of infrastructure proposals
- Post project assessment mechanisms.

Pre Project Assessment of Infrastructure Proposals

The BIC supports the work undertaken by Infrastructure Australia (IA) to date in assessing infrastructure proposals from State Governments. We see the development of the Urban Transport Strategy by IA as being a significant step towards the formalisation of this process and the development of a nationally agreed set of criteria for both pre and post project assessment of infrastructure proposals.

The definition of "national significance" in the lexicon of infrastructure assessment needs to take into account the importance of our cities and regions to the national economy and the national cost of social and environmental externalities such as congestion even when it is experienced at a local level. There is scope for Infrastructure Australia and the Commonwealth Government to address a number of gaps not only in nationally significant infrastructure development, but also small to medium scale local infrastructure projects under the value of $100 million.

As Infrastructure Australia stated in its 2012 report to COAG, these smaller scale projects, built within a framework of strong strategic planning principles have the potential to improve the liveability and viability of our major cities, towns and regions.[1] There is potential for a wider recognition within the definition of infrastructure, and consequently the development of infrastructure, for urban public transport infrastructure to be recognised as delivering national benefits at a local level. This comes through the myriad of environmental, social and economic benefits produced by public transport system improvements that alongside delivering travel time, financial and health benefits to individual users also deliver congestion and emissions reduction, social inclusion and productivity benefits to the whole nation.

The context within which this need for broader definitions of national significance and more rigorous assessment of infrastructure proposals is embodied in the backlog of infrastructure investment facing Australian cities and regions. In *Moving People: Solutions for a Liveable Australia* (Stanley, 2012) the BIC noted that the road traffic task continued to grow strongly over the 1986 to 2007 period, even though road expenditure was flat in real terms.

There has been a dramatic decline in the transport infrastructure investment as a share of GDP, and flat road expenditure levels in real terms over an extended period, while the transport task has continued to grow. For example, if road expenditure had grown at the same rate as population between 1986-2007 total road expenditure would have been $35 billion higher, in constant prices, in aggregate over that period. A broader and more widely sourced identification of infrastructure needs, performance assessment and project evaluation processes should help to tackle these problems and the BIC sees IA as integral to this improvement of processes.

Within this framework of pre-project assessment the BIC has proposed the development of assessment mechanisms which are specific to infrastructure types. These could sit on a level below the broader assessment of national significance identified by IA and assist in both the assessment of proposals and in guiding the design stage of these proposals.

In *Moving Australia 2030* (Moving People 2030 Taskforce, 2013) the BIC and seven other national organisations identified the need for greater segmentation in the way Governments view infrastructure use and for the development of *Moving People Infrastructure* criteria in assessing all land transport infrastructure bids.

In *Rapid Transit: Investing in Australia's Transport Future* (BIC, 2014) the BIC proposes the development of a pre-project assessment framework that by the very nature of its requirements will help deliver better outcomes in the development of Rapid Transit (Light Rail, Bus Rapid Transit) projects in Australian cities.

[1] Infrastructure Australia, 2012, Progress and Action, June 2012 Report to the Council of Australian Governments, Australian Government Canberra.

Post Project Assessment Mechanisms

Post project performance benchmarking and service metrics should form an integral part of proposals for infrastructure funding. The BIC supports the model outlined in IA's Urban Transport Strategy (see figure 1).

Figure 1: Metrics for Infrastructure Funding Proposals (includes post project metrics)

L.E.K — Project 1

The following metrics could potentially be used to support infrastructure funding requests

Illustrative

Investment Benefit	Benefit sought	Possible service or outcome metrics	Currently reported by
Service Capacity	• Reduced crowding on current PT Infrastructure	• Passengers / m2 in peak • Passengers load factor (% capacity) • % passengers standing 20mins from the CBD	• RailCorp, NSW • Metro (rail operator), VIC • Translink, QLD
	• Reduced congestion on current road system • Reduced car dependency and increased PT mode share • Supporting anticipated patronage and population increase	• Average speed on major arterials • VTK and PT mode share • % household daily trips by car • # annual peak period passenger trips	• DoT NSW; DTMR QLD • DoT NSW; DTMR QLD, Dot VIC • DoT NSW; Dot VIC • DoT NSW; Dot VIC, Translink QLD
Service Coverage	• Improved network coverage in growth centers • Improved accessibility to public transport, especially for socio-economic disadvantaged areas	• % houses within 500m of PT stop • SEIFA index	• PTA WA; DoT VIC* • ABS
	• Guiding urban form to achieve agglomeration benefits	• Job density by region	• Data not sourced (mentioned in Melbourne Metro 2 submission)
Service Quality	• Savings in PT journey time • Providing safer public transport • Improved on-time running and reliability • Improved accessibility to stations / stops	• Average journey time • Incidents per million service km • % services arriving & departing on time • % vehicles / infrastructure complaint with DSAPT^	• BTS NSW; Dot VIC • PTA WA • DoT NSW; Translink QLD • DoT VIC (until 2008)
Service Efficiency	• Improved asset utilisation • Improved reliability of infrastructure • More efficient vehicles having lower GHG emissions	• % peak vehicle utilisation • Service faults per 100,000km • CO_2 emissions per passenger km	• Sydney Ferries, NSW • State Transit Authority NSW • DoT VIC

Note: * Victoria uses % of population within 400m of a bus / tram stop, 800m of a train station; ^ Disability Standards for Accessible Public Transport (national standards)

Source: NSW govt submission (2010); Melbourne Metro 1 and 2 submissions (2009). Council of SEQ mayors submission (2010); ACT govt submission (2008); Yarra City Council submission (2008); Bureau of Transport Statistics; L.E.K. Analysis; Infrastructure Australia. Projects 1 & 2.

