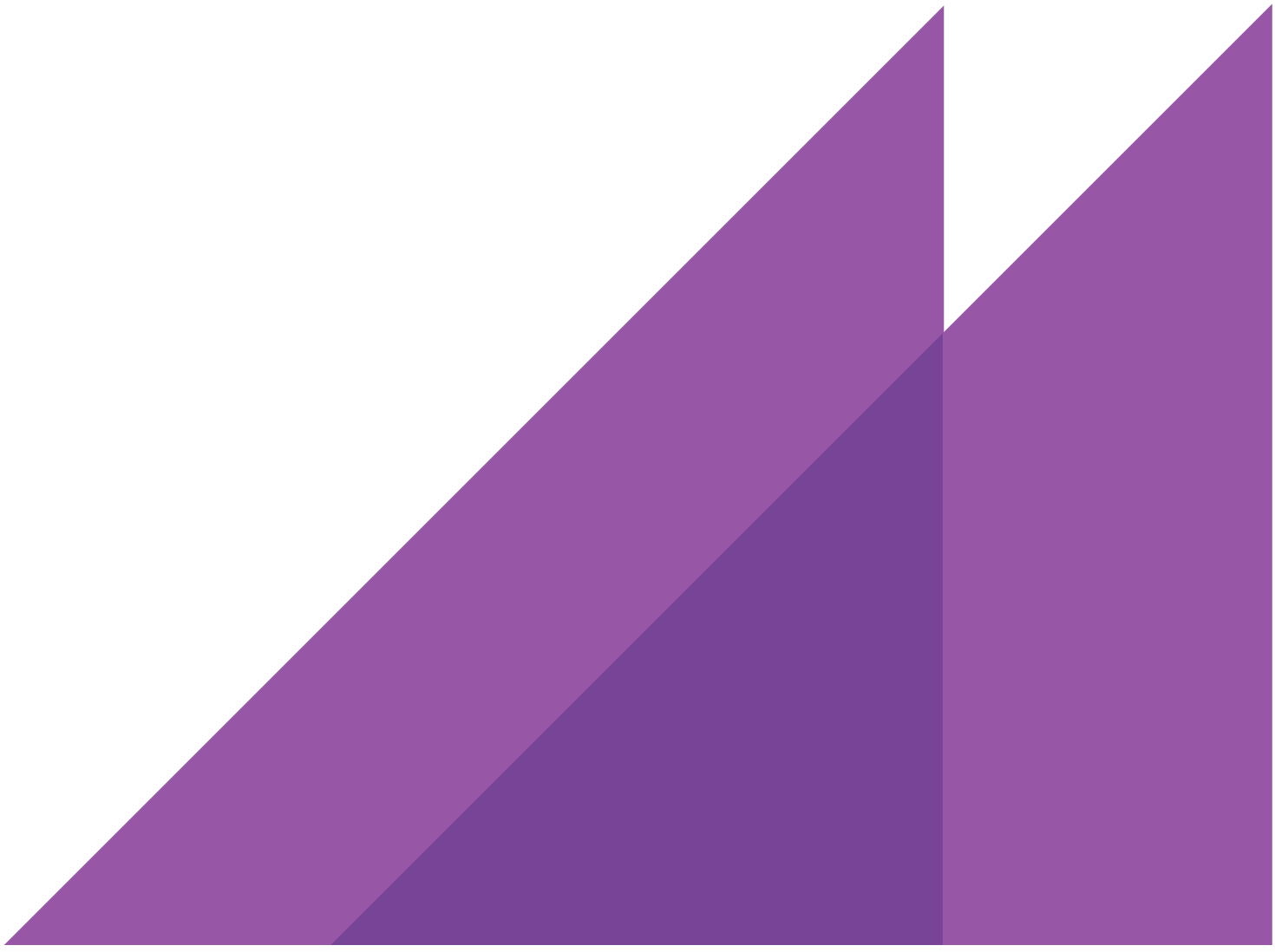
ACIL ALLEN CONSULTING

REPORT TO
AUSTRALIAN AUTOMOBILE ASSOCIATION
23 JUNE 2016

LAND TRANSPORT FUNDING:

TRANSITIONING TO A BETTER MODEL



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C O N T E N T S

C O N T E N T S

FIGURES

TABLES

CONTENTS

KEY POINTS

Australia's land transport infrastructure is not coping well with demands placed upon it at many locations and peak times. Traffic congestion is a severe and worsening problem on major arterial roads within or near metropolitan areas. Road freight routes across the country are subjected to damage by heavy vehicles, as road freight quantities grow faster than gross domestic product (GDP). Crash costs are rising partly because older roads have not been designed to allow sufficient opportunities to recover from mistakes.

State/territory, local, and federal governments have allocated considerable resources to address these problems. Government expenditures on roads in Australia have grown from about 0.94 per cent of gross domestic product (GDP) in 2003-04 to about 1.61 per cent in 2015-16. To further expand capacity in the context of funding constraints, state governments have initiated toll-road projects. Also, state/territory governments have funded large public transport deficits to hold down fares and increase services to alleviate traffic congestion in capital cities. In 2015-16, these deficits were about 76 per cent of accounting costs and 0.45 per cent of Australian GDP. In addition, a national, proxy road-use charging regime for heavy vehicles, based on registration fees and part of fuel tax, was established in the early 1990s to recover costs of use of roads by heavy vehicles.

Despite these efforts, land transport problems have worsened as the gap between demand for, and supply of suitable infrastructure services at peak times and in many locations has widened.

An important funding anomaly is that the Commonwealth Government returns only part of its revenue from road-related taxes (dominated by fuel tax) for state/territory and local governments to spend on roads. In 2015-16, only 44 per cent was returned. In 2003-04, it was under 14 per cent. This has declined more because of declining Commonwealth revenue as a percentage of GDP than higher Commonwealth allocations for roads.

Revenue and expenditure on land transport for all governments are roughly in balance. However, state/territory expenditure on land transport is substantially higher than revenue, while Commonwealth outlays are substantially less than road-related revenue. The Commonwealth shortfall is equivalent to state/territory outlays to cover public transport deficits in capital cities. Recently, the Commonwealth has indicated preparedness to contribute to public transport projects, but it is unclear if future funding of such projects will be additional to or at the expense of road funding.

There has been much discussion about infrastructure shortfalls. In economic terms, they are gaps between demand and supply at prevailing prices for infrastructure services. Discussion of shortfalls is meaningful only when it occurs in the explicit context of the accompanying pricing regimes.

State, federal and local governments have focussed on supply-side strategies, with limited pricing, in their attempts to solve land transport infrastructure problems. Pricing has been limited to flat tolls on some arterial roads, with zero pricing on the rest of the network, and substantial under-pricing of public transport services aimed at changing relative prices of road and public transport usage.

These measures have added to, or freed-up unpriced road capacity on the road network. This has tended to attract more traffic that has dissipated a considerable part of the benefits of additional road and public transport capacity (the induced traffic problem).

Substantial improvements to road and public transport infrastructure to bring facilities to an acceptable standard, and subsequent enhancements to accommodate growth of traffic as population and economic activity grow are essential elements of land transport market reform. However, this medium- to long-term policy measure needs to be complemented by short- to medium-term policy instruments: well-designed, consistent road and public transport pricing.

Simultaneous well-designed reform of pricing to require road and public transport users to bear the social marginal costs of use of facilities would perform four important functions. First, it would lock-in benefits of new infrastructure, rather than them being dissipated through induced traffic. Second, it would ensure more efficient use of existing and new infrastructure, mitigating the road funding problem. Third, it would release resources tied up in funding public transport deficits to compensate for un-priced roads. Fourth, it would provide revenue flows that are likely to be sufficient to recover costs of providing, maintaining and operating highly used parts of the land transport network.

Currently, there is severe stress on arterial land transport infrastructure in Australia's major cities and on major road links between major centres. This would be relieved by reform of pricing of road and public transport, but complementary increases in public transport and bypass road capacity would also be required to prevent unduly high prices and provide an efficient balance between prices and investment. Therefore, land transport pricing reform should be preceded by substantial improvements to public transport services in major cities and to highly trafficked parts of the road network within and between those cities. This is necessary to improve the efficiency of allocation of resources and to gain public acceptance of land transport market reform.

The land transport market reform process will require considerable time, because of the long gestation period of major land transport investments required on the supply side of the market. Planning and implementation of efficient pricing arrangements to improve demand management will also take substantial time. In addition, the substantial infrastructure component will need to be funded.

This market reform process will need to be supported by substantial transitionary institutional reform. This would include evolutionary changes to arrangements for funding, providing and operating land transport infrastructure. The institutional reforms would have multiple elements.

First, revenue from existing road-related taxation and potential application of value capture mechanisms to gain revenue from infrastructure improvements would be hypothecated to land transport funds. Second, hypothecated revenue would a provide basis for borrowing by the land transport funds to finance substantial infrastructure improvements prior to implementation of pricing reform. Future pricing revenue would also provide a basis for borrowing to provide infrastructure in advance of pricing reform. Third, well-designed pricing would replace road-related taxes in the interests of efficient allocation of resources, equity, and public acceptance of reform. Fourth, land transport funds would be transformed into land transport enterprises with price-setting capabilities. These entities would be subject to economic and safety regulation to protect the interests of users and ensure an efficient allocation of resources.

In the context of this transitionary reform process that involves substantial infrastructure improvements, the magnitude of the infrastructure deficiencies highlighted by Infrastructure Australia's (2016b) Priority List, and the analysis of infrastructure "shortfalls" or "gaps" in this report, hypothecated allocations by the Commonwealth for roads would need to rise to *at least the full amount* of Commonwealth road-related revenue. The extra Commonwealth funding that this would provide over the next five years (about $45 billion) would only be approximately enough to supply the currently unsecured funding for 10 land transport projects for which costs were publicly available, among 82 projects on Infrastructure Australia's Priority List. However, more infrastructure could be provided sooner by hypothecating Commonwealth and state/territory government road-related revenue and land transport value capture revenue to land transport funds. This revenue could be used to service debt to finance improvements to infrastructure before pricing reform is implemented. Resources to be made available by future land transport pricing reform could be leveraged in the same way to bring forward provision of additional land transport infrastructure.

Responsibility for lightly trafficked local roads in urban and rural areas should be excluded from future road enterprises, because they would yield deficits under an efficient pricing regime. Those roads should be managed by government and funded by means of efficient taxes such as rates or taxes on land value. Similarly, pricing concessions that metropolitan public transport enterprises are required to offer for equity or political purposes would not be the responsibility of those enterprises. Such concessions should be funded by efficient taxes.

Co-operation between Commonwealth, state/territory, and local governments will be important requirements for successful reform to resolve Australia's land transport infrastructure problems, because all three levels of government currently fund land transport infrastructure, each relies on different sources of taxation revenue, and only two have responsibility for managing roads.

EXECUTIVE SUMMARY

ACIL Allen has been asked to focus on the issue of adequacy of funding of land transport, particularly roads, by the Commonwealth Government. This has been done in the context of funding by all levels of government in Australia and a process of transition to a better funding model.

The report necessarily addresses the important underlying economic problem that demand for land-transport infrastructure services at peak times and in many locations exceeds supply of suitable infrastructure services, and the gap is widening. This problem has been recognised by state/territory, local, and federal governments, which have allocated considerable resources over the past 30 years to address it. Nevertheless, symptoms of the gap have become worse.

Financial Perspective on Road-Funding Shortfalls

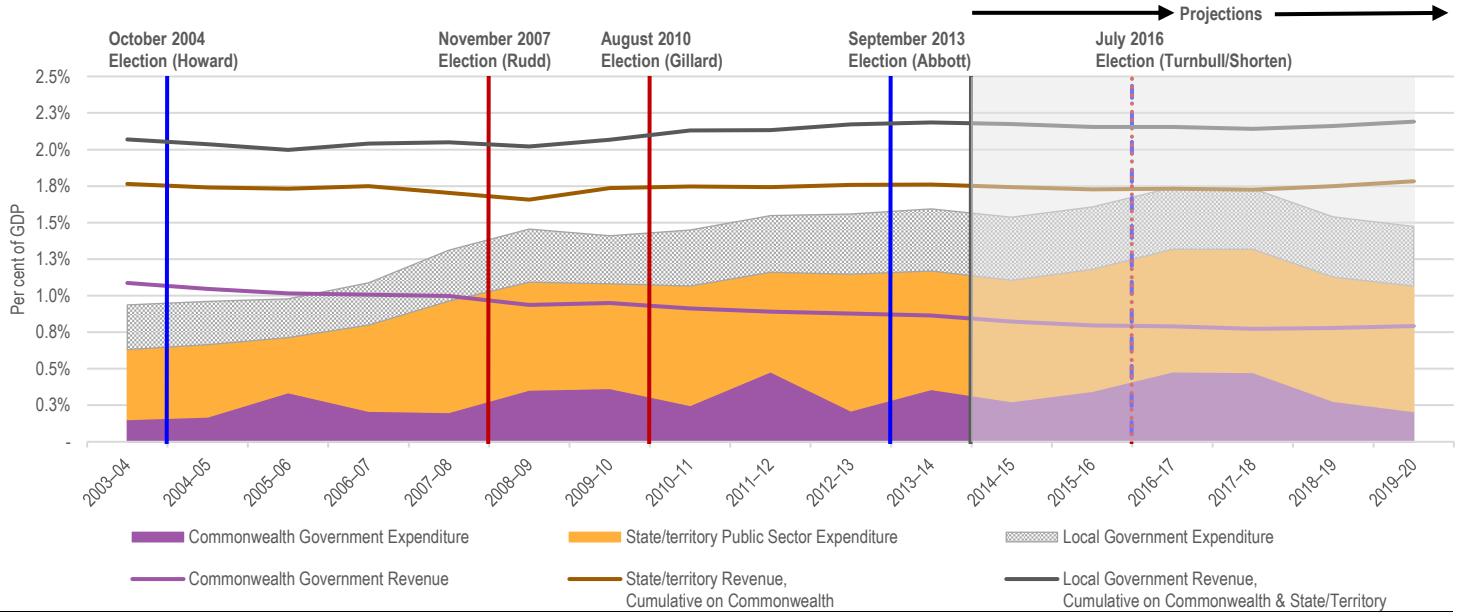
Road funding provides a prime example of the vertical fiscal imbalance that pervades the Australian Federation. Taxes and charges levied on motorists are split more or less equally between federal and state/territory governments, but the former does not have any responsibility for managing roads. In addition, local governments spend heavily on roads, but do not levy taxes or charges on motorists directly.

Recent History of Road Funding

The historical part of **Figure ES 1** shows interesting patterns of revenue and expenditure.

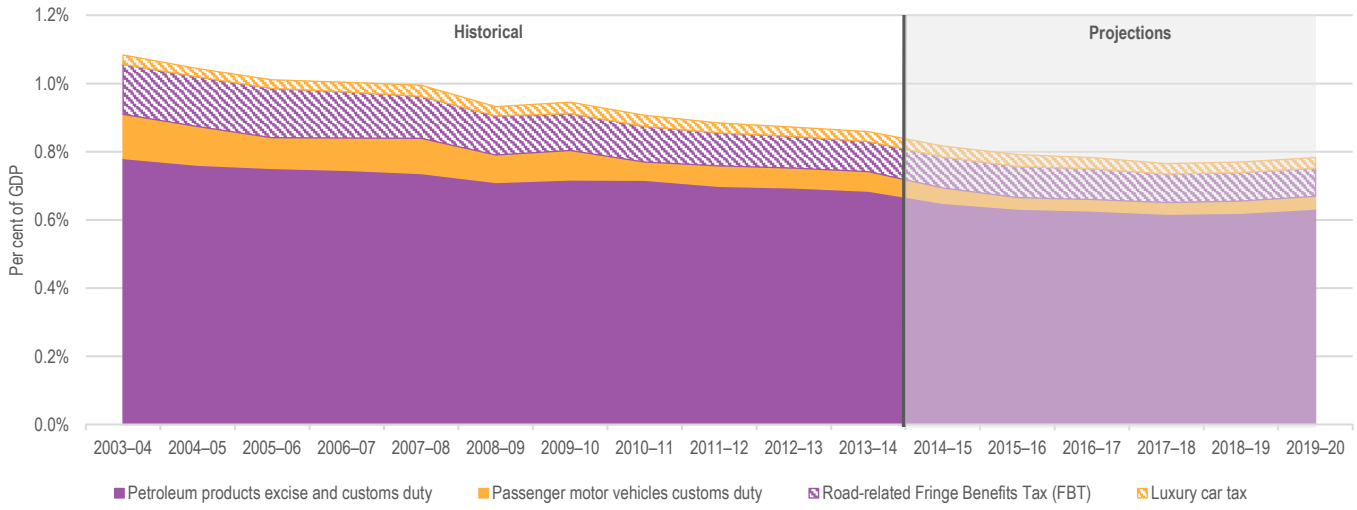
- There has been a trend decline in Commonwealth revenues from road-related taxes/charges, but a trend increase at the state/territory level. The trends offset each other, so that the aggregate of these revenues has remained roughly constant as a share of GDP.
- Commonwealth allocations to road funding exhibit a marked cyclical pattern, with spikes in allocations typically following Federal elections. Fluctuations at the Commonwealth level have been largely offset by changes in state/territory and local expenditures. Consequently, aggregate expenditure has not exhibited the cyclical pattern of Commonwealth expenditure. Overall, expenditure has increased as a share of GDP, but most of the increase has come at the state/territory level.

FIGURE ES 1 REVENUE, EXPENDITURE – COMMONWEALTH, STATE/TERRITORY AND LOCAL GOVERNMENTS



SOURCE: BITRE, ABS, ACIL ALLEN

FIGURE ES 2 ROAD-RELATED TAXES AND CHARGES – COMMONWEALTH GOVERNMENT



SOURCE: BITRE, ABS, ACIL ALLEN.

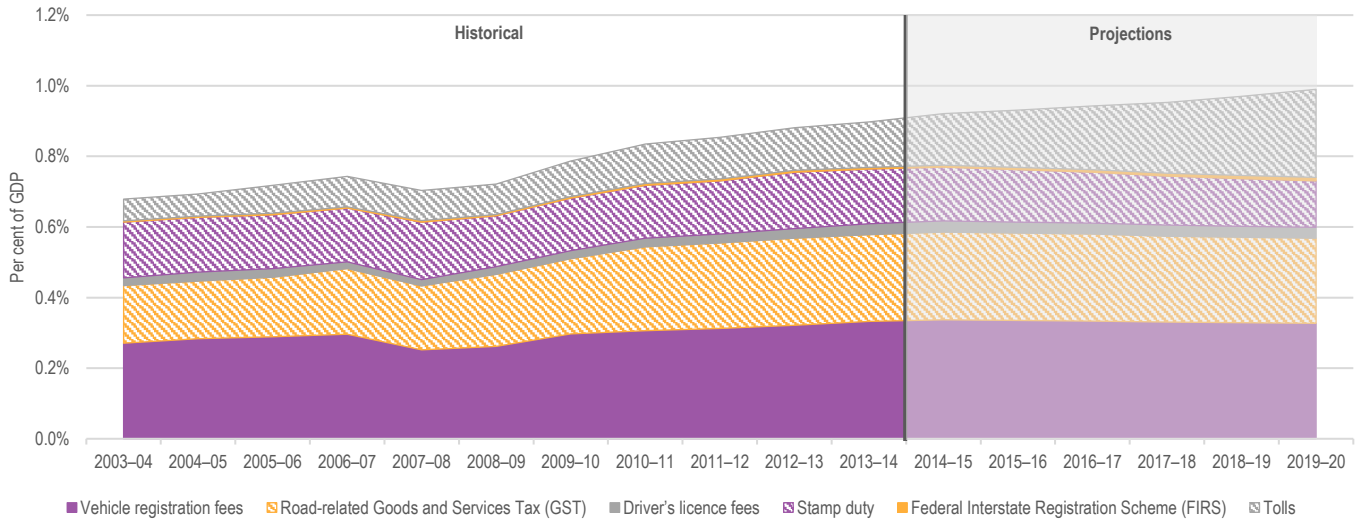
The main source of Federal road-related revenue is fuel customs and excise duties (fuel taxation). Motor-vehicle customs duties, road-related fringe benefits tax and the luxury car tax make small contributions.

As shares of GDP, all Commonwealth sources except the luxury car tax have shown trend declines (**Figure ES 2**).

- The decline in fuel taxation reflects failure to index duty rates for inflation for nearly 14 years, and technological advances in fuel efficiency directed to improvements in fuel economy.
- Australia's tariff-reduction policy accounts for the decline in motor-vehicle customs duties, offsetting increases in the import share of vehicles in Australia.

At the state/territory level (**Figure ES 3**), the main sources of road-related revenue are (in order of importance) vehicle registration fees, road-related GST, stamp duty on vehicle purchases and road tolls. Drivers' licence fees make a small contribution.

FIGURE ES 3 ROAD-RELATED TAXES AND CHARGES – STATE/TERRITORY GOVERNMENTS

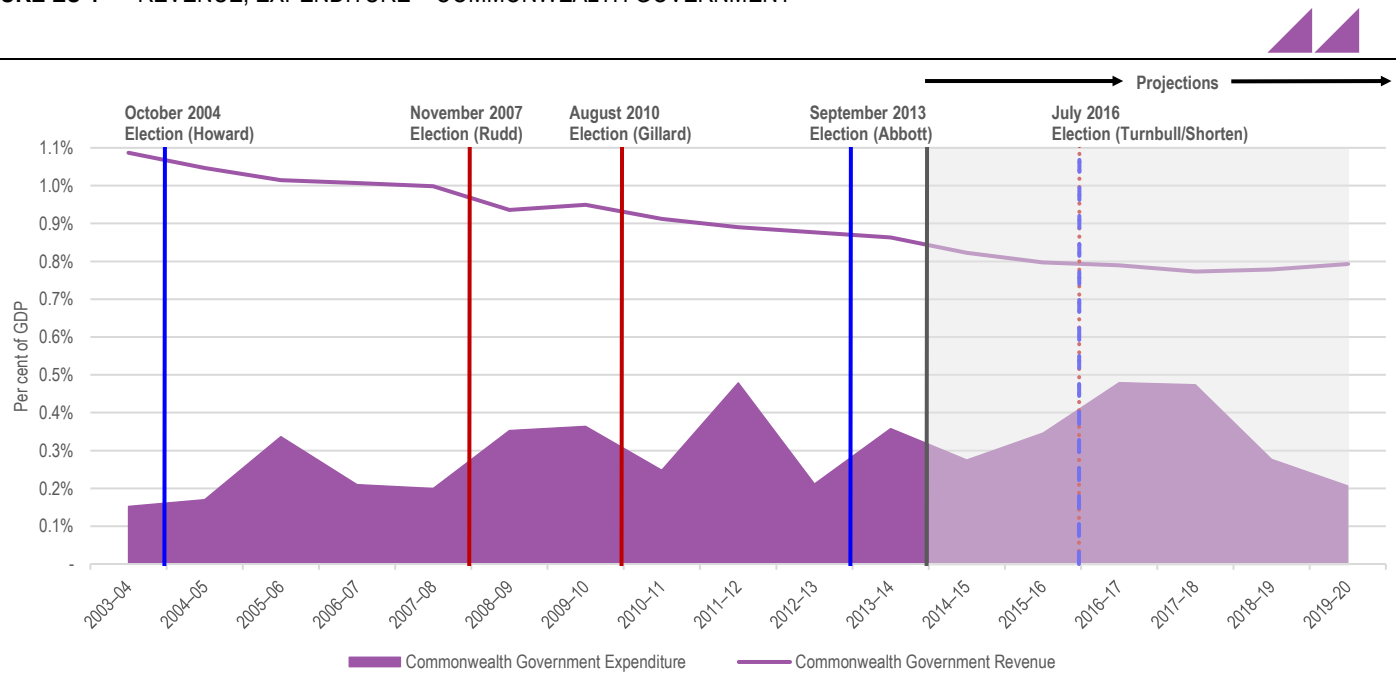


SOURCE: BITRE, ABS, ACIL ALLEN.

Vehicle registration fees, road-related GST and road tolls account for most of the increase in state/territory revenues.

The historical data show that the Commonwealth government has consistently raised more revenue from road-related sources than it has allocated to road funding (**Figure ES 4**).

FIGURE ES 4 REVENUE, EXPENDITURE – COMMONWEALTH GOVERNMENT



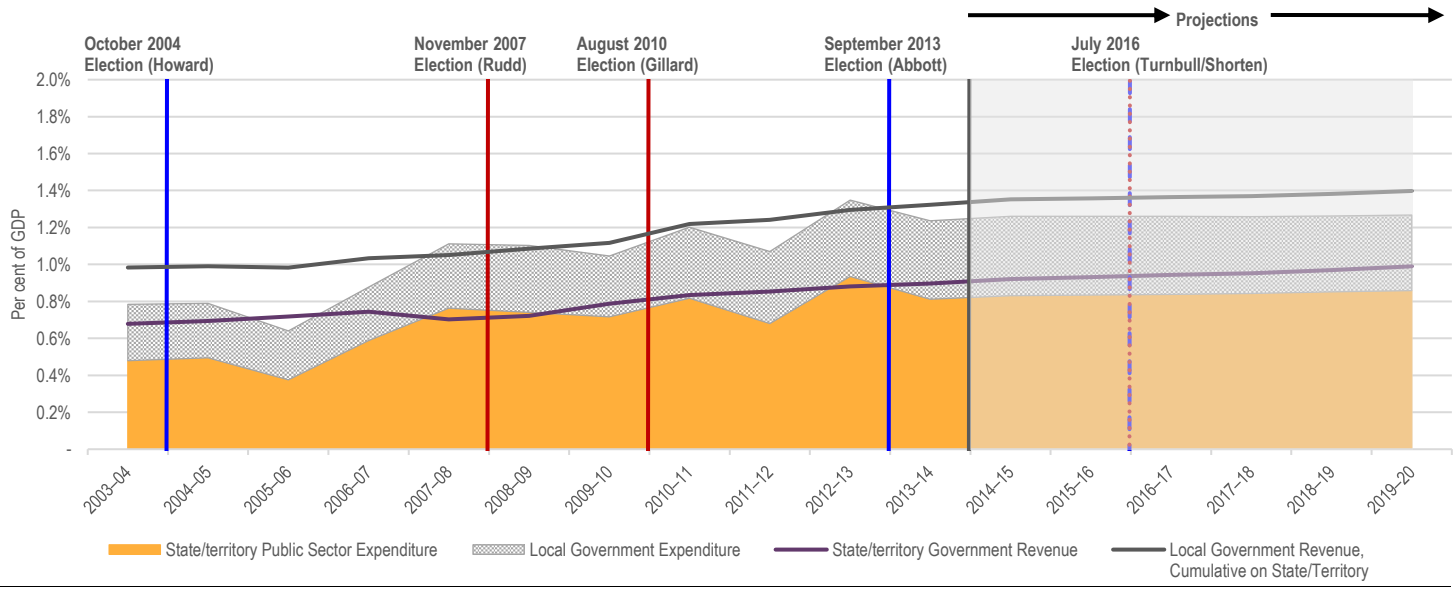
SOURCE: BITRE, ABS, ACIL ALLEN.

The shortfall of funding allocations relative to revenue has decreased, but this has been due more to the decline in revenue rather than any consistent increase in allocations to road funding.

Unlike in some other countries, Australia has no formal system of hypothecating road-related revenues to road funding. If such a system had existed, Commonwealth allocations to road funding would have been higher, but there would have been revenue-driven pressures for them to fall over time in a way that has not been evident in the relatively low allocations that the Commonwealth Government has actually made historically. Nevertheless, if the road-related revenues had been hypothecated for roads, Commonwealth funding would have been substantially higher than its actual level even at the end of the historical period.

At the State/Territory level, road-related expenditure has remained roughly in balance with road funding (**Figure ES 5**).

FIGURE ES 5 REVENUE, EXPENDITURE: STATE/TERRITORY AND LOCAL GOVERNMENTS



SOURCE: BITRE, ABS, ACIL ALLEN

Expenditure has risen over time in line with revenues. The figure shows that these patterns persist when local government expenditure is added.

However, state/territory governments have outlaid substantial amounts to cover public transport deficits in capital cities. This reflects policies of holding down fares and expanding services, mainly in an attempt to reduce traffic congestion. When these outlays are included, expenditures on land transport substantially exceed revenues. For example, in 2015-16, it is estimated that state/territory land transport outlays are equivalent to 1.28 per cent of Australian GDP, but revenues represent 0.93 per cent of GDP.

In summary, the data presented above show that over the past decade there has been a persistent, although shrinking, shortfall of government expenditure on road infrastructure relative to revenue raised from taxes and charges on road users. This shortfall is attributable to fact that the Commonwealth Government has generally allocated substantially less than half of its road-related revenues to land-transport funding. Even though the shortfall has decreased, at the Commonwealth level the current ratio of expenditure to revenue was still only 0.44 in 2015-16.

Revenue and expenditure on land transport infrastructure for all governments are close to equivalent. However, state/territory expenditure on land transport is substantially higher than road-related revenue, while Commonwealth outlays are substantially less than road-related revenue. The Commonwealth shortfall is approximately equivalent to state/territory outlays to cover public transport deficits in capital cities. In recent months, Commonwealth preparedness to contribute to public

transport projects (indicated by support from all major political parties) has emerged. However, it is unclear if future Commonwealth funding of public transport infrastructure will be additional to or at the expense of road funding.

Projections to 2019-20

The (shaded parts of the) figures above show *projections* of revenue and expenditure out to 2019-20.

Projections at the Commonwealth level are consistent with the 2016-17 budget. The budget projected that aggregate road-related Commonwealth revenues will remain relatively stable at 0.77 to 0.78 per cent of GDP. It projected that road-funding allocations will rise to almost 0.5 per cent of GDP by 2017-18, but then a drop back to 0.2 per cent of GDP by 2019-20, a level similar to that applying in the early stage of the mining boom (2004-2011). It is noted, however, that by 2018-19, a federal election will be due, and therefore, the projected reductions in expenditure may be replaced by a new round of electoral promises that lead to a temporary increase in Commonwealth grants for roads.

Revenue projections at the state/territory and local government levels to 2019-20 were made on the basis of recent historical trends – a "business-as-usual" scenario.

There are two further scenarios on the evolution of expenditure at the state/territory level (not depicted in the figures above, refer to figures **3.2** to **3.5** in the report).

In *Scenario 1*, state/territory governments are assumed to continue to compensate for swings in Commonwealth allocations to road funding. Hence, the sum of Commonwealth and state/territory road expenditure evolves relatively smoothly, as it did in the historical period. In this scenario, local government road expenditure remains stable as a share of GDP.

Commonwealth budget projections have allocations to road funding returning to levels applying early in the mining boom by the end of the projection period. In *Scenario 2*, a similar pattern is assumed at the state/territory level, although expenditure and revenue do not revert fully to pre-mining boom levels.

Both scenarios imply that a substantial shortfall of road funding relative to road-related revenues will persist through to the end of the projection period. In Scenario 1, the shortfall in 2019-20 is about 0.6 percent of GDP. In Scenario 2 it is about 0.8 percent.

Funding Gap – Infrastructure Australia Plan

Additional funding is required for the Australian Infrastructure Plan and its associated Priority List. The list included 82 land-transport projects and initiatives, of which 51 are to be completed within five years, 19 are to be completed within 10 years, and 12 are to be completed within 15 years. Cost data are not yet publicly available for most of the projects and initiatives. ACIL Allen sourced costings for 11 key projects adding to a total between $43.7 and $45.4 billion. The shortfall will be substantially higher than this, and therefore, substantial funding will need to be re-directed to land-transport infrastructure to complete the priority projects and initiatives.

Outcome Perspectives on Road-Funding Shortfalls

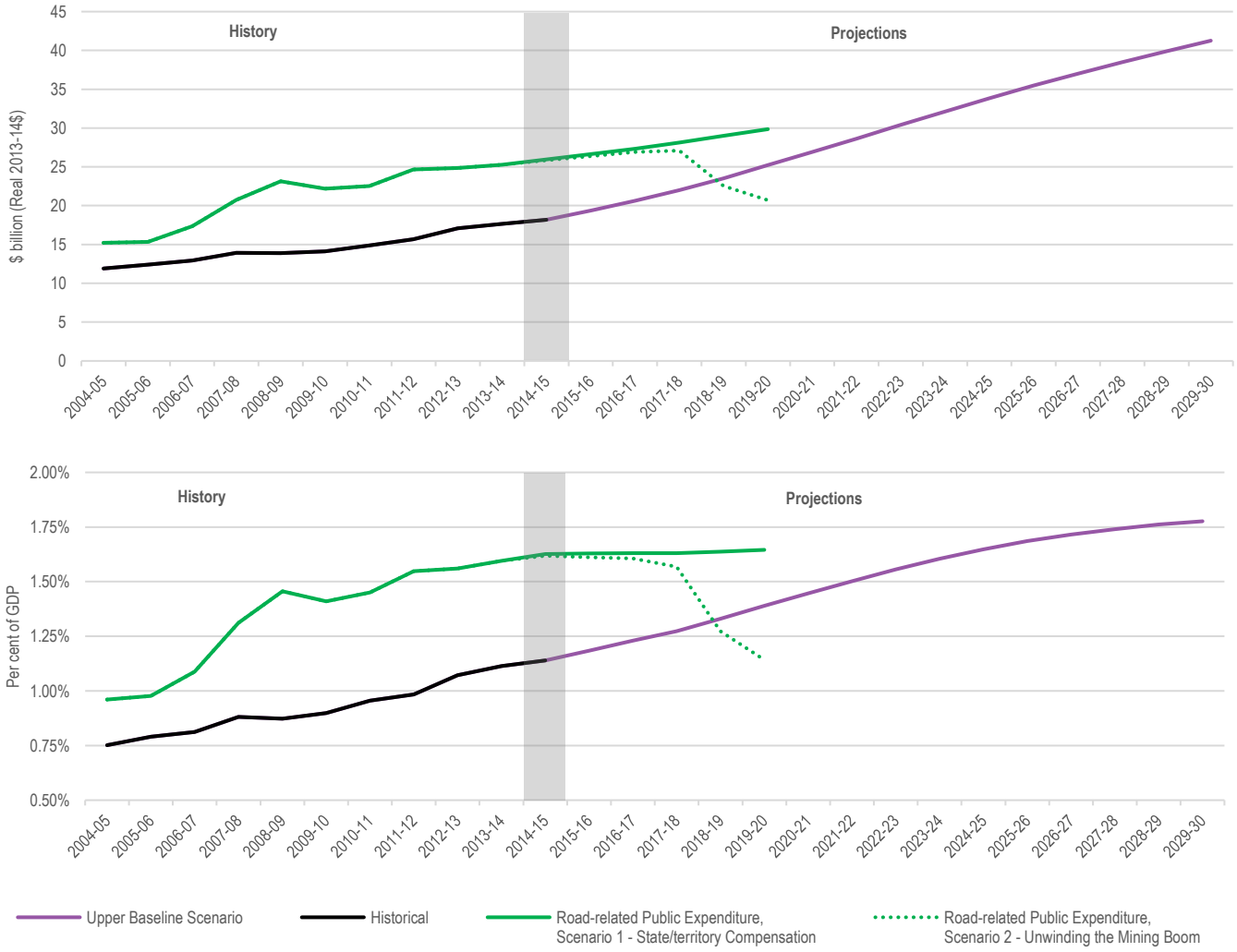
An alternative to the financial perspective on the land-transport infrastructure shortfall is to focus on the extent to which investment in the infrastructure has alleviated the problems that it is intended to address – principally road congestion, but also road safety concerns.

Congestion

In measuring congestion costs, it is important to bear in mind that a complete absence of congestion would not be socially optimal – it would reflect *over*-investment in infrastructure. Congestion in excess of the optimal level occurs because in deciding whether or not to travel, motorists consider only the costs (in terms of length and variability of travel time, vehicle operating costs, etc.) that they incur themselves, but ignore the costs that they impose on other motorists by increasing congestion. What is relevant to policy decisions about road investment is not aggregate congestion costs (i.e., costs

relative to an absence of congestion), but the costs of congestion relative to the socially optimal level. BITRE has provided estimates of these policy-relevant congestion costs.

FIGURE ES 6 AVOIDABLE CONGESTION COSTS (DEADWEIGHT LOSSES) AND ROAD-RELATED PUBLIC EXPENDITURE



Notes: **(1)** Costs refer to annual avoidable congestion costs (deadweight losses) associated with the relevant capital city's levels of excess trip delay, trip variability, vehicle operating expenses and motor vehicle emissions due to congestion. **(2)** When measuring congestion costs as per cent of GDP, it is important to avoid interpreting these as costs which could be *translated into* increased GDP. Even if they could be eliminated altogether, not all congestion costs could be transformed into GDP gains. In particular, a proportion of road users' private time savings is likely to become leisure, which would not be reflected in GDP measurement (although it would increase wellbeing).

SOURCE: ACIL ALLEN, BITRE (2015).

The BITRE data plotted in **Figure ES 6** shows historical estimates of policy-relevant congestion costs (as percentages of GDP) for the period 2004-05 to 2014-15. It also shows projections to 2029-30 under BITRE's Upper Baseline scenario, based on "business-as-usual" policy, in which current approaches to investment and to road and public transport charging are assumed to continue. In addition, the figure shows historical road-related public expenditure for all levels of government for the period 2003-04 to 2014-15, and projections under two scenarios: Scenario 1 which assumes continuation of the historical pattern of state/territory governments compensating for fluctuations in Commonwealth Government funding; and Scenario 2 which assumes that expenditure falls as part of the process of unwinding the mining boom.

Between 1989-90 and 2014-15, congestion costs rose from 0.39 to 1.14 per cent of GDP – a compound annual growth rate of 4.4 per cent. During the period 2003-04 to 2014-15, congestion

costs rose from 0.69 per cent of GDP to 1.14 per cent of GDP, while aggregate road expenditure by governments rose from to 0.94 per cent to 1.61 per cent of GDP, slightly faster than congestion costs.

Figure ES 6 shows that congestion costs have grown to a level approaching the value of road-related expenditure by all levels of government, which stands at approximately 1.6 per cent of GDP in 2014-15. According to the projections, under BITRE's Upper Baseline scenario congestion costs will exceed the value of road-related expenditure by 2018-19, if expenditure falls as in Scenario 2. Even if expenditure follows the historical pattern of Scenario 1, congestion costs are likely to exceed it circa 2025.

Of course, road expenditure occurs across the nation, not just in congested areas. Public transport subsidies have been a key anti-congestion policy instrument for state governments. Funding of public transport deficits in capital cities by state/territory governments is equivalent to 52.9 per cent of state /territory government expenditure on roads in all areas, and 27.8 per cent of expenditure on roads across the nation by all levels of government.

The data show that the combination of the magnitude and allocation of land transport road spending by governments in Australia, and the growth of that spending over the past 12 years have been ineffective in dealing with growing congestion costs. In addition, BITRE's forecasts indicate that a "business-as-usual" approach to funding and pricing will perpetuate the worsening congestion that has been experienced under that approach in the past. To alleviate congestion, a change in approach will be required.