Source: Infrastructure Australia, 2014

Better Institutions

"The identification of a party that can carry forward responsibility for reporting publicly on performance under the system we envisage is not optional. It is essential. Our chief reform weapon in improving process is publication. The chief factor in creating a pipeline is publication. We need an institution capable of doing this, persistently, fearlessly." (Peter Harris, 2014)

Infrastructure Australia

In our submission to the Inquiry into Infrastructure Australia Amendment Bill and testimony to the Senate Hearing as part of this Inquiry the BIC outlined our views on Infrastructure Australia's role in the context of infrastructure assessment and the development of policy frameworks to enable the right investment to be made in Australia's infrastructure networks.

The submission was produced by the Moving People 2030 Taskforce, a group of six like minded national organisations of which BIC is the lead organisation. Below are excerpts from the Moving People 2030 Taskforce's submission to the Inquiry into the Infrastructure Australia Amendment Bill and the testimony of BIC Executive Director, Michael Apps to the Senate Hearing.

"*The Moving People Taskforce supports the role of Infrastructure Australia as an advisory body to the Commonwealth Government.*

We support the commitment from the Government to strengthen the role of Infrastructure Australia and the process of reform being undertaken to make Infrastructure Australia more effective in its role.

The Moving People Taskforce is concerned that the independence of Infrastructure Australia will be diminished by the proposed amendments. This independence has been its major strength in providing fearless and frank advice in assessing Australia's transport infrastructure priorities.

Although the Moving People Taskforce believes in the overall merits of the proposed reforms to Infrastructure Australia by the Commonwealth Government, there are a number of areas in the proposed Bill that we seek clarification on." (Moving People 2030 Taskforce, 2014)

"...strengthen Infrastructure Australia so that it has the independence and the capacity to provide frank, independent, transparent advice that actually lets us assess all of the infrastructure projects that states might put up to the federal government so they can be assessed on an apples versus apples basis, and that the projects that are identified as priority are the ones that deliver the best outcomes for Australia and for the economy. Currently we would argue that Infrastructure Australia has done a pretty good job at that...." (Apps, 2014)

"…the current amendment bill provides greater scope for the current government to actually possibly influence more greatly and to stifle the independence of Infrastructure Australia, if the clauses that relate to publishing of advice, the clauses that relate to the evaluation of classes of infrastructure, are implemented. We think that state governments should be able to put in a bid for an infrastructure project that they think is their priority…" (Apps, 2014)

"If Infrastructure Australia has the independence to assess projects on an independent basis that needs to be done in an assessment process that identifies that it is a priority because it provides the most benefits for the Australian economy and the people. To exclude classes of infrastructure from consideration will have serious impacts, particularly if, as we understand it, that relates to urban transport infrastructure..." (Apps, 2014)

The BIC strongly supports the strengthening of IA's role in as much as it gives IA the capacity to provide frank and fearless advice to Governments. We also believe IA has an important policy development role to play and that this policy agenda, embodied in work like the National Freight, Port and Urban Transport Strategies, should be allowed to continue without limitation.

Institutional Arrangements

The need to reform land transport pricing in Australia should be complemented by reforms to the way transport funding is arranged. We propose the establishment of state-based land transport funds, which would receive revenue from users, value capture and government (federal and State, and possibly local in some situations). These funds would implement priorities that have emerged from integrated land use/transport plans that include ten year transport infrastructure plans. Tying strategic planning processes closely to pricing and funding arrangements should help drive improvements in strategic planning processes and help deliver better outcomes.

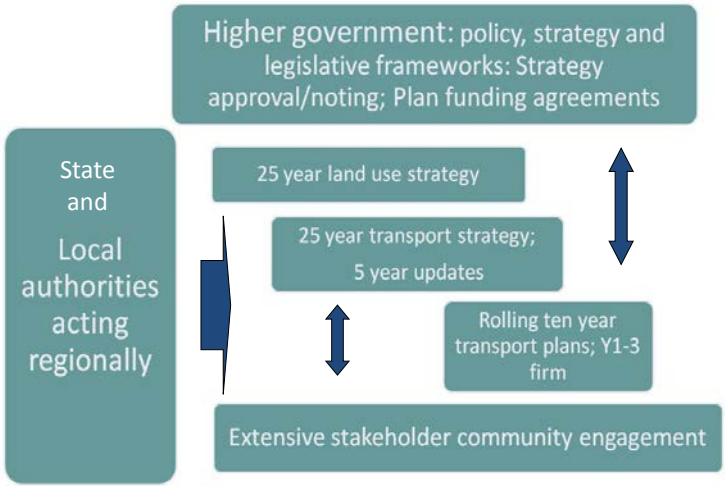
The way we see the land use/transport plans operating is summarised in Figure 3, which is taken from Professor Stanley's 2013 lecture material at ITLS, University of Sydney. Figure 4 then suggests how this might be linked to funding.

The emerging UK experience with Single Local Growth Funds (SLGFs) is in the general direction BIC is proposing but goes even further and is well worth consideration, in terms of better integrating strategic planning processes and funding flows. The SLGF provides Local Enterprise Partnerships (or LEPs, which include local business leaders, local authority leaders and other partners) with a potential national revenue stream to pursue priorities that are agreed through a strategic economic planning process. It provides for a wider span of national level infrastructure funding flows than simply transport, through 'Growth Deals' with local areas, to support activity in those areas. For example, 'City Deals' have been negotiated with core cities such as Greater Manchester, Leeds, Liverpool and others. The funding pool is provided over a ten year period, for competitive bidding by local areas, with the LEPs having responsibility for spending on the basis of the strategic economic plans. As noted in HM Treasury (2013), Investing in Britain's Future (p. 68) the SLGF model provides

... LEPs with the flexibility to tackle the barriers to growth in their areas and provide influence over the key levers of transport, skills and housing. As area's allocation from the SLGF will be available to be spent on the priorities LEPs and their partners have determined in their strategic economic plans.