Road Safety

Another perspective is to consider the safety performance of the road network. The Australian Road Assessment Program (AusRAP) for National Highways provides star ratings ranging from 1 to 5 stars, with the safest roads attracting a 5-Star rating, and the least safe a 1-Star rating. A 4-Star rating is viewed as an acceptable level of safety. In the latest AusRAP report (AAA, 2013), only 8 per cent of National Highways achieved a 4-Star rating. Only Victoria had any national highway with a 5-Star rating, but only 2 per cent of its highways achieved this rating. At the national level, 53 per cent of highways achieved a 3-star rating and 39 per cent achieved 2 stars or less. This indicates that, from a safety perspective, Australia's road network falls substantially below what could be considered adequate.

Efficiency of Revenue Sources and Case for Hypothecation

Most taxes reduce economic welfare by distorting resource allocation. But, the extent to which this occurs varies between different taxes.

Figures **ES 2** and **ES 3** showed the main sources of road-related revenue relied on by the Federal and State/Territory governments in Australia. Local governments rely mainly on council rates, which are essentially taxes levied on land values.

As instruments for road funding these revenue sources have two main problems:

- Several are among the more distorting of the tax instruments available to Australian governments. The extent to which taxes distort resource allocation is conventionally measured by the extent to which they reduce GDP per dollar of revenue raised. Studies conducted to support the 2010 Henry review of the Australian taxation system provided estimates of these measures for most Australian taxes, including:
  - fuel taxation $0.15
  - luxury car tax $0.20
  - motor vehicle registration $0.37
  - motor vehicle stamp duty $0.38

  This compares to estimates of $0.08 for the GST and $0.40 for the company income tax. Taxes based on land values do not adversely affect the efficiency of resource allocation significantly, provided that they do not discriminate between different uses of land and do not apply to structures. Indeed, they may improve the efficiency of resource allocation.

- They are ineffective as instruments for improving the efficiency of road use:
  - The amount of fuel taxation paid by road users does depend on the total distance that they travel, but is not directly related to the extent to which their road usage contributes to congestion and road damage – two serious costs associated with road usage.
  - Vehicle registration fees do not relate in any way to the extent to which vehicle owners access the roads.
  - Flat-structure tolls designed only for cost recovery that are charged on some urban freeways divert traffic to un-tolled substitute roads, allowing congestion to persist. When most of the network is unpriced, the constrained optimal tolls in peak periods may be close to zero. Moreover, tolls discourage usage of the tolled roads at off-peak periods when usage would impose no substantial costs on the network or other network users.

Notwithstanding the deficiencies of the current revenue instruments, there is a strong case for hypothecating them to the funding of land-transport infrastructure. This is the case for several reasons.

- As shown by the analysis of the shortfall of Commonwealth funding relative to road-related revenue, hypothecation of revenues to funding would result in a much-needed increase in federal funding.
- Hypothecation would provide the planners and deliverers of investment in the land-transport network with more certainty of funding than they have under the current system of *ad hoc* Commonwealth allocations driven by factors such as the electoral cycle. This would facilitate an increase in the efficiency of the investment program.
- If road users understood that revenues raised from them would be used to improve the network, they would be less resistant to replacement of existing taxes and charges with more efficient alternatives. It would allow governments to make it clear that the land transport pricing-reform process represents a change in the *structure* of charging, not an attempt to increase the overall *level* of charges.

Other Aspects of Reform of Land-Transport Management

While hypothecation of current road-related revenues to the funding of land-transport infrastructure would be a substantial improvement over current arrangements, the longer-term aim should include other reforms. Australia currently lags well behind several other jurisdictions with respect to these issues.

Transport Network Planning

In most countries, planning of transport systems has been fragmented, with insufficient attention paid to network issues and the interdependence of investment decisions in respect of different transport modes. Infrastructure Australia's recent Infrastructure Audit and Infrastructure Plan represent recognition of this need in Australia.

Without a strong network focus, it is not even possible to sensibly frame benefit-cost analyses. For example, an economically sensible decision cannot be made on how much to spend on widening Melbourne's Tullamarine Freeway (a "High Priority Project" in the Infrastructure Plan) without a clear view about whether Melbourne will join other comparable cities in providing a public-transport link from its city centre to its major airport.

Internationally, the UK is prominent in attempting to impose a network focus on its road planning. In March 2015, the UK Department of Transport published its *Road Investment Strategy: for the 2015/16-2019/20 Road Period.* Its main concern is England's Strategic Road Network, comprising motorways and major trunk roads. The Road Investment Strategy recognises the importance of coordinating investment plans for the Strategic Road Network with those for other transport modes, including railways (especially the planned high-speed facility – HS2), airports and water ports.

Funding Certainty

Ad hoc funding of land-transport infrastructure from general revenues impedes efficient planning of infrastructure investment. Yet, Commonwealth Government funding allocations appear to be driven more by the imperatives of election cycles than by the needs of rational investment planning.

New Zealand is one of the few countries that has moved to increase funding certainty or security by hypothecating road-related revenues for land transport. New Zealand's *National Land Transport Fund* is resourced primarily by hypothecated revenues from fuel taxes, road-user charges and vehicle registration and licence fees.

The United States Government has a less appealing hypothecation regime. Revenue from that government's gasoline tax and some other road-related taxes is allocated to the Highways Trust Fund, originally for roads, but over time, an increasing proportion has been allocated to public transport and other functions, and the gasoline tax rate has been capped in nominal terms since 1993.

Institutional Transition and Accountability

Most reviews of the management of transport infrastructure, including the Australian Productivity Commission (2006, 2014), have recommended establishment of independent funds or authorities at arm's length from government. Initially, these entities would be resourced by hypothecation of road-related taxation revenue. They should have borrowing capacity, to allow separation of the timing of investment from the timing of revenue. Later, such authorities could be commercialised or corporatised. The commercialised entities would collect road charges, manage relevant parts of the road network, undertake maintenance and invest in new facilities. In view of the monopoly power that an independent road-network authority with pricing capabilities would have, it should be regulated to protect user interests by preventing abuse of monopoly power, and by ensuring safety standards.

The UK and New Zealand have transport authorities with some of these features.

Efficient Charging

It is now widely accepted that the solution of Australia's transport infrastructure problems will require measures to enhance the efficiency of the usage of existing infrastructure (now and in the future), as well as to increase the nation's physical infrastructure. This reflects the recognition that what is important for the community's economic welfare is the quantity of infrastructure *services* enjoyed by users, not just the quantity and quality of physical infrastructure in existence (and potentially available to users).

It is not difficult to find examples in which symptoms of infrastructure inadequacy persist, but opportunities to improve the efficiency of usage of existing physical facilities and additions have been neglected. Such problems usually arise from failure to treat transport infrastructure facilities as parts of an inter-related network. They arise in particular from pricing, under-pricing or not pricing access to components of the network without regard to the implications for usage of the network as a whole.

The importance of ensuring that transport-infrastructure policy addresses issues of efficient pricing as well as investment in new physical facilities was recently highlighted by Infrastructure Australia in its February 2016 Australian Infrastructure Plan. It was also emphasised by the 2010 Henry review of the Australian taxation system, by the Productivity Commission in its 2014 Report on Public Infrastructure, and by the 2015 Harper Competition Policy Review.

As emphasised in these reviews and the literature on road pricing in general, the key issues in the reform of land transport pricing are as follows.

- In the case of heavy vehicles, user charges should reflect the facts that it is heavy vehicles that account for most of the damage to roads and that the need to accommodate heavy vehicles is a significant determinant of the costs of road construction.
- In the case of congestion, especially on urban roads in peak periods and locations, user charges should induce urban road users to consider the costs that they impose on other users by adding to heavy demand at peak periods and locations. Overseas applications of pricing have resulted in significant, and permanent, reductions in congestion.

– Implementation of pricing should be preceded by substantial improvements to road and public transport infrastructure, and pricing and investment policies should be designed to work in tandem to alleviate congestion in short-, medium-, and long-term timeframes.

Efficient Investment

Road charging and simultaneous public transport pricing reform are policy tools for management of external costs of road use, such as those associated with traffic congestion and road, in the short- to medium-term. Investment in road and public transport infrastructure to bring it up to an acceptable standard by the time of implementation of pricing reform is an essential complement to such reform from the perspective of an efficient allocation of resources and public acceptance of changes reform. It is also an essential complement to charging in the medium- to long-term to accommodate additional traffic as population and economic activity grow.

Hypothecation of revenue from existing road-related taxation and potential application of value capture mechanisms to gain revenue from infrastructure improvements could a provide basis for borrowing to finance substantial infrastructure improvements prior to implementation of pricing reform.

Land Transport Market Reform Process

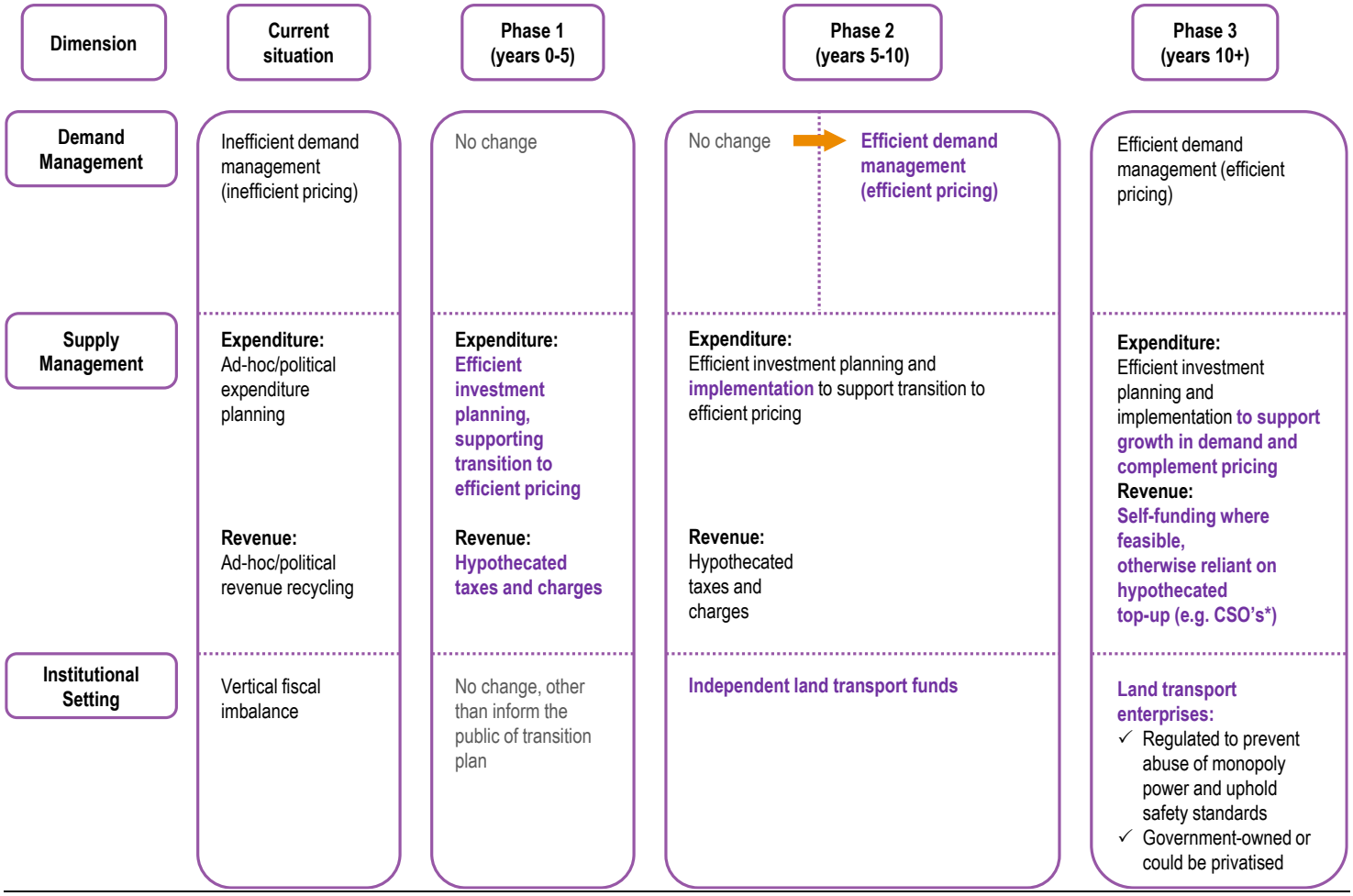
This report proposes a transitionary reform process for land transport policy. A description of the transition process from the current situation towards a long-run efficiently-managed system is presented in **Figure ES 7**, together with an indication of the potential timing associated with each phase during the transport market reform process. Changes relative to the previous phase are highlighted using bold purple font.

The transitionary reform process includes undertaking substantial improvements to land transport infrastructure prior to implementation of pricing reform. In this context, and in the light of the magnitude of the infrastructure "shortfalls" highlighted by Infrastructure Australia's (2016b) Priority List, and the analysis of the issue of "shortfalls" or "gaps" in this report, hypothecated allocations by the Commonwealth for roads would need to rise to *at least the full amount* of Commonwealth road-related revenue.

The extra Commonwealth funding that this Commonwealth policy change would provide over the next five years (about $45 billion) would only be approximately enough to cover the unfunded component of 10 land transport projects for which costs were publicly available, among 82 projects on Infrastructure Australia's Priority List. However, more infrastructure could be provided sooner by hypothecating Commonwealth and state/territory government road-related revenue and land transport value capture revenue to land transport funds. This could be used to service debt to finance improvements to infrastructure before pricing reform is implemented. Resources to be made available by future land transport pricing reform could be leveraged in the same way to bring forward provision of additional land transport infrastructure.

The final stage of the reform process would involve implementation of road pricing and simultaneous reform of public transport pricing. The institutional setting for pricing reforms would be land transport enterprises that are regulated to protect the interests of users by preventing abuse of monopoly power and neglect of safety.

FIGURE ES 7 TRANSPORT MARKET REFORM – TRANSITION PROCESS WITH INDICATIVE POTENTIAL TIMING



Note: * CSO's – Community Service Obligation payments, such as for rural roads.

SOURCE: ACIL ALLEN.

Economic Contribution of Land-Transport Infrastructure

The economic contribution of land-transport infrastructure hinges on the productivity effects of the investments under consideration (supply-side effects), the demand management scheme that will be in place once those investments become operational (efficiency of demand management) and the opportunity cost (best alternative use) of the resources tied down in the investments. Demand-side economic considerations, such as effects on employment during construction, are for the most part transitory, and in general draw resources (labour and capital) away from alternative uses, dampening their economic contribution.

However, land-transport infrastructure investments that are targeted towards relieving acute bottlenecks in the network and operate under an efficient demand management scheme, can make important long-term economic contributions.

Analysis of economic contributions of land-transport infrastructure requires a project-by-project microeconomic approach, since it is the accumulation of the individual benefit and cost impacts of the projects that determines their economic contribution. Existing studies have focussed on macroeconomic correlations (econometrics) or economy-wide modelling relying on broad assumptions, with little consideration of individual projects or the operational efficiency implications of their demand management schemes. In particular, the *induced traffic effect* is typically not taken into

account. The *induced traffic effect* is the observation that better infrastructure attracts more traffic, to an extent negating the initial benefits from the improvements.

In spite of these challenges, key findings of the economic contribution of land-transport infrastructure are as follows.

Econometric Studies

Studies conducted in Australia and overseas found that a one per cent increase in the stock of public infrastructure results in an increase in economic activity lying between 0.1 and 0.4 percentage points. This is in addition to the underlying rate of economic growth, which, for Australia, tends to be between 1 and 3 per cent annually. These studies rely on macroeconomic data and some of their findings could, to some degree, be spurious.

Economy-Wide Modelling

Economy-wide impacts can be quantified using Computable General Equilibrium (CGE) models. CGE modelling can be conducted using microeconomic project-level data and economically justifiable assumptions on productivity improvements. The economic contribution of the Infrastructure Australia Plan was estimated to increase Gross Domestic Product (GDP) by one percentage point in the long run, relative to the baseline assumption.

Public Transport

Evidence of cost savings or efficiencies achieved by private providers of public transport services includes the following:

- in Britain, bus franchises reduced unit operating costs by 50 to 55 per cent
- in Sweden, bus and train franchises reduced costs by 33 per cent
- in The Netherlands, public transport efficiency improvements were between 20 and 50 per cent
- in the U.S., cost savings were between 30 to 46 per cent
- in Melbourne, train and tram delays and cancellations were reduced by 35 per cent
- in Perth, bus franchises reduced unit operating costs by 29 per cent.

Inclusion of Wider Economic Impacts

Inclusion of wider economic impacts is, in general, not widely accepted in the economic assessment literature. Wider economic benefits include agglomeration effects, increased competition effects, increased tax collection due to economic growth resulting from the project(s), and more generally, beneficial external effects arising from land transport infrastructure. Inclusion of wider economic impacts leads, not surprisingly, to larger estimates of economic contribution, typically doubling economic contribution.

1 INTRODUCTION

It is widely accepted that Australia's land transport infrastructure is not coping well with demands placed upon it at many locations and peak times. Traffic congestion is a severe and worsening problem on major arterial roads within, and providing access to metropolitan areas during spreading morning and afternoon/evening peak periods. It is also a growing problem on routes to important recreational locations at weekends and during school holiday seasons. Major and minor road freight routes across the country are subjected to damage by heavy vehicles, as road freight quantities grow faster than gross domestic product (GDP), and this leads to further costs in the form of vehicle damage. Crash costs are rising, not only because of errors and irresponsible behaviour by a minority of drivers among the growing driving-population, but also because many roads have not been designed to allow sufficient opportunities to recover from mistakes.

State/territory, local, and federal governments have allocated considerable resources to address these problems. Government expenditures on roads in Australia have grown from about 0.94 per cent of gross domestic product (GDP) in 2003-04 to about 1.61 per cent in 2015-16. These outlays have included contributions towards capital costs of toll-road segments meant to add capacity faster than could be achieved through full government funding. In addition, state/territory governments have funded large public transport deficits resulting from holding down fares and increasing services in capital cities to divert commuters from car use at peak times and locations to alleviate traffic congestion. It is estimated that in 2015-16, public transport deficits averaged about 76 per cent of accounting costs and were equivalent to 0.45 per cent of Australian GDP.

To address the problem of road damage, state/territory and federal governments established a notional road-use charging regime for heavy vehicles in the early 1990s. It was meant to recover costs of use of roads by heavy vehicles. It consists of a two-part charging system comprising a fixed annual registration fee determined on the basis of vehicle size and configuration, and a variable component based on a share of customs and excise duty on fuel used by heavy vehicles (currently about two-thirds of the rate of duty). However, it is a very imperfect mechanism for the task of inducing efficient changes to road-use and vehicle purchase decisions, because the fuel tax (variable) component does not discriminate adequately with respect to road conditions (road types and degree of congestion), vehicle types, and distance travelled.

State and local governments have faced considerable challenges in trying to fund sufficient land transport infrastructure to provide and maintain connectivity for individuals and businesses, and to ameliorate congestion, road damage and crash costs. They have been criticised for under-funding provision of these services. Some blame has been deflected to the Commonwealth Government for not providing more funding from road-related taxation revenues. It has been noted that historically, Commonwealth road grants to state/territory and local governments have fallen well short of Commonwealth revenues from fuel taxation, motor vehicle customs duties, luxury car taxation, and vehicle fringe benefits tax. For example, in 2015-16, Commonwealth road grants were equivalent to

0.35 per cent of GDP, while Commonwealth road-related revenues represented 0.8 per cent of GDP. In 2003-04, the corresponding figures were 0.15 and 1.09 percent, respectively.

State, federal and local governments have focussed on supply-side strategies with limited pricing in their attempts to solve land transport infrastructure problems. These strategies have comprised full government funding of most arterial roads, partial government funding of toll roads, and government subsidies that cover most of the capital and operating costs of public transport services. Pricing has been limited to flat tolls on some arterial roads, with zero pricing on the rest of the network, and substantial under-pricing of public transport services aimed at changing relative prices of road and public transport usage.

These measures have added to, or freed-up unpriced road capacity on the road network. This has tended to attract more traffic that has dissipated a considerable part of the benefits of additional road and public transport capacity. In contrast, the benefits of new road and public transport capacity would not be dissipated if roads and public transport were to be priced across the network to ensure that users bear the marginal social costs of use.

An important insight is that provision of more and better road and public transport infrastructure would be only part of the solution to Australia's land transport infrastructure problems. More efficient usage of existing and new infrastructure would also be required, because what is important for the community's economic welfare is the quantity and quality of infrastructure *services* enjoyed by users, not just the amount and attributes of physical infrastructure available to potential users. In addition, governments would have to find means of funding infrastructure improvements.

Efficient usage of land transport infrastructure can be achieved by well-designed reform of road and public transport pricing that targets costs of congestion, road damage, crashes, and emissions that users impose on others without compensation (external costs). It does so by requiring that users bear the marginal social costs of their travel activities. Well-designed pricing that varies in accordance with differing circumstances across the land transport network would encourage switching to under-utilised travel times, routes, and modes; could eliminate some trips; and would influence selection of vehicles. It would ensure that the alternative times, routes and modes also did not become over-used. It would avoid inducing traffic that dissipates benefits of new facilities.

Well-designed road and public transport pricing is a valuable land transport funding mechanism for three reasons. First, it reduces funding requirements by inducing more efficient use of existing and new infrastructure. Second, it provides revenue flows that are likely to be sufficient to recover costs (including an appropriate return on capital) of providing, maintaining, and operating highly-used parts of the land transport network. Third, it means public transport subsidies are not needed to change relative prices of use of public transport and roads to alleviate congestion, as road and public transport pricing reform would perform this function.

While well-designed pricing is an important mechanism for managing demand for, and efficient use of the land transport infrastructure in place, and for recovery of full economic costs of highly used facilities, it is a short- to medium-term policy tool. As demand grows, prices would have to rise to high levels to keep congestion, road damage, crashes and emissions at acceptable levels. High prices would signal that investment is required to expand capacity. Investment is a medium- to long-term policy measure that complements the short- to medium-term policy instrument in improving the efficiency of allocation of resources.

In the context of the severe stress on arterial land transport infrastructure in Australia's major cities and on major road links between major centres, any move to reform land transport pricing should be preceded by provision of substantial improvements to public transport services in major cities and to highly trafficked parts of the road network within and between those cities. This is necessary on efficiency and public acceptability grounds.

The land transport market reform process will require considerable time, because of the long gestation time of major land transport investments required on the supply side of the market, and the lengthy period required to plan and implement efficient pricing arrangements to address the demand side.

The market reform process will need to be supported by substantial transitionary institutional reform. This would include evolutionary changes to arrangements for funding, providing and operating land transport infrastructure. It would involve eventual replacement of road-related taxes with well-

designed pricing in the interests of efficient allocation of resources, equity, and public acceptance of reform. Co-operation between Commonwealth, state/territory, and local governments will be important requirements for successful reform to resolve Australia's land transport infrastructure problems, because all three levels of government fund land transport infrastructure and they rely on different sources of taxation revenue, but only state/territory and local governments manage roads.

This report is concerned with the important economic problem that demand for land-transport infrastructure services at peak times and in many locations exceeds supply of suitable infrastructure services and the gap is widening. It is also concerned with solutions. Simultaneous action is required on both demand and supply sides of the land transport infrastructure services "gap", consistent with the accepted need to improve the efficiency of usage of infrastructure, as well as to invest in new physical infrastructure. Policy action on just one front would be insufficient to solve the problem. Solutions offered in this report are framed in the context of a gradual evolution towards an efficient land transport infrastructure policy regime (package).

Chapter 2 outlines approaches to managing land-transport infrastructure historically and currently applied in Australia. It also assesses the extent to which these approaches conform to policy, institutional, and funding best-practice. The section presents expenditure and revenue data and projections for the Commonwealth, state/territory and local governments. This shows that the main revenue-expenditure imbalance resides with the Commonwealth Government.

In Chapter 3, the issue of infrastructure "gaps" is addressed from different perspectives. One approach compares budget projections for road-related revenue and expenditure with the outlays required to implement 11 key projects and initiatives, including 10 identified in the Infrastructure Australia's 2016 Priority List, as necessary to prevent infrastructure deficiencies from having "*a material impact on national productivity*", especially in the "*near term*" (i.e., 0-5 years). A second approach shows the worsening trend in traffic congestion, which is an indicator of an infrastructure shortfall and/or pricing regime inadequacy. A third approach focusses on the safety of roads. All three approaches lead to the conclusion that land transport infrastructure is becoming increasingly inadequate to support Australia's growing demand for land-transport services. The chapter concludes with a discussion of the extent of hypothecation of road-related revenues that is required as part of a package of policy reforms to address the issue of infrastructure deficiencies in Australia.

Chapter 4 reviews local and international studies that sought to quantify the economic benefits of investing in land-transport infrastructure. Explanations are provided regarding indicators that are required to establish that investment generates a genuine improvement to the nation's economic welfare as opposed to altering the national economic structure. A particular focus is the studies' treatment of the induced-traffic problem, which can lead to erosion of the efficiency benefits of infrastructure investments (congestion alleviation, for example). The relevance of road pricing to these issues is also discussed.

Chapter 5 outlines a case for reform of land transport infrastructure policy, identifies elements of a best-practice policy package for the management and funding of the land transport network, and describes "no-regrets" steps in a process of transition towards a best-practice system. It includes historical information and reviews of the economic literature on revenue hypothecation (tax-earmarking) and road funds, which are important elements of the policy transition process.

Chapter 6 expands on a best-practice package of complementary policy instruments, the economically ideal end-point of the policy transition process set out in Section 5. It explains why the policy package is best-practice from an economic perspective, and highlights inbuilt features to address potential unacceptability impediments. Key design and implementation issues that would need to be addressed by policy-makers are highlighted.

2 LAND TRANSPORT FUNDING, AUSTRALIA

2.1 Constitutional Position

2.1.1 Relevant Constitutional Provisions

The scheme of the constitution of the Commonwealth of Australia is to vest specific powers in the Commonwealth Parliament and leave the remainder to the states in so far as they are constitutionally able to exercise them (section 107). Few of the legislative powers vested in the Commonwealth are expressed as exclusive powers or are effectively exclusive because a section vesting a power in the Commonwealth is complemented by another withdrawing that power from the states. Most powers vested in the Commonwealth are concurrent powers, being also exercisable by the states.

Legislative power in respect of roads has not been vested in the Commonwealth Parliament. Therefore, it remains with the states. In contrast, the constitution provides that the Commonwealth shall have power to legislate with the consent of the state regarding acquisition of railways of any state on terms agreed between it and the Commonwealth, and in relation to railway construction and extension in any state (section 51, xxxii and xxxiii).

A pertinent example of an exclusive power of the Commonwealth Parliament is its authority to impose duties of customs and excise. In this case the provision vesting the power in the Commonwealth withdraws it from the states (section 90).

The constitution gave the Commonwealth Parliament to the legislative power to "grant financial assistance to any state on such terms and conditions as the Parliament thinks fit" (section 96).

The Commonwealth is not permitted to discriminate between states or parts thereof in exercising power to tax, or to give to preference to one state or any part thereof over another state or any part thereof by any law or regulation of trade, commerce or revenue (sections 51(ii), 99).

The most important and best known of the limitations on the power of both state and Commonwealth Parliaments is the provision that trade in goods and services and communication between states shall be absolutely free (section 92).

2.1.2 Application to Land Transport

Under the Australian constitution, state parliaments have legislative power in relation to roads. They have delegated responsibility for local roads to local government authorities. The Commonwealth Parliament does not have powers to legislate regarding roads. However, the Commonwealth controls the largest source of road-related revenue – fuel taxation – because of its exclusive power to levy customs and excise. Since 1926, it has provided financial assistance grants to the states for roads on terms and conditions of its choosing. However, the Commonwealth has never fully hypothecated (earmarked) fuel taxation for road grants to the states, although in the period 1926 to 1959, it did

earmark between one-third to two-thirds of revenue from duty on petrol for road grants. Much smaller fractions were hypothecated during the period 1982 to 2000. Subsequently, no fuel taxation revenue has been hypothecated for road grants.

State/territory governments have assumed responsibility for funding of public transport deficits, even when services are provided by local government and private sector entities. The Commonwealth has chosen not to seek the consent of states/territories to acquire or construct railways providing services to commuters in Australian cities.

Until recently, the Commonwealth has not provided grants for public transport infrastructure in Australian cities. During the past year, bipartisan political support has emerged for Commonwealth grants to states to help fund public transport projects in major cities.

2.2 Commonwealth Fuel Taxation and Road Grants – Historical Perspective

From the time of federation in Australia (1901), the Commonwealth Government has levied customs duty on imports of petrol (motor spirit or gasoline). In 1929, excise duty on locally produced petrol was applied at a lower rate, initially one-quarter of the customs duty rate. The disparity was reduced over time and was eliminated from 1956. Customs and excise duties on diesel fuel were not applied until 1957.[1]

In the 1920s, some Australian states applied taxes on imported and domestically produced fuel to provide resources for road construction and maintenance. Because of doubts about the constitutional validity of these taxes, Commonwealth and state governments agreed in 1926 that the imposts would be replaced with Commonwealth grants for major roads over a period of 10 years, with resources to be derived from an additional customs duty of two pence per gallon on petrol (an increase from one to three pence per gallon) and additional customs duty on motor vehicle chassis.

As a result of the onset of the Great Depression, revenue provided by the additional customs duties on petrol and motor vehicle chassis fell considerably. Under a new agreement between state and Commonwealth governments in 1931, 2 ½ pence per gallon of the existing 7 pence per gallon customs duty on petrol and 1 ½ pence of the existing excise duty of 4 cents per gallon (35.7 per cent and 37.5 per cent, respectively) were hypothecated for road grants to the states. Over the period to 1959, rates of duty and hypothecated components were adjusted at irregular intervals, but often not simultaneously. Therefore, the hypothecated proportions fluctuated. In 1956, when the excise duty rate finally attained parity with the customs duty rate of 11 ½ pence per gallon (after progressively moving closer over a period of 25 years), the hypothecated component was 7 pence per gallon or just over 60 per cent of the tax rate. In some years during the 1926 to 1958 period, Commonwealth grants to the states for road construction and maintenance exceeded the hypothecated component of proceeds of customs and excise duties on petrol.

When customs and excise duties were applied to diesel fuel for the first time in 1957, the stated purpose was to ensure that diesel-fuelled vehicles contributed to road construction and maintenance similarly to petrol-fuelled vehicles. However, no part of the proceeds of the duties on diesel was hypothecated for road grants to the states.

Off-road usage of diesel fuel was exempted from the new tax impost on diesel fuel, although off-road usage of petrol had never been exempted. The effective exemption of off-road use of diesel fuels has persisted to the present time, although the scope of exemptions, and the administrative mechanism has been varied from time to time.

In 1959, hypothecation of customs and excise duty on petrol for road grants to the states was abandoned. Commonwealth road grants continued without any formal link to proceeds of customs and excise duty on fuel. Over the five-year period from 1959, Commonwealth road grants increased considerably. One reason for this was recognition of the trend towards heavier and faster vehicles. Consequently, Commonwealth grants for roads during the 1960s were closer to revenues from fuel taxation than during the preceding 30 years.

[1] Early historical information in this section was drawn mainly from reports by the Industries Assistance Commission (1986), Corporate and Economic Strategies (2001), Trebeck, Landels and Hughes (2002), and Productivity Commission (2006).

In 1974, the Commonwealth Government took on responsibility for compensating the states for expenditure on approved construction and maintenance activities undertaken by the states/territories on a specified network of roads described as the National Highway. The network comprised defined roads between capital cities and the Brisbane-Cairns and Hobart-Burnie road links.

In 1982, partial hypothecation of fuel (petrol and diesel) taxation for road grants to the states was reinstated under the *Australian Bicentennial Road Development Trust Fund Act 1982*. The stated aim was to upgrade the road network, particularly major links between state and territory capital cities, via a programme scheduled to end in the bicentennial year, 1988. The hypothecated component of fuel taxation was provided by customs and excise duty surcharges. The initial surcharge was one cent per litre in 1982. It was raised to two cents per litre in 1983. Another fuel tax rate increase in 1983 was not hypothecated. The hypothecated components of fuel duties in 1982 and 1983 were 16 per cent and 22 per cent, respectively. The component of fuel taxation hypothecated for road grants varied over the programme period, peaking at 6 cents per litre. The programme and the surcharge ended in 1988. From 1989 to 2000, a small proportion of fuel taxation revenue was earmarked for road grants under the *Land Transport Development Act 1988*.

In 1983, the Commonwealth Government inflation-proofed fuel taxation revenue by introducing a system of six-monthly increases linked to the Consumer Price Index. Subsequently, the rate was adjusted downward to make room for application of GST to fuel in 2000. The system of adjustment of the rate to allow for inflation was abolished on 1 March 2001, leaving the rate at 38.143 cents per litre. The real rate of duty declined substantially over the next 14 ½ years. The real value of fuel taxation revenue was also constrained by a long-term trend of declining fuel consumption of vehicles that was accelerated by rising and then high fuel prices in the 2000-2014 period.

During the period 1982 to 1988, all Australian states and territories, except Queensland, introduced business franchise fees in respect of petrol and diesel fuel. The fees were based on fuel volumes. In New South Wales, Victoria and Western Australia the fees did not apply to diesel purchased for off-road use. Western Australia also deployed a subsidy scheme to effectively exempt petrol used off-road for agricultural purposes.

Over the period 1982 to 1997, business franchise fees for petrol and diesel were increased and became important sources of revenue for state and territory governments. However, Queensland continued to eschew such imposts.

In August 1997, a High Court decision on tobacco business franchise fees levied by the New South Wales Government cast considerable doubt on the constitutional validity of state/territory fuel, alcohol, and tobacco business franchise fees. Subsequently, the Commonwealth Government agreed to collect these fees on behalf of state and territory governments under the Commonwealth's exclusive power to levy duties of customs and excise.

Fuel business licence fees were replaced by a surcharge of 8.1 cents per litre on the rate of Commonwealth customs and excise duty on petrol and diesel. The surcharge was inflation-proofed along with the basic rate via adjustments based on the Consumer Price Index. Surcharge revenue was directed to the states and territories. In Queensland, which had not previously introduced fuel business fees, fuel wholesalers and refiners were paid a subsidy at the rate of the surcharge and were required to reduce the price charged to retailers, bulk end-users and off-road diesel-users. The Queensland fuel subsidy scheme remained in place until July 2009.

When GST was introduced from 1 July 2000, the Commonwealth ceased payment of proceeds of the surcharge on fuel excise and customs duty to states and territories. The Commonwealth assumed responsibility for payment of state rebates or subsidies to off-road diesel users.

In 1988, the National Highway was redefined pursuant to the provisions of the *Land Transport Development Act 1988*. The Act also established the concept of Roads of National Importance to which the Commonwealth would make financial contributions. The latter category of roads did not comprise a defined network and were determined on a case-by-case basis. Later, they were jointly funded by state and Commonwealth governments, typically on a 50/50 basis. In 1989, the Commonwealth Government initiated the Black Spots programme, which involves grants to improve the safety of roads at sites at which deficiencies have contributed to serious crashes involving deaths or serious injuries.

In the early-1990s, the Commonwealth and states agreed that the Commonwealth would have full responsibility for funding the National Highway. This defined road network was expanded in scope to include Sydney-Adelaide and Brisbane-Melbourne highways and urban roads through Sydney, Melbourne, Brisbane, Adelaide and Perth that connected to the rest of the National Highway. At the end of 2000, the Commonwealth Government established the Roads to Recovery Programme, involving payment of road grants for approved projects directly to local government authorities.

In 2005, the National Highway became part of the National Land Transport Network under the *Auslink (National Land Transport) Act 2005*. The network was expanded to include additional roads linking major urban centres (for example, the Pacific Highway), inter-modal facilities, and rail links between economically important locations. Projects on new additions to the road component of the National Land Transport Network typically were eligible for 50 per cent Commonwealth funding, while some segments of the previous network typically were eligible for funding of 80 per cent from the Commonwealth. The Black Spot and Roads to Recovery programmes were included in the *Auslink* programme along with Commonwealth funding of the national network.

Following a change in government, the Nation Building Programme replaced the *Auslink* programme in 2009. Also, the Building Australia Fund was established, and Infrastructure Australia was established to provide guidance on infrastructure priorities.

Another change in government in 2013 was followed by further re-packaging of Commonwealth grants regimes for road and rail infrastructure. From July 2014, the Nation Building Programme was replaced by the Infrastructure Investment Programme and the Infrastructure Growth package. From the end of 2014, the Building Australia Fund was confined to meeting payments previously approved.

The Infrastructure Investment Programme includes the Black Spot, Roads to Recovery, Bridges Renewal, Northern Australia Roads, Heavy Vehicle Safety and Productivity, Investment-Road, and Investment-Rail sub-programmes. The Investment-Road component accounts for 78.2 per cent of the Infrastructure Investment Programme's budget of $6455.8 million in 2016-17.[2]

The Infrastructure Growth Package comprises the Asset Recycling Initiative and a New Investments component.

The Asset Recycling Initiative has been resourced by the Asset Recycling Fund, which was established from 1 July 2014. This fund was established with uncommitted funds from the Building Australia Fund ($2.4 billion) and the Education Investment Fund ($3.5 billion). Its initial balance was $5.9 billion. It was intended that additional resources would be provided by Commonwealth asset sales, such as the sale of Medibank Private.

The Asset Recycling Initiative was designed to induce states to sell assets and re-invest the proceeds in productive infrastructure. Allocations were to be made from the initial fixed sum of $5 billion over five years on a first-come-first-served basis for specific projects agreed between Commonwealth and state governments before 30 June 2016. The basis of allocation was 15 per cent of the price of an asset sold by a state/territory provided that all sale proceeds were to be allocated to new infrastructure investment.

In the 2015-16 Commonwealth budget, an amount of $800 million was deducted from the $5 billion intended for the Asset Recycling Initiative to fund Northern Australian programmes. In the 2016-17 budget, uncommitted money of about $854 million was allocated to consolidated revenue. About $2.7 billion of the remaining $3.35 billion has been set aside for the Sydney ($1.85 billion) and Melbourne ($857 million) public (rail) transport projects. About $2 billion of the $3.35 billion will be provided in 2016-17 and 2017-18, with the remaining $51 million paid out in 2018-19.

Allocations from the Asset Recycling Fund have also been made to the Roads to Recovery and Black Spot Programmes, which are elements of the Infrastructure Investment Programme. Further allocations from the fund have been made to the National Highway Upgrade Programme, which is part of the New Investments component of the Infrastructure Growth Package.

[2] Commonwealth Budget Paper No. 3, May 2016, p. 48.

The New Investments component of the Infrastructure Growth Package ($765.4 million in 2016-17 and $795.6 million in 2017-17) provides "additional funding to expedite investment in high quality economic infrastructure." Targets include "significant road projects, the National Highway Upgrade Programme, as well as Black Spot projects and the Roads to Recovery programme."[3]

Over the past decade, there has been a marked trend towards Commonwealth funding under various programmes of short duration relative to the gestation period for major land transport projects, strong fluctuations with the electoral cycle, uncertainty regarding funding continuity and cost-sharing conditions, politically opportunistic and *ad hoc* selection of projects for funding, and obscurity regarding justifications for choice of projects for Commonwealth funding. This is not conducive to efficient planning, design, programming, and (re-) construction of major roads.

A significant recent development is the emergence of bi-partisan political support for Commonwealth contributions to capital costs of large public transport projects. It is not clear to what extent such contributions in future will add to Commonwealth grants for land transport infrastructure or be at the expense of road funding.

In November 2014, the rate of excise and customs duty for petrol and diesel that had remained at 38.143 cents per litre for nearly 14 years, was raised to 38.6 cents per litre, followed by reinstatement of six-monthly inflation adjustments on 1 February and 1 August, commencing in 2015. The Commonwealth Government's 2014-15 budget papers advised that the re-introduction of these adjustments would generate $2.2 billion of extra nett revenue over the forward estimates period (four years) for "productivity-enhancing" construction and upgrading of road infrastructure.[4] In June 2015, the government announced that $1.015 billion of this revenue would be allocated to increase the Roads to Recovery Programme over the next two years. In the same month, the government also established the Fuel Indexation Road Funding Special Account from which road grants would be made to states/territories. So far, one payment of $98 million has been paid into the account. The 2015-16 budget papers indicated that revenue from fuel taxation inflation adjustments had been allocated to the Infrastructure Investment Programme for roads.[5] This programme includes Roads to Recovery as a sub-programme.

It is not verifiable whether or not these allocations and future payments into the Fuel Indexation Fund will result in Commonwealth grants for roads that will be higher, lower or unchanged from what otherwise would have been made. Nevertheless, the Fund's establishment is notable because it involves hypothecation of part of fuel taxation for roads for the first time since 2000. It also suggests continuation of some interest in establishing funds for such purposes, as it follows the Building Australia Fund established in 2009, and the Asset Recycling Fund in 2014

Revenue raising for general government purposes has been a persistent target of fuel taxation policy in Australia since 1901. Other targets have co-existed at various times. From 1926 to 1959, funding of road grants to the states was an equally or more important objective. In the 1980s, funding of roads was a minor target. From the late-1970s, energy security was cited as a justification for fuel tax concessions for alternatives to petrol and diesel fuel. Later, regional development was cited as an objective of concessions for biofuels.

More efficient allocation of resources has been cited as an objective of the notional road-use charging regime for heavy vehicles that has applied in Australia since the early 1990s. It was meant to promote efficiency by recovering costs of use of roads by heavy vehicles. It consists of a two-part charging system comprising a fixed annual registration fee determined on the basis of vehicle size and configuration, and a variable component based on fuel use. The latter is collected as customs and excise duty on diesel fuel with a rebate to exempt heavy vehicles from the pure tax component of fuel tax that does not reflect estimated variable costs of road use. Elimination of the pure tax component is meant to avoid taxation of intermediate inputs that impedes productive efficiency and therefore interferes with efficient resource allocation. The variable charge (nett fuel tax rate) for heavy vehicles in 2015-16 is 26.14 cents per litre (frozen by the Commonwealth Government at the 2013-14 rate)

[3] Ibid, p. 53.
[4] Commonwealth Budget Paper No. 2, 2014, p. 17. The extra revenue from re-introduction of inflation adjustments to the rate of duty has been described as "nett" because the estimated gross revenue over the forward estimates period was offset by an allowance of about $10 million for ethanol production grants and the cleaner fuel grants scheme.
[5] Commonwealth Budget Paper No. 3, 2016, p. 40.

compared to the diesel tax rate of 39.5 cents per litre from 1 February 2016. The Commonwealth Government does not hypothecate nett fuel tax proceeds from heavy vehicles for provision, rehabilitation and maintenance of roads used by heavy vehicles.

A change to a much more efficient direct charging regime for heavy vehicles based on distance, location, and axle weight has been under investigation in Australia for more than a decade. However, such a system does not appear to be any closer to implementation than it was in 2006 when it was advocated by the Productivity Commission (2006).

2.3 Other Relevant Commonwealth Taxation – Historical Perspective

The Commonwealth Government collects road-use-related revenue that is additional to revenue from taxation of fuel. These additional revenue sources include goods and services tax (GST) on vehicle- and road-related outlays, fringe benefits tax (FBT) on employer-provided motor vehicles, customs duty on motor vehicle imports, and taxation of "luxury cars".

GST is the most important. It has applied since 1 July 2000. The relevant part of GST revenue has grown significantly as a percentage of Gross Domestic Product (GDP) since the tax was introduced on 1 July 2000. Over the period between 2000-01 and 2003-04, relevant GST revenue represented about 0.16 per cent of GDP and is estimated to represent about 0.25 per cent of GDP in 2015-16.

While the Commonwealth collects GST, the nett proceeds are paid to the states/territories as untied grants in accordance with horizontal fiscal equalisation principles determined by the Commonwealth Grants Commission. Therefore, GST revenue on vehicle- and road-related outlays reasonably should be categorised as state/territory road-use-related revenue.

FBT was introduced in 1986 as part of major reforms of the Australian taxation system. Over time, concessionary elements of the FBT regime applying to employer-provided motor vehicles have been reduced. However, the exemption of employer-provided utility vehicles from FBT remains a major loophole that has helped underpin strong growth in demand for highly specified utility vehicles.

Customs duty was levied on motor vehicles by the Commonwealth Government as early as 1907. The purposes of this imposition was to assist local manufacture of vehicle bodies and components. After World War 1, duties were increased. Local assembly of passenger motor vehicles commenced in 1925.[6]

In 1926, the Commonwealth Government hypothecated additional customs duty on motor vehicle chassis and petrol to fund Commonwealth grants for major roads over a period of 10 years. The Great Depression considerably reduced revenue from the additional customs duties applied to motor vehicle chassis and petrol. A new road grants agreement between state and Commonwealth governments in 1931 hypothecated more customs and excise duty from petrol for road grants to the states, but hypothecation of customs duty on motor vehicle chassis ceased.

Customs duties on motor vehicles were raised during the 1930s to promote complete manufacture of motor vehicles in Australia, which began in 1948. Further increases in rates of duty were applied during subsequent decades before the Commonwealth Government commenced a process of phasing down duties on motor vehicle from the mid-1980s. The process has continued for the past three decades.

The luxury car tax (LCT) was imposed from 1 July 2000, when the GST was introduced and wholesale sales tax was abolished. The LCT applies at a rate of 33 per cent on the GST-inclusive value of a car in excess of a threshold. A higher threshold applies to vehicles with superior fuel economy.

FBT, customs duty, and luxury car tax on motor vehicles collectively are estimated to be equivalent to about 0.15 per cent of GDP in 2015-16. In comparison, fuel excise and customs duty revenue in 2015-16 is estimated to be about 0.63 per cent of GDP. Each of these revenue sources as a percentage of GDP, except the luxury car tax, has displayed a marked downward trend over the past 12 years. Revenue from the luxury car tax has remained static as a percentage of GDP.

[6] Early historical material on customs duties on motor vehicles was drawn from the Industry Commission (1997, Appendix K) and the Industries Assistance Commission (1986).

2.4 Commonwealth Road Revenues and Expenditures Compared

Over the past decade, the Commonwealth Government's grants for roads have averaged about 35 per cent of Commonwealth road-use-related revenues. During the previous decade, the average percentage of relevant revenue recycled by the Commonwealth was around 15.5 per cent.

Over the past 12 years, Commonwealth grants for roads as a percentage of GDP have displayed an upward trend from about 0.15 per cent to an estimated 0.35 per cent. However, there have been marked funding peaks associated with federal elections, followed by mid-term troughs. More detailed information is presented in section 2.7.

2.5 State/Territory Taxes Linked to Road Use

In Australia, states and territories obtain road-use-related revenues from annual vehicle registration fees, stamp duty on vehicle purchases/transfers, drivers' licence fees. Registration fees are the most important of these sources of revenue. Stamp duty yields revenue that typically is less than half of the revenue provided by registration fees. Licence fees typically provide revenue that is less than 10 per cent of revenue from registration fees.

State/territory road-use-related revenues as a percentage of GDP have risen significantly over the past 12 years, from about 0.68 per cent in 2003-04 to an estimated 0.93 per cent in 2015-16. This contrasts with the downtrend in Commonwealth road-use-related revenues as a percentage of GDP over the same period.

There is some hypothecation of vehicle registration fees in Australia. Arrangements vary between states/territories. In most states/territories, registration fee monies are paid into consolidated revenue. In South Australia and New South Wales, registration fee revenue is hypothecated to road funds, but Treasury retains oversight of allocations in South Australia. In Victoria, a small part of registration fees is hypothecated to a road fund to target projects that contribute to economic development.

Revenues from stamp duty, drivers' licence fees, and GST revenue allocations from the Commonwealth are paid into consolidated revenue.

2.6 State/Territory Road-Related Revenues and Expenditures Compared

Over the past 12 years, state/territory expenditures on roads nett of Commonwealth tied road grants generally have fallen short of own-source road-use-related revenues plus GST revenue allocations related to roads and vehicles. The difference has been relatively small in aggregate. It has been much smaller than the gap between Commonwealth road-use-related revenues and road grants. More detailed information is provided in section 2.7.

2.7 Public Transport Subsidies

Public transport subsidies constitute a significant state/territory outlay across eight Australian cities. Governments have held down fares and increased capacity and services, and then covered large deficits mainly as an anti-congestion policy measure.

Table 2.1 presents data on expenditure on public transport, revenue from fares, deficits or revenue shortfalls, and cost recovery ratios for eight Australian cities. Cost recovery through fares averages about 24 per cent of expenditure. Public transport deficits across the eight cities total approximately $7.6 billion. This is a conservative estimate, since costs do not include regional expenditure, and (with the exception of Sydney) they exclude the opportunity cost of capital, that is, the return *on* capital. Costs do, however, include the return *of* capital (through depreciation), in addition to operating costs.

It is instructive to compare public transport subsidies to cover deficits with road-related expenditure across all levels of government. This is presented in **Table 2.2**. The conservative estimate of subsidies to public transport in 2015-16 ($7.6 billion) is equivalent to 52.9 per cent of state/territory government expenditure on roads in all areas, and is $1.8 billion higher than road-related expenditure funded by the Commonwealth Government ($5.8 billion).

TABLE 2.1 PUBLIC TRANSPORT – EXPENDITURE AND COST RECOVERY, EIGHT AUSTRALIAN CITIES

	Public Transport Expenditure	Fare Revenue	Revenue Shortfall	Cost Recovery Ratio
		2015-16 $ Million		Per cent
Sydney	4,744	1,105	3,638	23%
Melbourne	2,107	590	1,517	28%
Brisbane	1,573	378	1,196	24%
Perth	897	206	691	23%
Adelaide	496	100	395	20%
Hobart	50	11	39	22%
Canberra	138	23	114	17%
Darwin	24	2	22	9%
Total	**10,029**	**2,416**	**7,613**	**24%**

Note: Sydney data is for 2010-11, and for other cities data are for 2012-13. Data are expressed in 2015-16 $.

SOURCE: BITRE (2014)

TABLE 2.2 PUBLIC TRANSPORT SUBSIDIES VS. ROAD-RELATED EXPENDITURE, 2015-16

Road-Related Expenditure			Total Road-Related	Public Transport Subsidies	Total Land Transport	Public Transport Subsidies ÷ Road-Related Expenditure
Commonwealth Government	State/territory Government	Local Government				
$ Million	$ Million	$ Million	$ Million	$ Million	$ Million	Ratio
5,816	14,394	7,168	**27,379**	7,613	**34,991**	27.8%
% of GDP	% of GDP	% of GDP	% of GDP	% of GDP	% of GDP	Ratio
0.35	0.83	0.43	1.61	0.45	2.06	27.8%

Note: Data are expressed in estimated 2015-16 $.

SOURCE: BITRE (2014B), ACIL ALLEN.

2.8 Analysis of Actual and Projected Road-Related Expenditures and Revenues

This section provides historical analysis and "business as usual" projections of road-related revenues and expenditures for the whole of the public sector at the Commonwealth, state/territory, and local levels. Results are shown as percentages of GDP, from 2003-04 to 2019-20. Historical data are available until 2013-14 from the Bureau of Infrastructure, Transport and Regional Economics (BITRE)[7] and projections run from 2014-15 to 2019-20. The data are parsed by BITRE so that Commonwealth grants are netted out to avoid double counting. This is a complex task, and for this reason, BITRE makes historical data available only with a one year lag. Projections at the Commonwealth level are based on budget data, using historical budget figures for 2014-15 and 2015-16, and thereafter using projections from the 2016-17 budget. Projections at the state/territory and local government levels are based on recent historical trends.

[7] Yearbook 2015 – Australian Infrastructure Statistics, Tables T 1.2a-e, T 1.4 (pp. 39-42). Available at https://bitre.gov.au/publications/2015/yearbook_2015.aspx

2.8.1 Analysis by Level of Government

Figure 2.1 and **Table 2.3** present revenue and expenditure as percentage of Gross Domestic Product (GDP), at the three levels of government. GDP is based on ABS National Account historical data and projections contained in the 2016-17 Commonwealth budget.

The top panel in **Figure 2.1** shows Commonwealth government revenue and expenditure. States/territories revenue and expenditure is shown in the centre panel. The bottom panel presents the consolidated views across all levels of government – Commonwealth, states/territories and local.

The overall picture is that road-related Commonwealth revenue has been declining as a fraction of GDP, while state/territory revenue has been rising. Commonwealth expenditure has been rising, but has been subject to significant volatility. State/territory expenditure has been rising. Local government revenue and expenditure rose slightly during the historical period and is projected to remain approximately steady as a fraction of GDP. The Commonwealth government collects more road-related revenue than it spends, choosing to allocate revenue from road-related taxes and charges to non-road expenditures.

Federal elections are highlighted by vertical lines in **Figure 2.1**. This is relevant to the analysis, since road-related spending is affected by the electoral cycle. Road-related spending by the Commonwealth government tends to rise after elections.

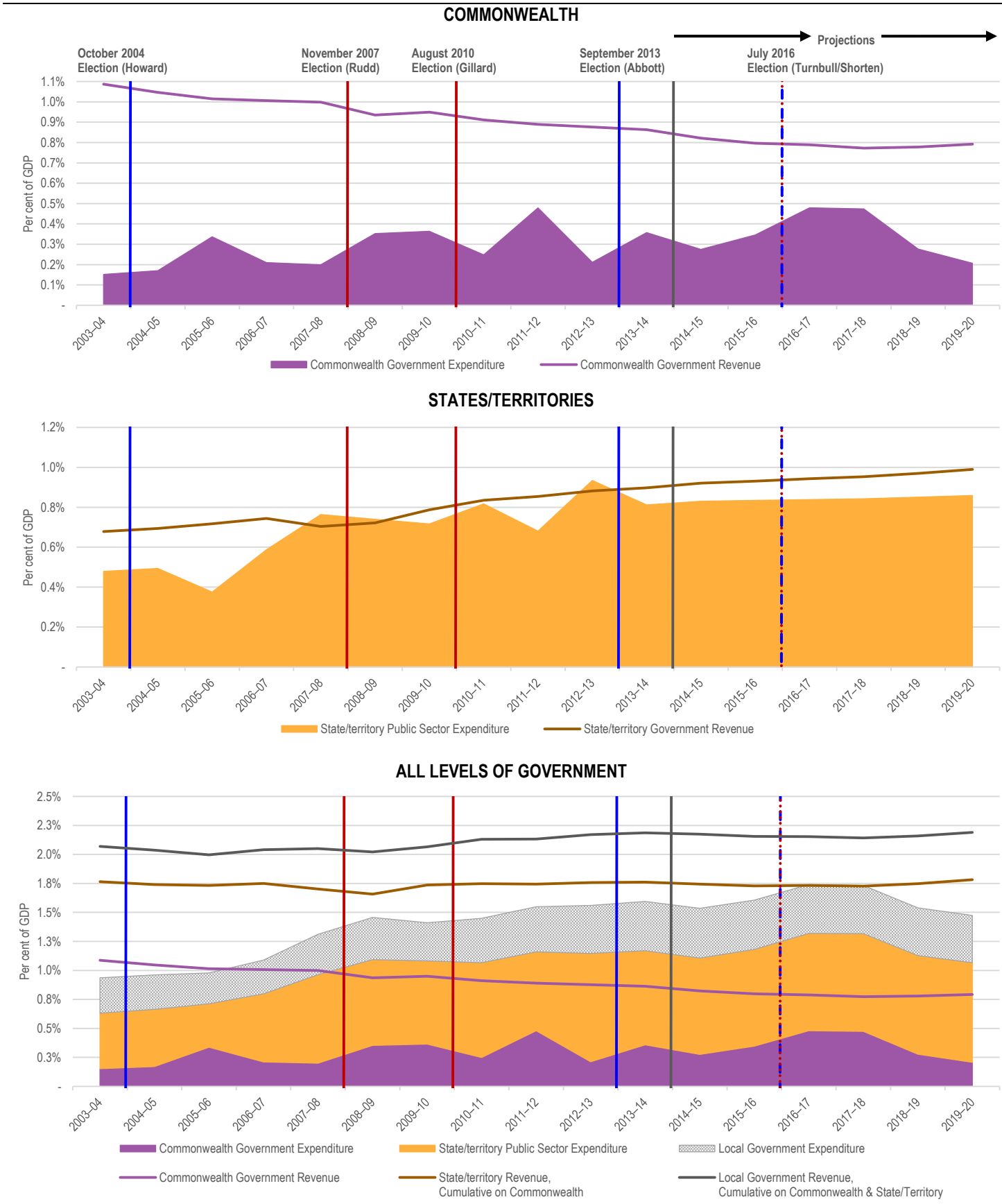
Columns (1)-(4) in **Table 2.3** show road-related expenditure at the three levels of government, as calculated by BITRE. The Commonwealth Government does not, *per se*, carry out expenditures on roads. These are carried out by state/territory and local governments. Commonwealth Government "expenditures" are funds that are assigned by BITRE to that government, essentially Commonwealth Government tied grants, which are spent by state/territory and local governments. The methodology followed by BITRE to allocate historical data across different levels of government includes public non-financial corporations (that is, government-owned non-financial corporations) where relevant.

Columns (5) and (6) in **Table 2.3** show road-use-related revenue for Commonwealth and state/territory governments. In this sub-section, the focus is on *aggregate* revenue and expenditure streams. Detailed analysis of revenue collection instruments is presented in the next sub-section (2.8.2). Road-related revenue for the Commonwealth is calculated as the sum of: petroleum products customs and excise duty (fuel taxation), motor vehicles customs duty, road-related fringe benefits tax (FBT), and the luxury car tax. The main source of revenue at the Commonwealth level is, by far, fuel taxation. Road-related revenue for state/territory governments is calculated as the sum of: vehicle registration fees, road-related GST (collected by the Commonwealth and recycled to state/territory governments), driver's licence fees, stamp duty, the Federal Interstate Registration Scheme (FIRS),[8] and revenue from tolls. The main sources of revenue at the state/territory level are vehicle registration fees, road-related GST, stamp duty and tolls. In relation to local government, the main sources of revenue are council rates.

Columns (7) and (8) in **Table 2.3** calculate the funding "gap" at the Commonwealth and state/territory levels. This is calculated as revenue less expenditure, as per cent of GDP.

[8] FIRS revenue is collected by the states/territories, passed to the Commonwealth, and then returned to the states/territories on the basis of a tonne-kilometre-based formula.

FIGURE 2.1 ROAD-RELATED REVENUE AND EXPENDITURE – BY GOVERNMENT LEVEL



SOURCE: BITRE, ABS, ACIL ALLEN ANALYSIS.

TABLE 2.3 ROAD EXPENDITURE AND REVENUE, PUBLIC SECTOR, PERCENTAGE OF GDP

	Expenditure				Revenue		Gap: Revenue minus Expenditure	
	(1) Commonwealth Government	(2) State/territory Public Sector	(3) Local Government	(4) All Public Sector (including Public Non-Financial Corporations)	(5) Commonwealth Government	(6) State/territory Government	(7) = (5) - (1) Commonwealth Government	(8) = (6) - (2) State/territory Government
2003–04	0.15%	0.48%	0.30%	0.94%	1.09%	0.68%	0.93%	0.20%
2004–05	0.17%	0.49%	0.30%	0.96%	1.05%	0.69%	0.88%	0.20%
2005–06	0.34%	0.38%	0.27%	0.98%	1.01%	0.72%	0.68%	0.34%
2006–07	0.21%	0.59%	0.29%	1.09%	1.01%	0.74%	0.80%	0.16%
2007–08	0.20%	0.76%	0.35%	1.31%	1.00%	0.70%	0.80%	-0.06%
2008–09	0.35%	0.74%	0.36%	1.46%	0.94%	0.72%	0.58%	-0.02%
2009–10	0.36%	0.72%	0.33%	1.41%	0.95%	0.79%	0.59%	0.07%
2010–11	0.25%	0.82%	0.38%	1.45%	0.91%	0.83%	0.66%	0.02%
2011–12	0.48%	0.68%	0.39%	1.55%	0.89%	0.85%	0.41%	0.17%
2012–13	0.21%	0.93%	0.41%	1.56%	0.88%	0.88%	0.67%	-0.05%
2013–14	0.36%	0.81%	0.43%	1.59%	0.86%	0.90%	0.51%	0.09%
2014–15	0.28%	0.83%	0.43%	1.61%	0.82%	0.92%	0.55%	0.09%
2015–16	0.35%	0.83%	0.43%	1.59%	0.80%	0.93%	0.45%	0.10%
2016–17	0.48%	0.84%	0.42%	1.58%	0.79%	0.94%	0.31%	0.10%
2017–18	0.47%	0.84%	0.42%	1.55%	0.77%	0.95%	0.30%	0.11%
2018–19	0.28%	0.85%	0.41%	1.54%	0.78%	0.97%	0.50%	0.12%
2019–20	0.21%	0.86%	0.41%	1.52%	0.79%	0.99%	0.59%	0.13%

SOURCE: BITRE, ABS, COMMONWEALTH BUDGET (VARIOUS YEARS), ACIL ALLEN ANALYSIS.

Commonwealth Government

Column (1) in **Table 2.3** shows that Commonwealth expenditure rose gradually from 0.15 per cent of GDP in 2003-04 to approximately 0.3 per cent of GDP at present. Over the same period, Commonwealth revenue, column (5), contracted from 1.09 per cent of GDP in 2003-04 to approximately 0.8 per cent of GDP. The strong upward trend in expenditure in the period from 2003-04 to 2011-12 coincides with increased aggregate Commonwealth government revenue as a result of the mining boom. The contraction of revenue arises from the combination of a fixed nominal fuel excise rate (that is, not adjusted for inflation) and marked fuel economy gains in Australia's motor vehicle fleet in the context of high fuel prices. The dynamics of these trends are readily apparent in the top panel of **Figure 2.1**. It is clear that at the Commonwealth Government level there is an excess of road-use-related revenue over expenditure, but this has been contracting over time. This has also been shown in column (7) in **Table 2.3**. It is obvious that, historically, the Commonwealth Government has chosen to allocate substantial amounts of revenue from road-related taxes and charges to non-road expenditures, but this has declined in the context of an eroding road-related revenue base relative to GDP. Greater recycling of Commonwealth road-use-related revenues to roads would have contributed to alleviation of congestion, road damage, and crash costs in the context of rising road use with GDP growth.

The 2016-17 Commonwealth budget proposes to increase road grants to almost 0.5 per cent of GDP by 2017-18, but then to drop them back to 0.2 per cent of GDP by 2019-20. The expenditure pattern shown in the top panel of **Figure 2.1** and **Table 2.3** indicates that federal electoral cycles influence

investment in roads, indicating a politically opportunistic approach by the Commonwealth Government to what is a key component of national infrastructure capital. The resulting funding trajectory is inconsistent with efficient road planning and investment programming to meet Australia's rising demand for road services.

State/Territory Governments

Turning to the state/territory level, column (2) in **Table 2.3** and the centre panel of **Figure 2.1** indicate that since 2003-04, expenditure has risen from 0.48 to 0.83 per cent of GDP. For the same period, state/territory road-use-related revenue, shown in column (6), also grew from 0.68 to 0.93 per cent of GDP. This trend coincided with the mining boom over the period 2004 to 2012. The centre panel of **Figure 2.1** shows that at the state/territory level, revenue and expenditure moved roughly into balance during the period of the mining boom. This is also evidenced in column (8) in **Table 2.3**. These data indicate that the main imbalance resides at the Commonwealth Government level.

Comparison of the top and centre panels of **Figure 2.1** reveals evidence of state/territory expenditure compensating for the electoral cycle that is apparent at the Commonwealth level. This is obvious in the bottom panel of **Figure 2.1**, where aggregate expenditure across all levels of government exhibits a smoother trajectory than expenditure by each level of government separately.

State/territory projections to 2019-20 were made on the basis of recent historical trends, a 'business-as-usual' scenario. This features gradual rises of expenditure and revenue to 0.9 and 1 per cent of GDP by 2019-20, respectively. The gap between revenue and expenditure remains stable at approximately 0.1 per cent of GDP. State/territory expenditure is influenced by federal electoral cycles, and this would generate some cyclical patterns around the central tendency in the projections. Effects of state/territory electoral cycles on road expenditure in each jurisdiction and interactions between these cycles and the federal electoral cycle has not been investigated. It would be a complex task and is outside the scope of this study.

Local Governments

The picture is completed by local government expenditure, as shown in column (3) of **Table 2.3**. Over the past 12 years, this rose from 0.3 to 0.43 per cent of GDP, and is projected to remain relatively stable at 0.4 per cent of GDP, the 'business-as-usual' scenario.

All Governments

Commonwealth, state/territory and local government flows are brought together in the bottom panel of **Figure 2.1**. This presents expenditure as cumulative shaded areas. Revenue is depicted as lines, the bottom line showing Commonwealth road-use-related revenue, the middle line showing the total of state/territory and Commonwealth road-use-related revenue, and the top line depicting the aggregate of the three levels of government. Because local governments fund road construction and maintenance (along with various other responsibilities) mainly from taxes that are not road-use-specific, and because local government expenditure on roads is relatively stable as a percentage of GDP, local government revenue included in aggregate for all levels of government is the amount allocated (nett of grants) from the general local government revenue pool to roads.

A key conclusion that emerges from the bottom panel of **Figure 2.1** is that the gap between all public sector road-use-related revenue and expenditure has been shrinking over the past 12 years, but may widen from 2017-18. The increase in expenses over 2015-16 to 2016-17 is driven by additional funding for the Roads to Recovery Programme announced in the 2015-16 mid-year economic and fiscal outlook (MYEFO) statement and a funding spike associated with the July 2016 federal election campaign. The decline from 2017-18 to 2019-20 reflects the expected completion of major projects, such as the Toowoomba Second Range Crossing in Queensland, and reduced Commonwealth contributions typical of the mid-term period in the federal electoral cycle. Although road-use-related expenditures have risen as a percentage of GDP over the past 12 years, this has not been sufficient to counteract ongoing concerns about infrastructure inadequacies and maintenance gaps.

2.8.2 Analysis by Road-Use-Related Taxes and Charges

This sub-section presents analysis on the evolution of revenue collected by each of the road-use-related taxes and charges. **Figure 2.2** shows data for Commonwealth, state/territory and local governments. Commonwealth government road-use-related taxes and charges are shown in the top panel. The centre panel presents data road-use-related taxes and charges for state/territory governments. The bottom panel shows the consolidated view across both levels of government.

Commonwealth road-related taxes and charges have been declining, while at the state/territory level they have been rising. The main contributors to Commonwealth revenue are petroleum products excise and customs duty, followed by road-related Fringe Benefits Tax (FBT) and passenger motor vehicles customs duty. For the state/territory governments, the main sources of revenue are vehicle registration fees and road-related Goods and Services Tax (GST), followed by stamp duty and tolls.

Commonwealth Taxes

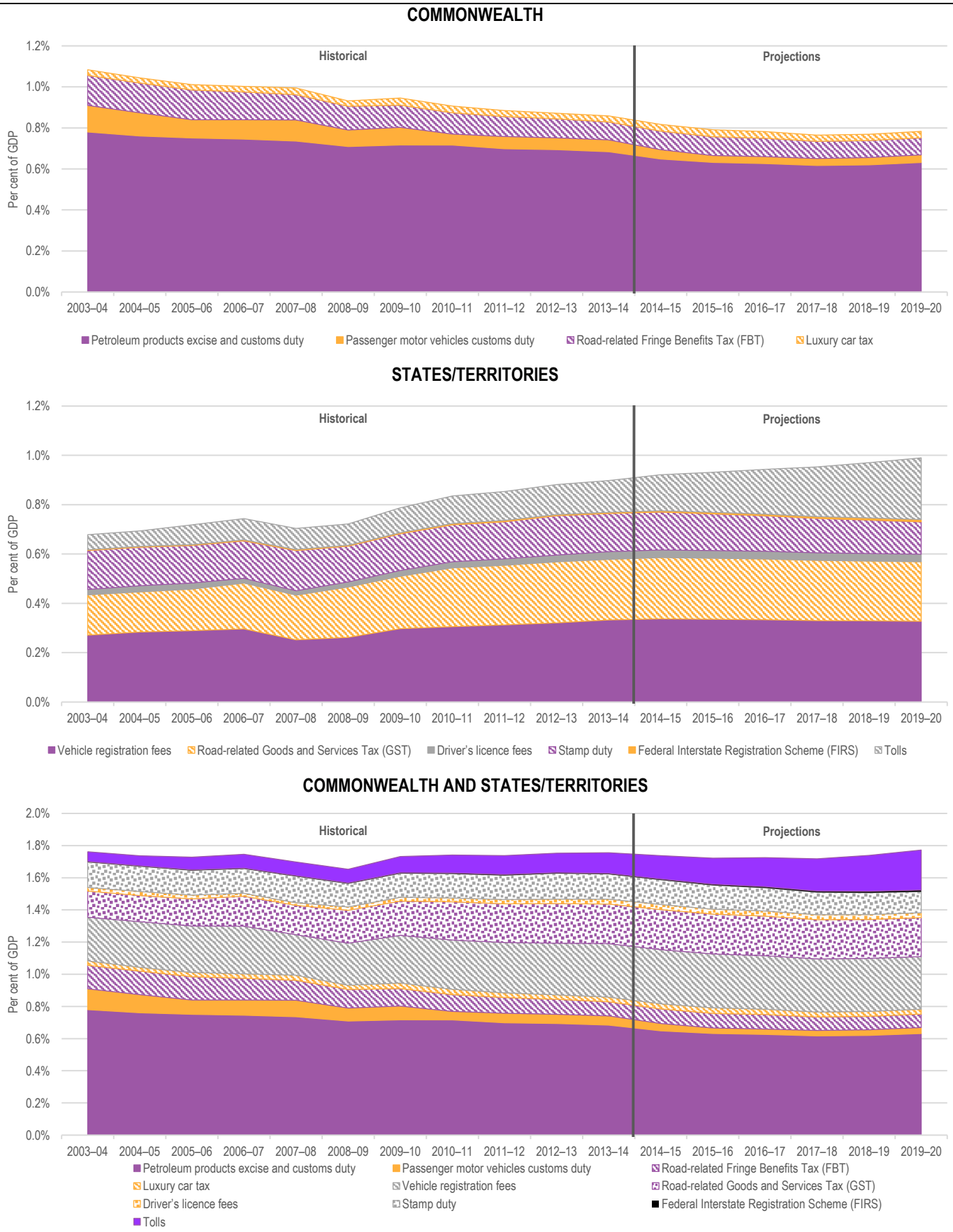
Table 2.4 presents Commonwealth government historical data and projections as percentage of GDP. As before, GDP is based on ABS National Account historical data and projections contained in the 2016-17 Budget.

Petroleum products customs and excise duty (fuel taxation) is shown in column (1), and has contracted over the past 12 years from 0.78 per cent of GDP in 2003-04 to 0.63 per cent in 2015-16. This decrease has been generated by a combination of two factors. First, until 2014, the rate of duty had been fixed nominally and lack of inflationary adjustments eroded the rate in real terms. Second, the past decade was characterised by high fuel prices, which led to faster fuel economy gains for Australia's motor vehicle fleet.

Inflation indexation of the fuel taxation rate was reintroduced in late-2014, but fuel economy gains are expected to continue. The rate of improvement in fuel economy of vehicles, and the extent of switching to energy sources, such as electricity and hydrogen, are likely to depend on oil prices, petroleum fuel taxation rates in major motor vehicle markets, and mandatory fuel economy or greenhouse gas emissions standards in major markets. Standards are more likely to be tightened in the context of high oil prices. The rate of improvement in fuel economy may be slower over the next few years than over the past decade, because of subdued oil prices in the medium-term future. Figures from 2014-15 onwards are based on budget data and projections contained in the 2016-17 Commonwealth budget. After falling from 2003-04 to 2014-15, fuel taxation revenue is projected by the Australian Treasury to remain static around 0.62 to 0.63 per cent of GDP to 2019-20.

Motor vehicles customs duty revenue is presented in column (2). This has contracted over the past 12 years, from 0.13 to 0.03 per cent of GDP. In the projection period to 2019-20, there are two counteracting drivers of motor vehicles customs duty. On the one hand, the closure of motor vehicle assembly plants in Australia is expected to translate into increased imports of motor vehicles, resulting in rising motor vehicles customs duty. On the other hand, once assembly plants have closed, the previous main rationale for maintaining motor vehicles customs duty rates at their existing levels (that is, protection of local motor vehicle manufacturing) will disappear. The 2016-17 Commonwealth budget projects that motor vehicles customs duty will grow roughly in line with GDP, increasing slightly to 0.04 per cent of GDP.

FIGURE 2.2 COMMONWEALTH AND STATE/TERRITORY GOVERNMENTS – ROAD-RELATED TAXES AND CHARGES



SOURCE: BITRE, ABS, ACIL ALLEN ANALYSIS.

TABLE 2.4 COMMONWEALTH GOVERNMENT – ROAD-RELATED TAXES AND CHARGES, PER CENT OF GDP

	(1) Petroleum Products Duty	(2) Motor Vehicles Customs Duty	(3) Road-related Fringe Benefits Tax (FBT)	(4) Luxury Car Tax	(5) Commonwealth – Sub-total
2003–04	0.78%	0.13%	0.15%	0.03%	1.08%
2004–05	0.76%	0.11%	0.15%	0.02%	1.04%
2005–06	0.75%	0.09%	0.14%	0.03%	1.01%
2006–07	0.75%	0.09%	0.13%	0.03%	1.00%
2007–08	0.74%	0.10%	0.12%	0.03%	0.99%
2008–09	0.71%	0.08%	0.12%	0.03%	0.93%
2009–10	0.72%	0.09%	0.11%	0.03%	0.95%
2010–11	0.72%	0.05%	0.10%	0.03%	0.91%
2011–12	0.70%	0.06%	0.10%	0.03%	0.88%
2012–13	0.69%	0.06%	0.09%	0.03%	0.87%
2013–14	0.68%	0.06%	0.09%	0.03%	0.86%
2014–15	0.65%	0.05%	0.09%	0.03%	0.82%
2015–16	0.63%	0.03%	0.09%	0.03%	0.79%
2016–17	0.63%	0.03%	0.09%	0.03%	0.78%
2017–18	0.62%	0.03%	0.08%	0.03%	0.77%
2018–19	0.62%	0.04%	0.08%	0.03%	0.77%
2019–20	0.63%	0.04%	0.08%	0.03%	0.78%

SOURCE: BITRE, ABS, COMMONWEALTH BUDGET (VARIOUS YEARS), ACIL ALLEN ANALYSIS.

Road-use-related FBT is shown in column (3). This has gradually fallen from 0.15 to 0.09 per cent of GDP over the period from 2003-04 to 2015-16. 2016-17 Commonwealth budget projections are that FBT will fall slightly as a percentage of GDP to 0.08 per cent by 2019-20. The luxury car tax is shown in column (4) and been relative stable around 0.03 per cent of GDP over the past 12 years. History has shown a long-term downward trend in the price/quality ratio of motor vehicles (in real dollar terms). This trend is expected to continue into the future. With ongoing falls in hedonic (quality-adjusted) prices, quantity demanded is expected to continue to increase. However, this trend is tempered as the ratio of vehicles to population approaches saturation and consumer demand growth tapers off, certainly in terms of the *quantity* of motor vehicle units demanded. However, saturation points for the *quality* of motor vehicles would not yet have been reached, and this is expected to result in ongoing demand growth for luxury vehicles. The 2016-17 Commonwealth budget projects that luxury car tax revenue will grow at the same rate as GDP, resulting in a stable ratio at 0.03 per cent of GDP over the projection period.

The overall picture for the Commonwealth government, column (5), is one of falling road-use-related revenues over the past 12 years, dropping from 1.08 to 0.8 per cent of GDP between 2003-04 and 2015-16. This trend is expected to continue, with projections featuring a somewhat slower contraction (relative to history) to 0.78 per cent of GDP by 2019-20. Thereafter, the trajectory of oil prices and government policy on fuel or greenhouse gas emissions standards are likely to be the most important determinants of the main source of Commonwealth road-related revenue, fuel taxation.

State/Territory Taxes

Historical and projected revenue sources for the states and territories are shown in **Table 2.5**.

TABLE 2.5 STATE/TERRITORY GOVERNMENT – ROAD-RELATED TAXES AND CHARGES, PER CENT OF GDP

	(1) Vehicle Registration	(2) Goods and Services Tax (GST)	(3) Driver's Licence Fees	(4) Stamp Duty	(5) Federal Interstate Registration Scheme (FIRS)	(6) Tolls	(7) State/territory – Sub-total
2003–04	0.27%	0.16%	0.02%	0.16%	0.00%	0.06%	0.68%
2004–05	0.28%	0.16%	0.03%	0.16%	0.00%	0.06%	0.69%
2005–06	0.29%	0.17%	0.02%	0.15%	0.00%	0.08%	0.72%
2006–07	0.30%	0.19%	0.02%	0.15%	0.00%	0.09%	0.74%
2007–08	0.25%	0.18%	0.02%	0.16%	0.00%	0.09%	0.70%
2008–09	0.26%	0.20%	0.02%	0.14%	0.00%	0.09%	0.72%
2009–10	0.30%	0.21%	0.02%	0.15%	0.00%	0.10%	0.79%
2010–11	0.31%	0.24%	0.02%	0.15%	0.01%	0.11%	0.83%
2011–12	0.31%	0.24%	0.03%	0.15%	0.01%	0.12%	0.85%
2012–13	0.32%	0.25%	0.03%	0.16%	0.00%	0.12%	0.88%
2013–14	0.33%	0.25%	0.03%	0.15%	0.00%	0.13%	0.90%
2014–15	0.34%	0.25%	0.03%	0.15%	0.01%	0.15%	0.92%
2015–16	0.34%	0.25%	0.03%	0.15%	0.01%	0.16%	0.93%
2016–17	0.33%	0.25%	0.03%	0.14%	0.01%	0.18%	0.94%
2017–18	0.33%	0.24%	0.03%	0.14%	0.01%	0.20%	0.95%
2018–19	0.33%	0.24%	0.03%	0.14%	0.01%	0.22%	0.97%
2019–20	0.33%	0.24%	0.03%	0.13%	0.01%	0.25%	0.99%

SOURCE: BITRE, ABS, ACIL ALLEN ANALYSIS.