The emerging UK model takes ideas such as those embedded in Figures 3 and 4 further along the integration pathway. To that extent, they are very worthy of close consideration. They are one logical outcome to institutional design from taking a broad view of the requirements for integrated thinking and delivery.

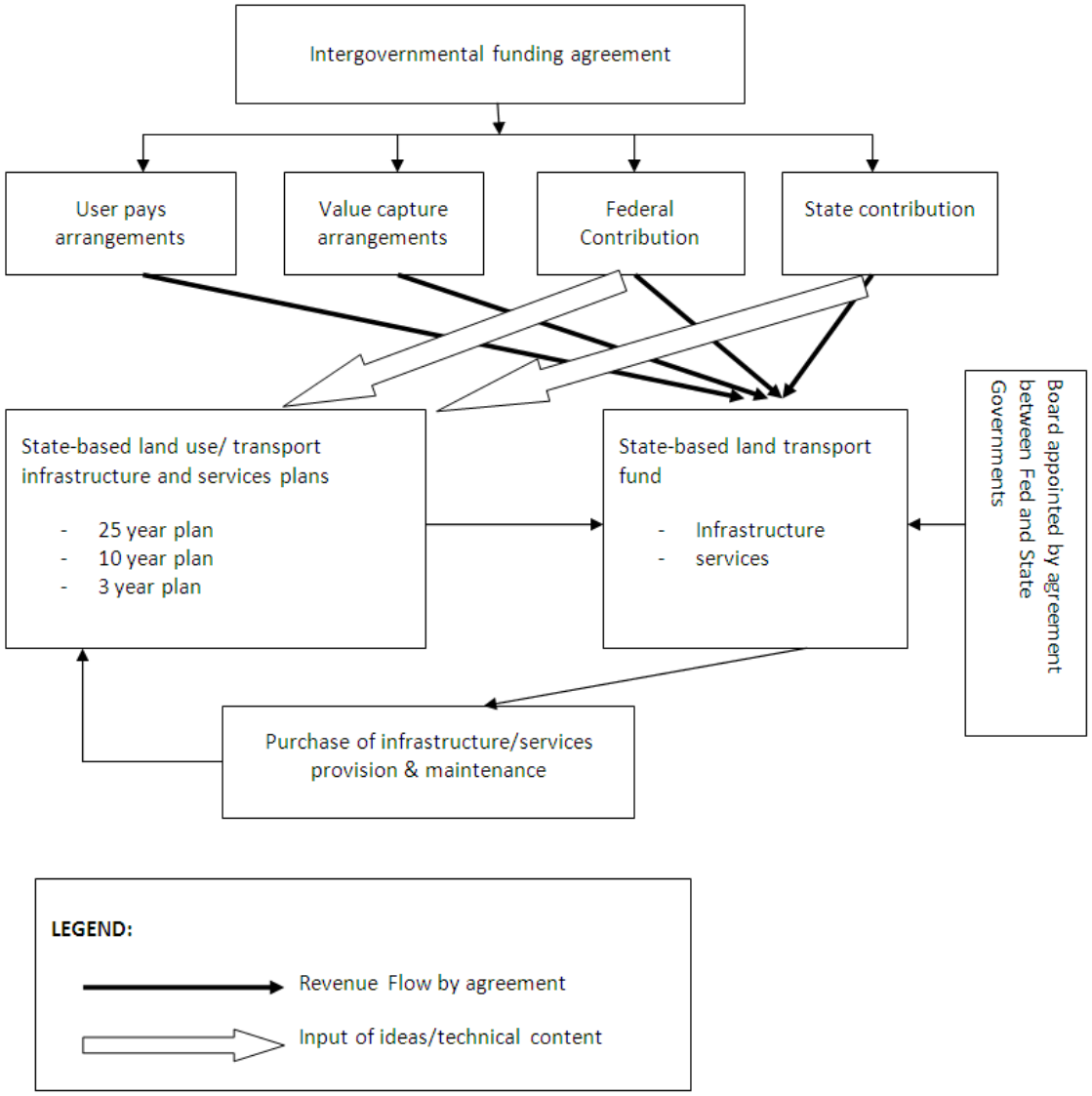
Figure 3: Integrated land use/transport planning process (Source: Stanley and Smith 2012)



As noted, Figure 4 suggests how the integrated land use/transport planning process would link to a dedicated land transport fund. The major advantages of the proposed approach are that it would closely link strategic planning with infrastructure and services prioritisation and also with pricing and funding/financing. The latter effect would be helped by the land transport fund being managed by a skills-based board, accountable for delivering outcomes in line with the brief set out in the proposed intergovernmental agreement and arising from the integrated land use/transport planning processes. This could be the result of strategic economic plans if one goes down the UK pathway. The prioritisation process would be less subject to political pressure and more linked to desired longer term outcomes set out in the founding intergovernmental agreement (where an emphasis on local economic partnerships could be embedded, if one was to go down the UK pathway). The fundamental principles underlying this proposed approach are:

- aligning pricing with marginal social costs
- aligning infrastructure priorities with the results of integrated land use/transport strategic planning processes, where partnerships are a key element in developing and implementing the plan
- aligning funding with revenue streams that (partly) flow from marginal social costs and value capture mechanisms (beneficiary pays), supplemented by government funding contributions for functions seen as community service obligations, such as support for base public transport service levels to help assure social inclusion and for functions seen as delivering significant external benefits
- increased professionalism in decision-taking, guided by more open strategic planning processes
- increased transparency and accountability in planning and decision-making.

Figure 4: Indicative Land Transport Fund



Source: Stanley 2012

Better Pricing and Efficiency

"Pricing reform is of course an efficiency improvement device in its own right, as is process and institutional reform. With these reforms, it is likely that less waste will occur and more funding should flow to areas of highest consumer need." (Peter Harris, 2014)

For the purposes of this submission the BIC concurs with Peter Harris in identifying pricing as a pathway to greater efficiency in how we move people and deliver infrastructure in Australia.