Column (1) contains vehicle registration fees, which have grown from 0.27 to 0.34 per cent of GDP from 2003-04 until 2015-16. These are projected to remain relatively stable as a fraction of GDP into the projection period, ending at 0.33 per cent of GDP in 2019-20. Column (2) shows road-related GST, which is collected by the Commonwealth government, but recycled to the states/territories. Over the past 12 years, this has grown from 0.16 to 0.25 per cent of GDP. Column (3) presents drivers' licence fee revenues, which have been fairly stable over time, and are expected to continue that way. Column (4) shows stamp-duty for motor vehicle sales. This has been fairly stable over the past 12 years at 0.14 to 0.16 per cent of GDP. However, stamp duty has been identified by authoritative sources, such as the Commonwealth Treasury, as a high excess burden revenue collection instrument. For this reason, and in the context of the existing need for nation-wide tax reform, stamp duty is projected to fall to 0.13 per of GDP by 2019-20. Column (5) presents revenue from the Federal Interstate Registration Scheme (FIRS), which is a minor item at circa 0.01 per cent of GDP, and is not expected to diverge from that level in the projection period. Tolls collected by states and territories are shown in column (6). As a consequence of the trend towards construction of tolled roads, this has been growing since 2003-04, from a level of 0.06 to 0.16 per cent of GDP in 2015-16. This trend is expected to continue, resulting in revenue from tolled roads growing from 0.16 to 0.25 per cent of GDP between 2015-16 and 2019-20. However, this does not allow for privatisation of government operated tolled roads or private provision of new roads.

The picture that emerges at the state/territory level, column (7), is one of growing revenue, from 0.68 to 0.93 per cent of GDP between 2003-04 and 2015-16. This is projected to continue growing, albeit at a slower pace, to reach 0.99 per cent of GDP by 2019-20.

Table 2.6 summarises aggregate results for all of the road-use-related taxes and charges for Commonwealth and state/territory governments. For both levels of government, revenue has been fairly stable over time, varying between 1.65 and 1.76 per cent of GDP over the 12 years from 2003-

04 to 2015-16. Projections result in a slight rise from 1.72 to 1.77 per cent of GDP between 2015-16 and 2019-20.

TABLE 2.6 COMMONWEALTH AND STATE/TERRITORY GOVERNMENT – ROAD-RELATED TAXES AND CHARGES, PERCENTAGE OF GDP

	Commonwealth	State/territory	Commonwealth and State/territory
2003–04	1.08%	0.68%	1.76%
2004–05	1.04%	0.69%	1.74%
2005–06	1.01%	0.72%	1.73%
2006–07	1.00%	0.74%	1.75%
2007–08	0.99%	0.70%	1.70%
2008–09	0.93%	0.72%	1.65%
2009–10	0.95%	0.79%	1.73%
2010–11	0.91%	0.83%	1.74%
2011–12	0.88%	0.85%	1.74%
2012–13	0.87%	0.88%	1.75%
2013–14	0.86%	0.90%	1.76%
2014–15	0.82%	0.92%	1.74%
2015–16	0.79%	0.93%	1.72%
2016–17	0.78%	0.94%	1.73%
2017–18	0.77%	0.95%	1.72%
2018–19	0.77%	0.97%	1.74%
2019–20	0.78%	0.99%	1.77%

SOURCE: BITRE, ABS, ACIL ALLEN ANALYSIS.

2.9 Inefficiency of Existing Road-Use-Related Taxes

It is widely recognised that existing road-use-related taxes cause welfare losses by adversely affecting the efficiency of resource allocation. Such losses are known as excess burdens or deadweight losses.

Estimates of marginal excess burden (excess burden for a dollar of additional tax revenue) associated with various taxes in Australia were undertaken for a review of the Australian taxation system by Henry and others (2010). They included marginal excess burden estimates for road-related taxes:[9]

- fuel taxation $0.15
- luxury car tax $0.20
- motor vehicle registration $0.37
- motor vehicle stamp duty $0.38

Estimates for other taxes by the same analysts included: GST, $0.08; and company income tax, $0.40. Later estimates by Australian Treasury economists using a similar computable general equilibrium model recalibrated to more recent data provided higher marginal excess estimates for GST ($0.19) and company income tax ($0.50), but did not produce estimates for the road-use-related taxes covered in earlier work.[10]

[9] See KPMG Econtech (2010).
[10] See Cao, others (2015).

Some taxes avoid excess burdens. Taxes that do not affect the efficiency of allocation of resources are said to be "neutral". Taxes that actually improve the efficiency of allocation of resources could be described as "better-than-neutral".

Two types of levy that are particularly relevant to road funding avoid excess burdens. Brief discussions follow.

Land Value-Based Council Rates

It has been shown clearly in the economics literature that local government rates (or other taxes) based on land value (not those based on property value) that do not discriminate on the basis of land use, would not affect the efficiency of resource allocation. Such tax regimes would not affect the amount of land in use, how it is used (including investments made on land), and when it is used. So, it is consistent with efficient intra-temporal and inter-temporal resource allocation.[11]

The demonstration of the neutrality of land value taxation that does not discriminate on the basis of land use, was underpinned by an assumption that relevant markets operate efficiently. It has been demonstrated by Gaffney (1973, 2009), Tideman (1999) and Stiglitz (2015, 2016) that land value taxation could correct market and policy failures and consequent inefficiencies in credit markets and monetary policy, resulting in improvements in the efficiency of resource allocation. Further discussion of the second point can be found in sub-section 5.5.2.

While taxation of the value of land involves administration costs for the landowner and government (a form of excess burden or deadweight loss), such costs are low relative to those of other important taxation instruments.[12] So, such taxation causes very low excess burden.

Recent analysis by Australian Treasury economists has suggested land taxation may be better-than-neutral in another way. With the aid of computable general equilibrium modelling, they estimated that the marginal excess burden of land taxation (ignoring administration costs) was zero. However, in the context of some foreign ownership of land, the marginal excess burden is negative, as spending of the revenue for the benefit local entities results in a nett transfer to locals. It was estimated that foreign ownership of 10 per cent of land would result in a marginal excess burden of –$0.10 (Cao, others, 2015).

Land value-based rates that do not discriminate on the basis of land use are attractive for another reason. Construction or improvement of roads, public transport and other infrastructure tend to boost land values in the catchment areas of those facilities, with the result that part of the land value increase is then captured by the efficient tax. Differential rates on the basis of location (but not land use) could increase this "value capture" without detracting from improvements in the efficiency of resource allocation. Further discussion of this matter is located in sub-section 5.5.5.

Well-Designed Road Pricing

Well-designed road pricing falls into the "better-than-neutral" category, because it can correct inefficiencies resulting from costs imposed on others without compensation (external costs) such as those associated with congestion, road damage, crashes and emissions. An additional economic attraction of such pricing is that its substitution for existing road-use-related taxes that cause high excess burdens can reduce the aggregate excess burdens or inefficiencies of the tax (and charging) system as whole. This substitution would also improve the political attraction of applying (well-designed) road pricing.

[11] For example, see Vickrey (1970), Tideman (1982, 1999). Oates, Schwab (1997, 2009).
[12] See Gaffney (2013), Foldvary (2005), Netzer (2001), and Anonymous, *The Economist* (2015).

3 INFRASTRUCTURE SHORTFALLS

Land transport infrastructure "shortfalls" or "gaps" can be viewed from three perspectives.

First is the perspective of revenue and expenditure sufficiency. This is addressed in section 3.2, which analyses scenarios on projections of revenue and expenditure across levels of government. This section concludes that the current framework and plans are unlikely to address land transport infrastructure shortfalls.

Second is the perspective of traffic congestion, which has been growing over time and has reached a point where it is causing significant costs to society. Studies conducted by the Bureau of Infrastructure, Transport and Resource Economics (BITRE 2007, 2015) and ACIL Allen (2012) show that congestions costs are likely to continue growing in the coming decades. According to the BITRE studies, annual congestion costs are of the same order of magnitude as the entire annual public expenditure on road infrastructure, currently between 1 and 2 per cent of GDP. This is the topic of section 3.3.

Third is the safety perspective. The Australian Roads Assessment Program (AusRAP) presents evidence that significant portions of the National Road Network are deficient. This is discussed in section 3.4.

The three perspectives indicate the same conclusion – land transport infrastructure provision and maintenance in Australia have fallen behind growth in demand for services, and the gap is widening. Addressing the existing, and growing, shortfall requires a multi-pronged strategy. First, it is necessary to improve existing, and build new, infrastructure (a supply strategy). Second, the efficiency with which land transport infrastructure is used needs to be improved (a demand management strategy). Ideally, this would include network-wide, variable road pricing. Third, better infrastructure and maintenance need to be funded, and funding needs to be better allocated (a funding strategy).

Transport market reform also should include co-ordination of planning and implementation of supply side, demand side and funding strategies. This encompasses formulation and implementation of suitable institutional arrangements.

Various reforms are discussed in chapters 5 and 6 of this report.

3.1 Conceptual Analysis of Shortfalls

The concept of "shortfalls" in the provision of road infrastructure services can be misleading. It is often interpreted as indicating the existence of a supply-side problem, without sufficient consideration of circumstances on the demand side. To make the concept meaningful, it needs to be placed in the context of the pricing regime that applies to the road network in question. Then, it becomes clear that a shortfall problem could reasonably be attributed to either excess demand or under-supply at the

prevailing price. It also becomes apparent that action on both demand and supply sides may be necessary, not just one or the other.

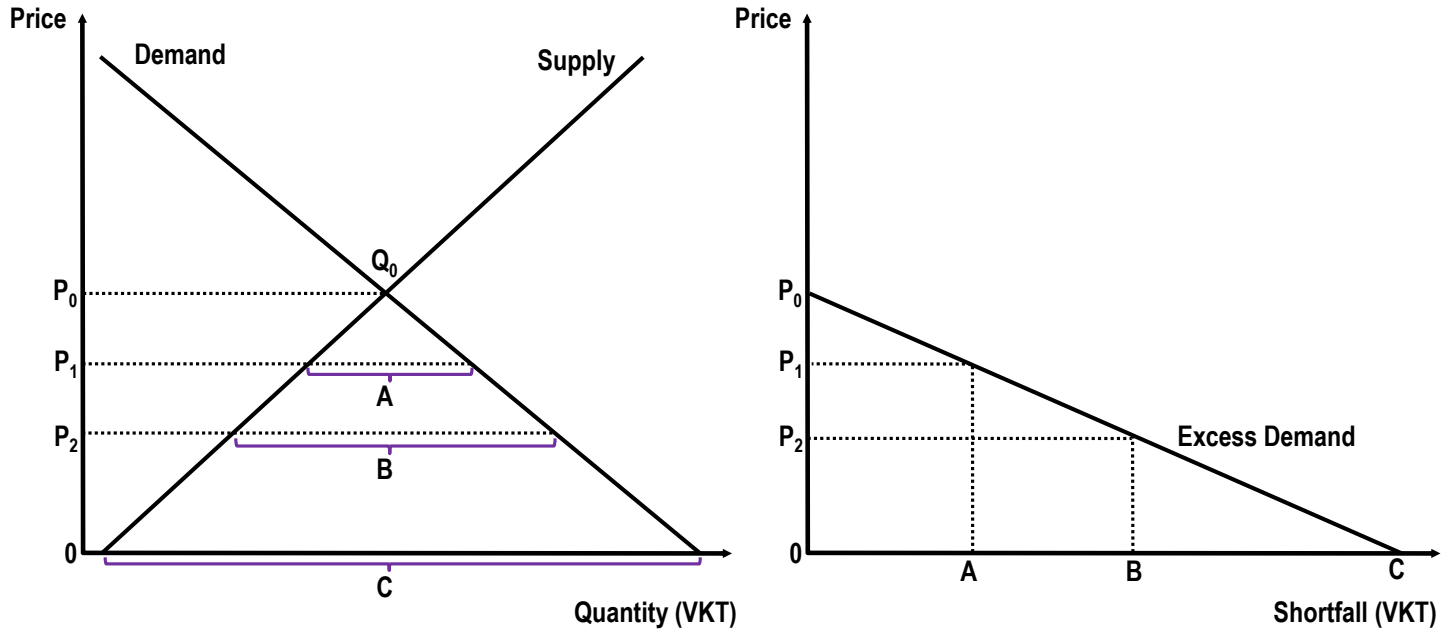
At present, most of the road network is unpriced or crudely priced. This can lead to utilisation rates above what is optimal from a society-wide perspective at busy times and locations for all vehicles, and for heavy vehicles at all times and locations, but particularly on lightly-constructed road segments. It also creates a funding problem.

Public transport services have been priced far below costs to attract commuters from crowded roads at peak times and locations, but services are not good enough and prices are not low enough to reduce traffic congestion to economically acceptable levels. Still lower prices or better services would exacerbate an already large funding problem.

The current heavy vehicle charging scheme has been designed to recover costs of road use by heavy vehicles. However, the charging regime does not provide price signals that induce changes to vehicle and road selections sufficient to reduce road damage to economically acceptable levels. So, there is excess demand for stronger roads and/or road maintenance, not just a road upgrading and maintenance problem.

A road network that is plagued by considerable traffic congestion and damage at a zero price for usage need not be so stressed if pricing is introduced. The correct way to think about shortfalls is to consider them as potentially consequences of "excess demand", as well as "deficient supply" at the prevailing price. This is shown in **Figure 3.1**.

FIGURE 3.1 DEMAND, SUPPLY AND SHORTFALL SCHEDULES



SOURCE: ACIL ALLEN

The left panel presents a demand-supply diagram for road services, and the right panel shows the shortfalls (excess demand or deficient supply) that arise at prices below equilibrium. The vertical axis measures the price of using roads, while road use is measured on the horizontal axis (vehicle kilometres travelled or VKT). Demand is downward sloping since use would diminish with higher prices. Supply is upward sloping since rising prices allow increasingly costly supply to be funded. If the road network operated in a competitive market, equilibrium price and quantity would be reached at a price of P_0 and a quantity of Q_0, at which point quantity demanded equals quantity supplied and there would be no shortfall (in the right panel, the shortfall schedule intercepts the vertical axis). However, the typical situation is that the price of roads is set at zero. In this case, demand exceeds supply by quantity C. At a higher price of P_2, the shortfall is reduced to B (shown in both panels). At

an even higher price of P_1 the shortfall is further reduced to A. Hence shortfalls are characterised as a downward-sloping schedule between prices and shortfalls, as shown in the right panel. **Figure 3.1** conveys the idea that as the price of using a road rises, usage falls and the extent of any infrastructure services "shortfalls" or "gaps" diminishes.

3.2 Revenue and Expenditure across Levels of Government

This section presents scenario analysis across Commonwealth, state/territory and local governments. The analysis centres on the evolution and comparison of revenue and expenditure across levels of government, and builds on the historical data and 'business-as-usual' projections discussed in section 2.8. Two additional scenarios are presented.

Scenario 1 proposes that state/territory governments actively compensate for swings in Commonwealth expenditure on roads, resulting in a trajectory for the sum of Commonwealth and state/territory road-related expenditure that is smoother than without active offsetting adjustments by the states/territories. In Scenario 1, local government road-related revenue and expenditure remain stable as a fraction of GDP.

Scenario 2 proposes a setting in which post-mining boom subdued economic conditions result in falling state/territory revenue and expenditure, with a downward trend towards pre-boom expenditure and revenue levels. Although expenditure and revenue fall during the projection period, they remain above their pre-mining boom levels. Like Scenario 1, Scenario 2 relies on 2016-17 Commonwealth budget forecasts for Commonwealth government revenue and expenditure. Local government road-related revenue and expenditure fall slightly in Scenario 2.

These scenarios are discussed in more detail below.

3.2.1 Scenario 1: State/Territory Compensation for Commonwealth Fluctuations

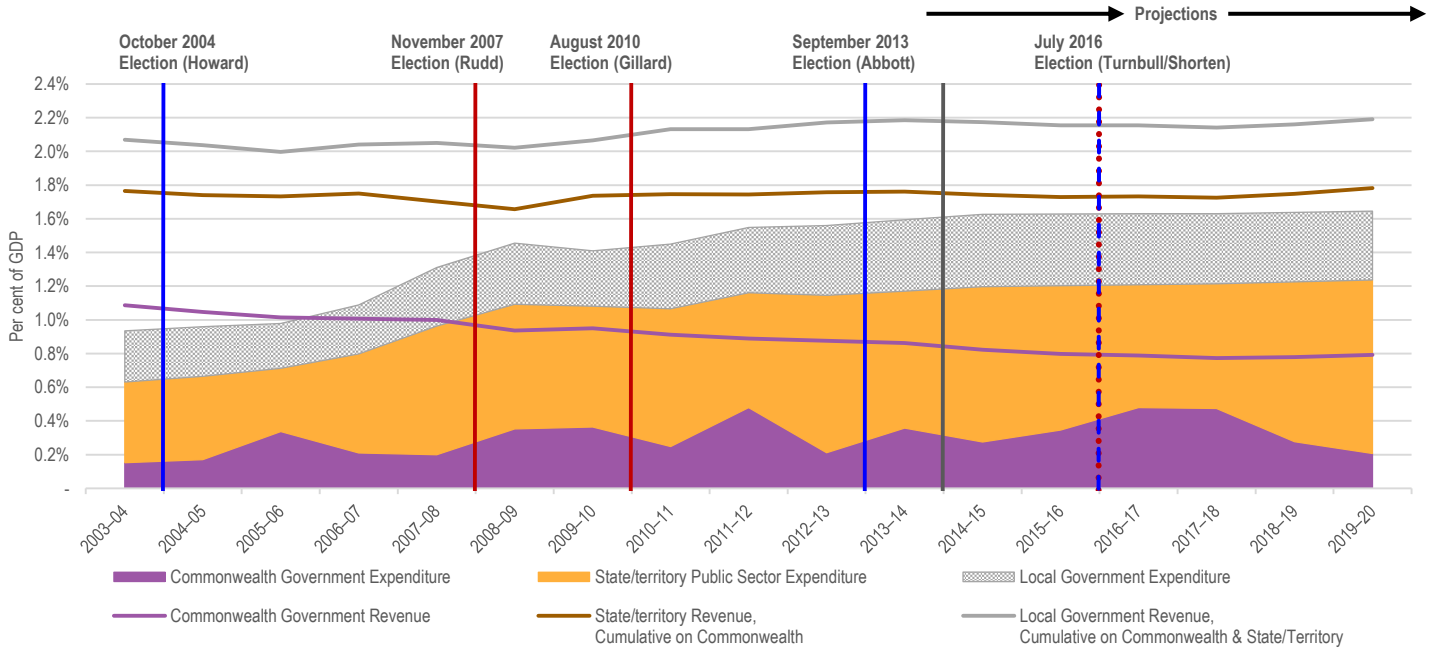
Scenario 1 is based on the historical observation (as noted in sub-section 2.8.1) that state/territory governments have compensated for swings in Commonwealth expenditure on roads. This is evident in the historical data in **Figure 3.2** (and has been previously highlighted in the discussion of **Figure 2.1**).

Throughout the historical period, the aggregation of Commonwealth and state/territory expenditure has been less volatile than its constituents. It is apparent that in aggregate the expenditure patterns of state/territory governments have adjusted to offset spikes in Commonwealth expenditure.

Commonwealth expenditure on roads has tended to rise shortly after elections (shown in **Figure 3.2**). This is consistent with electoral promises being honoured by the elected government.

Scenario 1 projects that the sum of Commonwealth and state/territory expenditure will grow approximately in line with the recent historical trend. Commonwealth expenditure is projected using the 2016-17 Commonwealth budget forecast, while state/territory expenditure is projected assuming that the states/territories actively compensate for swings in Commonwealth expenditure so that the pattern of their joint expenditure is not affected.

FIGURE 3.2 REVENUE, EXPENDITURE – SCENARIO 1: STATES/TERRITORIES OFFSET COMMONWEALTH VARIATIONS



SOURCE: BITRE, ABS, ACIL ALLEN

Expenditure and revenue patterns for the Commonwealth, state/territory and local governments separately are shown in **Figure 3.3**. In **Figure 3.3**, historical compensation of election-induced spikes in Commonwealth expenditure by state/territory governments is made clear. During the projection period, Commonwealth expenditure rises to almost 0.5 per cent of GDP by 2017-18, and then drops away, returning to 0.2 per cent of GDP by 2019-20, a similar level to that in place before the onset of the mining boom (2004-2011). State/territory expenditure offsets Commonwealth expenditure, falling to just over 0.7 per cent of GDP by 2017-18, and then rising to 1 per cent of GDP by 2019-20 in order to make up for the drop-off in Commonwealth expenditure.

The projection implies imbalances and unsustainable trends in road-related expenditure and revenue across the different levels of government, resulting in funding and expenditure gaps for land transport infrastructure. Discussion of revenue and expenditure across all levels of government is contained in section 2.8. The following sections discuss the key findings.

Results for Commonwealth Government

From the top panel in **Figure 3.3**, it is clear that a significant proportion of the Commonwealth Government's road-related revenue is used for purposes other than road-related expenditure. This gap between revenue and expenditure has been shrinking over time, from 86 per cent of revenue in 2003-04, to 56.6 per cent in 2015-16. Historically, falling road-related revenue, rather than rising expenditure, has been the most important contributor to the declining gap. In the projections, the gap continues to fall initially, with rising expenditure playing a greater role. But from 2017-18 the gap increases due to a rise in revenue and a fall in expenditure.

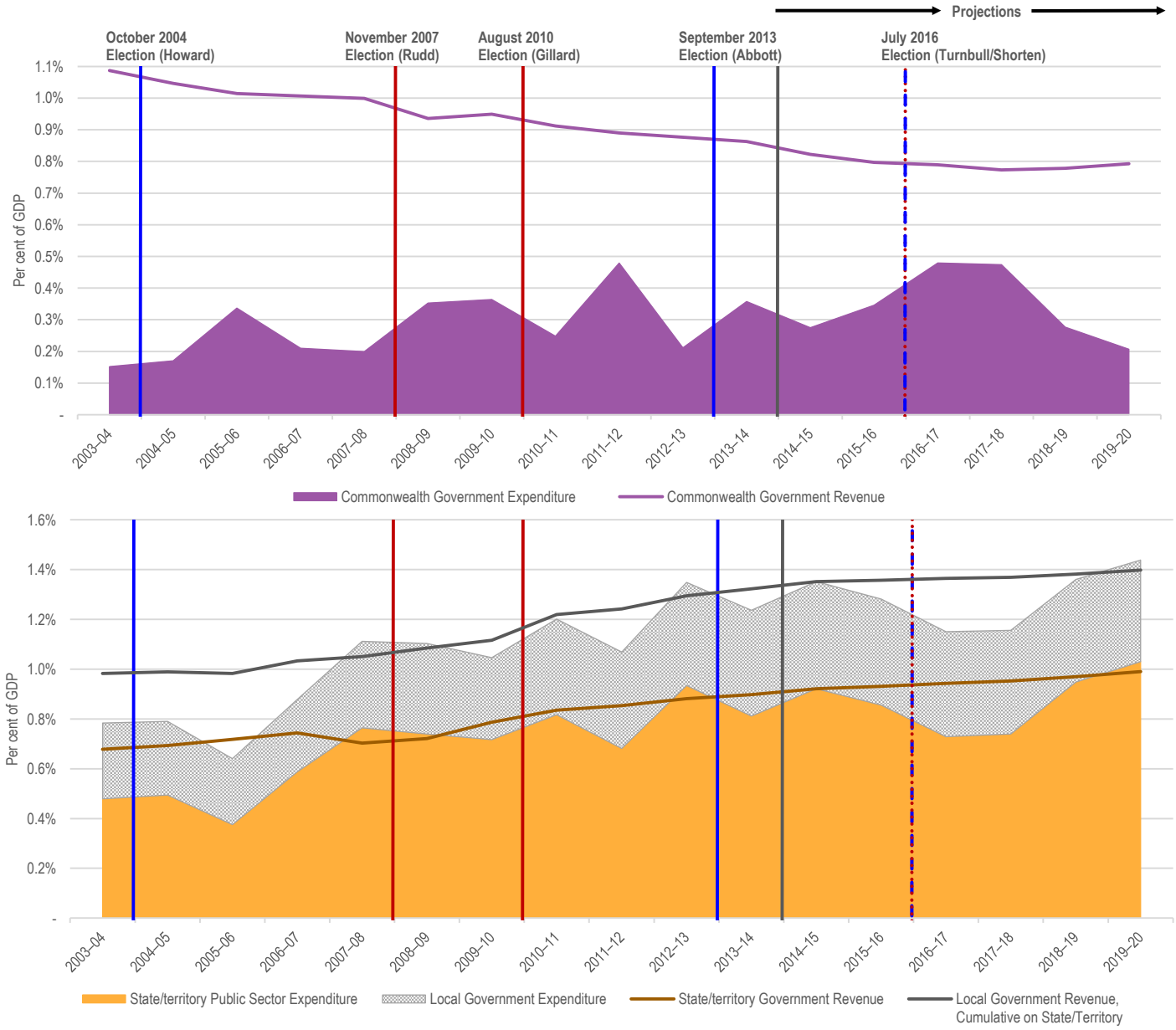
Results for State/Territory Governments

The bottom panel in **Figure 3.3** shows that at the state/territory level, road expenditure and road-related revenue are roughly in balance, with most years showing a small excess of revenue over expenditure. When there is an excess of expenditure over revenue, it tends to be small (2007-08, 2008-09 and 2012-13). Such instances are examples of state/territory governments compensating for drops in Commonwealth expenditure, with is typically the case during the down phase of the electoral cycle.

In the Scenario 1 projections for 2018-19 and 2019-20, Commonwealth expenditure drops to 0.28 and 0.21 per cent of GDP, and state/territory expenditure is assumed to step up to 0.95 and 1.03 per cent of GDP, respectively, in order to compensate for the drop at the Commonwealth level.

It is likely that there will be another federal election in, or close to, 2019-20. Therefore, the forecasted drop in road-related expenditure contained in the 2016-17 Commonwealth budget may not materialise. If that is the case, the projected drop in Commonwealth expenditure, and the compensating increase by the states/territories could be reversed, such that the change in cumulative expenditure will be dampened relative to its constituent parts.

FIGURE 3.3 REVENUE, EXPENDITURE – SCENARIO 1: COMMONWEALTH, STATE/TERRITORY AND LOCAL GOVERNMENTS



SOURCE: BITRE, ABS, ACIL ALLEN

Results for Local Governments

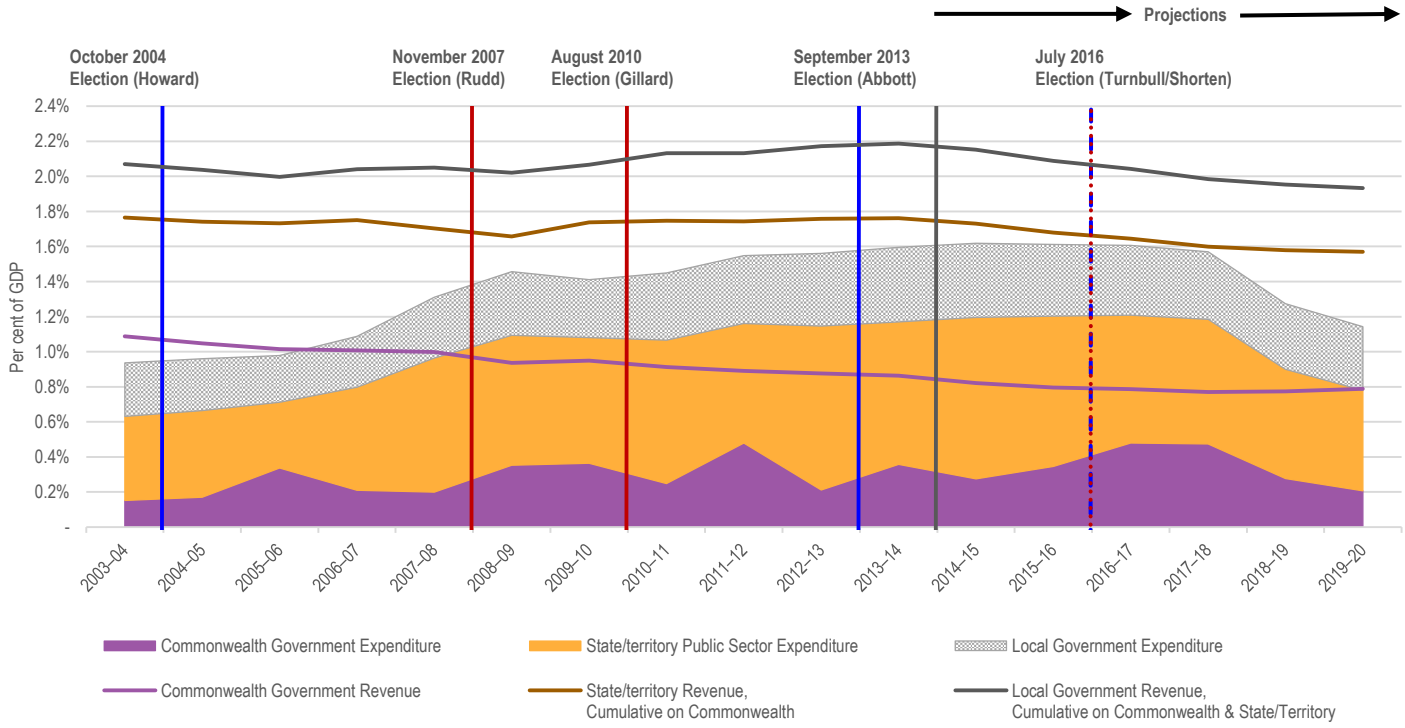
Expenditure for local governments has risen from 0.3 to approximately 0.4 per cent of GDP between 2003-04 and 2015-16. During the projection period this is expected to continue growing roughly in line with GDP, with no significant changes in arrangements envisaged.

Since local government funds road expenditures (nett of grants) from their general revenue pool, and expenditure is relatively stable as a percentage of GDP, revenue is shown as matching expenditure, nett of grants.

3.2.2 Scenario 2: Unwinding of the Mining Boom

In Scenario 1, the assumption is that the states/territories would compensate changes in Commonwealth expenditure driven by the electoral cycle. However, across all levels of government, road-related expenditure has been influenced by the mining boom and there were rising trends during the 2004-2011 boom period. Since the fall in mined-commodity prices, expenditure has grown at a slower pace, but has not returned to its pre-boom level. Scenario 2 considers a return of expenditure towards its pre-mining boom level as a percentage of GDP. This is shown in **Figure 3.4**.

FIGURE 3.4 REVENUE, EXPENDITURE – SCENARIO 2: UNWINDING THE MINING BOOM



SOURCE: BITRE, ABS, ACIL ALLEN

The logic behind Scenario 2 is that government expenditure (including road-related expenditure) was quick to rise with the increase in tax revenues in general. However, international experience has shown that cutting back public expenditure is a difficult process – there is a "ratchet effect" in public expenditure. Scenario 2 assumes that expenditure cutbacks take place in the second half of the projection period, albeit with several years' delay since the end of the mining boom. This would be driven by the different levels of government reaching debt tolerance ceilings, with the result that reducing expenditure becomes unavoidable.

Scenario 2 may be reflected in the 2016-17 Commonwealth budget forecasts. These indicate steep reductions in road-related expenditure from 2018-19 onward.[13]

In Scenario 1 the assumption was that the states/territories would compensate changes at the Commonwealth level and local governments would maintain expenditure approximately steady as a fraction of GDP. In Scenario 2, the assumption is that once the Commonwealth begins to cut back road-related expenditure from 2017-18, neither the states/territories nor local governments are able to

[13] However, by 2018-19 a federal election will occur within a year or so, and hence the projected reductions in expenditure may be replaced by a new round of electoral promises, which are likely to rule out cuts to road-related expenditure.

increase their expenditure to compensate the Commonwealth's drop. Hence, overall expenditure drops back, albeit to a slightly higher level than the pre-mining boom situation circa 2003-04. In Scenario 2, Commonwealth expenditure and revenue are as per Scenario 1 (based on 2016-17 Commonwealth budget forecasts). State/territory revenue and expenditure are projected to fall, with a steeper decline in the second half of the projection period. Local government expenditure is projected to fall from 0.40 to 0.36 per cent of GDP between 2016-17 and 2019-20.

Individual levels of government are shown in **Figure 3.5**, which offers better visualisation for each of the three levels of government. Relative to Scenario 1, curtailed aggregate investment in this scenario means that the road infrastructure gap widens in the projection period.

Results for Commonwealth Government

Since the underlying forecast for the Commonwealth Government has not changed, the analysis remains as for Scenario 1.

Results for State/Territory Governments

In Scenario 2, state/territory revenue is forecast to fall from 0.9 to 0.8 per cent of GDP between 2016-17 and 2019-20. This is a reflection of post-boom conditions affecting preferences for purchases and registration of motor vehicles – in a subdued economic environment consumers become thriftier, modifying behaviour to reduce unnecessary expenses. This may include car sharing, reduced vehicle turnover, etc. These behaviours would result in lower revenue from vehicle registration, motor vehicle stamp duty, road-related GST, and so on.

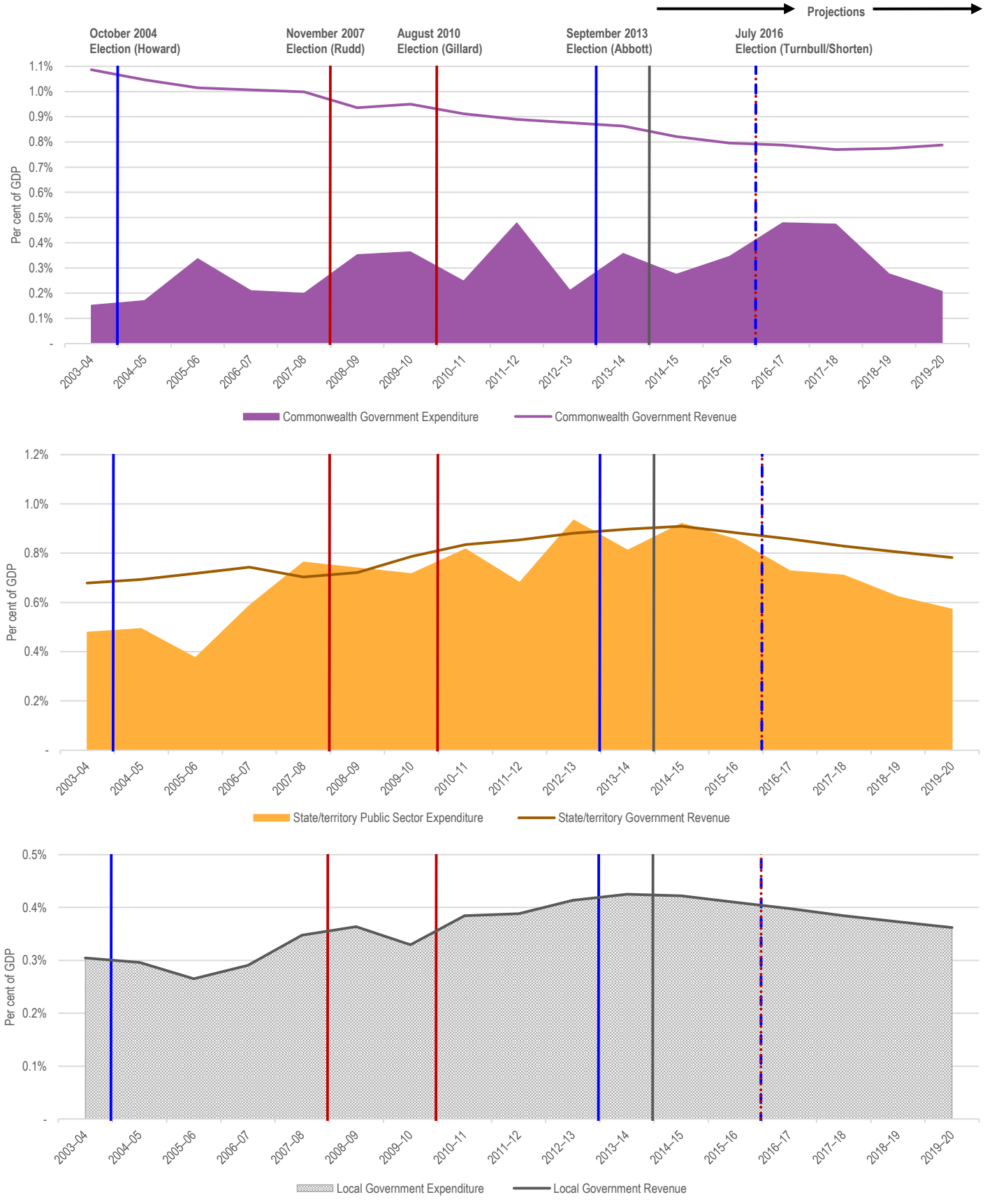
After an initial reduction which is tailored to compensate for the increase in Commonwealth expenditure over the 2016-17 to 2017-18 period, the expectation in Scenario 2 is that state/territory governments are unable to lift their road-related expenditure from 2018-19. This could be rationalised by rising pressures to cut back expenditure in the face on stagnant or falling state/territory (total) revenue. After postponing expenditure cutbacks for a number of years after the end of the mining boom, state/territory government funding conditions become adverse, leaving state/territory governments with no other option than to reduce expenditure. This could materialise through a number of avenues. One possibility is state/territory debt becoming too high. When combined with stagnant or falling state/territory total revenue, this would lead to reallocation of expenditure toward areas with higher political priority at the expense of investment in roads.

In the projection period, the middle panel in **Figure 3.5** shows a widening gap between road-use-related revenue and expenditure at the state/territory level. This highlights the rationale behind Scenario 2, with increasing pressure on state/territory governments to allocate resources away from roads in the face of subdued (post-mining boom) economic conditions.

Results for Local Governments

In Scenario 2, road-use-related expenditure and revenue for local governments are expected to grow slower than GDP during the projection period. Again this is reflective of a slow (post-mining boom) economy, which results in constrained revenue and expenditure at all levels of government, including local governments. In the specific case of local governments, council rates (land taxes) are the main source of revenue. With a slow-growing economy, land values would not rise rapidly, resulting in slow growth in the main tax base of local governments. After several years of slow growth in revenue, but rigid expenditure, debt levels would be at a point where downward adjustment of expenditure cannot be postponed. The decline in local government road-related expenditure is shown in the bottom panel of **Figure 3.5**.