The transport investment 'hole' resulting from the decline in share of infrastructure investment spending has been recently assessed by the National Institute for Economic and Industry Research at $111b. This is of a similar order to the transport projects in the Infrastructure Australia 2013 priority list, which totalled $82-91b as at June 2013 across all Infrastructure sectors but were dominated by land transport proposals. It is no surprise that transport projects figure prominently in the Infrastructure Australia priority project funding lists.

Pricing shortcomings in land transport are a major barrier to efficient use of existing infrastructure and send poor signals as to where infrastructure development is needed.

The BIC concurs with the key recommendation from Infrastructure Partnerships Australia, the Australian Automobile Association and Transport Reform Network in *Road Pricing and Transport Infrastructure Funding: Reform Pathways for Australia* (2014):

"The Australian Government should direct the Productivity Commission to establish a detailed Public Inquiry into the funding, regulation and pricing of Australia's road transport market, and related impacts in the broader transport market. This Inquiry must consider the capacity of the existing structure of road charging to fund future investment requirements; and the limitations of the current framework to achieve more efficient use of the transport system.

The Public Inquiry should evaluate the potential for new pricing mechanisms to better address funding, equity and demand management on the road network. It should ultimately recommend the principles for a new, optimal structure and a clear reform pathway for Australia's governments."

We believe the modelling work undertaken by in the recent report on how a road user charging system might work in Australia should form the basis of wider trials and situational tests of different models of road user charging in Australian cities and regional areas.

The following response is taken from the BIC's latest Moving People publication *Pricing Opportunities: Paying our way in Land Transport* which is authored by Professor John Stanley at the University of Sydney Institute of Transport and Logistics.

User Pays

The idea that people should pay the costs that result from their consumption, production and/or product disposal choices (often known as 'user pays', or 'polluter pays' in some contexts) is widely accepted throughout our community and has been increasingly applied in the traditional governmental utility sectors (which are increasingly being privatised), such as energy and water. Infrastructure Australia (2013), for example, promotes the concept of 'user pays-user says', for urban transport, arguing that this charging framework should include congestion costs. The NSW financial audit has suggested that efficient congestion pricing could raise up to $5b gross revenue annually in that state, with a net gain of about $2b after allowing for abolition of some existing charges (NSW Treasury 2011)[2].

The land transport sector in Australia has probably made least progress in applying user pays principles for use of infrastructure and services (BCA 2013). While fares are applied for use of public transport (usually well short of full cost recovery, for solid public policy purposes[3]), toll road users pay road tolls (also often short of full marginal social

[2] Market failures associated with 'public goods' (such as defence and law and order) and 'merit or quasi-public goods' (such as a decent base level of public education, disability support services and a core public transport 'social safety network') would typically sit outside a full user pays framework.

[3] The failure to price the external costs of car use argues for financial support to public transport, because of the savings in external costs of car use that result. The social safety net role played by public transport also argues for some governmental financial support.

cost recovery, because of the focus on infrastructure costs), heavy road vehicles are charged an explicit (albeit averaged) charge for road use (infrastructure cost focussed) and private car users pay their personal direct car costs (e.g. time, fuel), most land transport infrastructure/service use is not explicitly priced to users on a social cost basis.

Economically efficient road use pricing, as an example, is based on the idea of users paying the marginal social costs attributable to their road travel choices. Any jurisdiction seeking to pursue such pricing has some fundamental considerations to resolve, such as (for example):

- how to ensure that cost recovery targets are met, if a jurisdiction believes this is important (where the usual answer is to price at short run marginal social costs and raise any additional revenue required to meet cost recovery targets by charging higher prices to users who are least deterred by higher prices, called Ramsey (1927) pricing);
- how to calculate relevant marginal social costs, when there are frequently many joint and common costs involved in provision of transport services and the analytics of costing is still emerging. The European Commission has supported substantial valuable research to improve relevant marginal social cost estimates, with Maibach et al. (2007) a comprehensive source; and,
- how to design a pricing scheme that will be acceptable to voters (also the subject of a wide literature, with many commentators proposing dedicating (or hypothecating) the revenues that are raised to specific transport and/or closely related applications and upgrading alternative travel options prior to implementing charges, to give people a choice.

BIC (2012) identified that government revenue streams which might notionally be seen as charges for road use (esp. fuel excise and registration) are now barely meeting the direct costs governments spend on road construction and maintenance. When the wider 'external' costs of road use are taken into account, BIC (2012) suggests that Australian road users pay governments less than half the social costs that are attributable to their road use. This problem is compounded by declining fuel excise collections, under such influences as a lack (since 2001) of indexation, improving vehicle fuel economy and declining per capita car use in our cities.

Notwithstanding the complexities of implementing marginal social cost pricing, the conjunction of:

- a substantial Australian land transport infrastructure backlog, with increasing economic returns in prospect from tackling this backlog
- current road user taxes/charges barely covering direct road expenditure costs and being well short of covering the external costs of road use and
- declining fuel excise collections,
- in a fiscal environment where governments are wary of increased borrowings, demands a new approach to how Australians pay for road use and how transport investment is funded. *User pays* should be one foundation for this new approach, better reflecting all the marginal social (external) costs of road use that are amenable to reasonable measurement in relevant prices. BIC (2012) argued that wider application of *beneficiary pays* approaches is also important (user pays being one category of beneficiary pays). The increasing returns to scale identified by NIEIR (2013) supports an argument for continued and increasing funding support for land transport investment from general government revenue streams, as does the social safety net role played by some land transport services (e.g. a core set of public transport services).

Road Pricing Reform

A vast literature on road pricing has emerged over the past fifty years. The small number of live examples where this has been applied, however, means that most of this literature is largely theoretical. However, it now includes some recent very useful modelling work, which brings together land use/transport/computable general equilibrium modelling (LUT/CGE). This analysis, and the experience from the handful of live examples where an element of road pricing reform has been implemented, is very valuable for thinking about what might work in Australia.