FIGURE 3.5 REVENUE, EXPENDITURE – SCENARIO 2: STATES/TERRITORIES, COMMONWEALTH AND LOCAL GOVERNMENTS



SOURCE: BITRE, ABS, ACIL ALLEN

3.2.3 Funding Gap – Aggregate versus Project-Level Analysis

Thus far, the analysis has taken an aggregate view of expenditure and revenue. This sub-section takes a project-level perspective. The analysis proceeded in two steps. The first step compared proposed aggregate expenditure and revenue projections to 2019-20 with project-level projections. This step concluded that Commonwealth budget road-related expenditure is roughly in balance with project-level projections, providing assurance that the Commonwealth budget is consistent with project-level plans. The second step considered additional projects, including key projects proposed in the Australian Infrastructure Plan and the associated Priority List (Infrastructure Australia, 2016a,b). As of June 2016, costings were available only for a small number of projects. However, this is enough to indicate a substantial funding gap that is well above $45 billion, to be split between Commonwealth and state/territory governments.

Step 1 – Comparison of Aggregate with Project-Level Projections

Aggregate projections correspond to the three scenarios discussed above. The Business-As-Usual scenario is covered in section 2.8. Scenario 1 – State/territory Compensation – is discussed in sub-section 3.2.1. Scenario 2 – Unwinding of the Mining Boom – is outlined in sub-section 3.2.2.

The project-level projections correspond to the National Partnership Agreement project compilation. This was prepared by the states, collated by the Department of Infrastructure and Regional Development, and issued during the second half of 2015. It covers the period from 2014-15 to 2019-20 and sets out total Commonwealth committed funding.

TABLE 3.1 AGGREGATE AND PROJECT-LEVEL PROJECTIONS (2014-15 TO 2019-20)

	2014–15 to 2019–20		
Aggregate Data			
Scenario:	Business-as-usual	1 – State/territory Compensation	2 – Unwinding of the Mining Boom
		$ Billion, Nominal	
Road-related Expenditure			
Commonwealth	$35	$35	$35
State/territory	$86	$89	$74
Total	**$121**	**$124**	**$110**
Road-related Revenue			
Commonwealth	$81	$81	$80
State/territory	$86	$89	$74
Total	**$166**	**$169**	**$155**
Excess Revenue over Expenditure	**$45**	**$45**	**$45**
Commonwealth-Rail Expenditure	$4.7	$4.7	$4.7
Project-Level Data, National Partnership Agreement*			
Commonwealth Funding			
Roads	$29		
Rail	$5.7		
Total	**$35**		

Note: * Department of Infrastructure and Regional Development: National Partnership Agreement, available at: http://investment.infrastructure.gov.au/funding/projects/

SOURCE: ACIL ALLEN, 2016-17 COMMONWEALTH BUDGET, DEPARTMENT OF INFRASTRUCTURE AND REGIONAL DEVELOPMENT.

Table 3.1 contains revenue and expenditure over the 2014-15 to 2019-20 period. According to the Commonwealth budget, aggregate road-related expenditure is $35 billion. Road-related state/territory expenditure ranges from $74 to $89 billion, depending on the scenario. Total road-related revenue varies from $155 to $169 billion across scenarios, and is split roughly evenly between Commonwealth and state/territory governments. Across all scenarios, there is a surplus of revenue over expenditure of $45 billion, which can be traced to the Commonwealth Government, since road-related revenue and expenditure for the state/territory governments are approximately balanced.

Project-level data from the National Partnership Agreement project compilation prepared during the second half of 2015 indicates road-related expenditure of $29 billion, which is of a similar magnitude to the latest Commonwealth budget figures ($35 billion). There is a $6 billion gap which appears to be attributable to a one-year lag between the aggregate and project-level data.

Commonwealth expenditure on rail stands at $4.7 billion, while project-level plans add up to $5.7 billion. Again, the gap can be attributed to the data lag.

Two conclusions emerge from this comparison. First, aggregate and project-level projections are approximately aligned. Second, there is an excess of road-related revenue over expenditure at the Commonwealth Government level of approximately $45 billion during the period 2014-15 to 2019-20.

Step 2 – Funding Gap for Proposed Major Projects

Step 1 concluded that Commonwealth expenditure is approximately sufficient to cover the Commonwealth share of the planned and approved individual projects. Step 2 looked at available costs for selected key projects proposed in the Australian Infrastructure Plan (2016), and in particular, the Infrastructure Australia Priority List released in May 2016 (Infrastructure Australia, 2016a,b), as well as Brisbane Metro, which is too recent to have been included in the Australian Infrastructure Plan and is expected to cost $1.54 billion.[14] **Table 3.2** presents estimates of funding gaps for 10 substantial projects in the Infrastructure Australia Priority List, which have not secured full funding as of June 2016. The unsecured funding requirement for these projects together with Brisbane Metro is in the range of $43.7 to $45.4 billion. The Infrastructure Australia Priority List contains 82 land-transport projects and initiatives, including those reported in **Table 3.2**. The Infrastructure Australia Priority List distinguishes between *initiatives*, which require further development and assessment to select the appropriate option, and *projects*, which are more advanced in the assessment process. In particular, a business case assessment by Infrastructure Australia has been completed for "*projects*". Projects are required to address a nationally significant problem and to deliver robust economic, social or environmental outcomes.

In addition to the funding identified in Step 1, there will need to be further funding allocated to cover the Infrastructure Australia Priority List projects and initiatives, as well as other proposals, such as Brisbane Metro. The unsecured funding requirement for these projects stands at $43.7 to $45.4 billion, to be shared by Commonwealth and state/territory governments. This is just part of the funding requirements for the Infrastructure Australia Priority List and other land transport proposals. Of the 82 land-transport projects and initiatives, 51 are to be completed within five years (near term), 19 are to be completed within 10 years (medium term), and 12 are to be completed within 15 years (longer term).

Infrastructure Australia is currently awaiting business cases from the states for the projects and initiatives on the Priority List. As costings become available, the magnitude of the funding gap will become clear. At this early stage, most of the information is "commercial-in-confidence." The conclusion that can be drawn at this point in time is that the shortfall will be substantially more than $43.7-$45.4 billion. Regardless of how much larger the shortfall may be, significant re-allocation of funds will be required from other government programmes or from taxpayers through additional taxes or charges. Essentially, *all* of the excess of Commonwealth road-related revenue over expenditure identified in Step 1 ($45 billion) will need to be directed to land-transport infrastructure, just to plug the small part of the gap indicated in this sub-section.

[14] Brisbane City Council, June 2016 – Brisbane Metro Subway System Communications Newsletter, available at: https://www.brisbane.qld.gov.au/sites/default/files/20160610_communications_-_tagged_newsletter_-_brisbane_metro_subway_system.pdf

TABLE 3.2 FUNDING GAP – SELECTED MAJOR PROJECTS FROM AUSTRALIAN INFRASTRUCTURE PLAN (UNSECURED FUNDING)

Projects	Comments	Estimated Funding Gap (Unsecured)	Timeframe
	$ billion, nominal		
1. Melbourne Metro [1]	Total cost (est.): $10.9	$8 to $9	0-5 years
2. Level Crossings Programme [1]	Total cost (est.): $5-6		0-5 years
3. Sydney Metro [2]		$4.8	0-5 years
4. M4 Motorway Upgrade (NSW)		$0.9	0-5 years
5. WestConnex (NSW)	Stage 3	$7.2	0-5 years
6. Brisbane Cross River Rail [3]		$5.4	0-5 years
7. M1 Pacific Motorway (Qld)	Mudgeeraba to Varsity Lakes	$0.2	0-5 years
8. Inland Rail (Vic., NSW, Qld)	P50 estimate	$9.9	10-15 years
	P90 estimate	$10.6	10-15 years
9. Adelaide north-south corridor upgrade (remaining sections)	Northern Connector Stages 1 & 2 are already funded	$5.5	0-5 years
10. Mitchell Freeway extension (WA)	Burns Beach Road to Hester Avenue (Perth CBD-north corridor)	$0.3	0-5 years
Total [*]		**$42.2 to $43.9**	

Notes: [1] The estimate of unsecured funding for Melbourne Metro and Level Crossings Programme is not separated because allocation of funding between the two projects is not clear yet. The estimation of unsecured funding is based on a Melbourne Metro cost of $10.9 billion plus Level Crossings Programme cost of $5-$6 billion, less Commonwealth contribution (Asset Recycling Fund) of $0.857 billion and Port of Melbourne privatisation proceeds of $7 billion, giving a funding gap estimate of $8 to $9 billion. [2] Sydney Metro cost of $11 billion less $6.2 billion from the 2016-17 NSW Budget forward estimates (from Rebuilding NSW, to be raised through the lease of the NSW electricity distribution network), giving a funding gap estimate of $4.8 billion. [3] Brisbane Cross River Rail cost of $5.4 billion based on June 2016 business case. [*] Total of lower and upper bound estimates, respectively, based on the lower and upper bounds for Melbourne Metro and Level Crossings Project and P50, P90 for Inland Rail.

SOURCE: ACIL ALLEN, INFRASTRUCTURE AUSTRALIA, INDIVIDUAL PROJECT DOCUMENTATION.

Asset sales are once-off events, not an ongoing source of funding for state/territory governments. Furthermore, once sold the revenue stream through dividends from the assets is lost to the state/territory governments, reducing their future funding capacity. If the Infrastructure Australia Plan is to be successfully deployed, new sources of funding will need to be found by governments collectively.

3.3 Traffic Congestion

Traffic congestion has risen inexorably in major capital cities across Australia over the past 50 years, and is now a serious problem. Congestion is projected to continue increasing strongly under current policy settings as traffic grows with population and economic activity.

The existence of significant congestion costs is a clear indicator of infrastructure shortfalls under a given pricing regime, in this case, with most roads being priced at zero. Since most roads are unpriced, congestion costs are the highest they could be in the context of existing infrastructure and demand for services, and so the extent of shortfalls that can be concluded from this data are at the highest end of the price-shortfall schedule (in the right panel of **Figure 3.1**, point C – the intercept of the shortfall schedule with the horizontal axis). Introducing road pricing would reduce congestion costs in the context of current infrastructure. However, there would still be a need for public transport and road infrastructure improvements to facilitate transport and route switching, keep prices to levels just sufficient to cover costs, and cater for growth of demand with population and economic activity.

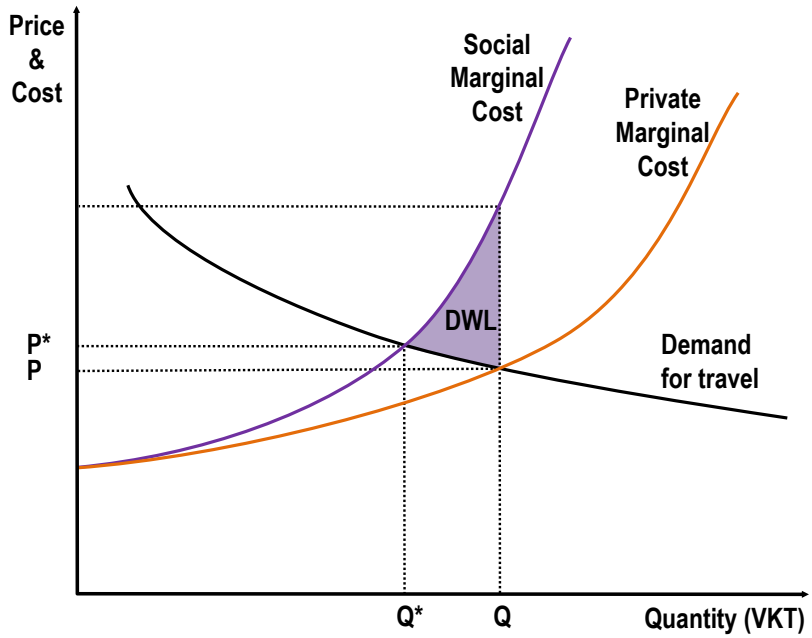
Congestion is largely confined to major cities. However, the Commonwealth Government historically has directed most of its road expenditure to nationally important roads outside major cities.

Studies by the Bureau of Infrastructure, Transport and Resource Economics (BTCE, 1996; BTRE 2007; BITRE, 2015) have provided estimates of congestion costs in Australian capital cities. Historical estimates and projections to 2030 have been compiled.

3.3.1 Theoretical Analysis of Avoidable Congestion Costs (Deadweight Losses)

The 2007 and 2015 BITRE reports estimate "avoidable" congestion costs. These are economic inefficiency costs or deadweight losses (DWL). A simplified depiction of these costs is provided in **Figure 3.6**.

FIGURE 3.6 EFFICIENT AND INEFFICIENT EQUILIBRIA IN ROAD TRAVEL



SOURCE: ACIL ALLEN

The figure shows a conventional demand and supply diagram, with price and cost indicated on the vertical axis, and amount of travel indicated on the horizontal axis. It is based on a simple, static partial equilibrium approach formulated by Alan Walters (1961). Illustrative demand for travel and private and social marginal cost curves are depicted and appropriately labelled.

The demand for travel curve shows road users' willingness to pay for each successive unit of cumulative travel (quantity), with willingness to pay decreasing with the cumulative amount of travel incurred. The private marginal cost curve captures all costs borne by individual road users, without taking into account the uncompensated costs that their individual usage imposes on other users. These external costs includes losses from congestion (increased time delay and trip time unpredictability), road damage and resulting vehicle damage, increased vehicle operating costs, and noxious emissions. Such external costs are captured in the marginal social cost curve.

Road users will travel up to the amount at which their marginal private cost equals demand, resulting in the equilibrium given by (P,Q). However, if they take into account the external cost of their travel, the equilibrium would be given by (P*,Q*), at the intersection of the demand schedule and the social marginal cost schedule, with a lower level of travel. The private equilibrium (P,Q) is inefficient since individual road users do not factor in their travel decisions the costs they impose on others, with the result that too much travel takes place relative to what is socially optimal (Q is greater than Q*) and social marginal cost exceeds marginal willingness to pay. The inefficiency costs or deadweight losses are depicted by the shaded triangle labelled DWL. They are "avoidable" congestion costs in the sense that they could be avoided by a charges on road users that raise their private marginal costs to the level of social marginal costs. The optimal charge is given by the vertical distance between the two

marginal cost curves at amount of travel Q*, and its effect would be to make the private price-quantity equilibrium coincide with the social equilibrium (P*,Q*).

3.3.2 Historical and Projected Avoidable Congestion Costs

BITRE's (2015) estimated congestion costs are presented in **Figure 3.7** and **Figure 3.8**. The latter figure is a simplified version of the former. Historical data and projections under various scenarios are displayed. BITRE's scenarios are based on a "business as usual" policy framework, which excludes road and public transport pricing reforms. The top panels show costs measured in real 2013-14 $ billion. The bottom panels show the data as percentages of GDP. **Figure 3.7** and **Figure 3.8** also show road-related public expenditure (for *all* levels of government) and associated projections under Scenario 1, "State/territory Compensation", and Scenario 2, "Unwinding the Mining Boom." Further supporting information is shown in **Table 3.3**.

Congestion costs have risen between 1989-90 and 2014-15 at a compound annual growth rate of 4.9 per cent, essentially tripling over this historical period from $5.5 billion to $18.2 billion (real 2013-14$). Measured as per cent of GDP, congestion costs have also tripled, rising from 0.39 to 1.14 per cent of GDP between 1989-90 and 2014-15 (a compound annual growth rate of 4.4 per cent).

Comparing avoidable congestion costs (deadweight losses) with public road-related expenditure in **Figure 3.7** and **Figure 3.8** reveals that avoidable congestion costs losses have grown to a point where they are of a similar magnitude to public road-related expenditure at *all* levels of government in all areas (not just congested areas) that represents approximately 1.6 per cent of GDP over the 2011-12 to 2017-18 period.

Of course, road expenditure occurs across the nation, not just in congested areas. Public transport subsidies have been a key anti-congestion policy instrument for state governments. Funding of public transport deficits in capital cities by state/territory governments is equivalent to 52.9 per cent of state/territory government expenditure on roads in all areas, and 27.8 per cent of expenditure on roads across the nation by all levels of government (see **Table 2.1** and **Table 2.2**). In other words, land transport funding is 52.9 per cent and 27.8 per cent higher than road funding provided everywhere by state/territory and the three levels of government, respectively.

The comparison of avoidable congestion costs with government outlays on roads and public transport deficits is important for three reasons. These are outlined briefly below.

First, it shows that the combination of the magnitude and allocation of land transport road spending by governments in Australia, and the growth of that spending over the past 12 years have been ineffective in dealing with growing deadweight losses from congestion.

Second, it illustrates the folly of anti-congestion policies based largely on supply-side policy instruments with very limited pricing. Supply-side strategies comprise government subsidies that cover most of the capital and operating costs of public transport services, full funding of some arterial roads, and partial funding of toll roads. Pricing is limited to flat tolls on some arterial roads, with zero pricing on the rest of the network, and substantial under-pricing of public transport services to change relative prices of road use and public transport patronage.

Third, a "business as usual" approach to funding and pricing will perpetuate the worsening congestion that has been experienced under that approach in the past. To alleviate congestion, a change in approach will be required that combines network-wide, variable road and public transport pricing with road and public transport improvements.

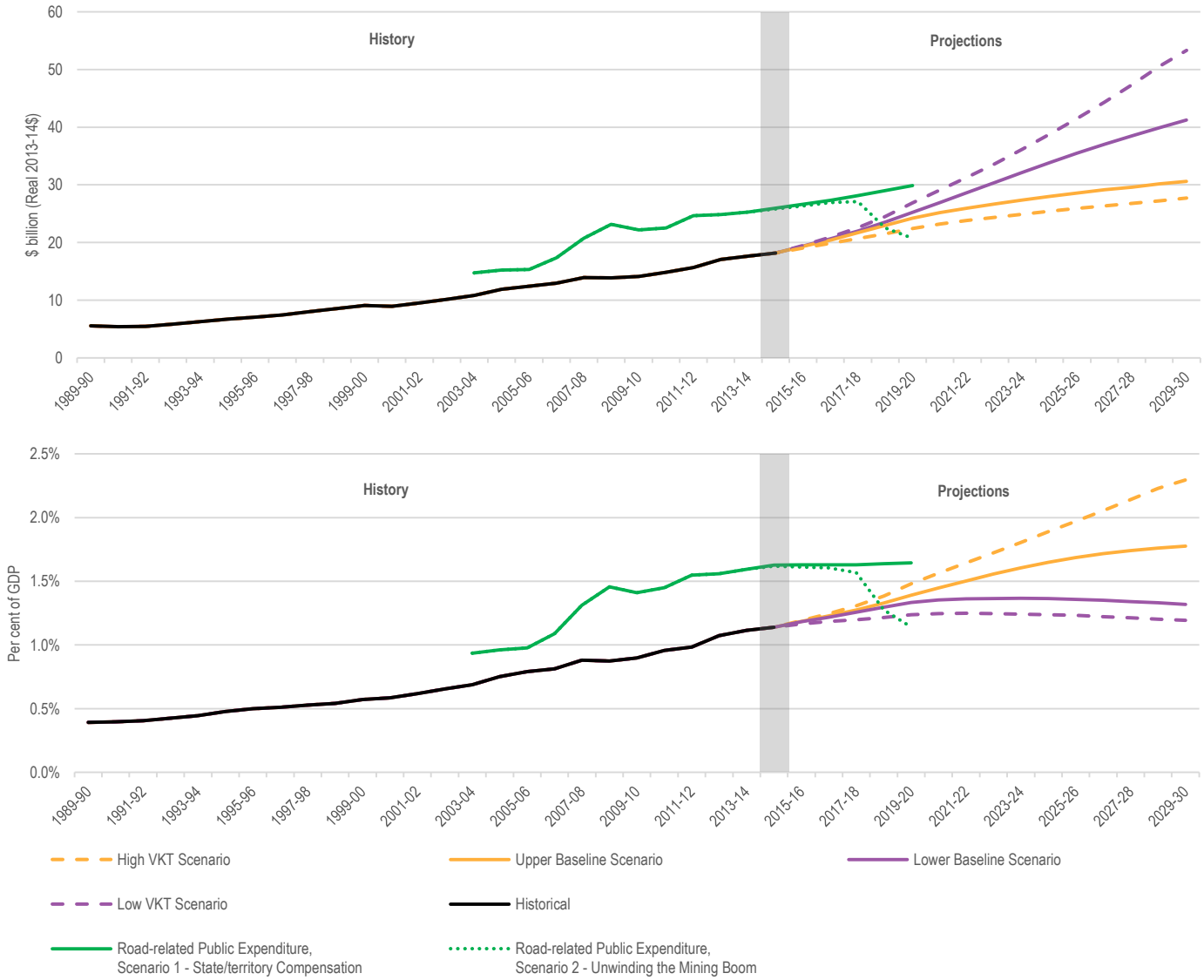
The effectiveness and efficiency of existing strategies is undermined by the induced traffic phenomenon.[15] While deadweight losses might decline to some extent, they would not be eliminated. Existing strategies add to, or free-up unpriced capacity on a city's arterial road network. This attracts more traffic because of lower travel costs in the form of shorter and more predictable trip times, lower schedule delay costs, and lower fuel and maintenance costs. The additional traffic dissipates a substantial part of the benefits of additional road and public transport capacity, in the context of

[15] For estimates of the magnitude of the induced traffic effect, see footnote 52 in sub-section 6.1.1.

congestion and fairly close substitutes for peak road use in the form of alternative travel times and transport modes.[16]

In contrast, the benefits of new road and public transport capacity are not dissipated if roads and public transport are priced to ensure that users bear the marginal social costs of use. In these circumstances, extra demand is not induced.[17] Pricing inserts a wedge between private marginal cost and marginal social cost that requires road users to confront the latter, rather than the former when making decisions regarding when, where and how they travel.

FIGURE 3.7 AVOIDABLE CONGESTION COSTS (DEADWEIGHT LOSSES) AND ROAD-RELATED PUBLIC EXPENDITURE



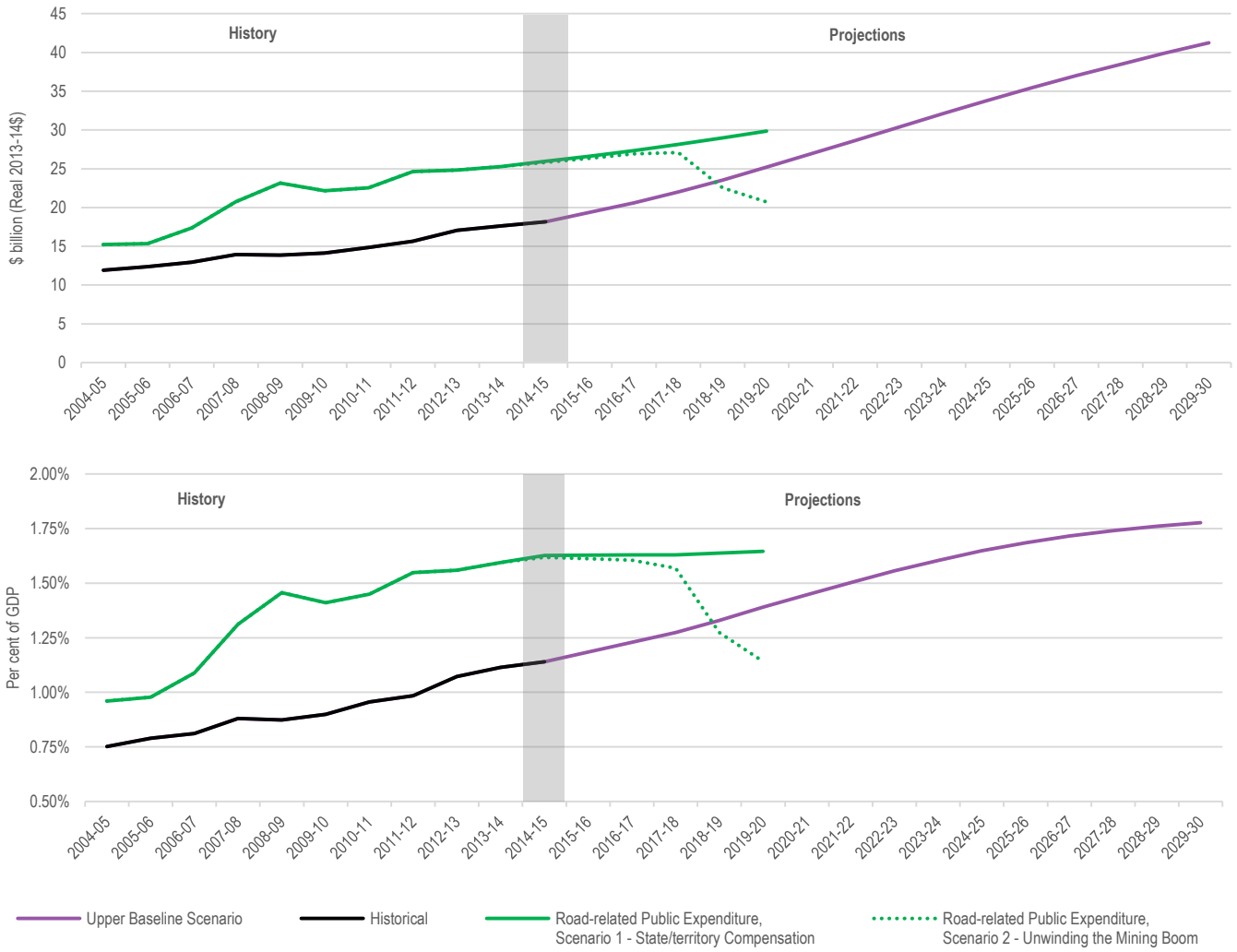
Notes: **(1)** Costs refer to annual avoidable congestion costs (deadweight losses) associated with the relevant capital city's levels of excess trip delay, trip variability, vehicle operating expenses and motor vehicle emissions due to congestion. **(2)** When measuring congestion costs as per cent of GDP (bottom panel), it is important to avoid interpreting these as costs which could be *translated into* increased GDP. Even if they could be eliminated altogether, not all congestion costs could be transformed into GDP gains. In particular, a proportion of road users' private time savings is likely to become leisure, which would not be reflected in GDP measurement (although it would increase wellbeing).

SOURCE: ACIL ALLEN, BITRE (2015).

[16] In the case of expansion of unpriced road capacity expansion, the marginal private and social cost curves in **Figure 3.6** shift to the right and there is movement along the fairly flat or price-elastic demand curve, down and to the right. In the case of extra public transport capacity that is greatly under-priced, the flat demand curve shifts to the left, initially reducing road use significantly. The initial reduction in congestion means lower marginal private costs of road use, attracting traffic back to the road network, depicted in **Figure 3.6** by movements along the lower demand curve, down and to the right, and along the marginal private cost curve, up and to the right.

[17] The demand curve and the cost curves in Figure 3.6 are not shifted by the policy action in this case.

FIGURE 3.8 AVOIDABLE CONGESTION COSTS (DEADWEIGHT LOSSES) AND ROAD-RELATED PUBLIC EXPENDITURE



SOURCE: ACIL ALLEN, BITRE (2015).

Turning now to projections, **Figure 3.7**, **Figure 3.8** and **Table 3.3** show a number of scenarios, namely High VKT, Low VKT, Upper Baseline and Lower Baseline. The scenarios were designed by BITRE (2015). As discussed, all of these scenarios assume a "business as usual" policy framework that does not include transport market reform.

Projections Measured in Real Dollars

In the projection period, avoidable congestion costs in real 2013-14$ (top panels in **Table 3.3**, **Figure 3.7** and **Figure 3.8**) grow at compound annual rates ranging from 7.4 to 2.9 per cent (High VKT to Low VKT scenarios). The ratio of avoidable congestion costs in 2029-30 relative to their 2014-15 value ranges from 2.9 to 1.5 times.

Projections Measured as Percentages of GDP

Avoidable congestion costs expressed as percentages of GDP are shown in the bottom panels of **Table 3.3**, **Figure 3.7** and **Figure 3.8**. By 2029-30, avoidable congestion costs grow to levels ranging from 2.3 to 1.19 per cent of GDP (High VKT to Low VKT scenarios). The ratio of avoidable congestion costs in 2029-30 relative to the 2014-15 value ranges from 2 to 1.05 times.

TABLE 3.3 AVOIDABLE CONGESTION COSTS (DEADWEIGHT LOSSES), VARIOUS SCENARIOS

	Historical	High VKT Scenario	Upper Baseline Scenario	Lower Baseline Scenario	Low VKT Scenario
	1989-90 to 2014-15	2014-15 to 2029-30			
	$ billion (Real 2013-14 $)				
1989-90	5.5				
2014-15	18.2				
2029-30		53.3	41.3	30.6	27.7
Congestion cost growth	1989-90 to 2014-15	2014-15 to 2029-30			
Compound annual growth Rate	4.9%	7.4%	5.6%	3.5%	2.9%
Cumulative growth	229%	193%	127%	68%	52%
Ratio	3.3	2.9	2.3	1.7	1.5
	Percentage of GDP				
1989-90	0.39%				
2014-15	1.14%				
2029-30		2.30%	1.78%	1.32%	1.19%
Congestion cost growth	1989-90 to 2014-15	2014-15 to 2029-30			
Compound annual growth rate	4.4%	4.8%	3.0%	1.0%	0.3%
Cumulative growth	191%	101%	56%	16%	5%
Ratio	2.9	2.0	1.6	1.2	1.05

SOURCE: ACIL ALLEN, BITRE (2015).

3.4 Safety Aspects

Shortfalls, deficiencies or gaps in the land transport network can be considered from the perspective of the safety performance of the network. The Australian Road Assessment Program (AusRAP) for National Highways has provided star and risk ratings.

TABLE 3.4 AusRAP STAR RATING RESULTS, BY STATE/TERRITORY

Jurisdiction	Total Length (km)	1-Star	2-Star	3-Star	4-Star	5-Star
New South Wales	4,722	9%	42%	46%	2%	0%
ACT	17	0%	18%	60%	21%	0%
Victoria	2,363	1%	22%	62%	13%	2%
Queensland	5,109	1%	29%	63%	6%	0%
Western Australia	4,671	5%	22%	57%	16%	0%
South Australia	2,041	14%	23%	59%	4%	0%
Tasmania	367	20%	46%	32%	2%	0%
Northern Territory	2,632	29%	32%	34%	5%	0%
Total	**21,922**	**9%**	**30%**	**53%**	**8%**	**0%**

SOURCE: AAA (2013), ACIL ALLEN.

Star ratings range from 1 to 5 stars for the various segments of the national highway network, with the safest roads attracting a 5-Star rating, and the least safe a 1-Star rating. A 4-Star rating is viewed as the acceptable level of safety rating consistent with AusRAP aims. More specifically, AusRAP "aligns

closely with Sweden's Vision Zero…roads and vehicles that have forgiving designs so that when a crash does happen, both road and vehicle work together to mitigate against injury." (Metcalfe and Smith, 2005).

Table 3.4 presents star rating results from the latest AusRAP report (AAA, 2013). Only 8 per cent of national highways achieved a 4-Star rating. All states/territories except Victoria, had 0 per cent of national highways with a 5-Star rating. In Victoria, only 2 per cent of the National Highway Network achieved a 5-Star rating. At the national level, 53 per cent of the national highway network achieved a 3-star rating. The remaining 39 per cent achieved worse than a 2-Star rating.

Risk rating assessments by AusRAP are based on "casualty crashes". A casualty crash is defined as a road crash in which at least one person is killed or injured. This metric was used as there is a lack of consistency across jurisdictions in how the severity of non-fatal crashes is reported. There is, however, consistency in the definition of a fatality between states and territories – death taking place within 30 days of the crash. Crash and traffic volume data used in risk reports were sourced from the road authority in each state and territory.

Risk ratings are calculated by means of *collective* and *individual* measures, which are used to quantify risk throughout the road network. *Collective risk* is calculated as the number of annual casualty crashes divided by the length of highway. It represents the density of casualty crashes over a given length of road. *Individual risk* is calculated as the number of annual casualty crashes divided by the distance travelled on each section of highway, per year. This metric represents the casualty crash rates per vehicle-kilometre travelled, which is the risk faced by an individual driver.

Table 3.5 shows results from the 2011 AusRAP study (AAA, 2011) which calculated risk metrics for the national highway network across Australia. The assessment covered more than 20,000 km of highways that represented three per cent of the total road network in Australia. These highways carried over 15 per cent of the nation's road traffic and experienced 1,170 road crash deaths, or 15 per cent of all road deaths in Australia during the period 2005-2009. To facilitate exposition, **Table 3.5** also shows the colour coding for each risk rating that is used in the maps presented in **Figure 3.9**.

TABLE 3.5 NATIONAL HIGHWAY NETWORK WITH VARIOUS RISK RATINGS, 2005-2009

Risk rating	Collective Risk	Individual Risk
	Average annual casualty crashes per km	Average annual casualty crashes per 100 m v-k
Low (green)	46%	23%
Low-medium (yellow)	21%	19%
Medium (orange)	9%	27%
Medium-high (red)	11%	15%
High (black)	14%	17%

SOURCE: AAA (2011) "AusRAP: How Safe Are Our Roads? Rating Australia's National Network for Risk, Benchmarking the Performance of Australia's Roads in the Decade of Action." Available at: http://www.aaa.asn.au/files/view/?id=328.

As reported in **Table 3.5**, AusRAP risk assessments classified around one sixth of national highways as high risk: 14 and 17 per cent, for collective and individual risk metrics, respectively. More than one-third of highways were assessed as medium collective risk or worse, and 59 per cent were assessed to be medium individual risk or worse. Low risk highways stood at 46 and 23 per cent for the collective and individual risk metrics, respectively.

The actual distribution of collective and individual risk ratings across the national highway network is shown in **Figure 3.9**. The colour coding is identified in **Table 3.5**. The locational differences between collective and individual risk ratings are striking. Collective risk ratings highlight the main corridor between Cairns and Melbourne as the highest risk section, with some sections around Perth and Cairns also being medium-high to high risk. From an individual risk perspective, the riskiest sections are more sparsely distributed, with most of the risk being located north of Brisbane in Queensland, the Coober Pedy to Alice Springs section, Darwin to Fitzroy Crossing, and specific sections around Sydney and Canberra.

FIGURE 3.9 RISK RATINGS – AVERAGE ANNUAL CASUALTY CRASHES PER KM, 2005-09

COLLECTIVE RISK RATINGS

INDIVIDUAL RISK RATINGS

Risk rating, colour code
Low
Low-medium
Medium
Medium-high
High

SOURCE: AusRAP (2011) "How Safe Are Our Roads? Rating Australia's National Network for Risk, Benchmarking the Performance of Australia's Roads in the Decade of Action." Available at: http://www.aaa.asn.au/files/view/?id=328.

In conclusion, from the perspective of safety, much remains to be done to address road network gaps or deficiencies, reinforcing the shortfall message that arises from the other two perspectives, namely, revenue and expenditure deficiencies and traffic congestion.

3.5 Extent of Hypothecation

From the preceding analysis, it is clear that there is a substantial gap in funding land transport (section 3.2) and that the approach taken in the past has not delivered reductions in congestion costs (section 3.3). The magnitude of the funding gap (well over $45 billion) is such that *all* road-related revenue across Commonwealth and state/territory governments will be required to fund what is but a small subset within the projects proposed in the Infrastructure Australia Priority List and other sources. As business cases for projects become available, the funding gap will grow.

Table 3.6 presents Commonwealth road-related revenue and expenditure from 2014-15 to 2019-20, as percentages of GDP. Fuel taxation revenue is included in road-related revenue, but is also shown separately. The ratios of Commonwealth road-related expenditure to Commonwealth road-related revenue and fuel taxation revenue are shown in columns (4) and (5), respectively. This reveals that Commonwealth road-related expenditure in 2014-15 was a third of Commonwealth road-related revenue, and 42 per cent of fuel taxation revenue. In 2015-16, Commonwealth road-related expenditure was 43 per cent of Commonwealth road-related revenue, and 55 per cent of fuel taxation revenue. In 2016-17 and 2017-18, these figures are projected to rise to 61 and 77 per cent, respectively, for both years, dropping down to 26 per cent and one-third, respectively by 2019-20.

TABLE 3.6 COMMONWEALTH ROAD-RELATED EXPENDITURE VS. REVENUE

	(1) Commonwealth Road-related Expenditure	(2) Commonwealth Road-related Revenue	(3) Fuel Tax	(4) = (1) ÷ (2) Commonwealth Expenditure / Revenue	(5) = (1) ÷ (3) Commonwealth Expenditure / Fuel Tax
	Per cent of GDP				
2014–15	0.28%	0.82%	0.65%	33%	42%
2015–16	0.35%	0.80%	0.63%	43%	55%
2016–17	0.48%	0.79%	0.63%	61%	77%
2017–18	0.47%	0.77%	0.62%	61%	77%
2018–19	0.28%	0.78%	0.62%	36%	45%
2019–20	0.21%	0.79%	0.63%	26%	33%

SOURCE: ACIL ALLEN, 2016-17 COMMONWEALTH BUDGET, DEPARTMENT OF INFRASTRUCTURE AND REGIONAL DEVELOPMENT.

In the light of the funding gap discussed in sections 3.2, 3.3 and 3.4, the Australian Infrastructure Plan and Priority List (Infrastructure Australia, 2016 a,b), and the prospect of additional projects not yet included in the Infrastructure Australia Priority List (such as Brisbane Metro), Commonwealth allocations to road-related expenditure will need to rise to *at least the full amount* of Commonwealth road-related revenue. In fact, over the next five years, this will barely be enough to supply the unsecured funding for projects selected from Infrastructure Australia's Priority List and shown in **Table 3.2**. Inclusion of Brisbane Metro would widen the funding gap.

The AAA has a long standing policy position that a guaranteed minimum of 50 per cent of fuel taxation revenue should be hypothecated to a fund for road-related expenditure. In light of the findings in this chapter, ACIL Allen considers that AAA's position is very conservative, having regard to the pressing funding requirements for land transport infrastructure.

The economic case for hypothecation of road-related revenue to funds dedicated to road construction and maintenance is set out in chapter 5.

4 ECONOMIC CONTRIBUTION: LAND TRANSPORT INFRASTRUCTURE

The economic contribution of land-transport infrastructure hinges on the productivity effects of the investments under consideration (supply-side effects), the demand management scheme that will be in place once those investments become operational (efficiency of demand management) and the opportunity cost (value in best alternative use) of the resources committed to the investments.

Some economic effects, such as effects on employment during construction are transitory. The construction phase draws resources (labour and capital) away from alternative uses, negating contributions to economic activity from those other applications of the resources.

On the other hand, completed land-transport infrastructure investments that are targeted towards relieving acute bottlenecks in the network and operate under an efficient demand management scheme, can make important long-term economic contributions. The idea that relieving bottlenecks across the economy can unshackle economic activity is a central aspect of the theory of unbalanced growth, developed by Albert Hirschman (1958). This view of economic development states that investment programmes can complement or correct existing imbalances or bottlenecks. This applies not just to land transport, but more generally to any sector or aspect of the economy. Once an investment is made, a new imbalance or bottleneck is likely to become binding, requiring further compensating investments. Consequently, growth need not proceed in a balanced manner.

The underlying economic driver in an unbalanced growth path is the fact that relief of bottlenecks implicitly entails high social rates of return to investments targeting them. Such investments will be characterised by high benefit to cost ratios, and a strong economic contribution. For this reason, analysis of economic contributions of land-transport infrastructure requires a project-by-project approach in a network context, since it is the accumulation of the individual benefit and cost impacts of the projects that determines their economic contribution.

Existing studies have focussed on macroeconomic correlations (econometrics) or economy-wide modelling relying on broad assumptions. Often, little consideration has been given to individual projects in a network context or the operational efficiency implications of their demand management schemes.

For example, the *induced traffic effect* is typically not taken into account. The *induced traffic effect* refers to better infrastructure attracting more traffic, to an extent negating the initial benefits from the improvements. Estimates of the elasticity of vehicle kilometres travelled (VKT) to lane-kilometres of road infrastructure in unpriced road networks range from 0.16 (Hymel, Small, Van Dender, 2010) to 1.03 (Duranton, Turner, 2009, 2011) to 1.34 (Hsu, Zhang, 2014). These elasticities mean that a 10 per cent increase in road infrastructure (capacity) would result in a 1.6, 10.3 and 13.4 per cent increase in VKT, respectively. In the last two instances, the increase in VKT overwhelms the increase in infrastructure, resulting in a counterproductive loss of efficiency (refer to footnote 52 in chapter 6 for further details about the magnitude of the induced traffic effect). So, the economic contribution of investment in land transport infrastructure targeting bottlenecks will be dampened by induced traffic.

The extent of the latter will depend on the efficiency of the demand management scheme that is implemented.

There are various methods to assess the economic contribution of land transport infrastructure, including the following:

— econometric approaches
— economy-wide modelling
— analysis of external effects and economic growth.

This chapter considers existing analyses and evidence in respect of these approaches, and discusses their implications for Australia.

4.1 Public Expenditures: The Crowding-Out versus Crowding-In Debate

The view that government investment would crowd out private investment has been reviewed since the mid-1980's. The discussion on 'crowding out' is based on the notion that public expenditures are funded either through taxation or public debt. Since public debt must eventually be repaid, at some future point taxes will need to be raised. David Ricardo (1888) stated that the private sector would anticipate this and increase savings in order to offset the future taxes that would be required to fund the current public expenditure, and so public expenditure would crowd out private expenditure. The effect on aggregate demand would then be neutralised by forward-looking consumers. This is the 'Ricardian Equivalence' theorem, stated in modern terms by Barro (1974).

Subsequently, empirical testing showed that while 'Ricardian Equivalence' is theoretically possible, evidence for or against it is mixed. Further research found evidence that the composition of public expenditure is important. Barro (1989) found evidence that economic growth is negatively related to government consumption and positively related to public investment in infrastructure. Subsequent studies[18] also found that public investment in infrastructure (and more specifically to this assignment, land transport infrastructure) is positively related to economic growth. The principal rationalisation is complementarity between public and private capital. If public and private capital are complements in production, increases in public capital will increase the marginal product of private capital, leading to increases in private capital and economic growth.

As is common in empirical macroeconomic studies, the literature finds mixed results. However, there is consensus that government consumption is unlikely to increase economic growth, but that public investment in infrastructure has positive growth effects. 'Economic contribution' is often measured by growth in GDP ('economic growth'), however, this is a strict definition. A wider definition of 'economic contribution' includes economic growth as measured by GDP as well as other aspects that extend beyond GDP, such as environmental and social contributions. Examples include 'Green GDP' which accounts for environmental aspects and the Genuine Progress Indicator, GPI, which is designed to take better account of economic wellbeing by incorporating environmental and social factors not measured by GDP. Under the strict definition, the economic contribution of public investment in infrastructure hinges upon the value added by the individual projects, and to the extent that the benefit-cost ratio (BCR) of the chosen projects captures this, then choice of projects with a high BCR will be associated with a strong economic contribution. The exception would be cases where individual projects have a high BCR due to, for example, environmental benefits or other social benefits not reflected in GDP, in which case the benefits of the project will not show up as (strictly measured) economic growth, that is, growth in GDP. Such benefits would, of course, be reflected as contributions to wider measures of economic wellbeing. At present, Australia is some way away from a full implementation of the wider measures of economic wellbeing, so this study will focus on the strict definition of economic contribution, namely, contribution to GDP.

[18] Pereira and Andraz (2013) present a review of the literature. Initial studies include Aschauer (1989, 1990). Otto and Voss (1994) present results for Australia.

4.2 Econometric Approaches

A number of studies have estimated the impact of public infrastructure on GDP or productivity growth, using a variety of econometric methodologies, discussed below.

4.2.1 Growth Regressions

Econometric studies across multiple countries have estimated the elasticity of value added (GDP) or productivity to public investment in infrastructure. The focus of these studies has been on estimating the elasticity of output (valued added, measured by GDP) with respect to public investment in infrastructure. The elasticity represents the coefficient linking percentage change in output to a given percentage change in public infrastructure capital. For example, an elasticity of 0.2 means that an increase of 10 per cent in public infrastructure capital, will induce a two per cent increase in value added (that is, a once-off addition of two percentage points of economic growth). If the increase in public infrastructure capital occurs regularly every year (10 per cent annual growth in infrastructure), then the effect on value added will also occur annually (two percentage points of additional economic growth).

Initial studies by Aschauer (1989, 1990) obtained elasticity values between 0.4 and 0.6 for public infrastructure, and between 0.3 and 0.4 for motorways. Given that these estimates are based on econometrics using macroeconomic data, there are data limitations, which may lead to somewhat imprecise estimates. In particular, estimation of capital stocks (public capital, in particular) is notoriously difficult. Moreover, the studies use different datasets. For this reason, the difference between the estimates for public infrastructure and land transport infrastructure is not seen as substantially different.

The above elasticities for public infrastructure were considered very high and subsequent econometric refinements led to lower estimates lying between 0.1 and 0.4 (Pereira and Andraz, 2013). This range of elasticities can be interpreted as follows. A one per cent increase in the stock public infrastructure results in a once-off increase in economic activity (GDP) lying between 0.1 and 0.4 percentage points. This is in addition to the underlying rate of economic growth, which, for Australia, tends to be between 1 and 3 per cent annual.

4.2.2 Growth Accounting

The second type of study uses a 'growth accounting' methodology. This consists of allocating economic growth across production inputs – labour, and various types of capital, including land transport infrastructure. This approach accounts for a proportion of economic growth which is assigned to modelled production inputs. There is also a fraction of growth (a residual) which is ascribed to inputs of production that have not been accounted for, labelled the 'Solow residual' after Robert Solow's (1957) seminal contribution to economic growth. Quinet and Vickerman (2004) reviewed research that found that during the second half of the 20th century, approximately half of German economic growth could be attributed to transport, which included improvements to roads and road transport.

4.3 Economy-wide Modelling

Economy-wide modelling has been used to elucidate the economic contribution of public land transport infrastructure since the 1960's. Economic contribution can be measured on the basis of the direct and indirect impacts of the infrastructure. Quinet and Vickerman (2004) reviewed international evidence and found positive impacts on GDP.

Economy-wide direct and indirect effects are quantified using economy-wide Computable General Equilibrium (CGE) models, or the simpler Input-Output (I-O) models. The fundamental difference between these is that CGE models account for adjustments to relative prices, and the associated changes to quantities supplied and demanded, across all sectors of the economy, whereas I-O models assume that the structure of agents' purchases is insensitive to prices. Both types of models generate flow-on effects arising from shocks to a base case. The flow-ons arising from CGE analysis

are typically smaller, relative to those arising from I-O analysis, since the price effects and the associated demand and supply responses will dampen the impacts throughout the economy.

4.3.1 Direct Impact Assessments

During the 1980's and 1990's, the view on public investment in infrastructure evolved from one where public investment was previously seen as crowding-out private investment, to a view that public investment in infrastructure could have a positive impact on economic growth.

In the direct impact assessment approach, the positive impact on growth arises from construction activity, particularly during periods of recession or slow economic growth, characterised by slack labour and capital markets. Quinet and Vickerman (2004) reviewed evidence that showed a small, but positive impact on GDP. The argument is in favour of countercyclical fiscal policy, which states that during recessionary periods there are benefits to be gained by means of expansionary fiscal policy. The emphasis of the countercyclical fiscal policy would be on public construction of infrastructure, funded through public debt. This would draw underutilised labour into production, triggering multiplier effects.

The extent to which this results in increases in value added hinges on good project selection, prioritising those with the highest potential for creation of value added. Otherwise the approach is subject to the risk that public funds will be spent in a wasteful manner, sacrificing benefits of alternative uses of resources, and offsetting any beneficial economic effects.

There is a rationale for making the timing of public investment in infrastructure contrary to the business cycle ('counter cyclical'), since this would tend to minimise construction costs and thereby maximise creation of value added. Public investment programs can achieve greatest value added during periods of high unemployment (counter-cyclical policy), since this would draw on inputs (labour and capital) which are currently unemployed or underemployed, without bidding up prices in labour and capital markets). The opposite is true during periods of low unemployment, when inputs would be closer to full utilisation and increasing input demand through public investment programs is likely to bid input prices up, thereby reducing the creation of value added associated with the projects.

4.3.2 Indirect Impact Assessments

Time savings arising from shorter travel times due to improved infrastructure increase value added and employment. In Europe, these were associated with increases in GDP and employment of 0.25 per cent and 0.11 per cent, per year, over a 25 year period. CGE studies have found that land transport infrastructure resulting in reductions of transport costs can account for a significant proportion of economic growth.

The economic contribution materialises through a variety of channels. These can be classified into activity and efficiency affects. Activity effects include the direct effects, as discussed in section 4.3.1, and indirect effects including population movements (for example, migration to the targeted area). Efficiency effects relate to improvements in productivity in economic activity resulting from the new infrastructure. In the case of roads, this relates to time, fuel, vehicle wear and tear, and road savings, plus improvements in trip reliability. More generally, efficiency effects refer to cost reductions for those using and funding the infrastructure, and for related sectors. On the other hand, road transport is subject to the induced traffic effect, which is the tendency for improvements to roads to attract more traffic, dampening the initial benefits.

Historical studies have generally found that road infrastructure makes a significant economic contribution. A study of Japan from 1875 to 1940 (Morisugi and Hayashiyama, 1997) revealed that the contribution of the rail network to GDP growth rose from 0.5 per cent in 1875 to 12.3 per cent in 1940. Robert Fogel (1964) conducted a U.S. study on the economic contribution of railways, which sought to quantify the railroads' contribution to U.S. economic growth in the 19th century. His findings overturned the commonly held conception that the development of railways was a major driver of U.S. economic growth. Fogel estimated that in the absence of railways, U.S. GDP would have hardly changed. Using a variety of counterfactual assumptions, Fogel estimated that U.S. GDP could have been between 1.5 and 1.8 per cent lower. Fogel quantified the "no railways" counterfactual scenario using econometrics and assumptions on the U.S. economy. The counterfactual scenario focussed on road and water transportation (a network of roads and canals which hypothetically grew over time).

The logic behind the counterfactual was that in the absence of railways, production would have found next-best ways to reach markets and that such adaptation would have enabled economic development that was only marginally less than that observed *with* railways. Given particular inefficiencies associated with water transportation in the U.S., such as canals in the North freezing during winter (Taylor, 1965), Fogel's results highlight the significance of the economic contribution of road transportation.

While Fogel's study is unlikely to be relevant today, the key point that in the absence of one transport medium, other means will tend to fill the void remains valid. The economy will adapt to achieve the next-best efficient configuration, which may actually be *more* efficient than the 'baseline' configuration. In the case of roads versus rail, recent evidence (Productivity Commission, 2006, Figure F.4 in Appendix F) shows that door-to-door costs are fairly similar, lending support to the argument that the economy would adapt to make the best use of available infrastructure.

Quinet and Vickerman (2004) also found that the change in GDP is closely approximated by the profitability of the project. This is to be expected, since GDP is a measure of value added, comprised of Gross Operating Surplus (returns to capital) and Compensation of Employees (returns to labour). This result highlights the point that projects with a high benefit-cost ratio will make a greater economic contribution. The fundamental driver behind a project's economic contribution is its benefit-cost ratio. There is nothing intrinsic about specific sectors or types of infrastructure which would lead our thinking away from the fact that what truly matters is the economic performance of individual projects. Of course, this implies that benefit-cost ratios need to be calculated appropriately, accounting not only for internal (private) impacts, but also for external (social) impacts. As discussed above, not all components of benefit-cost ratios are captured by GDP. In particular, environmental considerations may have a large effect on the benefit-cost ratio of a project, but in general this will be missed by GDP.

As Fogel's work highlighted, impact analysis (direct and indirect) centres on comparison of a *proposed* scenario versus a base case (the counterfactual). The key point arising from impact studies is the importance of deciding on a counterfactual that captures the opportunity cost of the *proposed* scenario. The opportunity cost is the *best alternative* use of economic resources, as opposed to a 'doing-nothing' base case. For this reason, well-developed impact analysis will often conclude that the proposed scenario's incremental effect is rather small, if not negligible or negative.

4.4 Wider Economic Impacts and External Benefits

There is debate on where to draw the boundary regarding which benefits to include in benefit-cost analysis. The conventional approach to benefit-cost analysis (BCA) of land transport projects considers benefits such as fuel cost and travel time savings, along with changes in external effects, including environmental damage and road safety. In the recent past (Department for Transport, 2005), wider economic impacts (WEI) have been proposed for inclusion in CBA. These encompass agglomeration effects, increased competition effects, increased tax collection due to economic growth resulting from the project(s), and more generally, beneficial external effects arising from land transport infrastructure.

On the one hand, Dobes and Leung (2015) argued against inclusion of wider economic impacts in BCA, on the basis that empirical estimates of such impacts tend to overstate benefits and would lead to implementation of projects that would otherwise not pass a conventional BCA test.

On the other hand, Quinet and Vickerman (2004) took the view that land transport infrastructure has public good[19] attributes, to a degree. This means that rather than acting as a standard economic input into the production process, it could influence production in a somewhat non-rival and non-excludable manner. That land transport infrastructure can be, to some degree, non-rival in consumption is seen by noting that, in the absence of congestion, an individual's use of the infrastructure does not hinder others' use of it. Non-excludability does not apply to public transport and toll roads, and in principle, it need not apply to roads. However, when roads feature free-access and are unpriced (the current situation for most roads), users are not excluded. It is clear that in the instance of land transport

[19] A pure public good is a good that is non-excludable and non-rivalrous. In this case individuals cannot be excluded from use and use by one individual does not reduce availability to others.

infrastructure we are not talking about *pure* public goods, the use of which is completely non-rivalrous and non-excludable. However, unpriced land transport infrastructure in the absence of congestion does become non-rivalrous and non-excludable. Clearly, non-rivalry is not the case once congestion, road damage and crashes are taken into account, and once pricing is introduced then non-excludability ceases to apply. For these reasons we say that land transport infrastructure has public good attributes *to a degree*.

The consequence of this is that land transport infrastructure may introduce increasing returns to scale in economic production, in ways similar to scientific knowledge in endogenous growth theory (Aghion and Howitt, 1998). In effect, land transport infrastructure provides dual roles in economic production. Firstly, it enters production as a regular production input, and is subject to standard diminishing marginal returns and substitutability laws. Secondly, it enters production as a public good, introducing increasing returns to scale. The first effect is typically captured by conventional *ex-ante* studies (including CBA). The second effect can be revealed through *ex-post* studies, since its nature makes it difficult to estimate *ex-ante*. The gap between *ex-ante* and *ex-post* estimates is then ascribed to the external benefits of land transport infrastructure.

In particular, elasticity estimates of output with respect to public capital typically lie in the range of 0.05 to 0.3. Quinet and Vickerman (2004) reported that *ex-post* analysis essentially doubles these estimates to a range between 0.1 and 0.6, highlighting the potential strength of external benefits.

On balance, it seems that external benefits cannot be discarded. On the other hand, proposing inclusion of unreliable estimates of wider economic impacts in BCA is likely to generate upwardly biased benefit-cost ratios. Therefore, careful estimation is required.

4.5 Recent Australian Studies

Recent literature on land-transport policy has concluded that issues of infrastructure provision cannot sensibly be separated from issues of access pricing, funding and institutional reform. Most recent attempts to quantify the impact on the Australian economy of extensions to land-transport infrastructure have accepted this conclusion.

Typically, the quantitative studies include consideration of *activity* effects and *productivity* effects. Activity effects include economic impacts associated with increased demand for inputs during the construction phase of infrastructure projects. These activity effects are relevant during the construction phase and are, at best, transient. Unless drawn from a pool of unemployed resources, inputs used during the construction phase are diverted away from other uses, and the opportunity cost of these resources must be accounted for. In general, the economic impact during the construction phase tends to be dampened by the fact that other sectors will be curtailing activity in order to accommodate the expansion in land transport infrastructure.

Some analysts (e.g., Deloitte Access Economics, 2015) assume that improvements in road infrastructure will induce substantial additional immigration. There is some econometric literature estimating the size of such induced migration effects for US cities. This gives rise to long-term activity effects, with additional GDP growth supported by the additional labour attracted to the investing region. There are, however, problems with the interpretation of economic-impact results generated under this approach. Firstly, although the induced migration increases the region's aggregate GDP regional income, it has little effect on its *per-capita* income. Hence, it is not clear that the induced growth is to the advantage of the region's base population. Improvements in the economic impact of the region's base population depend on improvements in infrastructure increasing the efficiency of the region's economy – reducing congestion costs, for example. It is important to recognise that induced immigration tends to erode efficiency gains that might otherwise result from infrastructure improvements. This is an example of the induced traffic problem that is well known in the transport-economics literature.

The productivity effects included in the quantitative studies of the impact of transport-infrastructure enhancements encompass freight-cost savings, commuter time savings and improvements in the operational efficiency of the road network. These are long-run effects. Modelling by PwC (2016) of the economic contribution associated with the Australian Infrastructure Plan (Infrastructure Australia, 2016) analyses the economic contribution of improvements and expansion of land transport

infrastructure on the basis of such productivity improvements. Productivity gains associated with the Australian Infrastructure Plan are generated by better use of capital and labour in transport and related sectors, as well as better targeting of investment in roads.

4.5.1 Heavy Road Vehicles

In relation to heavy vehicles, modelling by the Productivity Commission (2006) provides insight into the size of the productivity improvements that could be expected. This modelling featured two scenarios. The first scenario assumed a five per cent increase in road freight productivity achieved through regulatory reform, better funding mechanisms and better investment decisions. The second scenario assumed a 10 per cent increase in road freight productivity, reflecting, in addition to the gains in the first scenario, productivity gains from commercial road provision and efficient road pricing, such as mass-distance-location charges on National Network roads.

4.5.2 Rest of the Fleet

Regarding the rest of the fleet, PwC (2016) has identified two important reforms nominated in the Australian Infrastructure Plan, namely, 'proxy' user charges and congestion charges. At present, the main 'proxy' user charges consist of vehicle registration fees and fuel excise. Other sources of funding exist, but these cannot be clearly labelled as 'user charges'. Examples of the latter include the luxury car tax and driver licensing fees. Since the Australian Infrastructure Plan does not specifically propose a new structure of user charges, PwC assumed that the change would result in differences in the composition of the tax mix, and, in the absence of a more clearly defined proposal, that the new tax mix would feature a similar excess burden to the existing regime.

The second impact arises through the introduction of congestion charges. In this instance, PwC assumed that this would result in a 15 per cent reduction in congestion costs. This was supported by evidence cited from other jurisdictions that have introduced congestion charges.

- London's congestion charges resulted in a 16 per cent reduction in traffic volume.
- Stockholm's congestion charges resulted in a 20 to 22 per cent reduction in traffic volume.
- Gothenburg's congestion charges resulted in a 12 to 13 per cent reduction in traffic volume.
- Singapore's congestion charges resulted in a 10 to 15 per cent reduction in congestion.

4.5.3 Public Transport

The Australian Infrastructure Plan proposed that public transport be provided through private operators under a tendered, time-limited franchise model. Previous experience suggests that significant savings in unit costs are feasible. Evidence of the cost savings or efficiencies achieved by private service providers include the following:

- in Britain, bus franchises reduced unit operating costs by 50 to 55 per cent
- in Sweden, bus and train franchises reduced costs by 33 per cent
- in The Netherlands, public transport efficiency improvements were between 20 and 50 per cent
- in the U.S., cost savings were between 30 to 46 per cent
- in Melbourne, train and tram delays and cancellations were reduced by 35 per cent
- in Perth, bus franchises reduced unit operating costs by 29 per cent.

4.5.4 Modelled Shocks and Economic Contribution Results

PwC (2016) conducted economy-wide modelling of the following shocks:

- heavy vehicle pricing resulting in a productivity improvement of 10 per cent in the road freight industry
- congestion pricing resulting in a labour productivity improvement of 15 per cent in the following industries: Trade, Road Passenger, Communications, Financial Services, Business Services, Public Service and Other Services industries, which were selected on the basis that these industries would benefit the most

— franchising of train services resulting in productivity improvements of 20 percentage points in the first round, and 15 percentage points in the second round, generating a cumulative 35 per cent cost reduction

— franchising of bus services resulting in productivity improvements of 20 percentage points in the first round, 10 percentage points in the second round, and 5 percentage points in the third round, generating a cumulative 35 per cent cost reduction.

These shocks were phased-in over the relevant horizon and resulted in increases in GDP, relative to baseline, as shown in **Table 4.1**. As can be seen from the table, by 2040 these reforms could plausibly add one percentage point to GDP.

TABLE 4.1 PWC TRANSPORT REFORM CONTRIBUTION TO GSP/GDP (PER CENT)

Jurisdiction	2031	2040
NSW	0.8%	0.9%
VIC	0.7%	0.6%
QLD	0.8%	0.9%
SA	1.0%	1.1%
WA	1.2%	1.8%
TAS	0.6%	0.7%
NT	0.7%	0.9%
ACT	0.4%	0.3%
Australia	**0.9%**	**1.0%**

SOURCE: PwC (2016) AND ACIL ALLEN.

5 INITIAL POLICY REFORM STEPS: HYPOTHECATION AND ROAD FUNDS

5.1 Why is Reform Necessary?

The Australian land transport sector and the policy framework within which it operates are plagued by various problems. They include:

- high costs of substantial and worsening traffic congestion in major cities at peak times and locations, as access by each additional road-user imposes costs on all other road users (external costs of congestion)[20]
- large and growing public transport deficits in state capitals that are currently covered by subsidies of the order of 72-79 per cent of operating and capital costs (excluding a reasonable risk-adjusted rate of return on capital)[21] that are funded by taxes that cause excess burdens[22]
- high costs, ineffectiveness, and inefficiency of attempting to alleviate congestion by building unpriced roads, and by heavily subsidising public transport systems in the context of growing economic activity, as additional traffic is induced by both unpriced road use, and greatly under-priced public transport[23]
- underuse of toll-roads built to alleviate congestion, because of a tolling-off effect in the context of a largely unpriced road network, and continuing overuse of unpriced roads
- high costs of building, maintaining, and reconstructing roads to deal with damage caused by heavy vehicles, and costs imposed on other road-users by damaged roads (external costs of road damage)
- ineffectiveness and inefficiency of vehicle registration fees and fuel taxation as mechanisms for managing demand for road space by all road-users at peak times and locations, and by operators of different types of heavy vehicles causing road damage that varies according to road specifications
- crash costs not covered by insurance, and additional insurance costs borne by owners of light vehicles because of higher damage risks in collisions with heavy vehicles than in collisions with light vehicles (external costs of crashes)
- costs of noxious and greenhouse gas emissions that rise with congestion, damage to road surfaces, and vehicle size (external costs of emissions).

In summary, existing land transport policy has performed poorly in correcting external costs of congestion, road damage, crashes, and emissions. In addition, attempts to deal with these sources of

[20] See Bureau of Infrastructure, Transport and Regional Economics (2015, 2007) for estimation of economic efficiency costs (deadweight losses) of congestion in Australia's capital cities over time.
[21] See Bureau of Infrastructure, Transport and Regional Economics (2014a) for estimates for state and territory capitals. The proportion of costs covered by subsidies is higher in territory capitals than in state capitals.
[22] Excess burdens refer to adverse effects on the efficiency of resource allocation caused by taxes. They are also known as deadweight losses.
[23] For discussions of the induced traffic issue and how it can be caused by all expenditure and demand management measures except well-designed, network-wide, variable road pricing, see Downs (1962, 1992, 2004). For estimates of the magnitude of the effect of this phenomenon see footnote 52 in sub-section 6.1.1.

resource misallocation through government spending programmes have added new sources of resource misallocation through imposition of higher taxes or cuts to worthwhile programmes.

5.2 Economically Ideal Reform Package

Economically ideal reform would comprise a package of complementary policy instruments. Key elements drawn from the extensive economics literature on road pricing would include:

- a well-designed network-wide road pricing designed to require road users to internalise (bear or take into account) costs imposed on others (external cost) through their contributions to congestion, road damage, emissions, and crashes, so that road users make usage decisions on the basis of social marginal cost (marginal private cost plus marginal external cost) of road-use
- compensatory reductions in fuel taxation (including the fuel taxation component of the proxy heavy vehicle charging regime), registration fees, stamp duty on vehicle transfers, import duties on motor vehicles, and luxury car tax
- public transport pricing that requires users to make decisions regarding usage on the basis of social marginal cost of use, consistent with road pricing
- road infrastructure improvements, particularly debottlenecking, by-pass/ring-road capacity to be in place no later than commencement of road pricing, with resources provided through debt serviced by hypothecation of revenue from fuel taxation and other road-use-related taxes until these taxes are replaced with road pricing or by hypothecation of land value capture revenue (from taxation of land value increments) resulting from road improvements
- increases in public transport capacity to be provided no later than commencement of network-wide road pricing to accommodate switching to public transport by commuters, with resources provided through debt serviced by public transport's higher revenue and lower cost structure after reform of road and public transport pricing or by hypothecation of land value capture revenue (from taxation of land value increments) resulting from public transport improvements
- recycling of revenue from road pricing through government-owned road enterprises responsible for major roads to road operations, road maintenance, and investments that are supported by benefit-cost analyses
- recycling of increased public transport fare revenue through public transport enterprises to operations, maintenance and investments that are supported by benefit-cost analyses
- reallocation of resources from redundant anti-congestion subsidies to other uses
- ensuring that planning regulations do not impede increases in residential and commercial density in the vicinity of points of access to major public transport corridors
- economic regulation of road and public transport enterprises to prevent exercise of monopoly power by pricing above social marginal cost of use or delaying investments to support higher prices
- safety regulation of road and public transport enterprises
- deficits in respect of lightly-trafficked land transport assets (such as rural roads and suburban streets) under social marginal cost-based pricing to be funded by government from taxation of (increments to) land value (excluded from enterprises and directly funded or included in enterprises and indirectly funded through community service obligation payments).

More details on this policy package and the underlying economic rationale are provided in chapter 6.

5.3 Policy Transition Process

Transition to a land transport policy reform package as outlined in the previous section would be a complicated process. Considerable time would be required to formulate, plan and implement the pricing regime and the prior substantial investment programme. In addition, institutional transition would be necessary, as well as transition from blunt taxation instruments to carefully designed road pricing with multiple elements. The institutional transition will include establishment of mechanisms for allocating revenue to road provision and maintenance, and a regulatory regime to ensure that investment is not delayed and charges are not set to create and capture monopoly profits for the owner of the road network. The transition process should involve a succession and combination of

"no-regrets" steps that would improve efficiency progressively and facilitate political/community acceptance of the major transformation of policy.

Ian Heggie (1995) formulated such an institutional road policy reform process for developing economies on behalf of the World Bank. A decade later, Heggie (2006) reviewed progress with application of this process. He saw hypothecation and road funds underpinned by sound governance arrangements ("second generation road funds") as important steps in a transition process leading to full commercialisation of roads subjecting road management to market discipline. Gabriel Roth (1996) and David Newbery and Georgina Santos (1998) proposed similar institutional reform processes for road provision and maintenance.

These institutional road policy reform processes had the following common elements. First, government should move from a Departmental model supported by budget allocations from consolidated revenue (general fund) to a road-fund model that is resourced through earmarked road-use-related taxation revenue, and involves representatives of road-users in its governance structure. Second, a transition should be made to a commercialised or corporatised government-owned enterprise that applies efficient road pricing instead of earmarked road-use-related taxes. The associated transition from earmarked road-use-related taxes to road pricing (effectively hypothecated charges) would not have to wait until a corporatised enterprise is established. The road network enterprise (or preceding fund that applies road charges) would be subject to economic regulation to ensure charges are set in accordance with social marginal costs and to prevent exploitation of monopoly power, as well as to uphold safety standards.

The Productivity Commission (2006, 2014), a review of Australia's taxation system by Ken Henry and others (2010), a competition policy review by Ian Harper and others (2015), and Infrastructure Australia (2016a) proposed reforms similar to those advocated by Heggie (1995, 2006), Roth (1996), and Newbery and Santos (1998). The authors[24] of these analyses did not consider that privatisation of the road network was necessary to implement an efficient road pricing regime and achieve efficient levels and patterns of investment.

The remainder of this chapter focusses on the initial steps in the land transport policy transition process. First, it reviews arguments for and against earmarking or hypothecation of government road-use-related revenue to provision and maintenance of roads. Second, it considers arguments for establishment of road funds that would be responsible for various functions, including at least the functions of reviewing and funding road investment and maintenance programmes.

Earmarking of road-use-related taxes and charges to road provision and maintenance could be implemented with or without establishment of road funds. Also, road funds could be established with or without earmarking of relevant taxes and charges.

Without a fund, hypothecated revenue would be allocated through the government budget process. Consequently, this would complicate the task of managing mismatches between annual revenue and lumpy investments.

In the absence of tax-earmarking arrangements, funds would have to be financed through allocations from consolidated revenue by the government that establishes the fund or through transfers from other governments. This means the flow of resources to funds would be uncertain, making planning of construction and maintenance more difficult and causing inefficiency in performance of these activities.

Earmarking and establishment of road funds would be complementary steps forward from the current land transport policy regime involving government departments, annual allocations from consolidated revenue to fund investment and maintenance and public transport and rail deficits, and road-use related taxes that are not linked or only vaguely linked to expenditures. These steps would provide a bridge to a new efficient regime involving road pricing with multiple elements, combined with a commercialised or corporatised road network entity that collects road charges, manages the road network, undertakes maintenance, invests in new facilities, and is subject to economic regulation to ensure that it sets prices in accordance with social marginal cost and is unable to create and capture

[24] See also Newbery (1994).

monopoly profits from operation of the network. The final steps to the new regime are discussed in chapter 6.

5.4 Hypothecation

5.4.1 Concept of Hypothecation

Tax-earmarking or hypothecation is the dedication of revenue from a particular tax to a specific end-use. This does not mean that every cent raised from taxes on a particular activity should be allocated to support that activity. Hypothecation could range from allocation of all revenue from particular taxes to a specific end-use, through to allocation of a small fraction to cover pre-specified expenditure programmes.

A pertinent, well-known example of hypothecation is the allocation of revenue from the United States Government's gasoline tax mainly to roads. About three-quarters is allocated to the Highways Trust Fund for roads, a small proportion is allocated to public transport, and the residual is allocated to consolidated revenue for general budgetary purposes. More information about the hypothecation arrangements and the fund is provided in sub-section 5.5.2 below.

5.4.2 Hypothecation of Fuel Taxation in Australia

The Commonwealth Government, which has constitutional power to levy customs and excise duties, and has exercised this power in relation to transport fuel since federation in 1901, hypothecated a large fraction of fuel taxation revenue for roads only during the period 1926 to 1959. The fraction ranged from one third to two thirds of revenue from customs and excise duty on petrol. Duty was not applied to diesel until 1957 and the resulting revenue was not hypothecated for roads prior to abandonment of hypothecation of petrol taxation revenue in 1959. In some years during the 1926 to 1959 period, Commonwealth grants to the states for road construction and maintenance exceeded the hypothecated component of proceeds of customs and excise duties on petrol.

In 1982, partial hypothecation of fuel (petrol and diesel) taxation for road grants to the states was temporarily reinstated at a much lower level under the *Australian Bicentennial Road Development Trust Fund Act 1982* to upgrade the road network, particularly major inter-city links, through an expenditure programme scheduled to be completed in 1988. Surcharges on customs and excise duty provided the hypothecated component revenue. The initial surcharge of one cent per litre in 1982 was raised to two cents per litre in 1983. Another fuel tax rate increase in 2003 was not hypothecated. The hypothecated components of duties on petrol and diesel in 2002 and 2003 were 16 per cent and 22 per cent, respectively. The component of fuel taxation hypothecated for road grants varied over the programme period, peaking at 6 cents per litre. While the programme and the surcharge ended in 1988, a small proportion of fuel taxation revenue was earmarked for road grants from 1989 to 2000, under the *Land Transport Development Act 1988*.

In June 2015, the Commonwealth Government legislated to hypothecate revenue from reinstatement of fuel taxation rate inflation adjustments (indexation) to the Fuel Indexation Road Funding Special Account for the purpose of investing in road infrastructure.

The Commonwealth and the states have maintained a notional road-use charging regime for heavy vehicles since the early 1990s. It comprises a fixed annual component via registration fees that vary according to vehicle-type, and a variable component in the form of a portion of the rate of duty applying to diesel that is currently about two-thirds (26.14 cents per litre) of the standard rate (39.5 cents per litre). Although the aim of the notional charging regime is to recover costs of road-use by heavy vehicles, the Commonwealth Government has not hypothecated the nett fuel tax proceeds from heavy vehicles for road grants to the states/territories to help address road damage caused by heavy vehicles.

5.4.3 Hypothecation of Registration Fees in Australia

There is limited hypothecation of vehicle registration fees in Australia. Hypothecation arrangements vary between states/territories. In addition, vehicle registration fees are administered differently for heavy and light vehicles.

Under the notional road-use charging regime for heavy vehicles, each state/territory collects registration fees in respect of vehicles registered in that jurisdiction. Heavy vehicles used solely on interstate routes and incidental activities may be registered in a home state/territory under the Federal Interstate Registration Scheme (FIRS). If so, registration fee proceeds are paid by the home state/territory to the Commonwealth Government, which then re-distributes the revenue to states/territories in accordance with a tonne-kilometre-based formula.

In most states/territories, registration fee proceeds are paid into consolidated revenue, rather than hypothecated to road construction and maintenance. In South Australia and New South Wales, registration fee revenue is hypothecated to road funds, but Treasury retains oversight of allocations in South Australia. In Victoria, a small part of registration fees is hypothecated to a road fund to target projects that contribute to economic development.

5.4.4 Economics of Earmarking

Knut Wicksell (1896) formulated an individualistic[25] theory of public finance/economics in which decisions on government expenditure programmes would explicitly link each programme with a specific source of revenue. This would mean simultaneous determination of expenditure and the specific source of tax funding for each expenditure programme. Wicksell envisaged that the linked tax and expenditure packages could be approved or rejected by parliamentary voting. The content of tax and expenditure packages would be approved or rejected by a simple majority. Subsequently, significant minorities would be able to veto tax-expenditure packages. The majority could then decide either to offer a different tax distribution for a previously vetoed package or to reduce or abandon the proposed expenditure. Some proposals, such as payment of interest on government debt, would not be subject to veto, and would require just a simple majority.

Wicksell's analysis was translated from German into English by James Buchanan in 1958. In the meantime, tax-earmarking was subjected to a barrage of criticism. An important recurring theme was that earmarking of taxation imposed a constraint on the decisions of a *collective* decision maker – the fiscal authority – that was assumed to seek to maximise an implicit social welfare function. Consistent with the conventional theory of constrained optimisation, any binding earmarking constraint would adversely affect the attainable value of the social welfare function. From this perspective, earmarking is inefficient.

In an influential contribution to the literature, James Buchanan (1963) built on Wicksell's individualistic approach, looking at earmarking from the point of view of the individual voter/taxpayer/beneficiary. He pointed out that general-fund budgeting (non-earmarking) forces the voter/taxpayer/beneficiary to consume collectively-supplied services in a bundle, the composition of which may diverge from his/her preferred composition. In contrast, tax earmarking provides a means of compartmentalising fiscal decisions, and could allow the voter/taxpayer/beneficiary to influence the composition of the bundle of collectively-supplied services in a way that reflects his/her preferences. From this perspective, tax-earmarking could promote efficiency.

Since Buchanan's contribution, the proportion of economists taking a favourable view of tax-earmarking has transitioned from minority to majority. Support for tax-earmarking has been particularly apparent in relation to application of the device in specific circumstances, such as road-use-related taxes, rather than in relation to deployment of this policy instrument across the government's budget. Nevertheless, Treasuries typically have advised governments against hypothecation in general and in particular circumstances. Various arguments against and in favour of tax earmarking have been discussed in the economics literature.[26]

Four representative opposing arguments follow. First, it introduces rigidities into the budget process on both revenue and expenditure sides of the budget, complicating the task of adjusting to changing circumstances. Second, it may prevent allocation of resources to their highest value uses. Third, a spending agency's incentive to use hypothecated tax revenue efficiently could be weaker than if it has

[25] Attention was focussed on the preferences of individuals, rather than on the views of those formulating government budgets.
[26] See Buchanan (1963), Deran (1965), Musgrave and Musgrave (1973, pp 197-198), Teja (1988), Newbery and Santos (1999), Button (2006), Proost, De Borger and Koskenoja (2007), de Palma, Lindsey and Proost (2007a,b), Santos (2007), and Potter (2007).

to compete for funds in the general budget process. Fourth, decision-making costs may be higher than under the conventional budget framework, because of compartmentalisation of decision-making.

The arguments against tax earmarking have been challenged on various grounds. Several important counterarguments, and additional points specific to taxes related to use of particular types of facilities, such as roads, are summarised below.

First, a tax-earmarking arrangement need not be inflexible, contrary to a common argument against hypothecation. Foresight in the provision for adjustments should be part of the tax-earmarking regime either to deal with changing circumstances or as part of a process of policy reform. Indeed, earmarking of road-use-related taxes could evolve to an efficient road pricing regime that involves hypothecation of revenues to investment in, and maintenance of land transport facilities (see the eighth point below). Efficient road prices would be adjusted over time with changing circumstances.

Second, the opponents of tax-earmarking have not demonstrated that its deployment typically results in a lower overall social rate of return (efficiency losses) compared to their preferred option of general-budget allocations to various programmes. Buchanan's analysis showed that the reverse may apply. In the specific case of roads, other economic analysts have explained how hypothecation of revenue from road-use-related taxes to road provision and maintenance can contribute to improvements in the efficiency of allocation of resources in other ways.[27] These are covered in other points below.

Third, the claim by tax-earmarking's opponents that a spending agency's incentive to use funds efficiently could be reduced by earmarking appears to be based on implicit assumptions that have not been substantiated. One such assumption is that hypothecated revenue typically exceeds economically justifiable outlays. Another is that agencies receiving hypothecated revenues do not adequately evaluate expenditure options. A third is that policy-makers never review hypothecation arrangements. If any of these assumptions did apply, the appropriate policy response would be to review the extent and scope of the hypothecation and guidelines for economic assessment of expenditures funded by earmarked taxes, rather than to abandon the policy. However, it has not been shown that these implicit assumptions are likely to apply in practice. Quantitative analysis undertaken by Elizabeth Deran (1965) using data for highway, education and welfare programmes in 48 states in the United States strongly indicated that changes in earmarking (up or down) did not affect expenditure levels for highways and education. The analysis indicated only a borderline probability of a reduction in expenditure on welfare in the event of a reduction of earmarking.[28] These results indicate that tax-earmarking does not necessarily increase economically unjustifiable spending, contrary to the allegations of its critics.