Europe has shown strong interest in pricing road use. The European Transport White Paper (EU 2011), for example, argued that:

Getting prices right and avoiding distortions

58. Price signals play a crucial role in many decisions that have long-lasting effects on the transport system. Transport charges and taxes must be restructured in the direction of wider application of the 'polluter-pays' and 'user-pays' principle. ... Wider socioeconomic benefits and positive externalities justify some level of public funding, but in the future, transport users are likely to pay for a higher proportion of the costs than today. It is important that correct and consistent monetary incentives are given to users, operators and investors

62. For passenger cars, road charges are increasingly considered as an alternative way to generate revenue and influence traffic and travel behaviour. The Commission will develop guidelines for the application of internalisation charges to all vehicles and for all main externalities. The long-term goal is to apply user charges to all vehicles and on the whole network to reflect at least the maintenance cost of infrastructure, congestion, air and noise pollution.

The basic pricing theory of road pricing in the presence of negative externalities is pretty simple: following Pigou (1932), pricing a negative externality at its marginal social cost is the way to maximise economic welfare. However, applying such 'first-best' pricing principles on every road in a network is clearly very difficult, given such complexities as differing time costs/values of individual drivers (travel time being the major congestion cost), different speed-flow relationships on different road types, different road damage functions for different vehicle types and, in the past, technological difficulties of actually charging for use (a problem that can be largely overcome now by GPS technologies). One consequence of these difficulties has been that actual implementation of road pricing schemes has been kept simple, in terms of both the range of costs that are included and the refinement of the pricing method. Congestion pricing schemes (for example), typically charge:

- users who cross a designated cordon (cordon charging, as in Stockholm, Singapore or Bergen; exemptions may be provided) or
- users who travel in a particular area (area or zonal charging, as in London or Milan; again, exemptions may exist) or
- users who travel on a particular link (e.g. as with some US 'hot lanes').
- Congestion reduction has usually been the main motivation behind implementation, although the various Norwegian cordons have primarily had a revenue raising purpose and the Milan scheme has been largely aimed at reducing local pollution.

Cordon and zonal charging schemes have the advantage of simplicity but are crude as means of seeking to reflect external costs in charges. There are too few examples of each around for strong conclusions to be drawn about relative merits but cost-benefit studies of the Stockholm and London schemes are both supportive. Satellite-based (GPS) systems will probably be the long term answer, with some existing European heavy vehicle applications and a Seattle pilot leading the way. The Netherlands almost got over the line on a GPS system a few years ago but a change of government was highly correlated with a change of heart!

Integrated land use/transport modelling and pricing

As noted above, integrated land use/transport and computable general equilibrium (LUT/CGE) modelling is now being used to explore the implications of congestion pricing and of wider road pricing reforms. Anas and Hiramatsu (2013), for example, analyse three hypothetical toll cordons in Chicago as ways of incorporating congestion costs in road use charges. The benefits of the alternative schemes are assessed in terms of the monetary sum of:

- Consumer Welfare (or utility) gain, measured via the usual compensating variation, as an indication of willingness to pay, plus
- Government toll revenue (net of costs, which are not included in the analysis), plus
- Real estate benefits in the form of windfall gains in the value of building floor space or land (an important inclusion in terms of the idea of 'value capture' as a means of beneficiary pays pricing).

Anas and Hiramatsu (2013) find that a cordon focussed on the Chicago CBD is likely to see loss of jobs and residences from the centre to the suburbs, likely to be undesirable in view of the high agglomeration benefits of the central city. Conversely, a cordon enclosing the centre and inner suburbs was expected to lead to more centralised jobs and residences, decreasing urban sprawl (as people move to avoid crossing the cordon). This suggests that a land use policy intention to encourage agglomeration benefits might gain from such a wider cordon pricing approach. The presence of a good public transport system was seen as very important in providing people with the opportunity to avoid the toll.

An important conclusion from the Anas and Hiramatsu research was that the largest benefit component from each of the three cordon options they examined was the **increase in real estate income**, underlining the potential importance of value capture within the policy armoury for effective policy implementation. Consumer welfare fell with the wider cordons, being dependent on revenue recycling (from government toll revenue and/or the real estate gain) to achieve a net gain for consumers.

Safirova et al. (2007) analyse three cordon options for Washington DC, together with a freeway road toll, a comprehensive road toll and a vehicle mile tax (VMT). Unlike Anas and Hiramatsu (2013), they include both congestion and a number of other external costs of road use (air pollution, accidents, climate change, oil dependency, noise) in their pricing options. They find that comprehensive tolls (to approximate the 'first best' pricing solution) and the VMT deliver the highest benefits, with benefits increasing as the scope of the pricing initiative is broadened from just congestion costs (the largest single externality) to all social costs. The VMT they analyse is a toll that is fixed at the same level on all links and time periods, while the comprehensive tolls seek to capture external costs more precisely. They also find a tendency for cordon tolling to move jobs and population towards the centre of the region and for public transport to provide a vital escape valve for people to avoid cordon tolls, in line with the later findings of Anas and Hitamatsu (2013).

Based on the US modelling work and analysis of the effects of the London and Singapore schemes (May 2010, Anas and Lindsey 2011), it seems unlikely that either a cordon or zonal (area) based road pricing system would be of great value in an Australian setting, unless it was framed to include parts of the middle suburban areas of cities, as well as the centres and inner suburbs. This may then be a means of encouraging increasing densification of our cities, in line with most current State planning policy intentions. Those cities where cordon/area charging has worked have generally got high density central areas, clear geographic boundaries for scheme application (e.g. Stockholm is a set of islands; London uses its Inner Ring Road as a natural boundary) and very extensive public transport systems providing a good travel choice. However, most Australian cities lack these combined requirements. More importantly, as soon as such a relatively extensive urban scheme area is considered for scheme application in a US type city, the Safirova et al. (2007) research suggests pretty clearly that it would be better to simply move to a VMT, which captures a larger part of the potential benefits, and that it is better to extend beyond just congestion costs when seeking to price external costs.

Fuel Tax or VMT?

Fuel is a convenient base on which to charge for road use, its major advantage being that it has the benefit of administrative simplicity: countries have fuel taxes and it is possible (but seems politically hard in many jurisdictions!) to change the tax rate to achieve a rough proxy for external costs. However, it has long been recognised that fuel is also an imperfect tax base, if the intent is to make users pay the costs associated with their road use. The main reason is that only a minority of the external costs of road use are highly correlated with fuel use, these being costs associated with climate change and energy security. Air pollution, noise and accident costs are likely to be more strongly correlated with distance travelled than fuel used, as is the largest single externality of congestion, where time and place (as reflected in the level of congestion) are also very influential on the size of the external cost. A further disadvantage, of increasing importance, is that the fuel tax base is declining over time in many countries, as vehicles become less dependent on fossil fuels (e.g. as fuel economy standards tighten).

Parry and Small (2005) have developed an economic model that can be used to identify optimal fuel taxes to recover external costs of road use. Stanley and Hensher (2011) use the Parry and Small model to derive an optimal fuel tax for Australian cars, including:

1. a range of external costs of road use (local pollution, greenhouse gas emissions, energy security, accidents, congestion), to enable calculation of what is sometimes called a Pigovian (externality-reducing) tax, which prices the marginal costs of the relevant externalities;
2. an adjustment to allow for the efficiency trade-off between commodity taxation and income taxation (or Ramsey (1927) tax, which allows for the excess burden of different taxes within the welfare optimising framework). This component recognises that welfare maximising revenue arising from commodity taxation should impose higher taxes on those commodities that have lower price elasticities of demand (such as petrol and diesel used for motoring); and
3. a congestion feedback component, which relates to a positive impact on labour supply, and social welfare, of reduced congestion. The effect of this element is minimal within the total.

The relevant external costs are nominally estimated as marginal social costs but a lack of detailed knowledge about the shape of the relevant damage functions for a number of externalities, and the requirement to strike a single fuel tax rate, means that marginal and average social costs per unit are effectively assumed to be equal. External costs that correlate more closely with distance than fuel use are converted to a fuel charge equivalent. The effect of higher fuel prices is allowed to feed back to vehicle choice and to the fuel economy rate, which means the optimal fuel tax is less than might be implied by simply estimating external costs for the current vehicle fleet. Parry (2009), for example, estimates that about half the reduction in fuel use associated with optimal fuel taxation would come from improved fuel economy and half from reduced vehicle use (resulting from mode shift, and reduced miles per vehicle).

The Stanley and Hensher (2011) analysis suggests that Australian fuel excise on petrol needs to be raised to better reflect the external costs of car use (heavy vehicle charges were not assessed), the suggestion being that an increase of perhaps 14c/L would be appropriate, with congestion accounting for the largest component of the charge. Such a charge would raise an additional $5b a year, Stanley and Hensher arguing for separately quarantining urban and rural/regional revenue collections for use in those respective areas, recognising the absence of congestion costs in rural/regional settings. An increase of this magnitude will obviously be difficult to achieve in one jump, such that a series of cumulative increases of 3-4 c/L over several years would probably be needed to have any chance of implementation. In this regard, it is noteworthy that New Zealand has announced increases in its petrol excise duty of 3c/L on 1 July, 2013, 1 July 2014 and 1 July 2015, to deliver the Roads of National Significance program, with road user charges to increase by an equivalent amount[4], suggesting that such increases are achievable if there is sufficient political will

Previous work by Parry and Small (2005) suggests that a welfare maximising vehicle mile travelled charge (VMT, or VKT in Australia) as a road user charge will typically involve a greater increase in charges to users than a fuel excise, for reasons such as the lack of the option of the user shifting to a more fuel efficient vehicle to avoid a VKT5. That research also suggests that charges based on distance travelled deliver higher welfare gains than if the charging was fuel based, and that welfare gains will be achieved even if the VKT implementation (in place of a fuel charge) aims for revenue neutrality. In short, the case for distance travelled (VKT) as a base for charging for the external costs of road use, rather than just relying on fuel taxes (excise), is strong, albeit that it may be more difficult to implement a new VKT than to adjust fuel tax rates. Parry and Small (2005) suggest an optimal VMT charge in the US of around 14c/mile, or 9 cents a kilometre (2000 prices).

The US National Surface Transportation Infrastructure Financing Commission (NSTIFC 2009) proposed that the US should shift from its current road charging/funding system, based largely on indirect user fees in the form of federal motor taxes, which are in decline6, toward more direct user charges, in the form of a vehicle mile travelled (VMT) charging system (NSTIFC, 2009). The Commission adopted six guiding principles as criteria for selecting road pricing mechanisms:

1. Enhance mobility of all system users
2. Generate sufficient funding on a sustainable basis
3. Cause users to pay full cost of system use to greatest extent possible
4. Encourage efficient investment
5. Incorporate equity considerations
6. Support broader public policy goals (i.e., energy and environment)

It argued that a VMT best met these criteria (from among the large range of funding options evaluated). Increased fuel taxes were supported in the short term, to restore funding from the Highway Trust Fund, but a VMT was seen as the preferred long term solution, incorporating externalities.