Fourth, tax-earmarking for particular facilities is more likely than general-fund budgeting to facilitate preference revelation by politicians on behalf of constituents, and consequent preference-driven decision-making regarding expenditure programmes. In the case of earmarking, decisions can be made about specific expenditure programmes in the context of the particular taxes nominated to fund the programmes. In the case of general-fund budgeting, parliamentary votes on the size and composition of expenditure programmes are cast separately from votes on taxes. In addition, there may be bundling of programmes in the general-fund budget allocation process, inhibiting expression of preferences in the voting process. Meanwhile, in a general-fund budgeting regime, votes on taxes relate to the specifics of individual taxes, the composition of the tax-mix, and the size of the total revenue pool, without reference to the composition of the set of programmes and the specifics of individual programmes funded by the revenue pool.

Fifth, hypothecation facilitates greater transparency, monitoring, and accountability in respect of application of tax revenue. Tax earmarking helps taxpayers to compare the benefits they receive from a programme with their liability for the particular tax that supports the programme. Consequently, it facilitates choices by voters or their representatives regarding policy packages.

Sixth, there are cases in which hypothecation of taxes based on some indicator of usage of government-provided services could improve economic efficiency and equity. Hypothecation allows taxes related to access or usage to act as a proxy for user-charges or prices that finance provision of

[27] For example, see Newbery and Santos (1999), Button (2006) Santos (2007), de Palma, Lindsey and Proost (2007a,b), and Productivity Commission (2014).
[28] Deran (1965) applied a Wilcoxon matched-pairs signed-ranks test.

a service (effectively earmarked charges), helping to induce preference revelation by users, providing some degree of cost-recovery, and therefore, helping to improve expenditure decisions. Tax-earmarking tends to be consistent with the benefit principle of equity that suggests taxpayers should pay in accordance with benefits received from government, and more generally, the community. Hypothecated fuel tax and vehicle registration fees have some appeal as usage-related taxes on road-users that could improve efficiency of resource allocation and equity compared to funding of road expenditure from taxes unrelated to road-use.[29] Fuel tax is linked to the amount of road-use and vehicle weight, while vehicle registration fees are linked to road access and vehicle-type. While these imposts are highly imperfect proxies for road charges that reflect social marginal cost, earmarking provides them with appeal as "second-best" policy instruments from economic efficiency and equity perspectives, pending their replacement by genuine, well-designed user-charges.

Seventh, earmarking would facilitate the formulation and management of multi-year investment programmes without the inefficiencies and inflexibilities in planning, programming and construction that result from annual budget allocations and limited pre-commitment of future funding. These benefits would be realised from the time of implementation of hypothecation of road-use-related taxes. They would continue during and following any transition to an efficient road pricing regime.

Eighth, earmarking of fuel and vehicle registration taxes could facilitate a transition to an economically efficient road pricing regime that includes elements matched to present marginal external costs of congestion, road damage and crashes. These new efficient charges could be explicitly presented as replacements for the existing hypothecated taxes. After a link between road-use taxes and expenditures has become entrenched, the political/community acceptability of a transition to efficient road pricing from fuel taxation would be easier to achieve than in the current context of no earmarking of fuel tax and registration.[30]

Earmarking of fuel and vehicle registration taxes would be an important initial step towards an efficient regime for managing road-usage and land transport investment. However, current institutional arrangements would be an impediment to realisation of some of the potential benefits from tax-earmarking, and subsequently from road pricing. A key issue is that allocation of funds earmarked for roads would have to be made via the annual general budget process and in the context of electoral cycles. While earmarking would determine the amount of funds to be allocated, the way in which funds are allocated from that amount would remain unchanged. Allocations may be subject to political pressures, ideologies, whims and promises that may not be related to road users' preferences and willingness to pay. In addition, allocations may be subject to a use-it-or-lose-it convention that is inconsistent with lumpy, multi-year investments. These arrangements may lead to uncertainty regarding funding, and impede efficient programme formulation, planning and management. Well-designed road funds could help address these problems and complement hypothecation in the transition to an efficient land transport pricing and investment regime.

5.5 Road Funds

5.5.1 Road Fund Concepts

A road fund is an agency dedicated to funding the provision and maintenance of roads that is outside the general government budget framework (extra-budgetary). The scope of a road fund could be broadened by giving it responsibility for provision and maintenance of roads, as well as allocation of financial resources.

The scope of the road fund concept could be broadened to include public transport funding. The scope of funds established by national governments in the United States and New Zealand was broadened in this way long after they had been established as road funds. The former retained its road fund title. The latter was rebadged as a land transport fund.

[29] This example has often been cited in general discussions of earmarking, such as in Musgrave and Musgrave (1973, pp. 197-198), Teja (1988), and Productivity Commission (2014, vol. 1, p. 308).

[30] The concept of such a transition process was formulated by Newbery and Santos (1999). Later, the Productivity Commission (2006, 2014), Henry and others (2010), Harper and others (2015), and Infrastructure Australia (2016) proposed that similar transition processes be adopted in Australia.

5.5.2 Resourcing Land Transport Funds

A road or land transport fund could be set up with or without an inflow of earmarked tax revenue. However, the road fund concept typically has included hypothecation of taxes to the fund for relevant purposes.

Road-Related Taxes

Typically, road funds are resourced by hypothecated fuel taxation and vehicle registration fees. In addition, the arrangement may include hypothecation of revenue from vehicle transactions taxes (stamp duty), and other taxes relating to road vehicles and road-use.

The revenues provided by these taxes have documented and compared with road expenditures in chapter 2. The inefficiency costs or excess burdens associated with relevant taxes were also discussed there.

Land Transport Pricing

One of the most important roles of a road or land transport infrastructure fund is to facilitate institutional transition to road and public transport enterprises underpinned by efficient pricing regimes. Implementation of such pricing regimes in place of road-use-related taxes, ad hoc tolling, and current public transport pricing could be implemented before or at the time of substituting enterprises for funds.

Value Capture

Over the past 25 years, a growing international body of literature has argued that "value capture" be deployed to fund land transport infrastructure. This prescription has been extended to other forms of infrastructure, but discussion of application of this policy instrument to land transport has dominated the literature.[31]

In Australia, the Productivity Commission (2014) has proposed application of "value capture" to fund infrastructure. This is being investigated by Infrastructure Victoria (2016b).

"Value capture" could be a source of revenue for a land transport or road fund. The Productivity Commission (2014) considered that more work should be undertaken on use of "value capture" to resource infrastructure funds.

Value Capture Concepts

The term "value capture" originated in work undertaken for the United States Department of Transportation in the early 1990s. It typically refers to government appropriation of part of increments to land value resulting from new or improved infrastructure. Some analysts have increased the scope of the term to include value increments deriving from government regulatory actions. In addition, it has been noted that value generated by government activities could be partly captured by taxes on incomes, capital gains, and goods and services. However, the main focus of the literature has been on capturing increments to land value by various means.

The concept of capturing part of land value increments dates back to the foundational works in the field of economics (originally political economy) in the 18th and 19th centuries.[32] The original concept was broader than the one that has been the focus of most of the 21st century literature on value capture. The broader concept relates to the recovery of part of land value increments generated by activities other than the landowner's direct investments. These increments could derive from activities of the community generally, including growth of population and economic activity, as well as from the actions of governments.

[31] See Batt (2001), Peterson (2009), Levinson, Istrate (2011), Ingram, Hong (2012a), Walters (2012, 2013), Smolka (2013), Vadali (2014), Productivity Commission (2014), Jones (2015), Infrastructure Victoria (2016b).
[32] These included writings of the French Physiocrats, Smith (1776), Ricardo (1817), Mill (1848), George (1879), and Wicksell (1896).

Value Capture Mechanisms

Taxation of land value or land value increments is central to the original, broader concept of value capture, because the policy instrument and the concept are inextricably linked. This policy instrument is also the most commonly nominated value capture mechanism in the rapidly growing literature on the narrow concept of value capture. The economic efficiency and equity of taxation of land value and increments to land value are strongly grounded in the literature on the economics of taxation.

Various other value capture mechanisms have been nominated in the context of the narrow concept of value capture. They include betterment levies, sale of development rights around or above new infrastructure, property development by government in the vicinity of infrastructure, and financial or in-kind contributions towards infrastructure by developers. Any proposal to adopt one of the alternative value capture mechanisms would require careful assessment of the policy instrument relative to the efficient benchmark of well-designed land value increment taxation.

Taxation of Land Value Increments

The land taxation literature of the 18th and 19th century spawned the concept of "unearned increments" to land value (or land rents), proposals to tax land to capture those "unearned increments", and analyses showing that taxation of land rents, land value, or increments to such bases at a uniform proportional rate did not adversely affect the efficiency of resource allocation (economic efficiency) and complied with the benefit principle of equity. The efficiency of resource allocation is not adversely affected, because land owners cannot reduce their tax liability by altering the timing or the intensity, manner or type of use of the land. The benefit principle of equity is satisfied because the tax is proportional to the capitalised benefits provided by government activity and society more generally.

Subsequently, it has been shown that differential taxation of land value or increments to land value on the basis of *land use* is not consistent with economic efficiency, but differential taxation on the basis of location or value in best use is efficient, because land users can move or change when they do things, but land cannot be relocated (Vickrey, 1970; Tideman, 1982; Oates, Schwab, 1997, 2009; Henry, others, 2010).

This demonstration was underpinned by an implicit assumption that relevant markets operate efficiently. Some market failures have been identified that may be offset by land value taxation. As a properly designed and implemented land value taxation system would not adversely affect the efficiency of resource allocation in other respects, it could be termed "better-than-neutral" (Gaffney, 1973, 2009; Tideman, 1999).

Mason Gaffney (1973) explained that land value taxation would be neutral if financial markets operated efficiently. However, "strong" entities are able to obtain capital more cheaply, and to service debt over longer periods. Therefore, they have a comparative advantage in holding assets, such as land, for which the main cost is paying interest on loans and foregoing returns to equity. Gaffney explained with the aid of simple mathematics and examples that, because taxation of land value displaces interest costs of holding land (rather than supplementing them) in the capitalisation process, it would reduce the bidding advantage of "strong" entities relative to the advantage held over others in the pre-tax situation. So, land value taxation tends to lead to the transfer of ownership of some land from "strong" entities to others, and to make intensity of land-use more equal between these groups. The effect is greater in the context of rising land values. Entities with higher costs of capital that pick up land from "strong" entities could be expected to bring forward development activities on land, because they would discount future returns more heavily. Earlier development would occur only because of differential capitalisation of land value taxation that offsets the effects of an inefficiency in financial markets. This would *improve* economic efficiency.

Nicholas Tideman (1999, p. 110) summarised circumstances in which land value taxation could be better-than-neutral" as follows.

"The conclusion that a tax on land is neutral employs the premise, implicitly if not explicitly, that markets are perfect. When markets have customary imperfections, a tax on land is generally better than neutral. In particular, if there are unarbitraged disparate beliefs about the optimal future use of land because of the lack of a futures market in land rent, then a tax on land helps prevent a '(social) winner's curse' from generating an artificial scarcity of land for current use. And if there is dispersion in discount rates

because of imperfections in lending markets, a tax on land helps put land into the hands of persons with higher discount rates, whose investments are generally more productive than those of the persons with low discount rates who would otherwise have held the land."

Joseph Stiglitz (2015, 2016) also identified circumstances in which land value taxation could be better-than-neutral. He explained how market failures in credit markets, changes in regulation of credit availability, and easing monetary policy had worked together to contribute to rising land prices, but pointed out that an increase in the market price of land did not make the economy more productive. Indeed, investments in land *crowd out* productive investment, particularly in real estate bubbles.

Stiglitz (2015, 2016) argued that taxation of land rents, land value or land value increments (capital gains) lowers the price of land, leading to allocation of more of society's scarce savings to productive investment, and faster growth. In the words of Stiglitz (2016, p. 51), "…the lowered value of land as a result of (land value) taxation *crowds in* real investment." Stiglitz also argued that heavy taxation of land rents or land capital gains would also reduce inequality.

Complementary Tax Instruments: Efficient Pricing and Efficient Value Capture

Typically, the literature focussed on the narrow concept of value capture has regarded it as a means of obtaining contributions from those who benefit "indirectly" from the services of government infrastructure. Charging of users – those who benefit "directly" – is often ignored or discussed separately. However, a "direct" beneficiary may also be an "indirect" beneficiary. For example, an entity may benefit directly as a user of a passenger rail service and as owner of a nearby property that increases in value. In contrast, some users may not own nearby property and some owners of nearby property may not use the rail service.

This same literature developed in the context of growing concerns about land transport infrastructure inadequacies and strong reluctance to embrace or even investigate reform of road and public transport pricing. In this context, value capture was often perceived to be a substitute for pricing reform.

William Vickrey (1977, 1999a,b) explained that taxation of land value (not discriminating between uses) is complementary to efficient pricing of infrastructure (requiring users to bear the social marginal cost of use), because it is an efficient and fair mechanism for funding deficits from provision of infrastructure services involving economies of scale or public good characteristics. He pointed out that deployment of land tax revenues in this way would be self-financing because resulting increases in land values would increase revenues.

Efficient pricing and efficient land taxation are complementary mechanisms for capturing value. Taxation of land value or land value increments and other policy instruments commonly nominated as value capture measures should not be regarded simply as permanent substitutes for efficient pricing of infrastructure use. Land value taxation can be designed to avoid adverse effects on resource allocation when capturing value, but it does not correct inefficiencies arising from under-pricing of use of infrastructure. If it is deployed to avoid adoption of efficient pricing regimes, infrastructure inefficiencies (often perceived to be infrastructure inadequacies), such as those associated with economically excessive traffic congestion and road damage, will be perpetuated, because the better facilities attract more use (the induced demand problem).

Some of the recent value capture literature has recognised the positive attributes of taxation of land value with respect to an efficient allocation or resources and the benefit principle of equity.[33] But, the complementarity of efficient user charges and value capture mechanisms has been largely neglected outside of the literature on the economics of land taxation.

Value capture would be acceptable as a substitute for reform of road and public transport pricing only as an interim measure to provide funding for necessary road and public transport improvements prior to implementation of an efficient network-wide pricing regime. Thereafter, they would become complements, and value capture's funding role would be significantly diminished as pricing captures value from direct beneficiaries and less residual value is capitalised in land prices. Value capture via

[33] For example, see Jones (2015), Vadali (2014), Walters (2013), and Ingram, Hong (2012).

land taxation or rates will remain important for funding of infrastructure, such as suburban and regional roads, that would yield deficits under an efficient pricing regime.

Broad versus Narrow Value Capture Concepts

Advantages of the broader concept of value capture over the narrow concept are as follows. First, the economic efficiency and equity of taxation of land value and increments to land value are strongly grounded in the literature on the economics of taxation. Second, the revenue potential is much greater. Third, administration will be simpler and less litigious because there is no need to distinguish between sources of value increments over time and space, a difficult and contentious task.

The narrow concept offers the advantage of a more obvious link between benefits of, and tax payments relating to use of land transport infrastructure.

5.5.3 Road Fund Governance

Governance of a road fund could be arranged in various ways. The nature of governance arrangements will be an important determinant of success of the fund. The importance of governance arrangements is highlighted in subsequent sub-sections.

5.5.4 History and Examples of Road Funds

Road funds have a long history. They have been set up in developed and developing countries, with varying degrees of success and longevity.

Early Road Funds

UK Funds

A Road Improvement Fund (RIF) was established in the United Kingdom (UK) in 1910 under the *Development and Road Improvement Funds Act 1909*. The Act's purpose was to "provide the country with a new system of highways suitable for motor traffic, and relieve the ratepayers of the cost of making and maintaining those highways by placing it entirely upon the motoring community." [34]

Revenue from the RIF was provided by earmarked increases in taxes on motor vehicles (registration or licence fees) and a new tax on petrol. The earmarking arrangement was intended to ensure that owners of motor vehicles would pay for roads, rather than roads being funded by other taxes or cuts to other government programmes. The intentions were sound.

It was all downhill from there. The five-person board was appointed by Treasury and members remained at Treasury's discretion. The board included a railway magnate, who was elected as chairman, a shipping industry person, and people involved in banking, finance and law. The chairman made most of the decisions himself, without consultation with the board. He had no interest in building a road network to compete with the railway industry. No effort was made to gain the support of politicians or the public. Some road improvements were made, and grants were made to road authorities to compensate them for payments of local government rates, but local governments did not receive transfers to relieve them of the burden of road provision and maintenance. Large surpluses accumulated in the fund. Because the *Finance Act* required that taxation revenue be deposited in consolidated revenue, it was easy for Treasury to withhold revenue and divert it elsewhere. Treasury raided the fund in 1915 to obtain resources for the war effort. From 1916 to 1920, hypothecation of taxation revenue to the fund was suspended.

In 1920, the RIF was replaced with the Road Fund under the *Road Act*. The resources remaining in the RIF were transferred to the Road Fund. Responsibility for managing the Road Fund was given to the newly-established Ministry of Transport. The new fund was funded by grants from consolidated revenue, which ceased in 1923, and licence fees on mechanically propelled vehicles that were imposed from January 1921. Fees from drivers' licences, goods vehicle licences, and driving tests were added in the early-1930s. The Road Fund's main expenditures were grants to local government authorities for road construction and maintenance. The Road Fund was raided in 1929, 1935 and

[34] Historical material in this sub-section was drawn from Roth (1996), Newbery and Santos (1999) and Heggie (2006).

1937. Grants to local governments were reduced under the *Local Government Acts 1929* and the *Finance Act 1935* to make payments from the Road Fund to Treasury. Under the *Finance Act 1936* and *Trunk Roads Act 1936*, hypothecation of motor vehicle licence fees to the Road Fund ceased and was replaced by grants from Treasury. The Road Fund was terminated in 1955, and all subsequent road expenditure was provided by annual allocations from the general budget.

The UK funds failed for multiple reasons. First, the original board was not interested in or accountable to road users. Second, there was no visible connection between payments by road-users and expenditures on roads. Third, road-users had no influence on expenditures by the funds. Fourth, the Treasury and politicians were hostile to hypothecation of taxation revenue for roads. Fifth, the funds were easily raided.

In March 2015, the UK Department of Transport published its *Road Investment Strategy: for the 2015/16-2019/20 Road Period.*[35] Its main concern is England's Strategic Road Network, comprising its motorways and major trunk roads. The Road Investment Strategy has a strong network focus, consistent with the views of prominent economic commentators in the UK.[36] It recognises the importance of coordinating investment plans for the Strategic Road Network with those for other transport modes, including railways (especially the planned high-speed facility – HS2), airports and water ports.

Operation, maintenance and improvement of the Strategic Road Network is the responsibility of *Highways England*, which is an arms-length government-owned company that replaced the Highways Agency in April 2015. One aim of the new policy is to give *Highways England* more secure long-term funding than was available to the Highways Agency. However, funding is still dependent on allocations from the general revenue rather than by hypothecation of specific revenue sources.

Highways England is subject to regulation by two bodies: *Transport Focus* and the *Office of Rail and Road*. The former is an independent user watchdog and the latter is responsible for safety and economic regulation.

US Highway Trust Fund

In 1956, the United States Government established the Highway Trust Fund (HTF) under Title II of the *Federal-Aid Highway Act*. Title II also increased some taxes paid by road-users, applied new taxes, and provided that revenues from these taxes be deposited in the HTF to finance that government's share of the cost of the federal-aid highway programme, which included road segments authorised for the Interstate Highway System.[37] Fuel taxation was the main source of revenue for the HTF.[38]

Gabriel Roth (1996) stressed that the HTF was formed to cap federal spending on roads, not to provide an expenditure floor. Moreover, taxation revenues deposited in the HTF are not automatically allocated to road agencies to spend at their discretion. They have to be allocated from the fund through the normal budget appropriation process. There is no requirement to spend fund monies on roads. Indeed, less than 55 per cent of fund outlays (and falling) is allocated to roads, with the balance appropriated for public transport and other purposes, such as budget deficit reduction and environmental programmes.

In 1982, the *Federal Highway Revenue Act* established a Mass Transit Account within the HTF to add to public transport subsidies. Of the federal petrol taxation rate of 18.4 cents per gallon that has been fixed since 1993, the allocation to mass transit (public transport) was 1.5 cents per gallon or 8.2 per cent in 1994 and 2.86 cents per gallon or 15.5 per cent in 2010.

Funding of road outlays from the HTF has been eroded over many years for two reasons. First, real inflows have been limited by the fixed nominal petrol tax rate and persistent improvements in fuel economy of vehicles. Second, outflows have been constrained by growing diversions to mass transit and other purposes.

Allocations from the HTF to the states have been made to a notable degree on the basis of a formula that takes into account road miles, vehicle miles travelled, and payments into the trust fund. The

[35] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/408514/ris-for-2015-16-road-period-web-version.pdf
[36] See especially Dieter Helm (2013), available at http://www.dieterhelm.co.uk/assets/secure/documents/Brit-infra-oxrep.pdf
[37] Historical material in this sub-section was obtained from Roth (1996) and Winston (2010).
[38] State governments in the United States also impose fuel taxation. Many state governments also have road funds.

severity of congestion is not considered. Projects proposed by the states within state allocations have to be approved by the Federal Highway Administration. However, many projects by-pass this process through political deals relating to legislation.

States must show that road projects comply with numerous federal requirements relating to planning and environmental issues, and tender and construction processes. Winston (2010) pointed out that it can take 12-15 years to ensure compliance with the planning and environmental requirements. He observed that states sometimes put forward lower priority projects that would more easily satisfy federal requirements than preferred projects. Also, states occasionally choose to fund particular projects entirely from their own resources to avoid the maze of federal requirements.

The contribution of federal and state road-use-related taxes to highway funding in the United States has trended downwards over time. Shortly after creation of the HTF and allocation of federal road-use-related taxes to it, road-users contributed 70 per cent of expenditures on highways. It was down to 60 per cent in 1997, and 50 per cent in 2007, and the downward trend has continued subsequently. So, non-user sources of government revenue have funded an increasing proportion of highway spending over the last few decades.

The HTF arrangements are deficient for multiple reasons. First, federal road-related taxation revenues available for hypothecation to roads are severely constrained. Second, allocations to roads have effectively been subject to a declining cap. Third, the connection between taxation payments by road users and expenditures on roads has become increasingly tenuous. Fourth, it has been easy to raid the fund for non-road purposes. Fifth, road-users have little influence on fund allocations. Sixth, the task of obtaining approval of allocations to specific projects has involved high costs and delays for states, and distorted road investment priorities.

NZ National Land Transport Fund

New Zealand's land-transport fund arrangements have often been described as leading edge. Heggie (2006, p. 436) referred to the New Zealand scheme as the "star performer" among road fund regimes. The New Zealand system was also described sympathetically by the Productivity Commission (2014, vol. 1, pp. 312-315) in its public infrastructure inquiry report.

The New Zealand Government has maintained a road fund since 1953. Its current title is the *National Land Transport Fund*. The regime has been modified from time to time. The outstanding, core features of the fund are that it applies hypothecated revenues under a modified pay-as-you-go system, and it operates at arms-length from government.[39]

The fund is resourced primarily from all proceeds of taxation of specific fuels[40] and road-user charges[41] and a portion of vehicle registration and licence fees. The modified pay-as-you-go principle is that cash outflows should be covered by cash inflows, but with some flexibility allowed to deal with cash-flow variations and large, lumpy investments.

The majority of the Fund's outlays are directed towards investment in State Highways and local and regional roads (about 77.5 per cent). Some of the fund's outlays are directed to road policing (8.6 per cent), road safety promotion (one per cent), and public transport (10.5 per cent), in recognition of the importance of those activities to the interests of road-users. Supplementary funding from local governments for local and regional roads, road safety promotion, and public transport adds about 25 per cent to fund allocations for land transport. New Zealand Government appropriations for specific programmes, such as Metro Rail in Auckland and Wellington, railway management improvement, acceleration of regional road investments, and walking and cycling infrastructure, have also supplemented fund allocations by about 5 per cent.[42]

The New Zealand Transport Agency (NZTA) manages the National Land Transport Fund, including its land transport investment activities and auditing of performance of entities receiving funding. NZTA also manages the State Highway System. The NZTA Board has independent decision-making

[39] New Zealand Government (2014, pp. 37, 40).
[40] Petrol, compressed natural gas and liquefied petroleum gas.
[41] Road-user charges apply to vehicles over that are over 3.5 tonnes (based on the manufacturers' gross laden weight) and use diesel or other fuel that is not taxed at source. The charges are based on weight, distance and axle configurations.
[42] New Zealand Government (2014) and http://www.nzta.govt.nz/assets/resources/annual-report-nzta/2014-15/docs-nltf/nltf-2014-15-at-a-glance.pdf

authority regarding its land transport investments. However, it must give effect to the New Zealand Government's policy statements on land transport funding, and it is monitored and assessed by the Government through an annual reporting requirement and a statement of service performance. The New Zealand Government's (2014) policy statement on land transport for the period July 2015 to June 2025 confirmed continuation of the fund, and the existing management arrangements.

From 1996 to 2008, the fund was managed separately from the agency responsible for the State Highway System to avoid a perceived conflict of interest. This perception derived from the fund's role as provider of financial resources for state highways and for local governments' land transport activities. However, the managing entities were brought back together in July 2008 because it was considered that the benefits of integration, such as assessment of trade-offs between investments in all modes and projects by a single entity, would outweigh the benefits of separate organisations.

While the New Zealand land transport funding regime has been praised in the economic literature regarding road funds,[43] the regime has deficiencies. Four shortcomings are outlined below.

First, the NZTA board has no control over the revenue that flows into the fund. Determination of fuel taxation, road charging, and vehicle registration regimes has not been delegated by the New Zealand Government.

Second, the practice of supporting public transport from the fund is not consistent with the economic logic of improving the connection between payments by road users and expenditure on roads that underpins the concept of road funds. The New Zealand Government's (2014) policy statement confirmed that the fund provides financial resources to public transport, but did not provide an explicit rationale. There are indications in the statement that the logic is that subsidising public transport helps alleviate congestion, but there is also an explicit aim of reducing subsidies through increases in patronage. The attitude of the NZTA is not apparent. The issue of the connection between payments by road users and expenditure on roads could be addressed by supplementing the fund with revenue from value capture mechanisms linked to public transport improvements.

Third, New Zealand has not yet taken the economically appropriate step of implementing an efficient road and public transport pricing regime and hypothecating revenue to the fund. That step would certainly strengthen the link between payments for road-use and expenditures. It would increase demand for public transport services and also make provision of public transport subsidies largely redundant. Of course, as a land transport fund is a transitionary step in the land transport policy reform process, the pricing reform step could be deferred until the fund is replaced by land transport enterprises.

Fourth, the policy statement on land transport lacked the sharp network focus evident in the UK *Road Investment Strategy*. It also paid less attention to safeguarding the interests of road-users.

With refinements to address such deficiencies, the New Zealand land transport funding regime would provide a solid model upon which to base land transport funds in Australia.

"First-Generation" Road Funds in Developing Countries

In the 1970s and 1980s, many developing countries set-up road funds that were resourced by earmarked taxation revenue, typically some or all of fuel taxation proceeds. Several eastern and central European countries followed this lead in the early-1990s.

"First generation" road funds failed to deliver secure and stable revenue flows for roads. The following design flaws were identified. First, road funding was often at the expense of other government activities. Second, revenue flows into funds were often partly blocked by treasuries/finance departments and diverted elsewhere. Third, there was little effort to make explicit the link between hypothecated revenue and road expenditures. Fourth, funds were often raided to provide roads in politically sensitive areas. Fifth, financial oversight was poor, allowing diversion of funds by corrupt officials and politicians. Sixth, boards were not structured or incentivised to provide internal or external pressure to improve the road network or pursue good governance (Roth, 1996; Heggie, 2006; Potter, 2007; Gwilliam, 2007).

[43] For example, see Heggie (2006) and Productivity Commission (2014).

Ian Heggie (2006, p. 433) observed that "first-generation" road funds suffered from similar problems to those that inflicted the UK Road Improvement Fund in the early-1900s. He commented:

"No one appeared to have learned any lessons from this earlier experience."

"Second-Generation" Road Funds

Deficiencies recognised in early and "first-generation" road funds led to the design of "second-generation" funds that were established from the mid-1990s. The new designs were guided by principles formulated by Ian Heggie (1995) of the World Bank as part of that institution's roads management initiative. Features were also adopted from funds operating in New Zealand, United States and Japan. In addition, some innovations were introduced by designers of individual road funds.

The key changes were designed to improve incentive structures, transparency, and governance of road funds. With regard to incentives, the aim was to establish better connections between road-use-related tax payments and expenditures on roads and to ensure much greater consideration was given to preferences of road users. Governance improvements were focussed on prevention of corrupt practices, raiding of funds for non-road purposes, and allocation of road funds on the basis of political motives, rather than economic assessments. Transparency improvements were intended to help improve incentive structures and governance.

"Second-generation" funds in developing countries have produced some noteworthy improvements relative to "first-generation" funds in the efficiency of resource allocation to and within the road sector. However, their full potential has not been realised, because of various departures from the set of principles recommended by World Bank and International Monetary Fund economists (similar to desirable features outlined in sub-section 5.5.4 below).[44] Kenneth Gwilliam (2007) argued that a core problem contributing to these departures was the weakness of fiscal regimes in developing countries, and that this was less likely to occur in developed countries. Moreover, he said it was arguable that developed countries should focus to a greater extent on establishment of road services enterprises, than on setting-up road funds.

Fuel Indexation Road Special Account, Australia

In June 2015, the Commonwealth Government legislated to establish the Fuel Indexation Road Funding Special Account, and to hypothecate revenue from fuel taxation rate inflation adjustments (indexation) to the fund for the purpose of investing in road infrastructure.

A positive aspect of the fund is that the government does not have broad discretion regarding amounts to be allocated to the fund. Another positive feature is that the purpose for which the fund balance can be used is restricted to grants to states/territories for road investment. A third desirable aspect of the fund arrangement is that it has provided a foundation for a transition to hypothecation of a high proportion of fuel taxation revenue to the fund for roads.

The fund has several shortcomings. First, amounts of fuel taxation revenue earmarked for roads via the fund will remain small relative to the amount of fuel taxation revenue in the medium term, particularly if the historically low inflation rates of recent years persist. Second, the fund will not be managed independently of government and there is no mechanism to ensure that allocations are subject to economically rigorous assessments. Political discretion will be maintained regarding allocations to specific projects and types of projects. Third, the fund is not supported by a sharp policy focus on outcomes from road investments. Fourth, there is no guarantee that Commonwealth road funding will be any higher than it would have been without the establishment of the special account and the associated hypothecation arrangement. Fifth, the fund arrangements do not include borrowing to leverage inflows from hypothecated fuel taxation inflation adjustments.

5.5.5 Purposes of Road Funds

In the economics literature, road funds have been proposed for various purposes. A common theme is that a road fund is an institutional arrangement that would be an important early step towards, and

[44] See Heggie (2006), Gwilliam (2007) and Potter (2007) for reviews of performance of "second-generation" funds.

would facilitate transition to a commercialised or corporatised road services entity that is entrusted with management and improvement arterial road assets, applies efficient road-user charges, and is regulated to avoid exercise of monopoly power and to ensure compliance with safety standards.[45] The objective of this end result of the transition process is to improve the well-being of the community through more efficient allocation of resources within and to the land transport sector.

Most of the other nominated purposes of road funds contribute to or facilitate successful transition to a commercialised or corporatised road services entity that prices, maintains, and expands the road network efficiently. Such other purposes are outlined below.

A road fund could be established to complement hypothecation of road-use-related taxes. It could be set up to receive proceeds of earmarked taxes directly, rather than through annual budget allocations. This would help limit opportunities to divert hypothecated revenue elsewhere.

A road fund fed by hypothecated revenue could be established to improve the visibility of the connection between road-use-related payments and expenditures on roads.

Road funds could be set up to facilitate efficient management of lumpy, multi-year investments in three ways. First, they could avoid reliance on unpredictable allocations from the general government budget. Second, they could retain funds for future lumpy investments. Third, they could be allowed to borrow against expected revenues over many years.

A road fund could be designed as a step towards taking account of preferences of road-users. This could be targeted by establishing a board in which road-users are strongly represented, requiring a road-user-orientated project/programme focus, and keeping revenue and expenditures separate from the general budget process and electoral cycles.

5.5.6 Features Required for Successful Road Funds

Various requirements for successful road funds have been identified in the economics literature. Some of these have been formulated in response to identified deficiencies of UK road funds in the first half of the twentieth century, the United States Government's Highway Trust Fund established in 1956, and "first-generation" road funds established in developing countries in the 1970s and 1980s and in central and eastern European countries in the early 1990s. Also, some requirements for successful road funds were derived from scrutiny of the New Zealand road fund, which Ian Heggie (2006) described as "the star performer".

The list of nominated requirements is lengthy. An indicative list compiled from the work of several interested economic analysts, and additional analysis by ACIL Allen follows.[46]

Categories of roads eligible for allocation from the fund would need to be defined. It would be appropriate to exclude road categories that are likely to yield deficits under a road pricing regime. These would include local roads in all areas, and lightly-trafficked inter-regional roads. The former are typically funded by local government rates, and the latter typically are funded by rates and/or allocations from state general budgets.

Road users must pay for roads and know that they are paying to ensure they demand value for money. Therefore, funds should be fed by earmarked fuel taxation and registration fees. Later, they could be resourced by hypothecated road-use charges.

Earmarked revenue should be paid directly to the fund, not passed to the fund via the general budget. This would help protect the revenue from diversion to other activities (raiding). It would also protect the fund from the effects of uncertainty of annual budget allocations.

Revenue paid into a road fund must not be viewed as money that must be spent immediately. Investment requirements vary over time and large investments require considerable assessment and planning. Therefore, it may be appropriate to defer expenditures to accumulate resources for

[45] See Newbery (1994), Heggie (1995, 2006), Roth (1996), Newbery and Santos (1999), Productivity Commission (2006, 2014), Meunier and Quinet (2007), Henry and others (2010), Harper and others (2015), and Infrastructure Australia (2016a).
[46] See Roth (1996), Newbery and Santos (1999), Heggie (2006), Gwilliam (2007), Potter (2007), Meunier and Quinet (2007), Productivity Commission (2006, 2014),

worthwhile lumpy investments. However, as funds accumulate, the temptation to raid the fund increases, so limits to avoid raiding need to be considered.

A fund should have the ability to borrow to avoid having to defer projects with high social benefit/cost ratios. Expected hypothecated revenue over many years could be used to service loans.

A road fund should be managed by a board with majority representation of road-users through appointees nominated by automobile and trucking associations, and organisations representing heavy users of road freight services. These members should have a strong vested interest in a well-managed road network. The board should also include government and non-government members who can ensure other considerations are taken into account. It should not include representatives of service providers, such as construction contractors, labour, and manufacturers of inputs, as they have a vested interest in building more roads, regardless of the economics.

An independent person of standing should be the chairperson of the road fund's board. He or she could be elected by the other board members, rather than be appointed by government.

Road-users and community members more generally should also be involved through a transparent process of community consultation on major road programmes and road projects, including alternative options. The aims of this requirement and the previous two principles are to treat road-users as customers rather than taxpayers, and to establish a better connection between investment decisions and preferences of road-users and the community.

The board should be able to recommend changes in taxation instruments that provide revenue to the road fund following meaningful consultations with road-user groups and other interested parties. Recommendations should be supported by thorough economic and social analysis.

Resources should not be allocated from a road fund to urban passenger and freight rail projects, because it would interfere with the aim of strengthening the link between road-user payments and road-user preferences and willingness to pay. If a land transport fund is established, rather than a road fund, and if the broader fund is partly resourced through capture of value generated by public transport and freight rail projects, it would be appropriate to allocate those resources to such projects. This would be consistent with the principle of strengthening the link between payments and benefits.

A fund should not be required to provide finance to projects and programmes that have not been shown to be economically justifiable. Again, this would be inconsistent with strengthening the link between road-user payments and road-user preferences and willingness to pay. If government wishes to undertake projects that are not supported by sound economic assessments, it should fund them separately and explain the basis for the decision.

A road fund should be established by legislation that defines principles for assessment and allocation of resources, and provides for financial, economic and technical audits. Assessment and allocation methodologies and results of audits should be published.

The extent of hypothecation of existing road-use related taxes should be determined at the time a fund is established on the basis of rigorous independent economic assessment. The assessment should include assessment of taxation alternatives to any existing non-hypothecated component of road-use related taxes.

There are different schools of thought on whether or not a road fund should be involved in project delivery. One view, favoured by the Productivity Commission (2014) and Heggie (2006) is that a road fund should not be involved in project delivery, and that responsibility should be left to government road agencies. Of course, road agencies can contract out activities on a competitive basis to ensure value for money is obtained. A road fund that is not involved in project delivery also should be administered separately to government road agencies. It should have access to considerable independent traffic forecasting and economic assessment capabilities, so that it can independently assess project and programme proposals put forward by government agencies, politicians, and private sector entities and can compare them with other options.[47]

[47] It is puzzling that the Productivity Commission (2014, vol. 1, p. 312) stated that a road fund should not undertake detailed investment appraisal activities, leaving that to state road agencies and local governments, but then it argued that the fund should be able to consider unsolicited proposals from the private sector and have the autonomy to select projects that provide the highest nett benefits to the

An alternative view on the roles of road funds is that they should be involved in both project funding and delivery. New Zealand moved to this approach from the alternative road fund model in 2008, because of perceived issues relating to management and funding of separate entities, including lack of clarity in respect of roles and inconsistencies between entities with regard to planning and funding policies. In 1996, the New Zealand road fund had been established as a separate entity, because local governments objected that its previous management by the agency responsible for providing and maintaining the national road network created a conflict of interest.

Ultimately, a road fund would be transformed into a regulated, road services enterprise. The regulation would include safety regulation, and economic regulation to prevent abuse of monopoly power. The transitionary step would be smaller for the second road fund model than for the first one outlined above. A decision would have to be made on the timing of the move to an entity that combines funding and provision roles. Adoption of an evolutionary approach to reform would suggest that a road fund would start as a separate entity, and would take on provider functions later in the policy transition process.

Similarly, the transition from earmarked taxes to road pricing could be made at different stages in the policy reform process. A road fund could be retained during a transition from earmarked taxes to hypothecated, appropriately designed road-user charges. If so, it is important that the road fund be subjected to economic regulation to prevent it from exercising monopoly power to the detriment of road-users and efficient allocation of resources, and to ensure appropriate safety standards are achieved. Alternatively, the move to road pricing could be made when a fund is transformed into a regulated, road services enterprise.