The Commission proposed that the US Federal Government should commit to deploying a VMT charging system by 2020, this timeline recognising the difficulties in implementation. Importantly, the analysis underlying the Commission's work suggested that a VMT that incorporated external costs would reduce the required rate of increase in net annual US Transport Infrastructure spending by about $US20-30 billion, by encouraging better use of

[4] Light diesel vehicles also pay the road use charge.
[5] The low VKT elasticity with respect to fuel cost means that the VKT is an attractive target for Ramsey taxation.
[6] In part this is due to the long period over which fuel taxes have not been indexed.

existing infrastructure (including mode shifts from car to public transport and changes in travel times to ease peak loads) and reducing overall travel demands. Investment in transit would need to increase, to cater for modal shifts and growth, but road investment pressures would be eased. The relevant VMT charge could vary by type and weight of vehicle (for example), to reflect varying emissions performance and road damage (especially for heavy vehicles).

The Rand Corporation (2011) has identified eight ways in which a VMT/VKT charge could be levied, agreeing with NSTIFC that it would provide a more stable revenue source than fuel tax in the long term. Table 1 shows those eight options. As one moves down the options in Table 1, the approach moves closer to 'first best' pricing. Interestingly, responses to the NSTIFC work frequently cited privacy concerns with on-board devices, a problem that the Dutch plans for GPS-based charging seemed to have resolved. The main Rand conclusion was the importance of implementing trials to test the VMT approach.

Oregon has been a leader in such trialling. The state has been looking at alternatives to the gas tax since 2001 and began its first VMT charging trial in 2006. That study involved using GPS devices to collect data on the number of miles travelled by each motorist in the trial, transferring the data to gas stations and levying the appropriate fee when drivers bought fuel. Oregon wants to offer motorists a range of options for how VMT is collected so that nobody can accuse the system of being an invasion of privacy. Oregon Governor, John Kitzhaber, has recently signed SB 810, and Oregon will create a voluntary program for up to 5,000 motorists who will pay 1.5-cents for every mile they drive instead of the 30-cent state fuel excise tax.

Parry (2012), in reviewing road pricing reform options for Mauritius, has suggested that a transitional pathway for that country could include turning the country's fixed annual road tax into a variable charge, incorporating a congestion element per unit distance driven, with distances based on total distance driven the previous year (i.e. at the 'low tech' end of the eight Rand options). This form of assessment should encourage less driving. Parry suggests taking odometer readings when vehicles are put through a safety inspection and providing an incentive (lower fees) for drivers who can demonstrate (by installing GPS) that most of their driving is rural and/or off-peak. As the proportion of drivers using GPS increases, the charge on those remaining on the odometer system could increase, to encourage further switching and retain government revenue flows, Parry noting that the system could be set up to be revenue neutral if desired.

Table 1: Range of VMT-Fee Implementation Options

Metering option	**Description**
Self-reported odometer readings	Drivers report current mileage each year as part of an annual registration process. A similar approach is used for FBT assessment in Australia
Required odometer readings	Drivers submit to periodic (e.g. annual) readings at certified locations as the basis for assessing mileage fees
Optional odometer checks	Drivers are assessed an annual fee based on class average data; those driving fewer miles can submit to annual odometer readings for relief
Fuel consumption-based estimates	Vehicles are equipped with an AVI device that transmits vehicle fuel economy rating to the fuel pump; this is multiplied by fuel quantity purchased and the resulting fee is added to the fuel cost
RFID tolling on a partial road network	Vehicles are equipped with an AVI device that communicates with gantries set up along the most heavily trafficked road segments to enable facility-based tolls
OBU with OBD II	Vehicles are equipped with an On Board Unit connected to the OBD port to estimate distance travelled
OBU with OBD II/cellular	As above but vehicles are also equipped with cellular communication technology to determine area of travel
OBU with GPS	As above but vehicles are also equipped with a GPS device to determine specific route of travel.

Source: Based on Rand Corporation (2011).

NSW Treasury (2011) looked at replacing the state's light vehicle taxes with a state-wide per kilometre charge, with a resulting charge rate of 4c/L for revenue neutrality. They noted that a change of this nature would tend to favour urban motorists over those in rural areas, where travel distances are typically longer. However, as noted previously, they suggested that congestion pricing could accompany this change in charging base. The NSW research then looked at a lower state-wide light vehicle base charge of 2.5c/km plus hypothetical congestion charges of 3.83c/km in the weekday am peak, 2.65c/km in the inter-peak and 3.46c/km in the pm peak. Weekend congestion charges were modelled at a lower level (NSW Treasury 2011). The resulting charging scheme was estimated to raise about $2b net from light vehicles. This work is the most advanced published work on congestion charging by an Australian state government that BIC has identified.

More recently, Hensher and Bliemer (2012) and Hensher and Mulley (2013) have taken a lead from NSW Treasury (2011) and Parry (2012) and proposed converting part of the Sydney (NSW) fixed annual vehicle registration charge to a vehicle kilometre charge (VKT) for peak period road use, as an early stage towards a reformed road user charging regime. A major rationale for these two Australian papers is to tackle the **problems of implementation** that beset most attempts at road pricing reform (particularly congestion pricing). Their proposals would provide Sydney drivers with an opportunity to save money, by shifting away from peak travel, and assure the NSW State Treasury of at least revenue neutrality, to encourage implementation. The Hensher and Mulley (2013) proposal does this by reducing the Sydney annual vehicle registration fee to $185, a reduction of over 50%, adding a new charge of 5c/vkm for peak travel for those who opt-in to this payment scheme. Total peak vkms in Sydney are projected to fall by 4.7 per cent, which would deliver significant increases in travel speeds and associated time savings benefits. Fuel tax revenues (collected by the Federal Government) are projected to decline marginally with reduced vehicle use.

Heavy vehicles

Australia

The Australian heavy vehicle road charging system, first introduced by the(then) National Road Transport Commission in the early 1990s, included a road use charge, as a designated component of the fuel excise (with the difference between this designated amount and the total excise rate being refunded to operators), and a registration charge, which varied by vehicle axle category. Charges were only to recover infrastructure and related costs of road system provision and operation and were based on several averaging processes. This ensured that probably no single vehicle/operator paid the correct costs attributable to their road use but that the overall total collected was about right and the distribution between vehicle types was probably about right. Vehicles that travel long distances for their axle class, however, have tended to pay too little, while those that are lighter than their axle class average pay too much.

It has taken about two decades for any real progress to be made in refining this initial charging system, with the COAG Road Reform Plan (now called the Heavy Vehicle Charging and Investment Reform, or HVCI (2013)) examining ways to, *inter alia*: improve cost recovery; better connect charges, infrastructure planning and investment expenditure and funding flows to road managers; and provide for a greater industry input in investment prioritisation (via state road infrastructure co-ordinators). The HVCI program is examining three major charging options, from a modified version of the current arrangement (putting more emphasis on the road use charge and less on registration), to a simplified version of a mass-distance-location (MDL) charging scheme (not charging for actual mass, which would not be measured at the individual vehicle level)[7] and then to a refined MDL model, based on in-vehicle technology.

The HVCI approach should improve some aspects of the way Australian heavy vehicle road use is charged, priorities are determined and authorities are funded, as these matters relate to heavy vehicles. However, the discussion remains limited to direct road costs, excluding other externalities, and excludes light vehicles. This is a serious limitation. HVCI (2013) points out that only $2.8b of the $17b spent on Australian roads is attributable to heavy vehicles. However, if external costs are included along the lines indicated in BIC (2012), that $2.8b represents less than 10 per cent of total external costs. With apologies to the bard, this reformed charging approach might be called 'much ado about very little', unless it is a precursor to a more radical overhaul of the way road use is planned, charged and funded. There is no suggestion as this stage that this is the case.

[7] Approaches such as New Zealand's distance-based charging scheme, using hubodometers, are in this middle ground.

A serious problem with the HVCI proposed approach is that it relies in part on being able to disentangle the interests of heavy vehicle users from those of the remainder of the vehicle fleet, particularly the far more numerous cars, in the infrastructure prioritisation process. In cities, for example, there are few road initiatives that can stand on their own feet solely with respect to what they do for heavy vehicles. HVCI (2013) acknowledges that light vehicles exist and that light vehicle planning will need to be addressed but has no useful insights into how an integrated approach that encompasses all modes might be implemented, when one mode (heavy vehicles) is proposed to have its own infrastructure co-ordinators but no such creatures speak for light vehicles! The HVCI efforts to improve heavy vehicle charging are to be commended but it is a retrograde step to even contemplate further siloed planning for heavy vehicles in our cities, at a time when the COAG Reform Council (2011) has pointed out how much more we need to do to have effective integrated urban land use/transport planning.

Europe

European countries use time-based (vignettes) or distance based (tolls) charging methods for heavy vehicles. Countries can be classified into six categories in terms of how they price road use by heavy vehicles[8]:

1. Vignettes: a time-based charge based on prepaying for network access for a period ranging from one day to one year. Four countries have national vignettes and five others are part of the common 'Eurovignette', with some of the latter countries having plans to replace this system.
2. Countries developing vignette systems (UK, Latvia).
3. Electronic network wide tolling with distance charging: six countries, including the well known German and Austrian systems.
4. Countries developing electronic network wide tolling (four countries at present).
5. Manual tolls (5 countries).
6. No tolls (2 countries plus the two that are developing vignettes).

The Eurovignette charging system goes back to 1999 and covered charging for heavy vehicle use of about half the 30,000 kms of the motorways in the Trans European Network (TEN-T). Individual jurisdictions can also charge for roads that are not part of that network, under local arrangements (which need to meet EU requirements in terms of, for example, proportionality and non-discrimination). The heavy vehicle charging system was initially set up for only infrastructure costs but charges were able to be differentiated by vehicle emission performance, with Germany being a well known example of a variable charging regime dependent on emission performance.

In 2011, EU Directive 2011/76/EU introduced several important changes:[9]

- It allowed member states to calculate separate explicit heavy vehicle tolls based on the cost of traffic-based air pollution and noise, as well as infrastructure costs.
- It provided for differentiation of infrastructure toll rates to help congestion management (provided such toll variations were revenue neutral in total).
- Revenue collected from the air pollution/noise externality charge is to be used to reduce the sources of the externalities, which includes such applications as developing alternative transport infrastructure, R&D into clean technologies, etc.

The network over which charging is to take place is the whole 30,000 kms of the TEN-T network. The external cost charges are set at a level that would see heavy vehicles paying 20-30% more than under the previous arrangements, compared to where just infrastructure costs are charged. EU Member States can, of course, also set charges for roads outside the scope of this Directive (i.e. roads that are outside this network). Switzerland, which is not part of the EU, is well advanced in charging heavy vehicles for external costs.

The European Environment Agency (2013) has recently reported on suitable air pollution charge levels for vehicles under Directive 2011/76/EU, with charges varying by vehicle axle category, emission performance rating, location and country, as a reflection of the underlying causes of the external cost levels. Table 2 includes some relevant examples for two vehicle types, two emission performance levels and four countries. The table shows that air pollution costs for any vehicle class, emission rating and road type are much higher in a country with a large alpine

[8] http://roadpricing.blogspot.com.au/2012/8/truck-tollshgv-road-user-charging-in.html. Accessed 8th November, 2012.
[9] http://europa.eu/rapid/press-release_IP-11-681_en.htm?locale=en. Accessed 25th November, 2013.

component (Austria). The level of variability is much less between the other three countries shown, increasing most markedly with vehicle mass and reducing as the level of applicable Euro emission rating improves. Variability is less marked across the different road speed environments shown (speed assumptions are 35 kph on suburban roads, 55 kph on interurban roads and 80 kph on highways). It is not compulsory for any particular jurisdiction to apply the relevant charges but the EU Directive sets up a framework within which countries that wish to apply charges need to operate.