5.5.7 Pros and Cons of Road or Land Transport Fund Model

A road or land transport fund model with the features outlined in the previous sub-section should improve the efficiency of resource allocation through:

— creation of a visible connection between payments for roads or land transport and expenditure on provision and maintenance of roads or land transport

— a strengthening of the economic credibility of project assessment and selection processes.

A more important benefit of the institutional arrangement of a road or land transport fund supported by tax-earmarking outlined in the previous sub-section is that it would facilitate transition to a commercialised or corporatised road entity that applies efficient road and public transport pricing and is subject to economic regulation to prevent abuse of monopoly power. Inclusion of a road/land transport fund or funds in the policy reform process is consistent with evolutionary reform, rather than revolutionary change. The evolutionary approach would provide opportunities to test and refine parts of the changing institutional structure, and it would improve the probability of community acceptance of the reform process as it proceeds on the basis of no-regrets policy steps. The ultimate institutional structure would provide substantial improvements in the efficiency of resource allocation through direct targeting of external costs of congestion, road damage, crashes, and emissions.

Features required for successful road/land transport funds set out in sub-section 5.5.6 above were formulated to address deficiencies of early road funds and "first-generation" funds that were outlined in sub-section 5.5.4 above.

Many of the lingering criticisms of road funds are basically objections to tax-earmarking. These objections were outlined and addressed in sub-section 5.4.4 above.

Further criticisms of road/land transport funds relate to their shortcomings compared to commercialised or corporatised road and transport services entities. In particular, hypothecation of fuel taxation and registration fees are poor substitutes for well-designed road and public transport pricing regimes, because those taxes are very imperfect devices for management of demand for road space, do not provide a signal that indicates an expansion of capacity is required, and provide only a weak link between road expenditures and road users' preferences and willingness to pay. These criticisms are valid. However, their force is greatly weakened when a road/land transport fund is set

community, and should monitor and assess investment outcomes. The ability to assess proposals, select projects providing the highest nett benefits, to undertake ex post assessments will require access to considerable assessment expertise.

up as part of a process of transition to the superior system against which road funds have been unfavourably compared.

5.5.8 Design and Implementation Issues

A key issue is to determine which government(s) should undertake road fund establishment. State governments have constitutional responsibility for roads, collect vehicle registration fees, and have delegated responsibility for local roads to local government authorities. State/territory governments have the authority to charge for road-use. The Commonwealth has constitutional authority to impose customs and excise duties on commodities, including transport fuel. It provides road grants to state/territory governments that fall far short of customs and excise duty receipts. Fuel taxation is an important impediment to implementation of road pricing, because many road-users perceive that they pay for roads through fuel taxation.

In these circumstances, it is logical that states/territories should establish road funds as a transitionary step towards application of a road pricing regime. Initially, these would receive hypothecated registration fee revenue and fuel taxation revenue passed on by the Commonwealth Government.

The Commonwealth Government could establish and manage a road fund and hypothecate fuel taxation to it until the tax is cut to make room for road pricing. From that fund, resources could be re-directed to state/territory and regional road funds for specific projects or programmes. The Commonwealth could build on the foundations of the Fuel Indexation Road Funding Special Account, which was established in June 2015. Alternatively, fuel taxation proceeds could be allocated directly to state/territory funds on the basis of dutiable fuel sales.

The Productivity Commission (2014) proposed that regional funds also be established by groups of local government authorities for regional roads. It envisaged that local roads would remain the responsibility of individual local governments. The Commission suggested that revenue could be directed to regional funds from local government rates, value capture measures such as betterment charges, and grants from state and federal governments. Presumably, grants would be based on shares of hypothecated revenue from fuel taxation and registration fees.

The creation of three layers of road funds (regional, state/territory, and federal), with transfers from the federal fund to state/territory and regional funds should be accompanied by co-ordinated, comparative economic assessments of projects and programmes in the context of the whole network. Such assessments are required to guide transfers, and to ensure that when, where and how the contents of funds are spent is economically justifiable. In particular, assessments should ensure that transfers between funds and allocations to projects are not made just because hypothecated revenues are available.

Another important issue is the amount of fuel taxation and registration fees that should be earmarked for roads via road funds. There are multiple options.

One option is hypothecate all of the revenue from those levies for roads. Another option is to hypothecate just the proportion of each impost (including a proportion greater than one) that is equivalent to current spending on roads by the relevant government. Both of these options would lead to arbitrary hypothecated allocations. There is no logical reason why either the current or expected future yield of these levies or the proportion of their yield that is equivalent to current spending by Commonwealth and state/territory governments is the economically appropriate level of road spending. Another problem with both options is that the base for fuel taxation is likely to grow at a lower rate than road use, because of an inexorable improvement in fuel-economy for light vehicles,[48] and it is unlikely that revenue from other Commonwealth road-related taxes will compensate for erosion of the fuel taxation base. An additional issue with the first option is that the Commonwealth Government would have to find expenditure savings or extra revenue from other sources to pay for non-road programmes to which fuel taxation revenue currently contributes. Extra issues with the second option are that it would perpetuate the Commonwealth's much lower allocation of resources to roads than fuel taxation takes from road-users, the absence of a link between fuel taxation payments

[48] The proportion of fuel taxation that operators of heavy vehicles are required to pay is adjusted periodically, in conjunction with registration fees, to recover estimated costs of road-use by heavy vehicles.

and Commonwealth spending on roads, and the perception of under-funding of road capacity and maintenance by the Commonwealth Government.

A third option is to hypothecate taxation revenue considered to be sufficient to provide land transport infrastructure on the assumption that its commissioning occurs no later than implementation of network-wide road pricing. Determination of the pricing regime, and the form, location, and capacity of the infrastructure should be made simultaneously, because the appropriate settings will be interdependent.

While the perceived inadequacy of road capacity is likely to be greater in the current context of zero pricing of most of the road network than in the presence of an efficient road pricing regime, it is desirable that introduction of the congestion pricing element of road pricing be preceded by a significant increase in by-pass road capacity and road debottlenecking, and substantial additions to public transport capacity. These investments will be required to help gain public acceptance of road pricing, and in recognition of the importance of both road pricing and land transport capacity increases for achievement of efficient levels of road-use and capacity in medium- to long-term timeframes.

This increase in capacity would have to be financed in some way. Three approaches are discussed briefly below.

One approach is for states/territories or their road funds to borrow to increase capacity knowing that future road pricing revenue could be applied to service the debt.

Second, the Commonwealth Government could contribute to the transition to an efficient road pricing regime by hypothecating all of its fuel taxation revenue to road funds and borrowing more than otherwise to undertake other government capital programmes. This would help to underwrite completion of capacity increases prior to application of the pricing regime. Later, the Commonwealth could cut fuel taxation to make room for road pricing, a policy move advocated by Infrastructure Australia (2016a), the Productivity Commission (2014), Harper and others (2015), and Henry and others (2010).

A third approach for funding capacity increases prior to implementation of road and public transport pricing reforms is that state and local governments could deploy value capture mechanisms, such as differential taxation of land value increments, and hypothecate the proceeds to land transport funds that could borrow on the basis of future revenues to finance additional road and public transport infrastructure. This could be combined with the second approach.

Road fund (and subsequent road services enterprise) models are appropriate for arterial roads in major cities and major intercity roads. They are not well suited to provision of some road categories.

Roads in the latter categories include urban and rural roads that carry few vehicles and would yield deficits following application of road pricing, as efficient congestion charges would be zero and revenue from road damage pricing would be small if not zero. Such local roads typically are funded from local government rates and developer charges. There is no reason to change this practice. These roads should be excluded from direct funding from road funds. However, a relatively small indirect allocation could be made to local government authorities in recognition of payment of fuel taxation and registration fees paid by users of these roads.

Some regional roads that have been funded by state/territory governments also would produce deficits under a road pricing regime. If they were made the responsibility of a road fund and later a road services enterprise, they would require cross-subsidies from users of other roads that are more heavily trafficked. This would be inconsistent with the advancement of efficient allocation of resources through creation of a visible connection between payments for road-use and expenditures on roads. In the interests of transparency and minimisation of inefficiencies in the allocation of resources, such roads should be excluded from the responsibilities of road funds and subsequent road services enterprises. They should be funded separately by governments and the justification for this funding should be made public. Again, a relatively small indirect allocation could be made from fuel taxation and vehicle registration revenue to reflect fuel taxation and registration fee payments by those who use these roads.

6 TRANSITION TO LONG-TERM OPTIONS

Chapter 1 and section 5.1 above explained why land transport policy reform is necessary. An economically ideal policy reform package has been outlined in section 5.2. An evolutionary process of reform to transition from the *status quo* to an economically ideal set of policy settings via a series of "no-regrets" steps has been summarised in section 5.3. The "no-regrets" steps have been designed to improve efficiency progressively and to facilitate political/community acceptance of the final set of policy settings. Initial steps have been identified, explained and justified in sections 5.4 to 5.6. They involve earmarking (hypothecation) of revenue from existing road-use-related taxes to road funds for road construction and maintenance. The hypothecation and road fund elements of these early-stage reforms are highly complementary.

This chapter is focussed on the next and final steps in the evolutionary reform process: design and implementation of road pricing with multiple elements, reform of public transport pricing in a manner that is consistent with reform of the road pricing regime, provision of road and public transport improvements no later than the application of the pricing reforms, and establishment of regulated road and public transport network enterprises to effectively hypothecate revenues for roads and public transport, respectively, and ensure an efficient combination of pricing and investment.

A description of the transition process from the current situation towards a long-run efficiently-managed system is presented in **Figure 6.1**, together with an indication of the potential timing associated with each phase along the transport market reform process. Changes relative to the previous phase are highlighted using bold purple font.

6.1 Reform Involves a Package of Policy Measures

6.1.1 Why a Policy Package is Important

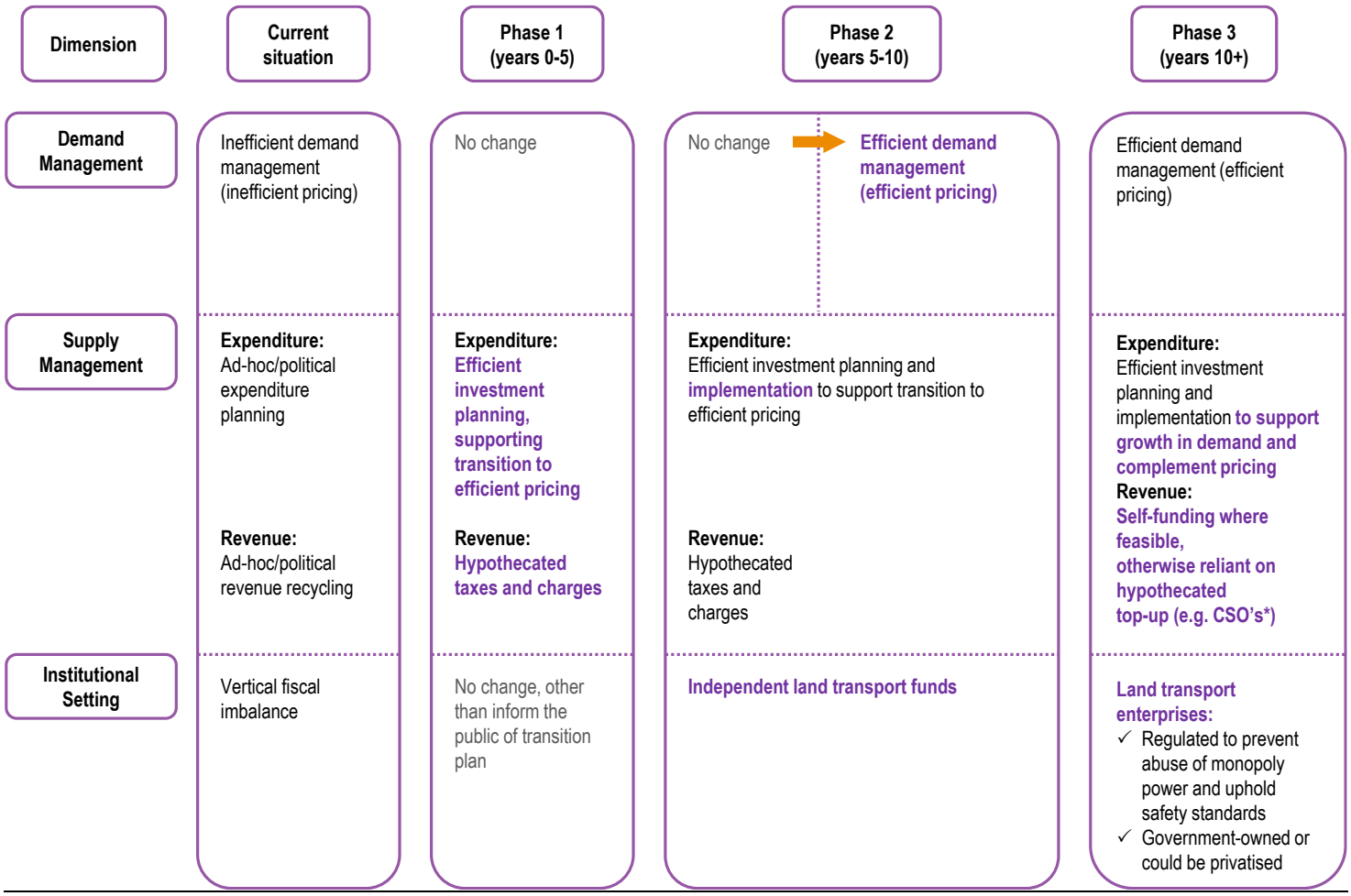
In the economics literature, a strong case has been made for implementation of road-use pricing or charging regimes as a complement to road and public transport improvement programmes. The case has been outlined below in an Australian context.

The purpose of road pricing regimes is to help users recognise the uncompensated costs that their travel/transport choices impose on others. These imposts are known as external costs. The attention of economists has been focussed particularly on pricing to correct external costs of congestion.[49]

[49] Seminal work on congestion pricing was undertaken by Vickrey (1955, 1959, 1963, 1969), Walters (1954, 1961, 1968), Buchanan (1952), and Roth (1967). A pioneering report to the UK Government was prepared by Smeed, Walters and Roth (1964). For overviews of the economics literature on congestion pricing, see Button (2004), Arnott, Rave and Schöb (2005), Lindsey (2006, 2012), Small and Verhoef (2007), Parry (2009), Fosgerau and Van Dender (2010), Anas and Lindsey (2011), and ACIL Allen (2012). For a through comparative analysis of congestion pricing and anti-congestion measures typically deployed by governments, see Downs (1992, 2004).

Pricing to address external costs of road damage,[50] crashes, and emissions has received comparatively little attention.[51]

FIGURE 6.1 TRANSPORT MARKET REFORM – TRANSITION PROCESS WITH INDICATIVE POTENTIAL TIMING



Note: * CSO's – Community Service Obligation payments, such as for rural roads.

SOURCE: ACIL ALLEN.

Road-use pricing is a necessary element of an economically efficient solution to the problems outlined in section 5.1 above. However, it is not sufficient to solve these problems in an efficient way in the medium-term to long-term future.

Road pricing is a necessary policy response because it:

— can be designed to include elements that directly address various external costs of road use (congestion, road damage, emissions, and crashes) by requiring each generator of external costs to internalise them, so that users confront the social marginal costs of their involvement when making usage decisions

— it rations use of scarce road-space by influencing choice of travel time, route, and transport mode on the basis of social marginal cost of use, rather than by inefficient mechanisms such as queuing or regulation

[50] For useful discussions of road damage pricing, see Newbery (1988, 1989, 2005), Small and Winston (1988); Small, Winston and Evans (1989).

[51] For example, surveys of road-use-related external costs and potential road pricing responses have tended to focus particularly on congestion, as illustrated by perusal of reviews by Parry, Walls, Harrington (2007) and Anas and Lindsey (2011).

— provides signals to indicate when and where expansion of capacity is economically warranted

— counteracts the tendency of other commonly-deployed policy measures in areas suffering serious congestion – notably road provision and improvements, and heavily subsidised public transport services – to induce additional traffic that at least partly dissipates benefits from these policy instruments, thereby partly wasting resources applied[52]

— is the only policy measure for dealing with congestion and road damage that is not undermined by a tendency to induce additional traffic

— yields a revenue stream to fund complementary infrastructure improvements without creating excess burdens or deadweight losses (unnecessary tax-induced resource allocation inefficiencies), improves efficiency of resource allocation by directly targeting inefficiencies associated with external costs, and can reduce aggregate excess burden of the tax-charging regime as a whole through displacement of inefficient taxes.

This policy option of road pricing reform poses problems for the identification of infrastructure "gaps", "deficiencies", "inadequacies" or "shortfalls". The conventional approach to determination of "gaps" or "deficiencies" is illustrated by the *Australian Infrastructure Audit* conducted by Infrastructure Australia (2015). The Audit included an attempt to project the demand for infrastructure services, based on *explicit* scenarios for population growth and the development of the global and local macro economies. It looked at infrastructure "shortfalls" in terms of differences between the future demand for infrastructure services and the capacity of existing and new infrastructure to provide infrastructure services. However, in projecting the demand for infrastructure series, the *implicit* assumption was that there would be no substantial reform in the pricing of access to infrastructure.

Building on the Audit, Infrastructure Australia (2016a,b) has published its *Australian Infrastructure Plan* and an accompanying *Infrastructure Priority List*. The latter was based on an assessment of "infrastructure gaps and requirements" and "challenges and potential solutions" over short-, medium- and longer-term horizons. However, it does not appear that in formulating its list of land-transport infrastructure priorities Infrastructure Australia accounted for the need to adjust the Audit's forecasts of demand for infrastructure services for the effects of the introduction of efficient road user pricing that it advocated for the short and medium terms. The concept of an infrastructure "gap" or "shortfall" is meaningful only in the context of the applicable pricing regime. Current congestion suggests road infrastructure "shortfalls" or "gaps", but the context is zero pricing of most roads and substantial under-pricing of urban public transport services. Considerable road damage by heavy vehicles also indicates "shortfalls" in the sense that it suggests roads or maintenance programmes should be upgraded, but the context is a proxy charging system for heavy vehicles that does not vary according to road conditions and discriminates imperfectly on the basis of vehicle types and distance travelled. These "shortfalls" would diminish if and to the extent that network-wide differential road pricing was introduced to manage demand for road services.

Rather than focussing on identification and filling of "infrastructure gaps" without reference to the existing pricing context of zero pricing of most roads and substantial under-pricing of urban public transport services, the modern transport economics literature has considered how to transition to a policy regime that activates both demand-side and supply-side responses to address perceived "infrastructure shortfalls" in the current pricing context – a policy regime that comprises a *package* of policy instruments.

[52] Estimates of VKT-road provision elasticities in the United States based on econometric techniques range from 0.16 on a state-wide basis (Hymel, Small, Van Dender, 2010), through 0.39 for freeway expansion projects in California (Cervero, 2003), and 0.7 and 0.9 for Californian state highways in counties and metropolitan areas, respectively (Hanson, Huang, 1997), with a top of the range estimate of 1.03 for interstate highways in entire (urban plus non-urban parts) metropolitan statistical areas (Duranton, Turner, 2009, 2011). An elasticity of a 0.7 or 1.03 indicates that an increase of 10 per cent in lane-kilometres would result in an increase of 7 per cent or 10.3 per cent, respectively, in vehicle kilometres travelled (VKT). An elasticity of 1.24 to 1.34 has been estimated for national expressways in Japan (Hsu, Zhang, 2014). Estimates are highly context-specific, with estimates tending to be higher when they relate to the most congested parts of road networks (Small, Van Dender, 2007; Lindsey, 2012; Hsu, Zhang, 2014). The low estimate by Hymel, Small, Van Dender (2010) was not representative of congested conditions as it was made on a state-wide basis. The Duranton, Turner (2009, 2011) estimate covered the most congested road-type in the United States, but would have been higher if it related only to urban parts of metropolitan statistical areas. The Hsu, Zhang (2014) estimate covered Japan's busiest roads. Analysis of the estimates and their contexts indicates that induced traffic effects in heavily congested areas are likely to be substantial.

Road pricing in isolation is not sufficient to solve problems identified in section 5.1 above, because it can address them only in the short-term, given the infrastructure that is in place.[53] In medium- to long-term time-frames, additional investment in roads, and public transport facilities and freight rail, and ongoing maintenance activity would be required, even if existing facilities are deemed adequate in the short-term. In the absence of new investment, prices would have to keep rising to ration scarce road space to constrain congestion, road damage, crashes and emissions in the context of rising demand deriving from population growth and other sources of increases in economic activity. This would deliver monopoly profits to the road network owner to the detriment of road users and efficient allocation of resources. Ideally, new investments should be undertaken when they would yield an appropriate risk-adjusted social rate of return on capital, not delayed to provide monopoly profits to the network owner.

It is widely perceived that current road infrastructure in Australia provides inadequate levels of service on arterial routes at peak times in metropolitan areas, on major intercity routes, and on important regional roads. In metropolitan areas, the dominant concern is traffic congestion, but road damage is also a significant issue. On intercity routes the concerns are safety, road damage and congestion. On regional/rural roads, there is concern regarding safety and road damage.

In metropolitan areas, public transport services are often perceived to be overcrowded (congested) and unreliable, and in outer suburbs, insufficiently frequent and accessible. Another criticism is that public transport services are mainly radial in nature, making cross-city or city by-pass trips difficult or impractical.

Such judgements of the current quality of services provided by road and public transport facilities typically are made without consideration of the implications of the context of zero pricing of most roads in the network, and heavily subsidised public transport services. Perceptions of inadequacy of these facilities need to be reconsidered in the context of potential land transport pricing reforms.

In the context of road pricing, the quantity of road services demanded at peak times and locations (typically busy radial roads) would fall, as commuters switch to other times, other routes, and other transport modes. Then, the existing road network would be used more efficiently, and its deficiencies would not be as severe as it typically is perceived to be in the current policy context. Of course, demand for by-pass roads would tend to rise as people driving across the metropolitan area seek alternatives to driving on busy, priced radial roads.

Demand for public transport services at peak times and locations in metropolitan areas would tend to rise when congestion pricing applies to roads at those times and locations, as commuters switch from cars to public transport. This would exacerbate perceived inadequacies of current public transport facilities.

However, higher demand for public transport services would allow increases in public transport fares. On the other hand, there are also cost-reducing factors that would constrain fare increases. Increased demand for public transport services would facilitate capture of cost-reducing economies of network density and scale deriving from more frequent services, additional routes and better load factors. Greater density of services would, in turn, induce additional demand for public transport services providing further cost reductions. In addition, less congestion would lower fuel and wages costs of bus operations, because of less stop-start traffic on roads and quicker trips, respectively. Moreover, better public transport services would facilitate increases in residential and commercial density that in turn would increase demand for public transport services and provide access to additional cost-reducing economies.

[53] It has been understood for several decades that in the context of multiple objectives (such as alleviation of congestion in the long term, as well as in the short term), an efficient outcome would require that the number of policy instruments deployed should be no less than the number of targets, and the instruments selected should be the best available to pursue the targets (Tinbergen, 1952; Hansen, 1955). It follows that the targets of congestion alleviation in the long term and in the short term would require at least two well-suited policy instruments: road pricing and investment. Adding the objective of reduction of excess burden from road-related taxes and taxes used to fund public transport deficits would require at least two more complementary policy instruments: replacement of road-related taxes by well-designed road pricing, and public transport pricing reform that is consistent with road pricing. Another complementary policy instrument would be to reform land-use regulation to facilitate increases in residential and commercial density in the vicinity of access points to major transport corridors and activity centres. This would facilitate efficient responses to pricing reforms and land transport infrastructure investment programmes.

Since pricing that targets congestion changes relative prices of driving on arterial roads at peak times and using public transport, the current practice of running large public transport deficits to change relative prices to reduce congestion would become redundant. This would allowing release of funding applied to public transport deficits for other public purposes.

Because of the widespread perception of inadequacy of road and public transport infrastructure in the absence of road pricing, the reality of a substantial increase in demand for public transport services and by-pass road capacity in the context of road pricing, and political wariness of pricing of the road network, it is important to provide substantial additional public transport capacity, extra road by-pass capacity, and road debottlenecking facilities no later than the commencement of road pricing. These investments would improve the political and community acceptability of road pricing, because they would moderate prices and provide users of land transport facilities with better road and public transport services in return for the charges they pay. Such investments would also facilitate achievement of an efficient balance between prices and investment, thereby contributing to achievement of medium- and longer-term objectives in respect of congestion-alleviation, better road safety, and limitation and repair of road damage.

Acceptability considerations, and economic efficiency reasons for funding new capacity to accommodate and facilitate traffic growth associated with increases in economic activity and population support the concept of earmarking road pricing revenue on a long-term basis to finance investment (directly or via servicing of debt) in road and public transport capacity, and to undertake maintenance activities. This is akin to retention of revenue from pricing the services of any infrastructure business to cover operating, maintenance and capital costs, including a reasonable risk-adjusted rate of return on capital.

Acceptability and economic efficiency considerations also suggest that introduction of road pricing should be accompanied by reduction or elimination of fuel taxation and vehicle registration fees.[54] These taxes cause deadweight losses, while well-designed road and public transport pricing would reduce deadweight losses through correction of external costs of road use. Moreover, existing taxes are already considered by many road-users to be payments for use of roads, fuel taxation being a variable payment related to road use, and vehicle registration being a fixed annual payment for road access. Indeed, the existing notional heavy charging regime in Australia treats vehicle registration fees and the 66 per cent of the fuel taxation rate (26.14 cents per litre rather than 39.5 cents per litre) borne by heavy vehicles as components of a proxy for a road damage charging regime that is meant to recover costs of accommodating heavy vehicles on the road network.[55] This road-charging regime for heavy vehicles is a very imperfect mechanism for the task of inducing efficient changes to road-use and vehicle purchase decisions, because the fuel tax (variable) component does not discriminate adequately between road conditions (road types and degree of congestion), vehicle types, and distance travelled.

Retention of fuel taxation and registration after application of road pricing could reasonably be regarded as double-charging for road-use. In addition, their retention would result in unnecessary deadweight losses.

Replacement of road related taxes with road pricing, and the accompanying improvements in land transport infrastructure would have implications for the distribution of well-being. The distributional effects would influence the public acceptance of the reform package.

Within and near major cities, the changes would be complex. There are several relevant matters. It is widely acknowledged that fuel taxation is regressive, and therefore its reduction or elimination would tend to improve equity. Those who commute to the central business district (cbd) would benefit from much less congestion and better public transport services. The sub-set who drive to the cbd would use less fuel and pay less for each litre, but incur congestion charges. So, those with longer drives and vehicles with poorer fuel consumption would be relatively better-off, but higher charges for large four-wheel-drive (suv) vehicles to reduce external costs of crashes would offset this. Others who drive

[54] This has been proposed to governments in Australia by Infrastructure Australia (2016a), the Productivity Commission (2014), Harper and others (2015) in a competition policy review, and Henry and others (2010) in a taxation system review.

[55] Heavy vehicles are not required to pay the remaining 34 per cent of the fuel taxation rate to avoid taxation of an intermediate input to road transportation on economic efficiency grounds. The rationale for avoiding taxation of intermediate inputs was set out in an appendix to an Industries Assistance Commission (1986) review of taxation of petroleum products.

across the metropolitan area to workplaces would benefit from better by-pass roads. People who drive locally to workplaces, educational institutions, shops or sporting events would benefit from lower fuel bills. The complexity of distributional effects is exacerbated by the complex variation of patterns among various categories of people, as indicated in a recent report by the Bureau of Infrastructure, Transport and Regional Economics (2016).

Fuel taxation and registration fee relief to make room for road pricing would be advantageous to individuals in rural and regional areas. This would occur because people in those areas typically don't contribute to congestion, but often drive longer distances, consuming more fuel. In addition, as ratepayers, they would be relieved of the burden of their local governments having to deal with damage to lightly constructed rural roads by heavy vehicles.

6.1.2 Policy Package Synergies

The *policy package* outlined above would produce important synergies. Road pricing improves the efficiency of use of the land transport network, including improvements made by new investments. Meanwhile, new investments reduce the prices required to achieve efficient levels of congestion, road damage, crashes, and emissions in the short- to medium-term. These effects are outlined briefly below.

Pricing that is well-designed to target congestion ameliorates that problem by encouraging drivers to switch to other times, routes and transport modes, and to eliminate some trips. In the longer-term, it encourages changes in residential locations. Road damage pricing ameliorates road damage (proportional to the fourth power of axle weight) and resulting vehicle costs (extra wear, tear, and fuel) by encouraging freight transport operators to switch to other routes, change vehicle types, and switch freight to other transport modes. In conjunction with congestion pricing, it addresses the problem of higher damage in congested conditions (weight applying for longer periods).[56] In other words, road pricing extracts more services and consequent benefits out of the land transport network. Put another way, road pricing reduces the amount of investment required to meet particular levels of service.

In addition, road pricing increases benefits obtainable from new investment in roads and public transport, because it manages the induced traffic phenomenon that otherwise would substantially dissipate such benefits. This is achieved by adjustment of prices across the land transport network to ensure that usage is diverted, redistributed, or added across the land transport network only to the extent that social marginal costs do not exceed social marginal benefits. These prices insert a wedge between private marginal cost and social marginal cost that requires road users to confront the latter, rather than the former, when making decisions regarding when, where and how they travel.

Moreover, pricing that targets congestion increases demand for public transport, allowing capture of economies of scale and density, and it further reduces costs of bus operations by reducing fuel and wages expenses by reducing congestion. This removes the justification for subsidies to change relative prices of driving and public transport patronage. Therefore, pricing to alleviate congestion reduces the burden of having to fund public transport deficits and the excess burdens or deadweight losses (tax-induced inefficiency in resource allocation) of extra taxes required to fund those deficits. Network-wide road pricing of all types and reduction of public transport deficits provide resources to undertake road and public transport improvements and maintenance.

The pricing regime also provides signals that facilitate determination of when and where investment should be undertaken. Opportunities to raise prices strengthen the economic case for new investment.

The complementarity of road pricing and investment works in the other direction too. Investment in road and public transport debottlenecking, and new road and public transport facilities ease capacity constraints in the context of growing demand and facilitate switching of transport routes and modes in response to congestion pricing. This reduces the level of charges required to reduce congestion to efficient levels, and counters inefficiencies associated with potential monopoly pricing of use of roads.

[56] Emissions pricing reduces vehicle emissions by encouraging less driving (especially at peak times and locations), and acquisition of vehicles with better fuel economy. Crash cost pricing reduces costs imposed on others by encouraging switching to vehicles that are likely to reduce the extent of damage to other vehicles and their passengers, and insurance premiums paid by others. To the extent that it is distance linked, it would also tend to reduce driving.

Also, investment in stronger road pavements reduces road damage pricing levels required to reduce road wear and tear to efficient levels.

6.1.3 Recent Endorsements of a Reform Package in Australia

Over the past 20 years, there has been considerable analysis in the economics literature supporting proposals along the lines of the reform package outlined in the previous sub-section.

Road pricing regimes targeting traffic congestion are in place in Singapore, London, and two Swedish cities, Stockholm and Gothenburg. Implementation of these schemes was accompanied by complementary infrastructure improvements. Although these cordon-based schemes are not as sophisticated as the economics literature has proposed and current technologies would permit, it is widely accepted that they have been successful anti-congestion measures. In addition, road damage pricing schemes have been applied with success in some countries. As a result of the strong recommendations of the economics literature and the success of established road pricing regimes, road pricing trials are being conducted in various locations internationally.

Consistent with the messages from the economics literature, and overseas developments, the importance of ensuring that efficient infrastructure provision is packaged with efficient pricing and removal of road-related taxes has recently been noted in an *Australian Infrastructure Plan* formulated by Infrastructure Australia (2016a, pp. 8-9):

"On road networks, the transition to a more user pays approach would allow charging to be linked to funding and supply to be linked to demand. This will be fundamental to securing the required funding and sustainably improving the level of service.

That is why the introduction of direct heavy vehicle charging within five years, and direct user charging for all vehicles within 10 years, alongside the removal of existing taxes and charges, should be a priority for Australia's governments to provide greater fairness and equity in how we pay for roads."

A similar approach was proposed in a review of competition policy by Ian Harper and others (2015, part 2, p. 38):

"Recommendation 3 – road transport

Governments should introduce cost-reflective road pricing with the aid of new technologies, with pricing subject to independent oversight and revenues used for road construction, maintenance and safety.

To avoid imposing higher overall charges on road users, governments should take a cross-jurisdictional approach to road pricing. Indirect charges and taxes on road users should be reduced as direct pricing is introduced. Revenue implications for different levels of government should be managed by adjusting Australian Government grants to the States and Territories."

The Commonwealth Government's National Committee of Audit report prepared by Tony Shepherd and others (2014, phase 2, section 2.3) also advocated inclusion of road-use charging in the policy mix:

"Current arrangements do not reflect the different costs imposed by type of vehicle, time and location of road use. ….. For heavy vehicles, current charges[57] are based on averages rather than reflecting each operator's actual use of the network. Heavy vehicle road users are consequently provided with no price signals related to their use of the road network. This results in a lack of efficiency in vehicle usage. ….. Congestion on public roads remains a major community concern, resulting in strong pressure to expand metropolitan road networks. However, increasing congestion is not a result of a lack of investment, but rather a failure to align user-demand with price signals. User charging would introduce price signals that should lead to better use and investment in transport infrastructure.

Accordingly, the Commission considers there is significant scope for increased user charging to provide price signals and enhance the efficiency of transport infrastructure markets. User charging also has the potential to help fund infrastructure in an efficient and equitable way."

Similarly, a review of the Australian taxation system by Ken Henry and others (2010) and the Productivity Commission's (2014) public infrastructure inquiry report recommended that governments

[57] Heavy vehicle charges comprise registration fees that vary according to vehicle-type and fuel taxation around two-thirds of the rate of duty.

in Australia implement congestion and road damage pricing, earmark the revenue for road provision and maintenance, and eliminate road-use-related taxes.

Issues relating to design and implementation of an efficient road pricing regime are outside the scope of this study.

6.2 Cost Recovery

It has been demonstrated in the economics literature that under plausible assumptions, the revenue from well-designed congestion and road damage pricing systems would approximately cover the full economic costs of providing and maintaining an arterial road network in major urban areas and in heavily trafficked parts of major inter-city highways/motorways. Potential impediments to achievement of this result are cost economies or diseconomies of scale and scope in provision and use of road infrastructure, and lumpiness or indivisibilities in capacity.[58]

Various empirical studies have indicated that there are likely to be mild cost economies of scale in use and provision of segments of arterial roads. This means deficits would result. But, in large cities, there could be nett diseconomies, because of high costs of property acquisition. Then, road pricing could yield surpluses. Moreover, road intersections result in large diseconomies. While there are large cost economies of scale in construction of thicker pavements for heavy vehicles, diseconomies of scope arise when more capacity and thicker pavements have to be provided simultaneously to cope with joint use of roads by cars and trucks. More traffic requires more lanes, but if trucks can use all lanes, the pavement has to be thicker for all lanes. Heavier trucks require thicker pavement, but this has to be provided for all lanes. Summing up, in very large cities, there could be nett cost diseconomies that result in surpluses from pricing that targets both congestion and road damage on arterial roads. In small cities, there could be nett cost economies. On the arterial network in medium-large cities and on heavily trafficked segments of highways/motorways linking major urban centres, neutral cost economies could prevail.

Lumpiness or indivisibilities in capacity can lead to deficits as capacity is expanded followed by surpluses later. This is more likely to be an issue on arterial roads in regional areas and small cities. In large and middle-sized cities, a large arterial road network allows surpluses to offset deficits.

Cost recovery by efficient pricing that targets congestion and road damage is still reasonably likely to result in the aggregate both over time and across an urban network and heavily-trafficked parts of the inter-city network. However, efficient road pricing would result in deficits for local streets in all areas, for arterial roads in smaller cities, for arterial roads outside of major urban areas that are not heavily trafficked. Deficits would have to be covered by taxation. Local roads are already funded by land rates, a relatively efficient taxation instrument. Other roads yielding deficits would have to be funded from other forms of taxation. Options could include retention and hypothecation of a portion of revenue from registration fees and land value taxation, hypothecation of revenue from taxation of land value increases or other forms of value capture, or top-up allocations from consolidated revenue.

6.3 Funding of Investments before Pricing Reform

There are various ways in which investment can be funded prior to commencement of road and public transport pricing reform. One approach is borrow on the basis that debt can be fully or largely serviced by future revenue from road pricing and savings from redundant public transport subsidies. A second approach is to provide earlier and/or larger, explicit debt-servicing capability compared to the first approach, through earmarking of road-related taxation revenue to finance road construction and maintenance while the pricing regime is being designed and planned, and associated pricing infrastructure is put in place. A third option is to earmark revenue from application of value capture

[58] The seminal work on this cost recovery theorem was undertaken by Mohring and Harwitz (1962), focussing only on congestion pricing. The cost recovery theorem was extended to incorporate road damage pricing by Newbery (1988, 1989), Small and Winston (1988), Small, Winston and Evans (1989). Subsequent work found that the theorem tends to remain robust as assumptions are relaxed, so that cost recovery or over-recovery is reasonably likely to be achievable in practice in aggregate for major urban arterials in medium-sized or large cities, respectively. Cost recovery may also be achievable for heavily trafficked inter-city roads (Newbery, 2005; Verhoef (2007); Small and Verhoef, 2007; Verhoef and Mohring, 2007; de Palma and Lindsey (2007); Lindsey (2012, 2014).

mechanisms to gain revenue from consequences of public transport and road infrastructure improvements.

6.4 Road and Public Transport Enterprises

Chapter five discussed establishment of road or land transport funds and associated authorities as a transitionary step towards establishment of road funds. The funds would be resourced by hypothecated revenue from road-related taxes and value capture mechanisms.

It is envisaged that these institutions would be replaced eventually by road and public transport enterprises. They would have price-setting powers, which would be applied when road-related taxes are removed or reduced.

The enterprises would be subject to economic and safety regulation to guarantee that the interests of users of land transport infrastructure are protected. This regulation would be aimed at ensuring that achievement of an efficient allocation of resources is not impeded by enterprises that seek to exercise monopoly power by raising prices above competitive levels, deferring economically justifiable investments to justify high prices, and scrimping on safety features of infrastructure to increase profits.

It is envisaged that each state/territory would have at least one enterprise responsible for highly trafficked arterial roads, and another responsible for metropolitan public transport. Responsibility for lightly trafficked local roads in urban and rural areas should be excluded from the road enterprises, because they would yield deficits under an efficient road pricing regime. Similarly, public transport services in areas not subject to road pricing that targets congestion would not be included in the proposed enterprises. Public transport pricing concessions that enterprises are required to offer for equity or political purposes would not be the responsibility of metropolitan public transport enterprises. Such concessions should be funded by efficient taxes such as rates or taxes on land value. Existing toll roads could be accommodated in the context of arterial road enterprises and efficient road pricing regimes. Use of those roads would be priced on the same basis as comparable parts of the network. Private sector owners or franchisees would be paid shadow tolls by the government-owned road enterprise. These would be set to leave the private sector entity no worse off than under current tolling arrangements.

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